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Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JANUARY 2, 1904. No. 1.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office. In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, JANUARY 2, 1904.

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ELECTRICAL PRODUCT IN 1903.

In accordance with our usual custom we present herewith an estimate of the production of electrical apparatus in 1903. As will be seen, the figures given below represent a total output of $158,-650,000 as compared with $139,950,000 in 1902. There is good reason for believing that the figures of 1902 were correct, but a little doubt exists as to some of the items last year. As has been clearly shown by the census figures of the last twenty years, the usual rate of increase in electrical manufactures each year has been on an average from 15 to 20 per cent., taking good years with bad. During 1902, which was one of unparalleled activity, there is every reason to suppose that the production increased over the preceding year a full 20 per cent., but we are justified in questioning as large a gain in 1903.

ESTIMATED PRODUCTION, 1903:

Dynamos	$17,000,000
Transformers	5,000,000
Switchboards, for lighting and power	2,750,000
Motors, for all purposes	30,000,000
Storage batteries	4,500,000
Primary batteries	1,250,000
Carbons	2,000,000
Arc lamps	2,250,000
Incandescent lamps	5,500,000
Lighting fixtures	3,750,000
Telephonic apparatus	25,000,000
Telegraphic apparatus	2,000,000
Insulated wires and cables, submarine cables	30,250,000
Conduits, interior and underground	1,750,000
Rheostats, heating and cooking apparatus	2,500,000
Annunciators	250,000
Electric clocks	150,000
Lightning arresters, fuses, etc.	750,000
Measuring instruments	3,000,000
Miscellaneous apparatus	19,000,000
	$158,650,000

It will be seen that the figure of $158,000,000 represents an increase of about 10 per cent. all around during the year, and when it is remembered how sharp a check was sustained by many lines of industry in the year which has just closed it is fair to assume that such a rate may broadly represent the total, even while some of the items may be slightly more or less "off the spot." Telephonic activity, for example, in 1902, by more than one estimate, was represented by about $21,000,000. The past year it is set down at $25,000,000—a gain of 20 per cent. It may have been even higher than that, but there are elements of doubt. Electric motors in 1902 were estimated at $27,000,000 including all kinds. Last year they are put down for $30,000,000, and while this is only an increase of 10 per cent. and may be underestimated, it is undeniable that some of the largest concerns are hardly supposed to have shown a gain superior to that during the year. It will be noted that insulated wires and cables and submarine cables are set down for slightly in excess of $30,000,000, which is a gain of $2,500,000 over 1902. This seems an enormous figure, but it is substantiated by the reports of the companies themselves in 1900, and represents consumption in every other branch of the electrical field. It will of course be understood that such an item appears again in other branches, as, for example, the insulated wire used in dynamos, motors, telephone switchboards, etc., and to that extent it represents a duplication of product, but there is no way of avoiding such a feature in these calculations.

Altogether the showing of the year is quite satisfactory, and we have no reason for doubting that the production in 1904 will fall below this figure. Allowing for errors and possible overestimates in one direction off-set by underestimates in another, it stands to reason that an industry which has already attained a production of $150,000,000 a year in manufactured goods takes its place amongst the leading mechanical industries of the country. It must be recollected that all of this apparatus serves as a constituent of great systems and plants for railway work, lightning, telephony, telegraphy, etc., so that the actual increase in investment represented during the year, including real estate, buildings, line construction, track construction, engines, turbines, etc., may well represent not far short of $750,000,000. The annual increase in capitalization in the street railway field alone is now about $450,000,000 a year, and the other electrical industries grow in proportion, although, unfortunately, capitalization is not always investment.

Arnold Single-phase Electric Railway System.

Elsewhere we print an article by Mr. B. J. Arnold giving a description in full detail of his single-phase electric railway system, a preliminary account of which formed the subject of a communication by Mr. Arnold at the Great Barrington meeting in 1902 of the American Institute of Electrical Engineers. Mr. Arnold will have the sympathy of all who read the account given of the unfortunate series of delays, over a period of almost two years, which prevented a practical public demonstration of his system, and which culminated in the destruction of the apparatus by fire just prior to a public trial that had been set for the opening of the new year—a year which he in common with many others believe will inaugurate a new era in electric traction. Mr. Arnold, in the days when it was heresy to believe in the fitness of alternating current for railway work, took an open stand as its advocate, though, singularly enough, as an equally determined champion at an earlier period of the rotary substation system, and the first, we believe, to lay down such a system on a considerable scale, he had been a prime factor in establishing what for years deterred any attempts at development of alternating-current traction in this country. Believing that the solution of the problem lay in the use of single-phase and not polyphase power, he devised the system described in the article, which was experimentally tested in the early part of 1902. Had it not been for the most unfortunate series of delays, Mr. Arnold would have had the pleasure of giving the first public trial of a single-phase electric railway system operating commercially, and in electric traction would have figured as the pioneer in that art in virtue of such demonstration. The lack of such fortuitous record will not, however, obscure the value to alternating-current traction of his early and constant advocacy of the cause, and recognition of the stimulating effect which the announcement in 1902 of his system undoubtedly had in developing the single-phase situation.

The vital point of difference between the single-phase system of Mr. Arnold and the systems later developed is that all of the latter employ a commutator motor almost identical in construction with the direct-current motor, while the former uses a pure type of synchronous alternating-current motor. Since in this type the relative speed of the armature and field must always be constant, variation of operating speed is obtained by making both these members rotatable. In this manner the condition of synchronous speed with relation to the field and armature is maintained, while any operating speed between zero and synchronism is secured by rotating from an exterior source the field in a direction opposite to that of the armature; or a speed greater than synchronism may be obtained by rotating the field in the same direction as that of the armature. This exterior source consists of a compressed air outfit in connection with the car motor, which stores up energy when the motor car slows down, and gives it forth again when the car starts up; or the air storage can be increased at any time the car is running or is at rest, and the speed can be regulated at will. A salient advantage of the system is that an absolutely constant load can be maintained on the power house regardless of the stoppage of cars, and of the power required in acceleration. This follows from the fact that the car motor is always running, and when not delivering power to the car, is engaged in storing compressed air. The compressed air pumps are only idle when the car is running at synchronous speed; when reducing speed, air is being stored at a rate corresponding at each instant to the reduction of speed at that instant; and when the car is gaining speed, then is an expenditure of the stored energy corresponding to the rate of acceleration. Another advantage of the system is that a car can for a certain fixed period be deprived of any electrical supply and kept in motion by the compressed air auxiliary, as in passing through a town, in the streets of which it would not be advisable to install the high-tension supply conductor.

The disadvantage of the system is obviously the complexity introduced by the compressed air outfit, which doubtless also introduces a weight handicap. As the first practical working solution offered to the single-phase traction problem, this disadvantage was subject to offset by the great advantage of the high-tension current involved over the low voltage of the direct-current system. At present, however, the comparison is with the recent alternating-current systems, and it remains to be seen if their greater simplicity can be overcome by such advantageous features of the Arnold system as are not common to them.

The Telephone.

During the past year there have been no striking developments in the technical side of telephony, but the steady progress in the perfection of details, and especially of the minor ones, which have been so characteristic of the preceding several years, has shown no relaxation, as our weekly review of telephone invention has borne witness. The interest of inventors in automatic telephony has not abated, several new systems during the last year having been patented, and the older automatic systems have undergone steady improvement. The central energy system has become so thoroughly established in the art that an exchange not equipped for its employment may now be considered almost obsolete. A new field recently opened for telephony is in connection with railway working. The telephone, of course, has for some years been of much service as part of the dispatching system of electric railways, but its adaptation to the service of trunk line railroads has been a development of the past few years. Recently an impetus has been given to railway telephony by the perfection of a new and simple system for the simultaneous use of the same conductors for both telegraphy and telephony, and we are informed that a railway department has been established as a branch of the leading telephony organization of the country. This is not an innovation *per se,* since for ten years or more long-distance telephone lines have been utilized for telegraphic purposes. In the early stage and possibly to some extent even to-day, one who leased a private telephone line was not aware that his wires were also leased for two telegraphic circuits.

The advent of new systems and notable improvements in devices are widely heralded, but it is not generally realized what a great part the engineer, as distinguished from the inventor, has quietly played in placing telephony on its present efficient footing with respect to continuity of service, the extension of exchange service and in making possible reduction of rates. As an example, we may mention the use of lead-covered cables, which alone permits of properly distributing subscribers' lines in their present magnitude. Taking the case of great office buildings in the larger cities, each frequently containing several hundred telephones, a pole line of standard construction to feed such a building, assuming it to require 300 lines, would be some 160 feet tall, the cross arms beginning 20 feet from the street. The early types of telephone cable at once reduced the space required for such a number of wires to a few hundred square inches, while with more modern cables only some 16 square inches are required in which to conduct 300 pairs of wires. The step from the early lead cables with their large conductors, fibrous insulation and parafine filling with consequent high electrostatic capacity, to the modern small conductor cable having six or more times the number of conductors in the same bulk, was no small one, and arrived at only after the most careful study and co-operation between engineers and cable manufacturers. The situation in this connection has been still further ameliorated by the beautiful invention of Dr. Pupin, consisting in so distributing inductances along the line as to neutralize the disturbing effects of capacity, whereby transmission through cables of commercial proportions may be brought to equal or even exceed that through standard aerial lines.

A somewhat curious recent development as reflected in patent office issues, is in the provision of means to prevent infection from the mouthpieces of telephones. Since according to the ethics of the medical profession a physician cannot advertise legitimately, a certain class of medical men are prone to seek notice in newspapers by sensational announcements designed to attract to them the attention of the public. One of the subjects which several years ago served for this purpose was the alleged danger of infection from telephone mouthpieces, and since then scarcely a week has gone by without the issue of a patent on a sanitary mouthpiece attachment. Telephone users would, however, doubtless welcome an aurists' newspaper campaign that might lead to thought on the part of telephone inventors toward doing away with the cause that results in the violent "sound shocks" incident to the use of the relay system, which shocks at times are so severe as to be an actual danger to the hearing. The severity apparently has some connection with the temper of the operator, but in any event any improvement which can be made by telephone companies to eliminate this annoyance will most undoubtedly be gratefully welcomed.

THE ELECTRIC RAILWAY.

The single-phase alternating-current railway question has during the past year, and particularly during the latter months of the year, completely overshadowed all other developments in the electric traction field, and the new year opens with an electric railway situation such as has not been presented since the time of the Richmond experiments. The trials at Pittsburg, Berlin and Milan of single-phase systems have all met with a success so astonishing, that in view of the previous dubious status of alternating-current traction, the entirely unexpected outcome has had a dazing affect, and it will be some time before the probable outcome will be clearly evident. One thing, however, seems sure, and tbat is the passing of the rotary converter from a field where, indeed, it has only been tolerated *faute de mieux*. The commutator alternating-current motor is so nearly allied to the direct-current motor that it enters the lists as a competitor to the latter for all traction purposes. Even for urban service Mr. Lamme, who speaks with authority, pronounces in its favor, the disadvantage of extra weight being considered more than compensated for by the absence of rheostatic control.

Another issue brought into the field with the single-phase development is that of the trolley vs. third rail, which bodes ill for the latter, particularly in view of the Zossen experiments, which established the sufficiency of the suspended trolley system for the heaviest service. With the voltage that will be employed with the single-phase system, an ordinary street railway trolley wire would suffice in some cases where now the third rail is required to be used in order to obtain cheaply sufficient conducting cross section. The growing feeling on the part of the public against the third rail owing to its supposed "deadly" character and unreliability in winter weather, may aid in carrying the question beyond its natural limit and make it one of overhead conductors even where in heavy service this means an equivalent of a third rail supported overhead by a substantial structure. Indeed, this appears almost a necessity in the case of the rapidly coming applications of electric traction to railroad terminal service; for the use of the third rail in the terminal yard and at crossings appears to be out of the question, and a combined overhead and third-rail system would inevitably end in the survival alone of the fittest component—and a few derailments would clearly indicate the survivor.

Next in general interest to the alternating-current development has been the announcement of the New York Central of its plans for electric traction, which in outline comprise the establishment of a zone within which all through trains will be handled by electric locomotives, orders having already been given for 30 of these of 2200 hp each, and with a maximum speed capacity of 60 miles per hour, the ultimate number to be about 300; and the handling of all suburban traffic by trains operated on the multiple-unit system. The decision in favor of the direct-current system, coming as it did at a moment when the champions of alternating current felt that they had laid low the adversary, has doubtless been a source of severe disappointment to their sanguine spirit. In due time no doubt the New York Central authorities will make public the reasons for the decision in favor of direct current, and in the meantime it can readily be surmised that this may have little or no connection with the technical superiority of either of the competing systems. In fact, being limited by statute as to the time when electrical operation shall commence, and having to consider the absolute necessity of avoiding any risk of interruption of service such as is apt to be incident to a new and untried system, the decision could scarcely have been otherwise than in favor of a system with absolutely no question as to its fitness for the service required, and involving apparatus with no experimental features inviting delay. Moreover, the question of possible interchange of cars with the New York Subway System, which had already provided for direct-current operation, was no doubt a vital factor in shaping the decision. It is thus quite probable that the selection of the direct-current system depended on considerations largely or entirely of business policy, with perhaps full recognition of the probability of a change over to alternating current before many years.

WIRELESS TELEGRAPHY IN 1903.

In wireless telegraphy the sanguine expectations of a year ago cannot be said to have been realized in 1903 to any marked degree. It is true that Marconi, last January, fulfilled his promise and definitely established the feasibility of wireless communication across the Atlantic; but the effect of this achievement was discounted by the celebrated letter "S" experiment of a year before, and the abandonment of the attempt to maintain a continuous transatlantic service had its depressing influence. Perhaps, however, the greatest blows were those received at the time of the New York fall yacht races through the sad showing there made for syntonic wireless and the malicious interference set up by rival systems, which, in the eyes of the public, not only discredited all of the systems involved but, what is much worse, discredited wireless telegraphy as a whole. The truth is, the mercenary side of the wireless telegraph movement has been made so unduly prominent, the self-advertising which has accomplished the development has been so unblushing, and the squabbles between rival concerns so undignified, that the subject of wireless telegraphy as presented particularly in the newspaper press has well-nigh degenerated to a public nuisance.

To look at the brighter side of the situation, a most encouraging feature has been the practical demonstration during the year of the magnificent possibilities of wireless telegraphy for communication between ships and between ships and shore stations. Its usefulness also to communities physically isolated from the world has been demonstrated in several cases, notably in that of Santa Catalina, an island in the Pacific Ocean, 25 miles distant from Los Angeles, Cal., which, during the summer printed a newspaper having a wireless telegraph news service. In the matter of notable improvements in wireless telegraph systems, little appears to have been done in a practical way so far as recorded, though the patent offices of this country and of Europe have been sending out a constant stream of patents relating to wireless telegraphy. Prof. Lodge has at last come forward to make good his claims as the father of wireless telegraphy by presenting a system devised in collaboration with Muirhead, which has yet, however, to prove its practical merit. Braun claims to have found a method of directing to any point continuous trains of electric waves and also a method of largely increasing the energy emitted by the transmitting antenna. Hewitt has proposed a form of oscillator which seems to contain much promise. Tesla, Stone and Bull, as well as others, have made additions to the already long list of syntonic systems awaiting practical demonstration, and Fessenden and De Forest have put forth several new devices. In the purely scientific field much good work has been done in the investigation of the principles involved in wireless telegraphy in general and in the action of the fundamental details of apparatus in particular. The controversy concerning the nature of the etheric propagation of waves has continued to rage, with the advantage in the favor of those offering simple explanations based upon the work of Maxwell and Hertz, as opposed to brand new theories devised to fit the new phenomena developed.

An ominous happening of the year was the gathering at Berlin of an International Wireless Telegraph conference having for its purpose to lay down international regulations for the control of wireless telegraph communication. Aside from the baneful effect of governmental meddling with anything that does not directly relate to affairs of state, there is a particular menace in the case of a new development, which should not be trammeled at a period when every freedom of action is desirable. The part of wisdom would have been to allow a free development, and then deal with evils in the future as they arose. Our government has unfortunately become a party to this mischievous interference and it is much to the credit of England and Italy that representatives of those countries did not sign the protocol, with its hampering provisions. In this connection it is significant that in France the government has taken possession of all wireless telegraph stations, which will probably mean that instead of an inventor of a meritorious system or improvement having a free field for its development with willing capitalists to assist, he will be discouraged from proceeding owing to the bureaucratic barriers set in the way.

Curious Vacuum Tube Phenomena.

Elsewhere we print a communication from Mr. W. J. Hammer giving an account of a curious phenomenon he has noted in connection with a damaged Röntgen-ray tube. As will be seen, the tube, after having for a time been connected in an induction coil circuit, gave forth when disconnected a musical note for a considerable period with apparently no exciting cause exterior to the tube. Since the tube when removed had stored in it a considerable quantity of heat at the anode plate, the first thought is that the cause of the sound can be ascribed to some heat vibratory action, the Trevelyan "rocker" effect coming to mind in this connection. Mr. Hammer, however, appears inclined to refer the action to a condition of resonance established with respect to some etheric vibration, previous excitation of the tube having rendered it sensitive to such an etheric influence. Mr. Hammer also refers to his observation of the lighting up of a vacuum tube with apparently no exciting cause, which phenomenon has also lately been observed abroad. Both of these phenomena deserve careful study, for a complete explanation will not only be of the greatest interest *per se*, but may have an important bearing on etheric phenomena generally.

The Progress of Electric Lighting.

Electric lighting has long passed the apologetic stage of its history. It has assumed an importance so commanding that it would be scarcely worth while if it were possible to recount the details of its forward march. But they have on the whole been of about the same kind to which we have been accustomed. The student of electrotechnics as a rule finds little of a sensational character striking his attention. Yet there are dominant tendencies even if no radical changes. In the power station there has been a steady and conspicuous increase in the use of turbo-generators, which must have a salutary effect upon station economy, and now the gas engine is coming forward for recognition. We do not here propose to raise the moot point of turbines vs. engines. That will have to be fought out by the champions of the respective machines in the arena of strenuous competition. But we do wish to point out that particularly in stations of moderate size the light load conditions, always a source of anxiety, are greatly ameliorated by the introduction of turbines. Whatever the ultimate economy of the turbine may be, it undeniably has very small friction losses, and these are what count in the evil hours when there is no load to speak of and the plant must still be kept in operation. In methods of distribution there is a steadily increasing use of alternating current as might be expected, but no striking advances save in output.

The most interesting feature of the year's advance is in the direction of new illuminants. Of these the most striking is the mercury arc, which now has begun to work its way into commercial use. Its color bars it for general use in interior lighting, although improvements are promised; but this very failing makes it extraordinarily conspicuous when used for advertising purposes, a legitimate and growing branch of electric lighting. A mercury arc stops the passer-by almost as effectively as a sentinel with a fixed bayonet at charge, and its capacity for bizarre effects gives promise of continued usefulness even after the original novelty has worn off. Some very interesting experiments on its application to street lighting have been tried during the past summer, and the verdict seems upon the whole to be rather favorable, particularly where incandescents or widely spaced arcs would otherwise be used. A useful technical field has begun to develop in the application of this light to commercial photographic processes. In blue print shops and in photoengraving work the new light has already proved its usefulness, and a more recent application is in the printing rooms of photographic studios. It is found that platinum prints can be very quickly and conveniently worked off by the mercury arc, which is a great convenience in dull winter weather.

The arcs with composite electrodes of various compositions have also passed from a mere laboratory existence to tentative use outside, and while the results cannot yet be called decisive they are at least encouraging. As is probably known to our readers, some arcs of this class have given by far the highest efficiency yet attained by any artificial illuminant, even as high as four or five candle-power per watt, and the color effect is excellent. A certain tendency to smudginess seems to be the chief objection to the class in its present stage of development, but how serious this really will prove to be one can hardly say. Certainly the hope of so great efficiency will spur on experimenters to determined efforts. It is even reported that an out-and-out vacuum tube lamp is ready to pass from the experimental to the tentatively commercial stage, but this can hardly belong to the past year's record. The Nernst lamp itself, by no means now a novelty, has been quietly pushing its way into more considerable use and it really looks as if by another year the new illuminants will begin to cut some figure in the statistics of the art. Our old friends, the incandescent and the enclosed arc are still, however, doing business at the old stand and will not put up their shutters at the rumor of competition.

TESTING LARGE ALTERNATORS.

The rational design and construction of alternating-current generators depends upon the accuracy with which machines can be subjected to tests and experiments by which their properties and their behavior under different loads can be ascertained. It is not sufficient to be able to test machines after they are installed, because it is not only desirable but essential for the manufacturer to know whether the machine meets the specifications before it leaves the shop; and as usually the machines are put into service immediately after installation, the station engineer is loathe to sacrifice time and expense for tests which to him appear unnecessary and useless, being satisfied if they do the work for which they were intended. Now, it need hardly be remarked that a machine may well answer the requirements of a station without meeting the specifications according to which it was to be designed. With increased competition, it becomes incumbent upon the consulting engineer to satisfy his client and himself that the machines purchased are actually in accordance with the specifications, and that they do not evade some of the points at variance with the manufacturers' standard shop practice. It is from such considerations of the commercial importance of accurate tests on large alternators under full load conditions, and from the engineering interest of such tests, that the matter of testing large alternators is deserving of the most careful attention.

The primary points to be ascertained in the testing of alternators are the heating of the armature core, armature and field coils, and the regulation of the generators, under all possible conditions of load. Small alternating-current generators, up to 200 and 300-kw capacity, can generally readily be tested in the testing departments of the large manufacturing concerns. There are in most cases machines available of approximately the same output and voltage which can be operated as synchronous motors from the generators which are to be tested. If two machines of the same size and type are available, a test can be made on them which is a logical extension of the principle of the method of circulating power, originated by Dr. John Hopkinson in 1886 and applied to the testing of a pair of direct-current machines. While in Dr. Hopkinson's test of direct-current machines the relative position of the two armatures, which are rigidly connected, is immaterial, in circulating power between two alternators, it is this relative position of the two armatures or the two revolving fields which determines the power circulated. The greater or less difficulty in setting up two alternators and connecting them rigidly at a certain angle has limited the application of this method in practical work. Mr. William M. Mordey suggested in 1893 the feasibility of circulating power within a single machine. The Mordey alternator had a single rotating field coil, and the armature consisted of radial projecting coils, which were connected in series. By connecting more than one-half of the armature coils in series with the remaining coils, Mr. Mordey succeeded in circulating wattless current through the armature.

Applying the principle of this ingenious suggestion to the modern revolving field alternator, we have, in addition to Mordey's method of connecting armature coils in opposition, the other possibility of leaving the armature connected in series and of connecting the field coils in opposition, so that a larger number of field coils opposes a smaller number. While there is no theoretical flaw in this arrangement, the method becomes in actual practice impossible on account of the unbalanced magnetic pull produced by the armature current strengthening the fields that act as motor, and weakening the fields that act as generator. To overcome this difficulty, it has been suggested to split the revolving field into four sections, so as to distribute the disturbance uniformly over the circumference. This method seems to be but a make-shift requiring a number of connections inconvenient to make, and involves four places on the periphery of the armature at which the distribution of magnetism is different from normal. It has, moreover, the main disadvantage that the maximum induction to which the core is subjected is not the same as that in the generator when running. Another method consists in connecting the two halves of the same number of coils of the field in opposition, each half carrying the same current. There will thus be no e.m.f. generated in the armature coils, and by supplying direct current equal to the full-load current of the alternators, the current losses in the armature can be made up. In a polyphase generator tested in this manner, the direct current flowing through the armature coils produces a magnetic pull which is stationary, whereas the magnetism of the revolving field rotates with an angular velocity corresponding to the frequency of the alternator. The revolving field, therefore, with the closed exciting circuit and other closed circuits as field collars and dampers, cuts through this stationary armature field, thus leading to additional losses of a magnitude which cannot be calculated. This method, therefore, does not recommend itself, especially if we bear in mind that the accompanying conditions of armature reaction are altogether different from the actual working conditions of the generator, although it is possible by changing the connections of the armature to destroy almost completely this armature field.

Neither of the above-mentioned methods of testing large alternators permits the determination of the regulation. A modification and improvement of Mr. Mordey's method has recently been suggested by Mr. Behrend. Mr. Behrend's method consists in dividing the field of a revolving-field generator into two opposing halves, and in using different exciting currents in each half. The armature of the generator is short-circuited, and therefore no special connections have to be made excepting a lead from the common point of the field to the shaft or to a slide ring thereon. The advantage claimed for this method is its simplicity and the accuracy with which the full-load conditions are represented by artificial conditions. The experiments seem to have established the fact that the core loss in this method of testing is equal to the core loss under full load, and to the core loss on open circuit for the same terminal voltage. The method is also applicable to the determination of the regulation, as the conditions of armature reaction are almost identical with the conditions under full load at a power factor of zero Excepting the disturbances produced on a diameter by the opposing fields, there is no difference between the actual conditions and the artificial conditions for a power factor of zero. In machines having many poles, the error produced by this disturbance on a diameter is negligible, but it becomes considerable in machines in which the number of poles is less than eight. On all machines the testing of the regulation by this method is limited to the regulation for a power factor of zero.

Mr. Mordey suggested in his paper of 1893, "On Testing and Working Alternators," to supply the current in the armature from an external source. An improvement on this suggestion is found in Mr. Burnand's method, which we publish in this issue. Mr. Burnand divides the armature circuit into quarters so as to abolish the unbalanced mechanical stresses, and he forces alternating current of the same frequency as that of the generator through the armature coils. It is plain that in this manner the relative phase of the armature current in regard to the revolving field can be adjusted. The method, however, does not seem to be free from defects. In the first place, the number of field disturbances is again increased to four, and in the second place, the method is rather difficult to carry out in the testing room. It must be remembered that most commercial alternating-current generators are polyphase machines, and the splitting of the armature coils is a rather inconvenient operation. The field disturbances must affect the determination of the regulation, and, therefore, this method appears to have no advantage over that of Mr. Behrend, excepting that there are four field disturbances in Mr. Burnand's method, against two in that of Mr. Behrend. With the advent of the steam turbine generator, the number of poles in large units will be greatly reduced, and while 60-cycle engine type generators for 3,000 kw and 75 revolutions have 96 poles, the coming turbine generator has for the same output only 12 poles. For 25 cycles an engine type generator of this capacity has 40 poles, while a turbine generator has only 4 or 6 poles. The methods of test, therefore, which have been developed for large alternators of the slow-speed kind, will have to be adapted to the high-speed generator, and new methods originated which permit the satisfactory testing of high-speed alternators under full-load conditions. Meanwhile, all the various methods proposed will be put to test and the method which survives will finally be recognized as the fittest for the manifold conditions that must be satisfied.

The International Electrical Congress of St. Louis This Year.

Now that we open the year 1904, the prospect of the International Electrical Congress enlarges and takes definite outline. The evidences are gathering to show that the success of the Congress will be marked. The number who have in writing already accepted membership in the Congress is over eight hundred. European engineers are now being invited to join. Until quite recently the invitations to join the Congress have been restricted to Americans, in order to make sure that a fair start could be obtained before asking foreigners to participate. It is not to be expected that a very large number of foreigners will attend the St. Louis Exposition or the International Congress, but it is quite likely that a number of European electricians will naturally desire to join the Congress in order subsequently to secure copies of the *Transactions,* since these *Transactions* already promise to have great electrotechnical value, and the expense of obtaining them independently at a later date is naturally liable to be greater than by original adherence to the Congress.

Some of the best electricians in Europe have already promised to contribute papers to the sections in September, and all of the papers to be read are to be by special invitation. The result of this policy of the Committee of Organization should be to produce at least as fine a set of papers, discussions and transactions for electricity as the Physical Congress of Paris in 1900, whose volumes have world-wide recognition as marking the universal knowledge and status of each branch of physics at the end of the nineteenth century. A number of prominent American writers have also promised to contribute papers, so that the representation that America can offer in the world's electrical knowledge and applications is not likely to be deficient. The State Department at Washington has also promised to espouse the cause of the Congress, and is believed already to have taken action on the invitations of foreign delegates.

There now remains to arrange the details of the plans of co-operation with electrical organizations who may desire to participate in the Congress, collectively as societies or associations, as well as individually through their respective members. Notably this is the case with the American Institute of Electrical Engineers whose membership has a large representation in the Congress, and whose president is the chairman of the Executive Committee of the Committee of Organization of the Congress. Ten members of the Board of Directors of the Institute are also officially connected with the Congress. It is hoped that the Institute, which is interested in the work of most of the Congress sections, may take an official representation in the Congress and participate in the proceedings. Invitations are being forwarded to various other physical and electrotechnical societies, asking them to join in the official representation and participation at St. Louis. It is, therefore, to be hoped that the proceedings of the Congress will represent the best available papers, and also the best available work of individuals and of societies, scientific, electrochemical, electrical engineering and electrotherapeutic, all over the world. Ample accommodation has been promised within the precinct of the Exposition for the Congress. In fact, the accommodation offered will not only be ample for all the Congress sections working simultaneously, but also for such other electrical organizations as may desire to hold a convention in St. Louis simultaneously with the Congress.

The Progress of Electrical Theory During 1903.

No noteworthy discovery in electrical theory has received prominent notice during the past year, but steady progress in electrical science has been made. In particular, the electronic theory has steadily advanced. That is to say, the theory is gaining ground steadily that electricity is indissolubly connected with the component parts of an atom of matter; or, what may be the same thing, that atoms are composed of electricity, or are disturbances of ether corresponding to minute electric charges. Every year that passes extends the scope of the science of electricity, which is only another way of expressing the fact that the various sciences are approaching unification. Optics became a department of electricity when, by the labors of Maxwell and of Hertz, the electromagnetic theory of light was established. Similarly, there is now laid in the electronic hypothesis a basis for an electrical theory of matter in general, and of dynamics in particular.

It is by no means yet clear that the inertia of matter, the inertia of a billiard ball, for example, is due to the self-induction of electricity in the ball, and the opposition which self-induction sets up to an electric current or moving electric charge. But it now seems to be clear that there are large aggregate electric charges bound up in some intro-molecular way with the ivory or composition, of which the billiard ball is formed. It is also known that such electric charges must resist being moved or stopped, by the self-induction law, according to the same law as mechanical inertia; that is to say, according to the second differential of the distance with respect to time; or, in ordinary language, in proportion to the acceleration. There seems, therefore, to be no escape from the proposition that at least a part of the inertia displayed by a billiard ball is due to self-induction. The real question is whether there is enough electricity, on the whole, in the matter of a billiard ball, to account for all of the inertia. An electrified pith ball, for instance, is supposed to have a small amount of extra inertia, due to its electrification; but so little extra, that it has never been made evident. The total charge stowed away molecularly in a billiard ball must be immense, in order to account for all of the inertia electrically. If all the atoms carry the same charges that they carry in electrolytic processes, the electrical share of the inertia of a billiard ball would seem to be very minute. But if, according to the electronic theory, there may be numerous electrolytic atomic charges stowed away in an atom, then it would be possible to account for all of the inertia by self-induction.

The suggestion is strong, therefore, that dynamics is now a department of electricity; or that electricity is a department of dynamics; or that there is no longer any fundamental division of science into electricity and into dynamics; but that both are branches of a yet more fundamental knowledge, bringing to mind the time-honored remark of the French King to his son departing to ascend the throne of Spain: "The Pyrenees no longer exist." The signs of the times are that in this way each science will extend over the borders of its neighbors, until, when it has conquered them all, it will have destroyed itself, and all the sciences will be one and the same. This tendency to merging unification and desectionalizing is steadily pervading every human interest.

RECENT ELECTROCHEMICAL DEVELOPMENTS.

Under this title we have presented weekly concise analyses of current electrochemical patents, which latter collectively may be said to represent the only available authoritative literature on the newest developments in this branch. On the other hand, in electrochemistry—as in other departments of applied science—patent specifications are apt to represent rather the inventor's hopes than real accomplishments. A summary review of the present actual condition of the electrochemical industries may, therefore, not be without interest at the present time. The year 1903 has not witnessed any developments on remarkably novel lines, yet there has been a very considerable activity, and conscientious and persevering work along certain lines has resulted in some new additions to the art and considerable improvement in some of the established branches. Thus in electric furnace work, the apparently very simple reaction between silica and carbon in a furnace became with Acheson the starting point for the gradual development of the industries of carborundum, artificial graphite and more recently "siloxicon." The principal point established is that the decisive factor determining the product of the reaction is the temperature. While at the time of the advent of the electric furnace the desideratum was the production of the highest possible temperature, now the end is so to design a furnace that the temperature can be held uniform and can be exactly regulated within given limits. Acheson's siloxicon furnace and Tone's silicon furnace illustrate this development during the past year.

In one special line the electric furnace has made important advances, especially in Europe, and that is the metallurgy of iron and steel. It is true that we have here but the beginning of a development, but it is a branch which promises to become of great importance. At present ferro-alloys and special steels are commercially made in the electric furnace, and there is a greatly increased interest in the electric furnace metallurgy of rare metals. It is in the manufacture of the most expensive special steels that electric furnace methods appear to have the best prospect, and it seems probable that in a few years "crucible steels" will no longer be made in crucibles. One of the chief advantages of the electric method is easy control and cleanliness, there being no contamination from the fuel gases. In this connection it is interesting to note how electrochemical inventors strive to avoid contamination from the presence of carbon electrodes. Heroult and Keller use carbon electrodes which do not reach into the fused metallic mass, an arc jumping from the carbon to the mass and another arc back from the mass to the other carbon—a slag at the top of the mass protecting the fused steel from contamination. Kjellin is still more radical, since he dispenses any electrodes entirely, his charge forming the secondary of a transformer. The developments in this line are of particular interest to the electrical engineer owing to the bearing on the production of steel with special magnetic properties.

While the calcium carbide industry continues in a satisfactory state, its expansion depends upon increased uses of acetylene, and in this the development is somewhat slow. In this connection we may recall a remark of the late Luther Stieringer, who expressed the hope that, owing to the beauty of its light, he might have an opportunity to light an exposition with acetylene. The aluminum industry being now relieved of the uncertainty of status existing during the long patent litigation recently closed, is now in a position to strike out more vigorously in new directions. The use of aluminum for electric conductors increased largely during the past year, and its employment as a reducing agent in metallurgy for producing very high temperatures locally and almost instantaneously, has been developed by Goldschmidt into a new branch of engineering, aluminothermics. The electrolytic production of metallic sodium and potassium continues to increase annually, and their use is largely extending in the cyanide process of recovering gold. In this country the precipitation of gold from cyanide solutions is still mostly done by zinc shavings, but the electrolytic method continues predominant in South Africa. The production of caustic soda and bleaching powder by electrolysis of sodium chloride has become a very extensive electrochemical industry and in this field the new electrochemical methods have attacked, and in some cases finally conquered, old and firmly-established chemical industries. The variety of this electrochemical method is well illustrated by the fact that three essentially different processes are commercially successful in the same field in this country, namely, the Castner-Kellner mercury cathode process, the Acker process for the electrolysis of fused salt, and the diaphragm cell process. Unfortunately, the market is utterly demoralized at present, and the hope for better conditions rests in a mutual understanding concerning selling prices now said to be under consideration by the manufacturers.

An interesting development in the New England States is the installation by the larger paper and pulp mills of their own electrolytic plants for making the bleach required in their works. The general use of apparatus for making hypochlorites or bleaching liquors, while increasing in Europe, has not made much headway in this country, although it should here have a good future in bleaching finer linens and in laundries. In refining copper this country easily ranks first, and the industry is in prosperous condition. The United States now produces 85 per cent. of all the refined copper of the world. A very promising beginning in the refining of lead has been made in the Betts process, and gold is being electrolytically refined in the Philadelphia Mint. There is little doing commercially in the electrolytic production of metals from their ores, although the Browne process, which has been successfully used for several years in Cleveland for separating copper and nickel from the Sudbury ores, will be employed on a larger scale by the International Nickel Company upon the completion of a new plant now under way. In electroplating—the oldest branch of electrochemical engineering—

there is to be observed a pronounced tendency to get rid of the old rule of thumb, which has afflicted this particular industry to an extent that greatly handicapped its progress.

Perhaps the most interesting development in electrochemistry has been with respect to processes involving electric discharges through gases. The production of ozone from air and the use of ozone for sterilizing water have proven successful in Europe; whether they will obtain commercial importance in this country is simply a matter of dollars and cents, but the technical difficulties may be considered to have been overcome. The most promising development in this line is, however, the Bradley process for the fixation of atmospheric nitrogen, although no new developments have been recorded concerning it during the last year. In the battery field there has been again great activity, though confined principally to the patent office; and as in the past, but few of the inventions in this line there recorded give promise of any future. The lead accumulator's position seems assured as an auxiliary for light and power purposes. On the other hand, the future of the belated Edison nickel-iron accumulator seems very bright for automobile purposes. The old dream of electrochemical inventors of a carbon cell that will revolutionize the generation of electrical energy still remains a beautiful dream, and it is with regret that we have to state that there are no signs yet that it will soon be realized in practice. If aspiring inventors in this line would, before commencing to invent, make themselves thoroughly acquainted with the role that thermodynamics pl ys in electrochemical action, much waste of effort would be spared—and no inconsiderable sensational copy lost to the newspaper press.

A Year of Extreme Radioactivity.

No branch of physical science has, in the last twelve-month, been prosecuted—we had nearly said persecuted—with so much vigor as the investigation of the curious phenomena of radioactivity. The greatest interest has naturally centered about the remarkable discovery of Mde. Curie that radium salts seem able normally to maintain a temperature slightly above their surroundings—that is, they give out heat spontaneously to a very perceptible amount—and several of the year's researches follow directly along this line. As a preliminary to any discussion of this curious fact, it is well to remind the reader that in nearly all the popular articles and many scientific ones, radium is a word used to denote not the metal of that name, but its chloride or bromide, generally the latter. In a similar slipshod fashion the photographer sometimes refers to the silver in an emulsion, meaning thereby the bromide or chloride of silver. Radium, the metal, is as yet unknown, although a pretty good guess may be made as to its more general properties, but whether it is itself radioactive remains to be seen. So when the statement is made that radium decomposes or gives off emanations, or rays, it is wholesome to remember that the bromide of radium, generally quite impure, is the substance having these properties. As to the amount and character of the impurities referred to, it would be unwise to hazard a guess. Madame Curie, like her distinguished husband, is far more cautious and conservative in statements about radium than those whose knowledge is derived merely from a few decigrams of the stuff in a sealed tube. Her study of the atomic weight of radium showed steadily increasing values, for preparations of increasing purity up to her last figuring 225. Some rather reliable spectroscopic evidence indicates an atomic weight exceeding 250, so there is good reason to suspect that even the purest radium bromide yet obtained is by no means pure in the chemical sense, while the best commercial preparations are of much lower quality.

The spontaneous evolution of heat from radium is far from having a satisfactory explanation. The hastily jumped-at conclusion that radium breaks up into electrons with evolution of energy in enormous amounts, is hardly in accord with the physical and chemical stability shown by the spectroscope, and in the preparation of the substance. We fancy that as time goes on less and less will be heard of computations regarding the stored energy of radium in kilowatt-hours per milligram, and of the spontaneous formation of radium out of nothing in particular required to account for its continued existence. The hypothesis of Madame Curie, reinforced by Kelvin, that radium receives radiant energy of a kind usually neglected and gives it out as heat, is much more nearly in line with the ordinary facts of physics, but must wait for its proof until various problems in obscure radiations have been solved. The striking and beautiful work of M. Blondlot on the N-rays bids fair to throw much light on this phase of the subject, since these rays present many of the attributes of radioactive emanations and yet obey the ordinary laws of radiant energy, being reflected, refracted and polarized in the usual manner. The recent announcement that radium gives off an emanation that acts like a heavy gas (or is one!) which later spontaneously decomposes with probable evolution of heat and certain evolution of helium is, from a purely scientific standpoint, of much greater importance than even the thermal anomaly just discussed. The first chemical step toward the comprehension of an unknown substance is its resolution into known products of decomposition. Of course, in the case before us the next question to be asked is with what the resultant helium was combined to form the heavy gaseous "emanation." We do not like this word emanation—it smacks of the days of "caloric" and "dephlogisticated air." If impure radium bromide gives off a heavy, unstable gas, why not state the fact in so many words? The immediate inference, that radium must be regarded as a condensation of helium, is immensely important—if true.

The first step toward a proof would be to show that the heavy gas is a condensation and not a compound of helium. The spectrum of this gas is reported as of unknown character, but should, on investigation, show its kinship to helium or to something else, and thus answer the question one way or the other. Certainly the present evidence is a very slender foundation for the announcement of the transmutation of elements as an accomplished fact, although we believe that at least one stock company for modern alchemy is already being exploited on the strength of it. Unhappily, radium is extremely scarce and separated only with great expense, so that it is at present almost impossible to study it by ordinary chemical methods. Possibly pending a better source of radium a concentration of attention on thorium, which is far more accessible and has very similar properties, would tend to the advancing of our knowledge of radioactive phenomena. Radioactivity as such, now that attention has been called to it, seems to be a rather common thing, so common that it is hazardous to conclude from its appearance that any of the well-known radioactive substances are concerned in the phenomenon. It may even turn out that one should think of radioactivity as merely a quality rather than the result of the presence of an unusual substance. Experiments with the metals which furnish radioactive salts are likely to be of particular value in settling questions of this sort. Experiments like those of Bàskerville, who found that radium was greatly increased in activity by mixture with a powdered natural silicate of zinc, are also likely to be fruitful. Radioactive substances have been studied too exclusively from the electrical standpoint, and the important advances of the past year have been notable for the wholesome tendency to seek other kinds of evidence and to study the phenomena by the light of other branches of scientific research. The facts are now being accumulated rapidly, and we hope before another year is passed that generalizations of some value will be possible. And we are disposed to think that the whole subject will be greatly simplified when the phenomena are seen in their true relations.

The Government Printing Office—The Electrical Equipment of the Largest Printing Office in the World.—I.

INTRODUCTORY.

NOT only with respect to external dimensions and floor space, but in regard also to number of employees and extent of output, the Government Printing Office at Washington, D. C., is fully entitled to claim the distinction of being the largest printing office in the world. The American love of mere bigness is gratified in every figure that one can cite about it, while in equal degree the American passion for doing everything by machinery and mechanical appliances is manifested there in every respect save one, namely, the use of typesetting machines—but that is another story. To the visiting electrical engineer it is more than gratifying to note how with remarkable boldness, but with corresponding judgment and discretion, electricity has been called upon to discharge all the vital functions of light and power, as well as to furnish heat in novel and convenient manner. The display of the flexibility and resourcefulness of electricity in all parts of the plant is, indeed, a fascinating study. The work here done is done in such a way that he of all men whose heart it would most have rejoiced was at once this country's typical printer and pioneer master electrician—Benjamin Franklin himself.

Standing in a section of the city that is otherwise devoid of large buildings, the Office looms up in dominating proportions that gain by the clear vistas, and its huge red pile is a notable landmark of the National Capital. Many of the public offices in Washington suggest by their exterior a bureaucratic nature and a devotion to clerical work; but whether by design or not, the Printing Office wears a utilitarian air that well befits it without marring its quiet and unostentatious dignity of aspect. The building of red brick, with terra cotta and sandstone trimming, has a front of 175 ft. on North Capitol Street and a depth of 408 ft. on G Street, and has a height of seven stories, exclusive of deep basement and loft. It is nearly a hollow square, as shown by one of the floor plans in this article, so that the interior spaces of the vast area get their share of outside light. All told, there is not less than eight acres of floor space, and of this six acres is available for actual working purposes. The interior court is 30 ft. wide and 167 ft. long, and the power house at the northwest corner completes the rectangle. The framework is of steel, over 12,000,000 pounds having been employed, and the stories all 16 ft. apart from floor to floor, with an approximate distance of 12 ft. from center to center of the window spaces. The iron and steel structural work is covered chiefly with fire brick, and the substratum of all the floors is brick and concrete. Upon this in working areas is generally laid 1¼-in. maple flooring; and there is 210,000 sq. ft. of wood block floor, 300,000 sq. ft. of cement floor, and 15,000 sq. ft. of tile and mosaic. The main entrance on North Capitol Street is of richly ornamental character in gold, tile, mosaic and marble panelings and stairways, with a pedestal at the main stair flight to be occupied in all probability by a heroic bust of Franklin. It is at this point that interior decoration is concentrated, and but a few steps away everything is sternly and severely strong, for use, not show. There are numerous wide halls and stairways throughout the building, all strictly fire-proof, in steel, slate, etc., and there are over a dozen elevators which also afford means of entrance and exit for the 4,000 employees under Public Printer Palmer's administration, as well as for the vast quantities of material handled. It is quite needless to emphasize, even in passing, the necessity even on an ordinary basis, for careful and elaborate plans of wiring in advance; but it must be borne in mind that almost on every floor of this solid, rock-ribbed construction special circuits have had to be run to some piece of apparatus or line of machines. Hence, for complexity of distribution, it would be hard to match the building under consideration, whose daily consumption of current compares with that of many a large central station system.

FIG. 1.—VIEW OF THE EXTERIOR OF THE GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

In dealing with an institution of the scope and character of the Government Printing Office, it is impossible to bring to notice, and undesirable to do so, many features of great interest; and the present article is necessarily restricted to topics falling within the purview of this journal. But in order that the reader should understand what electricity is called upon to do, certain items must be noted before a detailed description of the plant is taken up. The data are perhaps unrelated, but all bear upon the subject. At first glance the annual expenditure of $6,500,000 annually here on government printing may seem fabulous, but a brief analysis of the work done and stock carried by the Office reveals conditions and capacity that attest the extraordinary practical importance of the plant as one of the elements of national diffusion of intelligence. When we find over 4,000 employees, to say nothing of visitors and business callers, we appreciate the necessity for the 8 electric passenger elevators, all of which could handle the whole crowd from the first to the top floor every twenty minutes. When we learn that the annual consumption of paper, for book printing alone, is 100,000 reams flat, and 110,000 reams in rolls; that 3,000,000 sheets of Bristol and cardboard are used; that 1,700 reams of cover paper, 35,000 reams of writing paper, 1,700 reams of typewriter paper, 4,700 reams of manila and tissue paper, and 10,000 reams of coated book paper are used up each year—then we grasp the utility of the five big freight elevators, all electric. One of these at the sidewalk, to carry paper from basement to first floor, will lift 6,000 pounds 100 ft. a minute. Another of the freight elevators has a capacity of 10,000 pounds 150 ft. a minute. The other three will each handle 5,000 pounds 350 ft. a minute. It will be seen at once that the Office in elevators alone has the capacity of a good-sized electric railway for passengers and freight, and needs it all.

Looked at from the other standpoint of output, and disregarding the other items of work within the Office as a self-sufficient organism, it will be seen that the data are again extraordinary. A consumption of 30 to 35 tons of paper daily on the presses all run by electric motors tells the story in one way. The fact that 700,000 volumes of departmental reports are carried in store, ready for distribution, tells it in another, for each volume has to be composed, proofread, printed, folded, bound, labeled and followed through to storage or to the proper depositories and channels of distribution. Then there are such incidental items as the *Congressional Record,* with a daily circulation of 23,000, while Congress sits, a single issue having reached 192 pages. The edition hereafter will run much higher, but the last copy must be off the press to catch the morning mail trains around 5.30 A.M. Such regular work is intensified by sudden demands for special printing required by Congress, to meet which all the resources of the Office are strained and the electrical plant is driven to its limit. The issuance of the famous report on the blowing up of the *Maine* is an instance. Consisting of 298 pages of text, 24 full-page engravings, and one lithograph in colors, and the manuscript being received at 6.30 P.M. one day, a copy lay on every desk in the Senate and House next morning at 10 A.M. As to the speeches of members of Congress printed in pamphlet form from the *Record,* they run into the tons and the millions. Moreover, there are other daily issues that must come out on time, hot from the press, as any "yellow," and even the United States Supreme Court has its daily with a select circulation of some three-score copies. Bills again use up a tremendous lot of paper and ink and electricity, for the passion to regulate everybody else by legislation never wanes, as evidenced by the ghastly fact that in last Congress there were printed 8,025 Senate bills and resolutions and 18,420 from the House, of which 1,384 became law, when at least one copy to be filed with the Secretary of State had to be printed by special motor-driven presses, on parchment. Every week the electrical field is brought into close touch with the work of the Office by the issuance from it of the electrical patents just out of the United States Patent Office and the weekly number of that Liebig's extract of invention, the *Patent Office Gazette;* while once and again come other reminders in the shape of Census Bulletins on street railways, electric lighting, etc. The Printing Office has had at one time 20 tons of fine type and rule work standing for the United States Census Office; while its ability to respond to calls for new editions, etc., is shown by its storage vaults under the sidewalks, with a capacity already pretty well occupied in the new building, for 2,000,000 electrotype plates, every one of which has been, or will be, made by the Office's own electrical equipment. Facts of this kind could be piled one on the other, column after column, but the data now quoted will probably suffice to illustrate at once the scope and quantity of the work accomplished as well as the absolute confidence placed in electricity as the actuating medium.

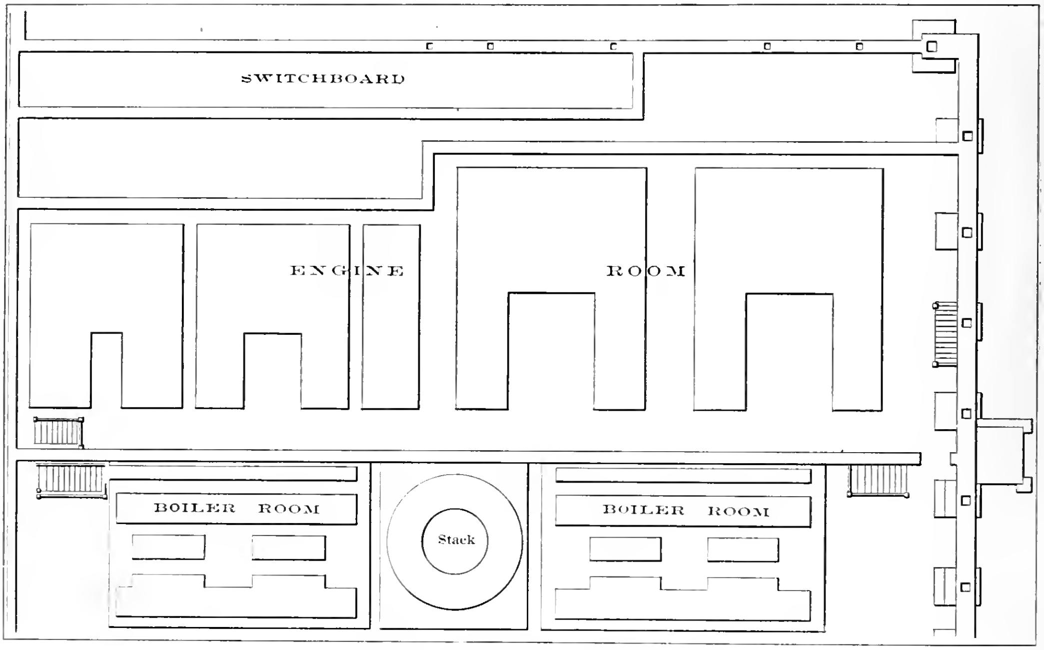


Fig. 2.—Plan of Engine Room, Dynamo Room, etc.

POWER PLANT.

The power plant of the Government Printing Office constitutes, as already noted, a part of the interior quadrangle, being flanked by the old and new wings, which together form the present establishment. The power house is a brick building 112 x 134 ft. in plan, and is divided longitudinally between the engine and dynamo room and the boiler room, as indicated by one of the line engravings herewith, which shows the foundation plans of the two sections and of the stack. While in a sense of evolutional growth, the plant is essentially a well-planned unit as it stands. The first plant was put in some years ago in the old building, and proving successful, but outgrown, it was abandoned and a new power house was erected. The work of moving was a difficult undertaking, as it had to be done without interfering with the operation of the plant. It was effected, however, very smoothly by Mr. W. H. Tapley, the chief electrician and electrical engineer, and Mr. H. K. Collins, the chief engineer. The plant then installed was adequate to the requirements of the old Office and consisted of one 300-kw, 125-volt generator, running at 150 r.p.m., and one 125-kw generator of same voltage and speed, both dynamos being built by the Crocker-Wheeler Company, of Ampere, N. J., and both engines by the E. P. Allis Company, of Milwaukee. When extensions to take care of the new office came up, one of the most important problems was that of continuing the lower voltage or of adopting 250 volts. It was finally decided to adhere to the old pressure of 125 volts, and the additional contract was placed for two additional Crocker-Wheeler generators of 600-kw capacity, 100 r.p.m., and two Allis engines of corresponding

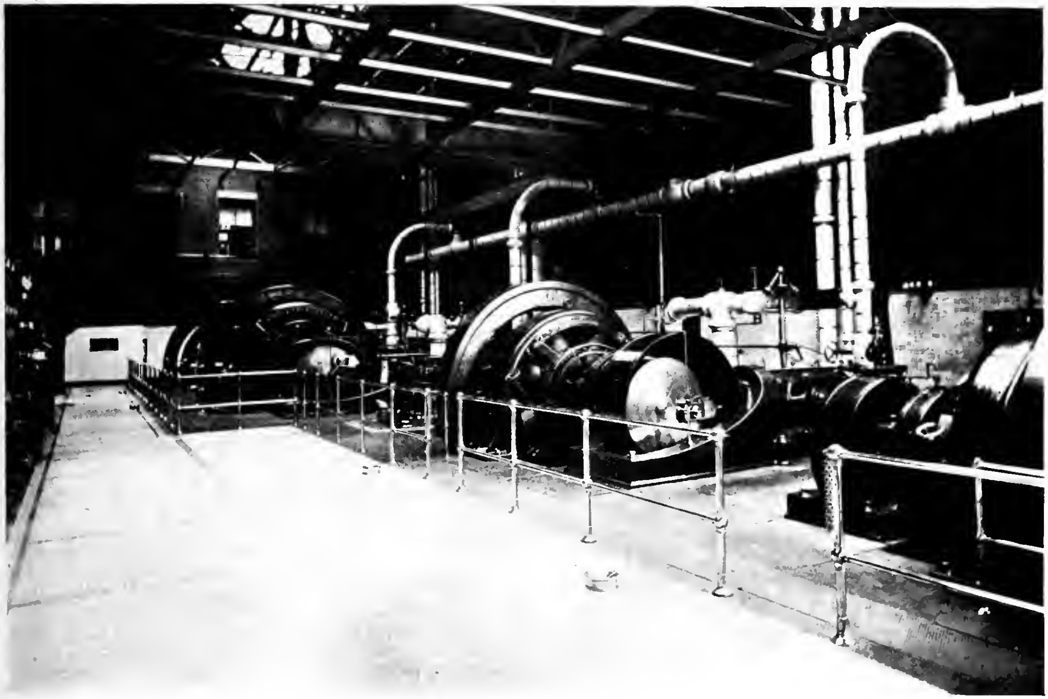


FIG. 3.—GENERAL VIEW OF ENGINE AND DYNAMO ROOM.

capacity. These generators, of the multipolar type, were required to be overcompounded 5 per cent. at full load, with series coils so proportioned as to overcompound by regular equal increments proportional to the output between one-quarter and full load, with a maximum variation at generator terminals not exceeding 1½ volts when running within 1½ per cent. of standard speed; this overcompounding being reduced in the regular operation of the plant to 3 per cent. by the use of German silver shunts in the service fields. The compounding is also so arranged as to permit the generator after having "built up" and when running at standard voltage, being thrown in circuit without taking any of the load or being reversed; and to run thus indefinitely, if necessary. The dynamos have a guaranteed efficiency of 94 per cent. at full load, and will withstand an overload of 25 per cent. continuously for four hours, as well as momentary overloads of 50 per cent. At 25 per cent. overload, the efficiency is 93½ per cent.

Special features of the machines are the internally-flanged frame, giving a very smooth outside appearance and great rigidity. The brush rigging consists of a circular cast-iron ring held in place by supports bolted to the frame and holding the brush [illegible]. The brush holders themselves secure the brushes by means of a [illegible] side of which is held tightly against the brush. Four sets of copper leaves carry the current from the brush box to the arm, and their position is such that the movement of the brush on the commutator is always radial. Hence, there is no necessity of changing the seating after the brush is once worn to place. The spiral spring with the thumbscrew attachment secures the proper brush tension, and the copper leaves, carrying all the current, relieve the spring of any such duty. In spite of the great capacity of the apparatus, its compactness is also a notable feature. The large air-gap tends to reduce field distortion and consequent sparking under heavy loads. The units have been in operation for several months and, as usual, they run very quietly and without heating.

The four Allis engines furnished by the Allis-Chalmers Company are all cross compound direct-connected, the smaller ones being respectively 10 x 19 x 30 and 16 x 30 x 30; while the two new larger ones are of the same size, namely, 22 x 44 x 42. The small machines are arranged to run 150 r.p.m., and are supplied with steam at 125 pounds pressure, exhausting into Knowles barometric condensers. The engines are fitted with the regular Reynolds Corliss automatic valve gear, and have separate eccentrics for operating the steam and exhaust valves on the low-pressure side. The regulator is of the standard heavy weighted type, operating the cut-off cams of both engines, and having in conjunction a safety stop, which guards the engine in case of the breakage of the governor belt. A variation of less than 2 per cent. is guaranteed between no load and full load.

In addition to the governor belt safety stop, there is provided an extra governor which operates a stop valve placed above the throttle valve in the steam pipe, so that if the engine reaches a speed of five revolutions above normal, this valve is released and closes, thus shutting off all steam to the cylinder. In view of this relatively high rotative speed, the steam passages are liberally large, so that the velocities are kept low, and all wearing parts are also amply large for smooth and satisfactory operation.

The engines are fitted with metallic packing, and are adequately provided with oil guards and fittings for due lubrication and cleanly operation. One of the requirements of the contract was a 30-day continuous operation without undue heating or wear of any part. A steam guarantee of 15½ pounds of water per indicated horse-power was also given when operating with steam of 125 pounds and a vacuum of 26 in. The normal rating of these two larger engines is 800 hp and of the two smaller ones 450 and 250 hp, respectively, so that the ratios to the dynamos are 1 to 1, 1.11 to 1 and 1.18 to 1, but it does not appear that the high rotative speeds of the small engines has militated against them in any way.

As will be noted by the engravings, all these handsome generator units are generously spaced with plenty of elbow room, within the brass rail that divides them off from the rest of the spacious hall and from the switchboard, a view of all being commanded by a broad gallery from which stairs run down to the main floor. Each generating unit foundation contains an opening by which an attendant can reach the anchor bearing plate and end of the bolt, and, indeed, the clear basement space affords freest access all around the foundations, which, by the way, are solid to a degree and remarkably free from tremor. The receivers between the cylinders of the engines are in the basement, but the piping connections of the low-pressure cylinders are, as will be noted, largely above the engine floor. The exhaust pipe between the high-pressure cylinder and receiver is also in the basement, but rises into the engine room, where the passage of steam to the low-pressure cylinder is controlled. The live steam connection to the low-pressure cylinder leads into this pipe and has a stop and a reducing valve. The exhaust pipe line from each engine runs in the basement to the partition wall and rises in each case to an independent condenser above the roof, being fitted with a back pressure relief valve for the escape of steam in case the corresponding condenser should be out of commission. The Knowles syphon condenser is used, with 27 in. vacuum, and, as seen, there are thus three lines of piping that rise against the wall at the rear of each engine, one the exhaust, one for the injection water from the District supply lifted to the condensers by the supply pressure, and one for the discharge from the condenser, going to a hot well tank in the basement, whence it is pumped to six attic tanks for house and toilet flushing, an aggregate capacity of some 4,000 gallons being thus furnished.

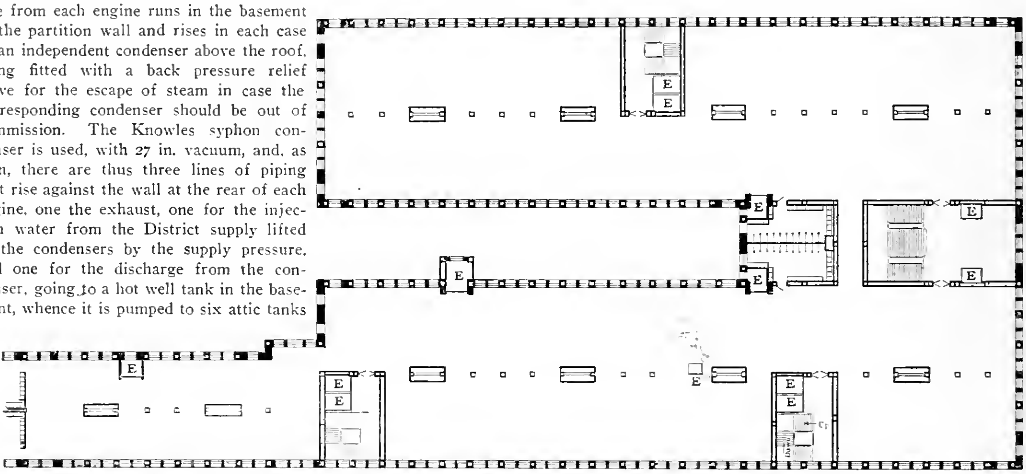


Fig. 4.—Typical Plan of Floor in New Building for Government Printing Office. E. Elevators.

The oiling system for the generating plant consists of overhead reservoir tanks, pipes to and from journals and bearings, a filter for return oil and a centrifugal pump for lifting it back again. The Warden filter is located in the engine room basement and empties into two tanks connected together, in one of which submerged is the pump driven by a direct-connected 3-hp Northern Electric motor. This pump delivers to three overhead tanks in the boiler room, with a capacity of 500 gallons. The oiler piping system is of brass. The steam piping throughout is protected by Keasbey & Mattison magnesia sectional covering, and its appearance in the engine room where so much of it is in sight is greatly enhanced by the white canvas brass-banded jackets.

BOILER ROOM.

Before passing to consider other details of the dynamo room, note must be made here of the features of the boiler plant, which is of somewhat unusual type in this class of work, and which comprises eight 300-hp marine type Scotch boilers furnished by I. P. Morris & Co., of Philadelphia. These boilers were built for a working pressure of 150 pounds, under the direction of United States supervising inspectors for steam boilers, and steam is supplied through an 8-in. dry pipe and nozzle to the main line of steam pipes. The plant is herewith illustrated, Fig. 8.

Each boiler is 12 ft. mean diameter, 13 ft. long from outside to outside of heads and 14 ft. 1 in. over all, with two 45-in. inside diameter Morrison furnaces, each 9 ft. 6 9/16 in. long with one combustion chamber common to the two furnaces, and containing 168 3-in. diameter standard tubes and 68 3-in. diameter No. 6 B.W.G. in thickness, screwed end stay tubes, the length of all tubes being 9 ft. 2 in. between tube plates. The thickness of material is as follows: Shell, 1 3/32 in.; heads, 15/16 in.; combustion chamber, sides and top, ⅝ in.; combustion chamber, back, 9/16 in.; combustion chamber, front or tube sheet, ⅝ in.; furnaces, 9/16 in. The longitudinal seams are double butt-strapped and triple-riveted with 1 3/16-in. steel rivets and 1¼-in. drilled holes, which gives a percentage for the strength of plate of 85.04 and for rivets 96.06.

Using the percentage of plate, which is 85, and figuring the tensile strength at 55,000 pounds per square inch, we get a factor of safety as follows:

$$\frac{1\ 3/32'' \times 0.85 \times 55{,}000}{72'' \times 150} = 4.734,$$

factor of safety at 150 pounds pressure per square inch.

The circumferential seams are double-riveted with 1¼-in. drilled holes and 1 3/16-in. rivets. The boiler heads are braced with twelve 2½-in. diameter boiler brace steel braces between and below the tubes. The top of the combustion chamber is braced with fourteen double-crown bars, spaced 7 in. center to center, each having four 1⅜-in. diameter steel studs for carrying the sheet. The back and sides of the combustion chamber are braced with 1⅜-in. diameter screw-stays. Over the front of each boiler and supported on steel framework is an economizer 85½ in. mean diameter, 8 ft. 10½ in. between tube plates, which contains 306 3-in. diameter tubes. The bottom of this economizer is connected to the smoke box of the boiler, so that the gases when leaving the boiler pass through the economizer and thence to the smokestack. The system of feeding these boilers is to combine the feed water with the dead water which is taken from the extreme bottom of the boiler, and pump this water into the bottom of the economizer; taking it from the top at a point low enough below the surface of the water to insure that no scum will go with it and then delivering the water to the boiler. The object of combining the dead water from the bottom of the boiler with the feed water is, first, to force a circulation in the boiler, and, second, to assist in heating the feed water so that it will not make the tubes in the economizer sweat, as it is likely to do if the feed water is low in temperature. Each boiler is connected to the main smoke flue by an oval connection 4 ft. x 2 ft. 6 in. The large diameter of the smoke flue for the eight boilers is 6 ft. 3½ in. The boilers are equipped with McClave shaking grates 7 ft. 2½ in. long.

The boilers are set in two rows facing each other across an aisle 21 ft. wide, and the boiler room is itself 53 ft. 2 in. wide. The floor is vitrified brick and the brick walls are whitewashed. A system

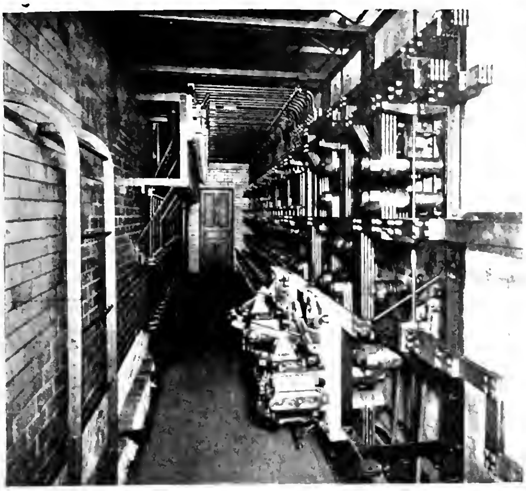


FIG. 5.—BACK OF SWITCHBOARD.

FIG. 6.—PUMPING OUTFIT.

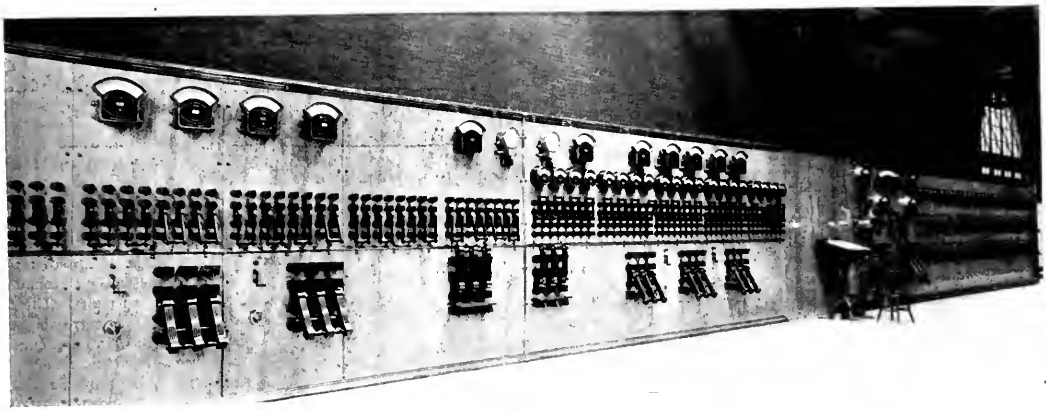


FIG. 7.—GENERAL VIEW OF SWITCHBOARD.

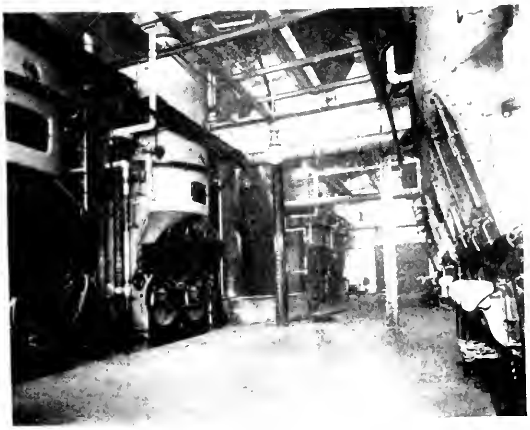


FIG. 8.—BOILER ROOM.

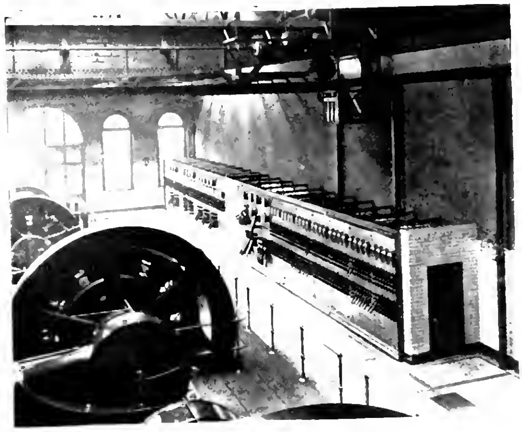


FIG. 9.—ELECTRIC CRANE, DYNAMO ROOM

THE GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

of light galleries runs around the upper part of the boilers, giving access to the valves, which have their stems disposed vertically and upward. Of this gallery there is about 750 ft. The main steam outlet from each boiler connects into a horizontal main by means of a 180 bend of copper pipe, 8 in. inside diameter and 5/16 in. wall, with a single valve in the branch pipe. The main system of steam piping comprises two parallel lines of 12 in. extra heavy wrought iron, one line forming the steam header in the engine room and the other line running along the outside wall of the boiler room, with four cross lines of the same piping as connections between the two parallel lines. This rectangular steam loop has dimensions of about 50 x 103 ft. but as the expansion even in the longer direction of the piping does not exceed ¼ in. no expansion joints have been used. Any boiler can be cut out or in at will, and each of the four cross connections has two valves, so that in case of need the pipe could be cut out at both ends. Along the side walls of the boiler room the steam mains are supported by cast-iron wall brackets, spaced an average distance of 8 ft. The smokestack is built up of steel plate, 150 ft. high and 9 ft. diameter at the top, and is self-supporting. It is mounted on a brick pier with granite coping, 24 ft. square and 19 ft. deep, and at the anchor bolts at the bottom the stack flares out to 17 ft., while it is lined with fire brick for 120 ft. up. Its cap carries a ring of incandescent lamps, which make a conspicuous beacon on special holiday occasions. The boilers are hand-fired with West Virginia bituminous coal, evaporating 10 pounds of water per pound, with steam at 120 pounds pressure, and water delivered to the economizer at 180° F. Coal storage to the extent of about 1,200 tons is provided in the basement of the new building. Feed water for the boilers is taken from two return tanks in the basement below the boiler room, the supply being furnished from the District supply, the condensers of the refrigerating system and from the heating returns. The steam for the feed pumps is taken from an auxiliary set of steam mains. There are eight Worthington feed pumps and eight Worthington circulating pumps, all set on glazed brick piers; the feed in the basement, and the circulating in pairs at the ends of the two rows of boilers, each pair cross connected for interchangeability. The exhaust from the feed and circulating pumps is utilized in two Baragwanath closed feed water heaters overhead in the boiler room. The fittings throughout the system referred to above were made specially of cast steel by the

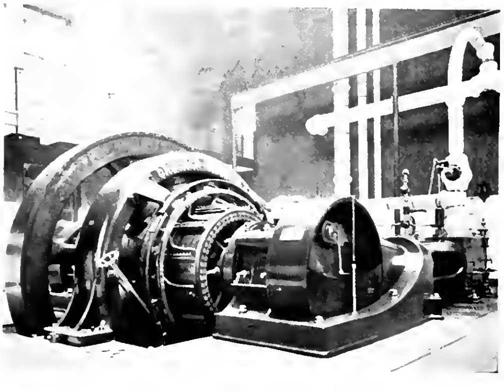


FIG. 10.—ONE OF THE GENERATING UNITS.

Bethlehem Steel Company, and the valves, like the rest of the steam plant, were designed by Mr. Collins.

Other pumps not noted above, but distributed around the power plant or adjacent in the basement, are all driven by electric motor. The vacuum pump for the steam heating system is operated through single-reduction gear by a 15-hp, 120-volt General Electric motor, and the plunger pump for elevating the discharge from the vacuum pump to a tank elevated 10 ft. above it is driven by a double-reduction 3-hp motor of the same make. The pump for supplying water to the spirojector condensers has a double-reduction 20-hp General Electric motor; and the two fire and house pumps, each of 1,000-gallons capacity per minute, with a pressure of 100-130 pounds at the pump, are driven by single-reduction 90-hp General Electric open multipolar motors, shown in one of the engravings. The cooled and filtered drinking water distributed all over the building to some 70 aluminum bronzed iron fountains recessed in the walls is furnished by means of a Knowles triplex pump driven by a 5-hp Crocker-Wheeler motor; and as indicative of the average North American thirst in summer it is interesting to note that the plant cools down daily not less than 4,000 gallons, or not less than a gallon to every parched employee in the Office. The time-honored, hard-worked "growler" of the printing office of one's youth is, indeed, remote and out of date.

THE SWITCHBOARD, ETC.

The main features of the boiler, engine and dynamo equipment having now been considered, it is time to speak of the other not less

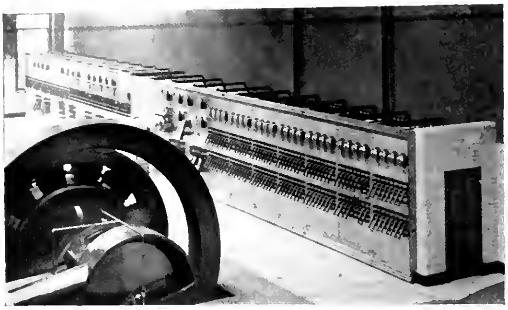


FIG. 11.—VIEW OF SWITCHBOARD FROM GALLERY.

important parts of the plant, such as the switchboard, which itself constitutes a striking element of the ensemble. It will have been gathered from what has been said that the Printing Office is one of the show places of Washington, and the power house is a part which visitors always take in. The handsome skylighted room is very light, not only because of the glass monitor roof, but on account of the interior lining of glazed white brick to a height of 9 ft., with red-faced brick above. The gallery floor and that of the engine room in front of the switchboard and around the side is of marble mosaic in figured panels; while within the brass railing around the generating units the floor is composed of cast-iron plates. The roof trusses and the traveling crane are painted in an agreeably cool shade of green, and the total effect of the room is excellent, the machinery and the switchboard being set off in artistic relief. The crane is an electric one of 25-tons capacity, built by Pawling & Harnischfeger, of Milwaukee, and supported by columns of 6-in. heavy wrought-iron pipe filled with concrete set about 14 ft. apart. The girders are braced to the structural framework of the building and these lateral braces support the steam header in the room.

The switchboard here shown is of a pinkish gray Tennessee marble, 82 ft. long and 9 ft. high, standing about 6 ft. from the wall and accessible from both ends. There are two sets of bus-bars, one for light and one for power, and this subdivision of service is maintained throughout the building, although the generator switches are double-throw, so that any generator can take care of either set. These switches are also double-pole, the equalizer switches being separate. A 5,000-amp. tie-in switch has also been provided of the circuit-breaker type without the automatic tripper, for connecting the two sets of busses together. There is likewise a large single-pole, single-throw switch for connecting together the light and power equalizer busses, in case two generators should be operating one on light and the other on power, with the tie-in switch closed. Each of the feeder switches are double-pole, double-throw, so that they can be independently thrown on either set of bus-bars. The board is virtually in two sections, the latest section for control of supply in the new building having been built by Albert & J. M. Anderson Manufacturing Company, of Boston, and consisting of nine panels, with a length of 34 ft—two generator panels and seven feeder. Here the feeder switches are in two rows. One set of busses extends along the middle of the panels in the rear of the board, with connections to feed both rows of switches, the upper ones when the switches are in the down position and the lower ones when the switches are in the up position. The other group of bus-bars is subdivided into two sets, one for the upper position of the upper row of switches and the other with less copper being installed only as a safety or emergency provision for the lower position of the lower row. All the feeders are protected by I. T. E. circuit-breakers mounted on marble panels at the rear of the board, and the generators also are protected by I. T. E. circuit-breakers behind the board, which can be thrown by means of push buttons on the front of the board. These breakers were supplied by the Cutter Electrical & Manufacturing Company, of Philadelphia, whose contract called for two 5,000-amp., double-pole circuit-breakers, 28 double-pole, breakers of 300 amp., and 28 double-pole, 600-amp. breakers. The Anderson contract on the new board called for the two 5,000-amp., double-throw knife switches; two 5,000-amp., double-pole, single-throw knife switches; one 5,000-amp., single-pole, single-throw and 56 600-amp., double-pole, double-throw knife switches, all of which are of special design, hand-finished, while the clamping nuts, bus connections, etc., have ground contacts.

The new section alone of the board carries about 25,000 pounds of copper exclusive of the measuring instruments, which include two illuminated dial voltmeters 0-150 volt, one illuminated differential voltmeter, two illuminated ammeters 0-6000 amp., one illuminated ammeter, 0-5000 amp.; 20 round pattern ammeters, 0-500 amp., and eight round ammeters 0-750 amp. All these were made by the Weston Electrical Instrument Company, of Waverly, N. J., and are finished in copper and black. The leads of the two large generators are also brought out to two Thomson recording wattmeters furnished by the General Electric Company, each with a capacity of 5,000 amp. at 125 volts. A tell-tale panel of all wattmeters is placed also in the office of Chief Electrician Tapley, who has spacious quarters, with filing cases and other adjuncts, on one of the main floors near by. A daily log is carefully kept of current output, based on 15-minute readings, and checking up each branch of supply. Some idea of the work done can be formed from the fact that the recent daily load in December, when the new building had hardly got into shape, has been from 8,200 to 8,900 kw-hours daily, and that during November the total output was not less than 167,000 kw-hours.

The board itself is bound by handsome heavy copper moulding, with iron framework, and angle-iron braces, cable carriers, etc., all of which was given two coats of the best asphaltum paint. Every detail of the board has been most carefully planned out for safety and perfect finish. No electrolytic copper was allowed, all being pure Lake (Calumet & Hecla) rolled hard-drawn, or soft-drawn, according to the part. Bolts used in making the electrical connections are made from hard-drawn brass rod, with solid heads and all flanged nuts are of pure cast copper. All finish on the front of the board, of switches, brackets and connections, is "drawn file finish"; all surface contacts are made with ground joints, and all edges are champered 3/64 in. Standard requirements in every respect pushed to their limit have been deemed none too good for the board and its accessories, in view of the imperative necessity of maintaining service at all times under all contingencies.

Back of the board extends a rubber-covered walk and a ladder drops down to the engine room basement, where the system of distribution from the board may be said to begin. The conductors as they leave the board and enter the iron conduits against the outside wall of the power house being shown in one of the cuts herewith.

Lighting the Tuileries.

Reports from Paris state that the lighting of the Tuileries Garden is not yet an accomplished fact. There have been differences of opinion between the State, the owners of the property, and the authorities of Paris as to which of the powers should direct the works. The question is now decided in favor of the State, and though the city engineers are actually conducting the operation of laying down the wires, it is under the superintendence and direction of the French Government. A further difference arose over the design to be employed for the lighting standards. The model submitted to the State architect by the municipality was rejected as bearing the arms of the city, and M. Redon has now himself designed and had cast a very artistic candelabra, which will be adopted. The new lamps are of the style known as "Art Nouveau," and are far finer than those proposed by the city. They will bear comparison with the four beautiful standards which now adorn the four corners of the Place de la Concorde, or with those others, different but equally handsome, around the Opéra.

Testing Large Alternators.

By W. E. Burnand

THE tests mainly required on alternators are for efficiency, regulation on unity and lower power factors, and for heating under load. Two methods appear to be available for making these tests; first, by the rather barbarous method of loading up the machine with resistances, choking coils, etc., or, second, by more scientific methods which may be said to have had their commencement with Hopkinson, in which the machine under test and other apparatus connected with it are supplied only with the amount of power lost in the system. Unfortunately, the second method as hitherto practiced seldom gives results strictly comparable with what will occur in actual use with the machine, and so though it may be said to be scientific, if by science is meant measurement, it is hardly so if by this is meant measurement of the thing you want to measure. The first method, however, is so cumbersome and expensive that in the case of really large alternators, it becomes quite

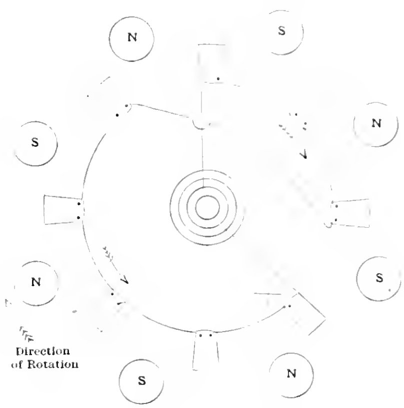


FIG. 1.—DIAGRAM OF COIL CONNECTIONS.

impractical, and the machine either has to go untested or some modification of the second class made, and the results that will occur in use with the machine deduced therefrom.

When two machines of equal capacity are available, they may be coupled together and the Hopkinson test pure and simple carried out, the power factor of the load being varied as desired by manipulation of the field strengths. As a rule, however, two machines are seldom available and recourse must then be had to opposing half (approx.) of the armature to the other half and circulating current through the windings in the manner described by Mordey, Behrend and others. But the methods that I have seen described have always been open to some great objection, such as, when the armature is the rotating part, putting great unbalanced strains on the machine, causing vibration which in some cases endangers the integrity of the machine, and also, in the majority of cases, the armature reaction and consequently the core losses and regulation observed are entirely unlike what will occur in actual use and, therefore, vitiates the results obtained as tests for regulation, efficiency or heating under full-load conditions. It seems to the writer that these objections can be overcome in a simple manner by the following methods:

First, as to the unbalanced strains in the machine, the cause of this will be readily understood by reference to the diagram, Fig. 1. Fig. 1 represents an eight-pole alternator, connected so that three coils oppose the other five. Connected thus, the five coils circulate a current round the armature against the e.m.f. of the three coils, the strength of which can be regulated by the field strength or by means of a rheostat in circuit. Thus half (approx.) of the armature will oppose the rotation of the machine, and the weaker half will help it, the difference in rotative effort plus friction having to be supplied from an external source. The arrows in Fig. 1 show the direction of this effort exerted by the two sides of the armature, from which it will be seen that both tend to force the armature in the same direction. If the armature is stationary, this is not usually of any great consequence; but if the armature is rotating, the effect is just the same as if a heavy weight were located at the point marked *x*, which naturally tends to put severe strains on the framework of the machine. This could be balanced by a weight on the opposite side, whose value could be calculated from the apparent horse-power of the machine, the peripheral speed, diameter and power factor; but a much better way would be to prevent these strains altogether, by dividing the armature circuit into quarters instead of halves, as shown in Fig. 2, coupling *A* and *C* in series, opposed to *B* and *D*. By this means the stresses, which are indicated in the figure by arrows, balance themselves round the circumference of the armature, leaving no unbalanced strains to be transmitted through the shaft to the framework of the machine.

Having got over this difficulty, there still remains that of armature reaction. The difficulty here results almost entirely from the great lag or low power factor of the currents circulating round the armature, when the current is caused to circulate by a higher e.m.f. in one-half of the armature than in the other half. Thus, the current in the coils is nearly at its maximum when they are directly opposite the pole pieces of the machine, whilst with a power factor of unity the current is zero in this position, the conditions being reversed again in the midway position, i. e., the lagging currents are nearly zero here, whilst the power factor current should be at its maximum. It is evident that this must have a great effect on any test for regulation or efficiency. The power factor having comparatively little influence on the poles, whilst with currents lagging nearly 90° the coils on the weaker half have a powerful tendency to help the magnetic field, and on the stronger half a powerful demagnetizing tendency, thus giving rise to induced currents in the magnetic system, and also affecting the core losses of the machine. The mechanical strains also are not those met with in use; there is more tendency to vibration, and less of a straight pull or push backwards on the coils than is the case under load, when the current through the coils is at a maximum at the point midway between the poles; hence, in a position of maximum effect.

The effect this has with a current lagging about 90° is that for

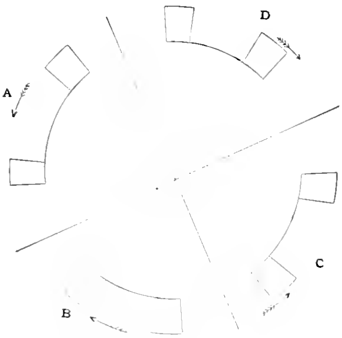


FIG. 2.—DIAGRAM OF ARMATURE CONNECTIONS.

every time a coil passes a pole-piece it is first subjected to a force in a backward direction till it gets opposite the pole and then in a forward direction till in the midway position. Thus there is a severe racking strain backwards and forward at the rate of four times the frequency of the machine, whereas with a current in phase with the e.m.f., the strain is always in one direction, either backward or forward considered with respect to the direction of rotation, according as the current circulates with or against the e.m.f.

The method devised by the writer to overcome these difficulties is to connect up the armature as in Fig. 2, the number of coils in the quarters *A* and *C* being equal to those in the other two quarters, *B* and *D*, so that the e.m.f of two quarters opposes and balances the e.m.f. of the other two quarters, and to circulate an alternating current through the armature from an external source of the same frequency as the machine under test, and whose phase with relation to this machine may be readily adjusted. This external source may consist of a small alternator with the same number of poles as the machine under test, and coupled to the same shaft; or it may be a machine of a different number of poles, driven from the shaft through chain or spur gearing. This machine, of course, may be in circuit with the large one, either direct or through a transformer, and need only be of a size capable of supplying the electrical losses in the large generator and connections. By this arrangement practically all the effects of full load can be simulated, in a manner to get practically reliable results. The auxiliary alternator can be so driven with relation to the machine under test as to circulate a current of leading, lagging or any desired power factor.

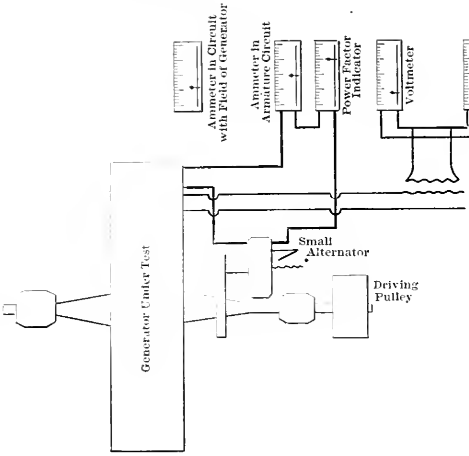


FIG. 3.—DIAGRAM OF TESTING APPARATUS.

The heating can, therefore, be determined for any of these conditions, and the regulation likewise. The efficiency can be determined from the balance of power required to drive the machine at its working speed with full load current circulating through the armature (at any desired power factor), after subtracting the power lost in the outside connections, the auxiliary alternator and the gearing driving it, all of which can be easily determined with an accuracy near enough to give materially correct results for the machine under test.

Fig. 3 shows the manner of testing the regulation of the machine, the voltmeter and power factor indicator being in connection with the half of the machine in which the current flows in the direction of the e.m.f.; the frequency meter being connected any convenient place, say in parallel with the voltmeter.

A reading is first taken with no current passing through the armature; afterwards a reading is taken with full-load current passing, the power factor of which can be regulated by causing the auxiliary alternator to lead, lag or keep in phase with the e.m.f. of the machine under test, the amperes being readily adjusted by a rheostat in the field of the small alternator.

Assuming the speed kept constant, the difference in the two voltmeter readings gives the drop in half the armature. If the machine is designed to work with the armature coils all in series, the regulation is, of course, double this value; if the two halves are to be in parallel the regulation is direct as given by the voltmeter readings. Should it not be possible to get the speed quite the same as when unloaded, the effect of this can be calculated from the difference in frequency—the e.m.f. being proportional to this at constant excitation.

A variation of this method might be to have a voltmeter on each half of the armature, the difference in the readings with full-load current passing giving the regulation; but the first method is probably preferable for a generator, as the armature reactions in the half referred to more nearly approach those of practice than is the case in the other half of the machine in which the current circulates against the e.m.f. as in a motor.

German Telegraphs.

Data to hand show that domestic telegraph business in Germany in 1902 was 43 per cent. above 1892, but it is said that business of Stock Exchange houses fell off 18 per cent. This may be due to the official restrictions on speculation.

Electrical Plant of the Lackawanna Steel Company.

THERE is now in process of completion, with part of the plant already in successful operation, a modern steel plant in which the electric current finds extensive application. The installation will serve to show the great strides being made in the use of electric current as an aid to the metallurgical engineer. Many of the applications are of especial interest to the latter because of the use of electrically-operated machinery where formerly the steam engine was almost exclusively employed. Other applications are of greater interest to the electrical engineer as having necessitated the solution of purely electrical problems. The plant further embodies features which are representative of the highest type of industrial engineering. It is true that all the advantages of an admirable site and ample capital are available. Nevertheless, the design embodies features which will conduce to the lowest operating cost consistent with a wise initial outlay.

The Lackawanna Steel Company was incorporated in 1902, with a capital of $40,000,000, to absorb the Lackawanna Iron & Steel Company and the Lackawanna Coal & Coke Company, the latter owning bituminous coal properties. The former operated a plant at Scranton, Pa., for the manufacture of steel rails, billets and merchant iron, and also several blast furnaces at various points. A site was purchased at Buffalo, N. Y., with a view to the removal of the Scranton plant to that point.

The output of the plant will consist of finished steel made by the Bessemer and open-hearth processes. As the produce of the plant is produced from raw material exclusively, the process will involve all the operations of coking, smelting, Bessemer and open-hearth steel making and the rolling of rails, billets, shapes and plates. The manufacture of the steel will further necessitate the storage and handling of very large quantities of ore, pig iron and coal, and the production, distribution and application of various systems of power and an auxiliary plant for the maintenance of the buildings, equipment and tools.

The tract of land acquired is about 3½ miles in length and nearly one-half mile in average width, on the south shore of Lake Erie, a short distance from Buffalo. The land adjoins the extremity of the United States breakwater, which affords a safe and commodious landing at the south end of the property. Here a ship canal 200 ft. wide, 21 ft. deep and 4,000 ft. long has been excavated parallel to the shore to afford entrance to ore-carrying vessels. On the opposite side of the property a railroad has been built to connect with the trunk and branch roads entering Buffalo.

The governing principle in the design of the plant has been the arrangement of the various buildings and equipment for the several processes in comparatively long and narrow areas parallel to each other and to the ship canal, such that the material in the various stages of manufacture is advanced progressively with the least expenditure of time and labor. To aid in this a system of longitudinal and belt tracks has been installed throughout the entire plant. Adjacent to the shore of the lake and extending to the ship canal is a complete coke plant, consisting of 940 by-product coke ovens with a capacity of 4,000 tons a day. To the south of this is a coal storage plant and yards for coal trains. Coal is received by rail and about 150,000 tons will be stored for emergency use in circular piles commanded by electrically-operated revolving locomotive cranes. Parallel to and approximately 75 ft. from the ship canal is located an ore dock which is about 270 ft. wide and ultimately will have a length of 2,500 ft. This consists virtually of a pocket about 13 ft. deep lined with concrete and supported on piles. The ore dock has a capacity of 750 tons of ore per linear foot, which will be piled on it to the height of about 70 ft. in the middle. The ore is unloaded from vessels and transferred to the former by five ore-unloading machines made by the Wellman-Seaver-Morgan Company, which travel from end to end of the ore dock, and are electrically-driven. Three ore-reloading machines of the same make, also electrically-operated, transfer the ore to steel bins set along the opposite side of the ore dock. Here the various grades of ore from different mines are deposited in separate steel bins.

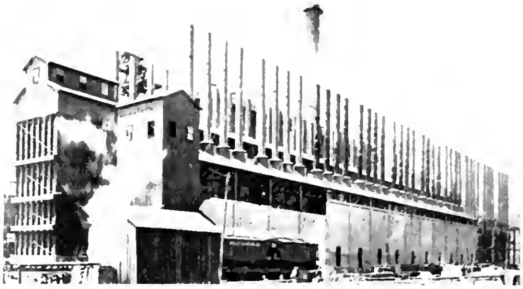


FIG. 2.—GENERAL VIEW OF BOILER HOUSE NO. 2.

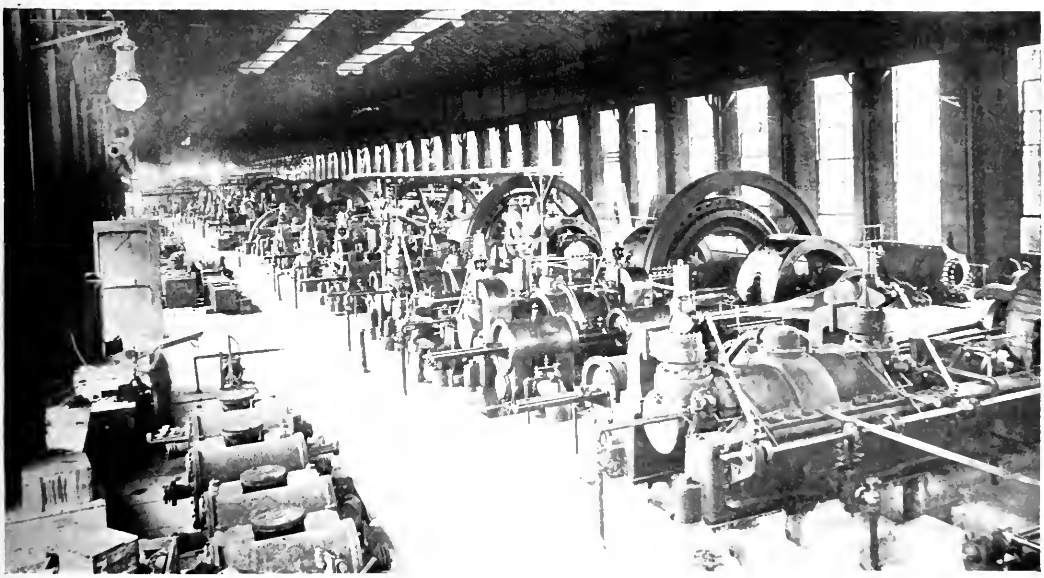


FIG. 1.—VIEW OF POWER HOUSE NO. 1.

After being discharged from these and weighed, the ore with the required amount of coke, limestone, etc., is then hauled by a cable up a steep incline and the contents of the car discharged by an Otis automatic electric machine into the top of the blast furnace. These furnaces extend in a row parallel to the ore dock and storage bins. At present two 300-ton furnaces are in operation, while four others of a capacity of 800 tons are in process of erection. The boiler and engine houses then follow, being arranged in a parallel group about 300 ft. wide and 3,000 ft. long. These separate the steel furnaces and rolling mills from the rest of the plant. Starting east from the lake shore in the various divisions enumerated, the materials are moved transversely in process of manufacture. The Bessemer works are in line with a mill for blooming and finishing heavy rail sections and one for making commercial billets, beyond which are two other rolling mills for light rails and for spliced bars and shapes. The most easterly division will contain the open-hearth furnaces, which are in line with three sets of heavy roughing mills delivering to other mills making finished plates and structural shapes. In these divisions the molten iron is received at the north end, and, passing continuously south without being interrupted or reversed, is carried in a long straight path through all the processes of manufacture. The finished steel is delivered for shipment or temporary storage at the southern extremity of the plant. In the northeast corner, adjacent to the steel furnaces, are located the foundry, machine shop and various auxiliary shops and buildings for the construction and maintenance of the plant.

The general scheme of power supply for such a large steel plant is one requiring a comprehensive treatment of the problems involved, which are not only of an engineering, but economical nature as well. As in the layout of the buildings and of the equipment, such methods and apparatus are adopted as will result in the lowest operating expense consistent with the least investment. The predominating principle, however, considered in the operation of the plant is that of certainty of operation, and the design consequently is affected to that extent. Economy is of minor importance, although receiving

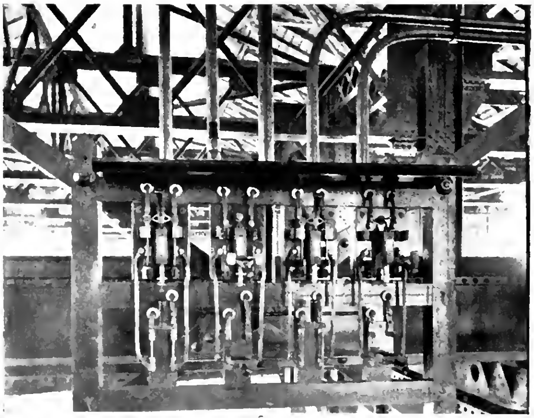


Fig. 3.—Switchboard for Transfer Table, Bessemer House.

attention wherever possible. As a consequence, the utilization of by-products has affected the problem materially.

The installation is of unusual interest, as affording a means for the study of the various motive powers as applied in a steel plant which is being erected under the most favorable conditions at the present time. The steam engine will be used exclusively for the roughing and blooming mills, as rolling mill service has been held to be too severe for the electric motor. The gas engine, not being readily reversible, is not available for this class of work. The steam engines will be run condensing, a practice not heretofore adopted in this country, although triple-expansion condensing engines are in use in such service in Europe. Gas engines of 1,000 and 2,000 hp, utilizing blast furnace gas, are employed to drive the blower engines of the blast furnaces. Although engines of the same type, but smaller capacity, have been employed in similar service in Germany, this is the first instance of their use in this country. What would otherwise be a waste product is thus utilized to advantage and at a greater economy in the gas engine than if used in the boiler plant, and its energy finally made use of in the form of electric current for driving blower engines. The investment required for any given capacity is without doubt also materially reduced.

It will thus be seen that the steam and the gas engine are employed at all points which are vital to the carrying out of the various processes for the production of the finished steel. Furthermore, it will be found that the aggregate horse-power of these greatly exceeds that of the hydraulic, pneumatic and electric machinery employed. The electric drive, however, will be extensively employed for live operations, and more especially in that part not directly concerned in the production of the finished product, as in the coke and ore-handling and the auxiliary plant. The electric installation, furthermore, is of especial interest, as both direct and alternating current are used, the former for crane and variable-speed motors and the latter for constant-speed work. Hydraulic and pneumatic machinery is installed

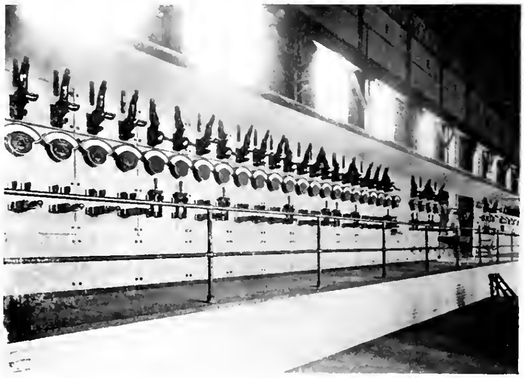


Fig. 4.—Switchboard in Power House No. 1.

under such conditions as are most favorable for its use or where absolutely necessary, as for instance, in the use of compressed air for the starting up of the gas engines.

As a consequence, one large central power house has not been erected. Each pair of blast furnaces is served by its own power plant operating the blower engines. Boiler houses are being erected at such points as will most economically supply steam to the steam engines located in the various mills. The main power house, which contains the electrical plant, as well as a pumping station which supplies the entire plant with water, receives steam from one boiler house which is located a short distance from both. Part of the boilers in the various boiler houses are fired with blast furnace gas. To insure against interruption of service and possible break-downs, the various boiler houses are interconnected by an equalizing steam main. This will also serve to take care of any sudden excessive demand at any point in the plant. This same principle is also pursued in regard to the supply of gas for the gas engines located in the various power houses. The plant when completed will also contain a producer gas plant from which the gas will be piped to the various gas engines for use in cases of emergency. As already stated, certainty of operation has been considered paramount in the design and operation of the plant.

Boiler house No. 2, which is the larger one of those at present constructed or contemplated, presents several interesting features. Although this contains Cahall vertical water tube boilers of a total capacity of 20,000 hp, a 250-hp size has been adopted, each boiler having its own independent stack, as will be seen in Fig. 2. Another feature which is of interest in the comparatively small coal storage capacity which has been provided, as coal is readily obtainable from the coal storage yards located near the coke plant. The capacity of the bins is merely such as to tide over any irregularities in unloading. Special precautions have been taken to prevent a shut-down. The main steam heater consists of a ring main with branches for power house No. 2 and the pumping station taken off at two points. Valves have been installed at various points such that one-quarter of the total number of boilers can be cut out at any time without in any way interrupting the service.

The boiler house is of the steel skeleton brick curtain wall type of construction. It is 68½ x 460 ft. in size, and contains 80 Cahall vertical water tube boilers arranged in two rows facing each other in batteries of four each; 48 of these are equipped with Roney stokers, whereas 32 will be gas fired. As the surplus blast furnace gas will be utilized in this plant, the boilers are equipped with grates for hand firing. This will be resorted to whenever the supply or the quality of the gas is deficient. It is also necessary for starting up a boiler. The blast furnace gas is not purified, although pockets are provided in the supply pipes at the boilers for the deposit of any dust contained in the same. It may be mentioned here that this will be the only plant requiring coal as a fuel, as the others will be gas fired exclusively.

As the steam header is more than 500 ft. in length, it has been anchored at the center of each side of the boiler house. A double bend is provided in each line, connecting a battery with the main header to take care of expansion. A very long elbow is provided at each boiler, which, by closing two valves located between the header and the former, can be entirely removed to permit the removal of tubes. A monitor in two halves of a larger diameter than the boiler is bolted to the roof over each. This can be entirely removed for repairs of whatever nature, and also serves as a ventilator. All steam valves 12 in. long or larger are by-passed. Drips under operating conditions are exposed, and 8-in. cast-iron pipe is used for blow-offs in the ground leading to the sewers. Compressed air is used for blowing out and feed water for washing out boilers. The stacks are 28 in. in diameter and 75 ft. in height above the grates. A boiler pressure of 125 pounds is carried, but this is reduced to 80 for some of the old machinery.

The coal storage plant consists of a tower to the south of the boiler house. This contains two bins, one of the 200-tons capacity called the service bin, and a reserve bin of 300-tons capacity. The coal in the latter is available for use in the boiler house only on being discharged and re-elevated to the service bin. The coal is discharged from railroad cars and delivered by a scraper conveyor from the hopper underneath the track to the flight conveyor, which in turn elevates the coal to either bin. A traveling coal pocket equipped with two 7-ton coal bins, receives its coal from the service bin and conveys it to any required point. This is in the nature of a [illegible] crane, and its character can be readily understood from Fig. [illegible]. The ashes are discharged in the basement into a pocket of a capacity of 28 cu. ft., which travels on an overhead trolley. From this the ashes are dumped into a skip, which elevates them to the ash bin, from which they are automatically discharged into cars as desired. All of the machinery is operated by direct-current motors. The coal handling and ash-conveying systems were designed by Heyl and Patterson, of Pittsburg.

Boiler house No. 1 in its general features is similar to the one already described. This contains 16 Cahall boilers, which are provided with grates and gas fired. Coal is used whenever the blast furnace gas is of an inferior quality. Boiler house No. 3, which is south of the pumping station, is 65 x 184 ft. in size. This will contain 32 Cahall boilers gas fired, and will furnish steam to several engines in the Bessemer rail mill.

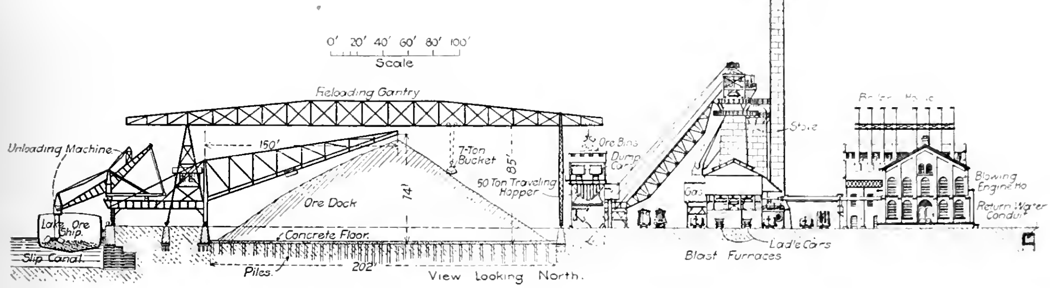


FIG. 5.—SECTION THROUGH ORE DOCK AND BLAST FURNACES.

As already stated, each pair of blast furnaces will have its own power house, containing an equipment of gas engines for driving blower engines. By utilizing the blast furnace gas in gas engines a saving is obtained as compared with burning gas under boilers, which has hitherto been done exclusively. Only one-third to one-fourth the gas is required by this method as compared with the other, and a further saving is made possible by the omission of the boiler equipment with its attendant cost of operation. The gas engines are of the Korting type, and made by the De La Vergne Refrigerating Machine Company. The engines are operated in pairs, each one being one-half the capacity of the unit and are of the double-acting, two-cylinder type. They differ to a great extent from the gas engines made in this country. The gas used in the engines is taken from the top of each blast furnace through three Downcammer flues leading to a dust collector. After being purified in centrifugal washers operated by induction motors, and its temperature reduced to about 80° F., the gas is delivered to the mains at a pressure of about five ounces. Each engine is equipped with an electric speed governor. A Monarch engine speed limit switch is belted to the engine shaft. This switch, when the engine exceeds a given speed, closes a battery circuit in which a solenoid is connected. This sole-

FIG. 6.—ELECTRIC ORE UNLOADER IN OPERATION.

noid operates a multi-point switch, which short-circuits magneto igniters of the engine, and consequently there are no more explosions in the engine cylinder until the speed falls to normal.

Blowing engine houses Nos. 2 and 3 will contain eight 200-hp engines each. As each pair of blast furnaces is operated as one unit, and as the utilization of the excess at any other point would involve an expensive pumping plant, besides introducing complications, it is self-evident that such a course is the most economical one to pursue. The blowers in blowing engine house No. 1 are operated by steam engines which were in use at the Scranton plant. Boiler house No. 1, which supplies the steam for these engines, has already been described. The use of the steam engine was resorted to in this instance because new machinery of the required type could not be obtained in time. The gas engine plant will probably displace the present one at some time in the future.

A pumping station which supplies water for the entire works has been built south of boiler house No. 2, from which it obtains its supply of steam. This contains at present two 50,000,000-gallon Wilson-Schneider direct-current, triple-expansion pumps. The pumping plant has its own Weiss counter-current condensing plant, built by the Southwark Foundry & Machine Company. The circulating and air pumps are operated by Porter-Allen engines. A 100,000-gallon water tank has been installed, from which 14 16-in. lines radiate. The water is obtained through a concrete tunnel from the lake.

Power house No. 2, the first to be built, was used during the early construction period, and is held in reserve at the present time. Power house No. 1 is the most centrally-located and the most important. It contains the electrical plant, the air compressors, the hydraulic pumps and several blowing engines for the Bessemer plant; in fact, all of the power plant which it has not been considered advisable to install in separate power houses. It contains all machinery for the generation of power which is to be distributed in small units over the entire area of the works. The power house is 77 x 725 ft. in size, and of the same type as employed for all buildings, namely, steel skeleton with brick curtain wall construction. A 25-ton electric traveling crane built by the American Engineering Company commands the entire floor space. It is heated by the Buffalo Forge Company's hot blast system.

Compressed air for the various pneumatic tools used throughout

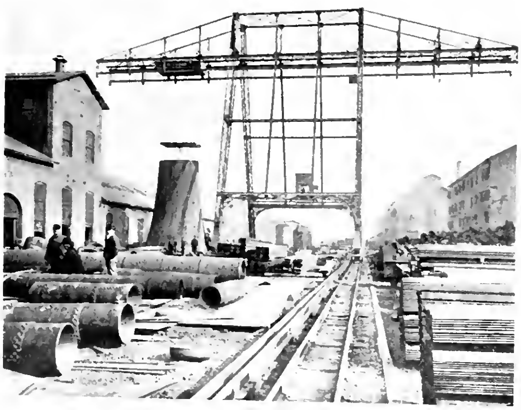


FIG. 7.—LARGE ELECTRIC GANTRY CRANE.

the works for operating the bells of the blast furnaces, for starting the gas engines and for many minor purposes, is supplied by four 14 x 16-in. Ingersoll-Sergeant cross-compound air compressors, each rated at 950 cu. ft. of free air per minute at 100 pounds pressure. Pneumatic machinery for tilting converters, manipulators, etc., is operated by water at a pressure of 450 pounds, three accumulators being installed in the building. There are two Snow and two Knowles 20 x 9 x 36-in. duplex pumps and seven 29 x 9½ x 36-in. Worthington pumps. The boiler feed pumps for power house No. 2 are also installed in the building. There are one Blake and three Knowles 30 x 16 x 24-in. pumps. The blowing engines housed in the power house supply air to the converters in the Bessemer steel department. There are four of these, two of these having engines 52 x 60 x 60 in., and two 50 x 54 x 60 in., made by the Allis-Chalmers Company. The engines are condensing. A 9,000-hp Weiss counter-current condenser has been installed. The exit pipe located in the basement is a built-up riveted wrought-iron pipe, which increases in size from 24 to 66 in. The circulating and air pumps are operated by Porter-Allen engines. The condensing water is supplied by the pumping station.

The electrical equipment of the power house presents several interesting features. The size of the generators has been limited to 500 kw, as gas engines of a larger size than 1,000 hp were not considered practicable at the time the plant was designed, although as already noted, engines of 2,000-hp capacity are being installed at present in the blowing engine houses for the blast furnaces. Another

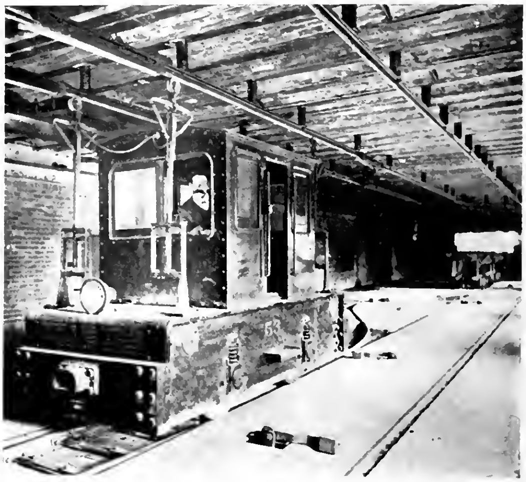


FIG. 8.—ELECTRIC LOCOMOTIVE, BESSEMER HOUSE.

feature is the use of both direct and alternating current in the plant. This course is more than justified when it is considered that large units were impracticable, and further that there are five direct and five alternating-current units of 500 kw each. Nine of these are driven by gas engines, whereas the other, a direct-current generator, is driven by a 36 x 48-in. Porter-Allen condensing engine. This unit is held in reserve for use in case the supply of gas is deficient or should fail entirely. The alternators are three-phase, 23-cycle, 440-volt machines of General Electric make, whereas the direct-current generators are 250-volt Sprague machines.

As gas engines are employed to operate the alternators, a somewhat unusual condition, these are guaranteed to operate successfully in parallel on condition that the maximum variation in speed of the revolving fields shall not exceed .2 of an angular degree on either side, of uniform speed, and to operate without cross currents should a means be adopted for mechanically coupling together when in place. There will be some thousand motors eventually, of a rated capacity of about 32,000 hp. The gas engines driving the generators are similar to the 2,000-hp units already described. These engines have cylinders 23¾ in. in diameter with a stroke of 43¼ in., being operated at 100 r.p.m. The generators are mounted on a crank shaft between the two engines. The cooling water for the cylinders is circulated by centrifugal pumps made by the Lawrence Machine Company, driven by Westinghouse induction motors. The engines are started with compressed air from the compressed air lines. There are three exciter sets, each consisting of a General Electric 125-volt, 37½-kw generator, direct-connected to a 10 x 10-in. Harrisburg Foundry & Machine Company's engine. There are also three 115-light, 6.6-amp. Brush series direct-current arc light machines, direct-connected to 1,000-hp General Electric induction motors.

The switchboard (Fig. 4) is simple in its design and substantial in its construction. It is built on a slightly raised platform, commanding a view of the electrical machinery. There are three sections, separated from each other, there being an alternating and direct current and a series arc board. The direct-current switchboard consists of five generators, one load and 14 feeder panels, the latter containing two circuits each. Each circuit is equipped with one double-pole, double-throw switch, a 2,000-amp. ammeter and a circuit-breaker in one leg of the circuit only. The bus-bar copper has been figured on a basis of 800 amp. to the square inch at normal load. Although all circuits are protected by circuit-breakers, this is done nevertheless in such a manner that certainty of operation is assured, and at times a piece of apparatus may be sacrificed in maintaining an uninterrupted service. The alternating-current board contains five generators, one exciter, one load and 20 feeder panels, each of the latter containing two circuits. These are provided with instruments and switches, as in case of the direct-current circuits. Each circuit will eventually be equipped with an integrating meter. The alternating and direct-current switchboards were built by the Westinghouse Electric & Manufacturing Company, in accordance with the company's designs and specifications.

All feeders and mains are run in conduits, lead-covered paper-insulated cables being used. The conduit is built of tile in the usual manner, but on account of the mucky soil, special expedients have been adopted to maintain alignment. At intervals of 30 to 35 ft. a couple of piles are driven on 4-ft. centers, which are capped, and serve to support concrete steel cantilever arches, which in turn carry the current. In building the underground system, the ground is removed to the contour required, thus saving the expense of forms for the concrete arches. In the design of the distributing

FIG. 9.—PIG IRON MAGNET.

system the limiting condition was not the drop in potential, but rather a five-watts loss per duct-foot in the underground system. All cables for direct-current circuits are 1,000,000 circ. mils single-conductor cables, made by the National Conduit & Cable Company. Those for alternating current are three-conductor No. 0000 cables of Standard Underground Cable Company's make.

The yards are lighted by series direct-current arc lamps, for which ornamental cast-iron posts have been erected at various points. The buildings and shops are lighted by constant-potential arc lamps and incandescent lamps. The former are placed two in series on a 220-volt, direct-current circuit. Current from the 440-volt alternating-current circuit is stepped down by means of transformers for incandescent lighting. As 25-cycle currents are employed, three lamps connected between the different phases are installed near each other, thereby obviating any disagreeable physiological effects.

The electric motor, as already stated, was considered not able to meet the severe and fluctuating demands of rolling mill service. The steam engines used for this purpose are of the reversing twin-cylinder type, geared about 1 to 2. To provide an elastic medium between the engine and the load, recourse has been had to a fly-wheel whose rim is driven by means of heavy springs from a spider keyed to the driving shaft of the mill engine, the spider and the inner shaft of the fly-wheel having a number of corresponding toothed projections. Then engines are operated by [illegible] entirely, although equipped with link motion. The ma[illegible] times will reach 6,000 to 8,000 hp, and because of the num[illegible] passes the load will fluctuate from nothing to a maximum [illegible] 30 to 40 times in one minute. A continuous-indicator diagram may be likened to an alternating-current diagram, the amplitude being largest at the beginning and then increasing as the number of passages increases, this cycle of operations being repeated several times in a minute. The engines in this case will be condensing, a course not hitherto pursued in this country, although triple-expansion condensing engines are in use in such service in Europe. Each rail mill will be equipped with its independent Weiss counter-current condensing plant.

The use of hydraulic and pneumatic machinery throughout the works is practically limited to such conditions as are most favorable to use of either as against electrical machinery, although the division line is not always clearly drawn, depending to a great extent upon the variability, accessibility, etc., of either. Compressed air is used for various pneumatic tools in the shops, for operating the bells of the blast furnaces, for starting the gas engines, and similar purposes. Hydraulic machinery is used for tilting converters, furnaces and mixers, for operating car pushers, hoists and transfers in the rolling mills, and in such places where a large amount of power is to be exerted with certainty within the range of a piston stroke. Although the use of the hydraulic motor is confined to the operation of cranes, hoists, shop tools and auxiliary machinery in the various processes, it nevertheless occupies no insignificant position in the operation of the works. As already stated, the application of the electric motor in many instances is of unusual interest to the metallurgical engineer, although not in itself having necessitated the solution of any new electrical problem. In many other instances electrical methods have been introduced in the various processes. In other cases original electrical problems of unusual interest to the electrical engineer have been solved. The alternating-current motor is used only for continuous service, where ordinarily a shunt-wound, direct-current motor would have been installed. The use of the alternating-current motor in such cases possesses inherent advantages, as the absence of a commutator, its dust-proof character, etc., are too well known to require extended comment. The direct-current motor of the series, compound and shunt-wound type is used for all cranes and intermittent service necessitating frequent reversals.

The application of the electric motor to the driving of roller tables in the various mills has also required the solution of a difficult problem, which has been done in a most satisfactory and simple manner. The conditions in this case are similar to those met with in the operation of the engines driving the various mills, which has been described.

Another problem, which was successfully solved by Mr. E. D. Edmonston, the electrical superintendent, was the design of an electromagnet, which would successfully handle pig iron as thrown promiscuously in piles. Such conditions, of course, are not conducive to the handling of material on as economical a basis as in the case of plates and similar material. The electromagnet shown in Fig. 9 weighs $3\frac{1}{2}$ tons and has a lifting power of $1\frac{1}{2}$ tons. The features of the design are the use of adjustable poles which allow the picking up of the iron in any position. These are bi-polar and separated some distance, so that the flux will penetrate the pole to a great depth. To separate the poles such a distance in an electromagnet of such a size requires very large and deep windings, for which it is necessary to provide special facilities for ventilating, which is accomplished by inserting fibre rods. Being used under all sorts of conditions, the magnet has been designed in such a manner as to be protected in all kinds of weather, and to permit of ready repair. It furthermore combines mechanical strength with excellent electrical features, to withstand the rough handling to which it necessarily will be subjected.

The installation of electric traveling gantry cranes in the yards required the placing of the conductor at such a point as not to interfere with the conveying of material in any position to any point in the yard. On account of railroad tracks which cross those of the gantries, a continuous conductor, furthermore, was not feasible, as an exposed third rail could not be adopted, on account of the danger of shocks to the workmen and the possibility of a ground or short-circuit through the throwing of material across the tracks. The system finally adopted comprises a bare (Fig. 8) trolley wire stretched between strain insulators placed in a trough formed by two hardwood pieces insulated from the ground. All crossings are bridged by a cable carried in a conduit. In this way it is not possible to make a ground, the trolley wire being placed below the level of the top of the wooden strips, and surface leakage is entirely prevented. The cost of construction is small, and repairs can be readily made. As the two collectors placed on the gantries bridge any opening, excessive sparking is prevented by the collector leaving one section.

Certainty of operation being the most important consideration, and the service required being of the most severe character, special precautions have been taken to prevent interruption of the latter. This is well shown in the case of a system of electric locomotives for haulage which has been installed in the Bessemer plant. There are three Baldwin-Westinghouse locomotives, each equipped with two 35-hp motors, railway rating. The controllers, four in number, are of a very flexible nature, permitting of their movement both in a horizontal and in a vertical plane to allow of the locomotives taking curves readily, as very sharp corners are made. A very substantial trolley construction has been adopted. This consists of a 2½ x 2¾ x ⅜-in. T-iron, insulated from the ceiling I-beams by vulcanized asbestos plates and washers. The trolley wire proper consists of a sheet of copper 18 x 2⅛ in., riveted to the iron. The solid construction adopted throughout is further illustrated at the switchboard, Fig. 3, one of several installed in the Bessemer house,

FIG. 10.—COAL-DISTRIBUTING CRANE, BOILER HOUSE NO. 2.

and which controls several transfer tables operated by series direct-current motors. All wiring is run in Sprague conduit, for which special fittings are employed.

Several interesting applications of electrical methods are in use about the plant. One of these is a mixer valve regulator for controlling the temperature of the hot blast on the blast furnaces. This apparatus consists of a regulating pyrometer with an extended pencil room, on which a fibre cup filled with mercury is fastened, a relay, a magnet and a globe air valve. As the pencil room of the pyrometer moves up and down it makes and breaks a battery circuit at the mercury cup. In this battery circuit is connected the relay which opens and closes a power circuit in which a large magnet is connected. This magnet controls a compressed air valve, and this compressed air valve in turn controls a large mixer valve.

Another application is that of an electric burner for blast furnaces. In the case of "freezing" of tuyeres, cinder notch or iron notch, the obstruction is removed by means of an electric burner. Formerly an oil burner or kerosene blow pipe was used for this purpose. The electric burner equipment consists merely of a brass clamp holding a 2-in. x 72-in. round carbon. A long wooden handle is fitted into this clamp, in order to apply the burner when in operation. A cable is tapped into this clamp, carried through a water rheostat and connected to one side of the direct-current power circuit. The other side of the circuit is grounded to the iron framework of the furnaces when it is necessary to use the burner. A current of from 500 to 1,000 amp. at about 80 volts at the arc is required to remove the obstacles.

The ore-unloading machines already mentioned and shown in Fig. — are electrically operated. In these the walking beam truck, walking beam and movements of a ten-ton bucket are controlled from the inside of the leg of the walking beam by means of small operating controllers connected with Electric Controller & Supply Company's magnetic switch controllers, which are placed adjacent to the motors for this work. It is thus possible to control the movements of the unloader without carrying the heavy power cables down into the leg of the walking beam, where the operator is stationed, and it is thus necessary to run only small flexible wires between the magnetic switch controllers and the smaller operating controllers.

It is impossible in an article of this scope to describe fully the various applications to which the erection of such a modern steel plant gives birth. This is further rendered impossible by the fact that a large part of the plant is still in course of construction, and increased confidence and the experience gained at present may lead to the further use of the electric motor and electrical appliances.

Mr. Henry Wehrum is general manager in charge of the Buffalo plant, and of the other properties of the Lackawanna Steel Company. Mr. F. du P. Thompson is the chief engineer of the company, who, believing that organization is essential to success, has gathered about him a most efficient corps of engineers. It has thus been possible to successfully carry into execution even to the minutest detail the general policies which have been outlined in regard to the construction and the operation of the extensive works. The mechanical engineering department is divided into four divisions—the engineering, the construction, the repairing and construction of shops, and the power and operating division, which is in charge of a mechanical and an electrical superintendent of power. The engineering division, under Mr. A. G. Hamilton, the assistant engineer, designs all of the various plants, buildings and equipment required. Under the former are nine division engineers, each one of whom has his own force of draughtsmen and inspectors, who inspect all work under construction designed by their respective departments.

Commercial Long Distance Telephony.

In discussing the commercial aspects of long-distance telephony, the *Wall Street Journal* remarks: "The consolidation of the 4,000 independent telephone companies in the Middle West, and a connecting up of the toll line system, will be the first real competition that the Bell Company has had in the long-distance service, although the independents have done a large short service business within their respective territories. The weakness of the various independent systems has been in the fact that they had no connection with the hub of the West, Chicago. This established, their position will be greatly strengthened. An authority on telephony says that the profit on long-distance service, excluding that between New York and Boston, is meagre for a distance in excess of 150 miles, and that on account of the extraordinary quality of construction and high standard of maintenance necessary, and regardless of rate the New York-Chicago lines cannot handle a sufficient amount of telephone business to make any profit. It must be remembered that it takes the exclusive use of two heavy copper wires to talk from New York to Chicago, and while a five-minute conversation is going on (to say nothing of loss of time in getting the subscribers together) the telegraph companies with their "quads" and a much lighter wire can transmit in five minutes 40 telegrams, at 50 cents, amounting to $20, as against $9 for a telephone call. Then the cost of maintaining of the lighter telegraph service along side of the railroads is from 25 per cent. to 50 per cent. less than the long-distance wires over the highways.

"Another important fact is that telegraph wires are not transposed, as are telephone wires about every 15 poles. This transposition is very expensive and increases cost of maintenance, as splices and tying to insulation is more frequent. The transpositions in a line of 30 or more wires is enormous, for the position of the wires upon the insulators the entire distance from New York to Chicago is changed about every 15 poles, and if another circuit is added, more transpositions are necessary. Successful service upon highway lines necessitates constant patrol at large expense."

Protection of Electrical Apparatus From Lightning and Other Destructive High Potentials.

By HOWARD R. SARGENT.

ELECTRICAL apparatus installed on lighting, railway, power and high-potential transmission circuits is subjected to abnormally high potential strains through various causes, such as lightning, switching, cables, governor troubles, differences in elevation between different portions of the circuits, etc.

Lightning is, in all probability, the worst of these conditions to be taken care of, and up to the present time we have not heard of any form of arrester which will entirely take care of a direct stroke. When a lightning discharge strikes any part of a circuit, the portion struck is generally damaged to a considerable extent at the point where the stroke takes place, and in a great many cases, if the stroke is near the station, the insulation of the apparatus in the station suffers in addition to the local trouble. We have seen numerous cases where, with the best possible protection, poles have been splintered, lines broken and short-circuits started, which have done considerable damage to all kinds of apparatus.

It is possible to take care of high potentials which are induced on lines through discharges from cloud to cloud, discharges from clouds to earth in the vicinity of the lines, or high potentials which have been merely induced by the presence of thunder storms. It has been observed that these induced charges in circuits may produce high potentials not only between lines and the ground, but between line and line in the same circuit, and it is, therefore, advisable to make arrangements to equalize these high potentials not only from line to ground, but from phase to phase.

Some districts are much more open to atmospheric disturbances than others, and it is often necessary to take greater precautions in some localities than in others, due to this reason. In the Southern States about 70 thunder storm days per year are experienced, while throughout the entire country there is an average of approximately 30 such days per year. Some of the installations in the mountainous States in the West have suffered to a considerable extent through the numerous atmospheric disturbances which occur in that district.

On high-potential circuits of considerable capacity, an arc produced by switching, circuit-breakers, fuses or short-circuits, causes an electrical oscillation of extremely high value. Voltages of more than double normal potential are often produced when connecting a circuit of considerable capacity to the generating system at no load. These high potentials subject the apparatus momentarily to enormous strains, and it is well to have some low break-down path in which the dynamic arc will be immediately ruptured, so that these high potentials will equalize themselves from line to line without damage to the apparatus.

In laying out circuits, it is frequently necessary and desirable to dip underground when passing through cities, or under rivers, etc., and in these cases some form of metal-covered cable is generally used. It has been noticed from numerous installations that high potentials invariably occur where these underground cables are used, due to resonance effects and these high potentials are often of sufficient value to break down the cables themselves, or the insulation of apparatus installed on the lines. The strains very often produce pinhole punctures in the insulation of underground cables and thus relieve themselves temporarily; they may, therefore, remain unnoticed for a number of months until the insulation becomes very much impaired, ultimately resulting in a complete break-down.

Whenever lines contain both inductance and capacity in noticeable quantities, high voltages which endanger the insulation of the whole system, and which it is impossible to detect on ordinary switchboard instruments, may exist. We, therefore, frequently find such abnormal voltages in circuits containing a combination of underground and overhead circuits, and in long-distance transmission lines.

A great many cases have been noted where engines and water wheels have raced, caused by the governors becoming inoperative and high potentials have resulted, which have caused serious breakdowns in insulation. This has generally occurred when a considerable load has been switched off from a circuit.

Particular mention was made at the recent general meeting of the A. I. E. E. at Niagara Falls of the abnormal high-potential strains which have been noted on long transmission lines running through mountainous country where considerable differences of elevation occur between different portions of the circuits. These differences in potentials, are, without a doubt, due to difference in magnitude of the atmospheric electrical potential at different altitudes, and in some cases the condenser effects of the line produce potentials considerably in excess of the line voltages.

In laying out protection against the troubles enumerated above, it is necessary to provide discharge paths from phase to phase and discharge paths from lines to ground with suitable ground connections, except when the circuits are entirely underground, when the ground connections may be omitted. In view of the fact that it is necessary to take care of considerable quantities of current from line to earth when lightning discharges take place, it is advisable to have an arrester of as large current-carrying capacity as possible, and with this in view it is often advisable to install a number of arresters in multiple where the conditions are particularly severe. With regard to potentials between phases, which are more of a static nature, these can generally be equalized with small flow of current.

In discharging a line to ground, the simplest form of discharger would be one single gap, or a series of small gaps with a break-down point just above the voltage of the circuit. Although it has been found that a single gap will discharge a line effectively, the single gap, of course, will not rupture the dynamic arc when it is once started by a high-potential discharge.

With a number of short gaps, it has been found that if a sufficient quantity is used, under certain conditions, the dynamic current is ruptured by chilling the arc down between the numerous cylinders; also due to the fact that in some of the gaps the value of the alternating wave is zero, and, therefore, after a high-potential discharge has passed, the dynamic arc does not start again. This arrangement of a large number of small gaps in series is, however, out of the question as far as practical use is concerned, as enormously high break-down voltage is necessary to overcome the gaps, resulting in injurious strains on the insulation of the apparatus. Under certain conditions of inductance, capacity, etc., a discharger of this construction will not interrupt the dynamic arc.

With a fixed length of spark-gap, a certain number of gaps are necessary before break-down will occur at a predetermined point above the voltage of the line, and this number of gaps has the power of interrupting a dynamic arc formed by a limited current value at the line potential. With this in view, it is necessary to place a determinate resistance in series with the gaps, in order to limit the current to this point. An arrester constructed in this way with non-inductive resistance is the simplest arrangement which can be made, and affords the best protection which, up to the present time, it has been possible to devise.

High potentials between lines or phases occur much more frequently than in the case with lightning, and it is advisable to increase the non-inductive resistance in series with the gaps to considerable extent, as this renders less liable the possibility of short-circuits, and as stated above, these high potentials between phases can be equalized through high resistances as well as through low resistances. A further reason for placing a considerable amount of resistance in series with the gaps when placed between lines is that in case of discharge from phase to phase, if the resistances are low, the circuit-breakers or other automatic devices on the line open, causing temporary shut-down, and this, of course, is inadvisable as well as annoying.

It is advisable to have all of the spark-gaps, resistances and operating parts of high-potential alternating-current arresters entirely in view of the operator, as this enables him to make immediately any changes or repairs which may become necessary during operating hours, and with this in view, it is always advisable to install switches in the lightning arrester circuits so that the lightning arresters may be isolated in case immediate repairs become necessary.

Although considerable doubt has existed as to the advisability of installing reactive coils in connection with lightning dischargers, it is believed by many prominent engineers that reactive coils are of considerable value in connection with the proper protection of apparatus. Without a doubt, the frequency of lightning disturbances varies greatly in different cases, although, as a whole, it is probably high. Inasmuch as the action of the reactive coils is not dependent on the voltage or frequency of the line, it is inadvisable to design a large number of coils having different reactances, and it is evident that a coil can be designed with ample current-carrying capacity, which may be used on a number of voltages, provided it has sufficient insulation for the highest voltage determined upon. In this connection air insulation is preferable between turns and layers, as other forms, due to minute discharges, gradually deteriorate and change, becoming partial conductors.

Protective wires have been used in a great many cases by different transmission companies with varying success, although the experience gained, as a whole, has been in favor of this form of protection. A great many of the troubles encountered through the use of this wire have been due to the selection of improper materials in making the installation. Barbed wire has been used in a great many cases, but the commercial barbed wire purchased on the open market is of very poor quality and has a tendency to hold water in the joints and interstices.

In Kalamazoo, Mich., different forms of protective wire have been used, placed in various relative positions with regard to the circuit wires, and it has been found that plain iron wire installed directly below the transmission wires furnishes practically as good protection as barbed wire installed over the transmission.

As a matter of fact, there are few reasons why this should not be the case, provided the iron wire is properly grounded at every third or fourth pole, as the disturbances which this form of protection is supposed to take care of are generally at considerable distance from the transmission wires. While this form of protection may help out in the case of a direct stroke of lightning, it is not to be presumed that it will prove entirely efficient under this condition of affairs.

While the experience of the above-mentioned company has been that a wire placed below the transmission is as satisfactory as if placed in any other position, it is as well to string it above the transmission lines at an angle of approximately 45° to the outside transmission wires, as without a doubt, this locality will aid in taking care of direct strokes of lightning.

With the improved lightning protective devices on the market, the grounded protective wire need only be resorted to where the most severe conditions exist, and then it should be put up in the most thorough manner with regard to the size and quality of the material used and with regard to grounds.

For direct-current work the general principles of construction mentioned above hold good, but in view of the fact that it is much more difficult to rupture a direct-current arc than an alternating-current arc, some other means are necessary of breaking the arc after a discharge has taken place.

Arresters with moving parts have been made for this purpose, but it will readily be appreciated that an arrester with moving parts is more of a menace than a protection, as many lightning discharges are immediately repeated over approximately the same course, and in this case the moving element is in the wrong position to take the second discharge, in which case the apparatus suffers. In addition to this, it has been found that the enormously high potentials, due to lightning, cause arcing and disintegration, so that the moving elements refuse to assume their normal positions of rest after a number of discharges.

After exhaustive tests in the laboratory and under practical operation the magnetic blow-out has been found to give most excellent satisfaction under all conditions, and the most satisfactory form of direct-current arrester is one consisting of a single spark-gap with sufficient resistance in series to shunt a portion of the dynamic current around the coil, so as to cause a strong magnetic field about the gap. The lightning discharge passes directly through the resistance and the spark-gap to the ground and the strong field immediately blows out the dynamic arc which follows, thus preventing damage to the arrester and to the apparatus.

In the installation of lightning arresters it is very undesirable to endeavor to effect a saving by cutting down the expenses connected with making proper ground connections, as fully 75 per cent. of lightning arrester troubles can be traced directly to this source. The connections from the line to the arrester and from the arrester to the ground should be as free from angles and bends as possible, and where turns are absolutely necessary the wire should never be bent at an angle, but in a curve of long radius; care should be taken that no inductive loops are formed by the complete arrester and its connections.

When the use of an iron pipe at the foot of a pole is considered advisable for the protection of the ground wire, a plug should be put in the top of the iron pipe and the wire soldered to it; otherwise the reactance of the ground wire surrounded by the iron pipe will impede the discharge.

Copper should be used for the ground, thick enough to prevent wasting away and having at least four square feet surface. The ground wire, which should not be less than 3/8 in. diameter in cross section and preferably in flexible strip form, must be carefully soldered and riveted to this plate, the joint covered with asphaltum, and the plate then buried in powdered coke in soil which is always damp.

Dry, sandy soil should be kept wet by artificial means if this is the only soil available for the ground connection, and it is advisable to dip several trenches radiating out 50 ft. from the main ground wire, in which ground wires are buried so as to get a large surface for the dissipation of the discharges. Where plates are buried in streams of running water or dead water, they should be buried in the mud along the bank in preference to merely laying them in the streams; and streams with rocky bottoms are to be avoided unless as a last resort. Where there are metal flumes, pipes or rails, it is advisable to rivet and solder the ground wires to them in addition to the connections to the copper plates, and when rails are utilized they should be thoroughly grounded.

In view of the fact that it is advisable occasionally to examine the underground connections to see that they are in proper condition, it seems advisable when the ground plates are installed to lay out exact plans of the locations of the plates, ground wires and joints, with slight descriptions of the same, so that at any future time the data may be referred to.

Revived Electrical Prosperity in Germany.

In the course of a report on returning trade prosperity in Germany, U. S. Consul-General Mason Says: "At length, after two years of anxious waiting and hoping, the crises in German industrial values which began in the spring of 1901 is definitely past, and a general recovery has not only begun, but has progressed so far as to have all the outward indications of permanence. To what extent the values of the prosperous period which preceded the collapse have been regained will be illustrated by the following table, which shows the market values of certain standard German industrial stocks on the 17th of April, 1900, when the general prosperity was at its height; on the 26th of September, 1901, when the depth of depression had been reached; on the last day of 1902, when recovery had definitely begun; and on the 20th of the present month, when the effects of returning activity had become manifest in the values of industrial securities. The exhibit includes electrical manufacturers, iron and steel works, iron ore and coal mines, and the Great Berlin Street Railway Company.

Company.	April 17, 1900.	Sept. 26, 1901.	Dec. 31, 1902.	Nov. 20, 1903.
General Electric Company	253.90	169.50	180.75	220.00
Siemens & Halske	176.00	145.00	120.10	140.00
Schuckert Electric Company	216.40	100.00	79.50	112.50
Electrical Enterprise Company	150.25	91.30	84.60	105.00
Electric Light and Power Company ..	114.25	96.75	93.75	109.75
Great Berlin Street Railway Company.	232.75	194.10	200.50	204.75

These companies may be taken as representative of the electrical industries of Germany. The foregoing comparison shows that while not one of them has recovered—in respect to the open-market value of its shares—the high-pitched prosperity of the early months of 1900, all have recovered in an important degree from the depressed prices of September, 1901, and each one now rules from 10 to 50 points higher than it did at the close of 1902.

An important element has been the fact that several of the leading electrical manufacturing companies—which have recently combined to avoid competition—have secured some important contracts for lighting and power plants, street railway installations, etc., in foreign countries, notably Mexico and South America. At a recent meeting of representatives from all the electrical manufacturing companies, it was found that they were, almost without exception, running on full time and with orders booked that will keep them occupied for several months to come. Many of these orders have been taken at what would seem in America low prices, but the German electrical industry is enormously developed, is equipped with up-to-date machinery, has an abundant supply of cheap, docile, skilled labor, and can turn out electrical machinery, cables, and all that class of work at minimum cost.

The Arnold Electro-Pneumatic Railway System as Employed on the Lansing, St. Johns and St. Louis Railway.

By B. J. Arnold.

As many of your readers know, I have persistently advocated the use of the alternating current directly in the motors for electric railways for several years (see *Transactions* American Institute of Electrical Engineers' joint meeting with the British Institution of Electrical Engineers, Paris, August 16, 1900; Niagara Falls Convention, August 24, 1901; Great Barrington, Mass., June 19, 1902, and New York, September 26, 1902). By referring to the discussions which took place at these meetings and to the technical papers, it will be found that there were few, if any other advocates, in this country of the alternating-current for railway work until recently, and that those who supported it abroad advocated the use of three-phase currents until within the last few months. Since my announcement of the principles of my system before the Great Barrington Convention, the development of the single-phase alternating-current railway motor has made remarkable strides, both in this country and abroad, and while at that time it had few friends the development has been such since, that it now seems destined to take its place as the leading railway motor, thereby effecting a revolution in electric railway work.

Many of your readers also know that, since announcing the principles of my system before the Great Barrington Convention, I have refrained from giving out any further information regarding it, giving as my reasons therefor my desire to test the system thoroughly before making further public statements regarding it, and then to present a full and complete description of it, together with the results of its operation, in the form of a paper before the American Institute of Electrical Engineers. Consistently pursuing that policy I have conducted my experiments privately and at my own expense, and had so perfected my apparatus that I had hoped to be able to celebrate the incoming of the year 1904 with a public demonstration, over 20 miles of railroad, which would conclusively prove that the single-phase electric railway is not only operative but efficient, and less in first cost and operation than any system now in vogue, not meaning to imply thereby that the system which I have developed was necessarily the only system or the best system, for only time can prove the correctness or incorrectness of such statements, but that it was a system which would successfully do the work, and the system which was first developed and first to be put in actual operation upon the first electric railway in the world, especially built for single-phase alternating-current motor operation.

That I would have made a demonstration on January 1 was a certainty to me until December 18, when I learned by telegraph, while in New York, that the car houses, located at Lansing, Mich., of the road upon which I had been experimenting, were completely consumed by fire at 4 o'clock that morning. The fire apparently originated from a stove in the engine house, and was communicated so rapidly to the car houses that it destroyed a steam locomotive and two new cars built for my system, as well as my experimental locomotive, thus leaving me unable to make the demonstrations as I had planned. In view of the fact, however, that the single-phase electric railway is now receiving so much attention at the hands of engineers and inventors in many parts of the world, and that I believe that the year 1904 will be an epoch-making one, marking the revolution from the direct-current to the alternating motor for railway work, as well as the beginning, on a large scale, of the displacement of the steam locomotive on railways by the use of a substantial form of overhead construction rather than the third rail, and from the further fact that I cannot get another machine ready in the near future, I have concluded that I will give to the technical press a record of my work up to the present time, in order that it, and the system which I have developed, may be properly weighed in comparison with the work and systems of others, leaving the more complete description of the system and the results of its operation to be presented at a later date before the American Institute of Electrical Engineers.

In January, 1900, I rode over the country between Lansing and St. Louis, Mich., a distance of about 60 miles, with a party of gentlemen who desired to build an electric road between these points. This trip resulted in my advising them that the territory was such that I believed the road should be built as economically as possible, and, inasmuch as they desired me to assist financially in its construction, I told them I would do so provided I was allowed to construct the road in accordance with certain ideas that I then had in mind, for by such construction the first cost of the road could be kept sufficiently low to warrant its construction, and that if it were built on any one of the systems, standard at that time, the advisability of building it was questionable. The result was that on April 23, 1900, a contract was entered into wherein I undertook to build and equip the road. Engineers were at once placed in the field to locate it, and after the plans were sufficiently completed the grading, bridging and track work of 20 miles of the road followed, and this much of the road was completed, to such an extent, that steam trains were put in regular operation over it about November 15, 1901.

For financial reasons the completion of the road was delayed, and, in the meantime, the development of my system was taking place and the parts being perfected in different offices and shops.

Since it was my intention to experiment with pressure as high as 15,000 volts on the working conductor, all of the line material had to be specially designed, but the work progressed to such an extent that the overhead and line work of 20 miles of road was practically completed and ready for operation about December 15, 1902, and the power installed, so that experiments began in March, 1903. On June 15, 1903, two trips were made, each about 3 miles long, with my first experimental machine, shown in Fig. 8 of the accompanying description. On the first trip seven persons were carried, and on the second trip thirteen persons were aboard,

The result of the experiments with the first motor proved the correctness of the theory and that the machine would work. Inasmuch as it consisted of but one somewhat crude electropneumatic motor, it was impossible to get full and efficient tests of the system, and it was thought best to conduct no further experiments until a complete new double equipped truck could be perfected. Not being connected with manufacturing establishments I have been compelled to develop this system under trying circumstances, necessitating the construction of parts in different shops and assembling them at far distant points with crude facilities. This fact, combined with the financial difficulties that have arisen, and the necessity of my having to give the main part of my attention to other matters, have been the causes of the delay in completing the road and the system.

A new double-motor equipment, in the form of a locomotive, was finally built and brought to perfect working condition on the evening of December 17, and it was this locomotive with the necessary instruments for testing purposes that was destroyed by fire the following morning. Since it is going to be impracticable for me to get a new one constructed for some time, I have thought best to state the facts as outlined above, and give to the technical press a description of the apparatus and the road, reluctantly omitting the records of operation and the tests which I had hoped to have accompany any future statements I made, but which, through "the irony of fate," must now be left for the future. Below will be found some particulars of the road and system:

ROADBED AND TRACK.

The Lansing, St. Johns & St. Louis Railway was originally projected to extend from Lansing, the capital of Michigan, northward through St. Johns, Alma and St. Louis, a distance of about 60 miles, but up to the present time only that portion extending from Lansing to St. Johns, a distance of 20 miles, has been constructed.

This road was built in accordance with steam railroad practice, with easy grades and curves, so that steam locomotives could be operated over it until such time as electrical equipment could be put upon it: the idea being to complete the road in such a manner that it could be utilized for both freight and passenger service, and thus secure all the business available from the territory through which it passes.

The road is equipped with 67-lb. T-rail, laid on ties spaced 2 ft. apart between centres, and as alternating high-tension current was to be used but one of these rails was bonded with 38-in. 0000 bonds, extending entirely around the splicebars.

Since it was impossible to secure rails from the rail manufacturers in time, rails and splice bars were secured from one of the leading steam railways, and this necessitated the adoption of a supported joint and a long bond, as there was not room under the splice bars for concealed bonds.

The road as at present constructed between Lansing and St. John has no grades exceeding 1 per cent, and no curves exceeding 7 degs., except in the cities themselves, where the terminals of the road run over the streets and make such curves as ordinary street cars make, the minimum radius being 50 ft. At each city a terminal was planned so that all freight would be diverted to connecting steam roads, thus making it unnecessary for the freight service to pass over the city streets or curves.

At the Lansing end it was necessary to pass over the steam railway tracks of the Pere Marquette Railroad, and this necessitated the construction of a bridge with pile approaches. The grade, as approached from the Lansing end, being 4 per cent for a distance of about 700 ft., and after passing over the bridge the descending grade is 2.3 per cent for about 500 ft. At the St. Johns end there is a grade on the principal street of the town averaging about 2 per cent for about 1,500 ft.

OVERHEAD CONSTRUCTION.

Considerable care was taken in planning a suitable insulator for carrying the trolley wire, and Fig. 1 shows the construction of the annealed glass insulator used.

Fig. 2 shows a typical arrangement of the straight line overhead construction, and it will be noticed that wood is used for the pole, cross-arm and braces, and that the insulator is supported by means of a short span wire from iron brackets secured to the wooden cross-arm. This construction insured a high insulation at a low first cost, the entire line having been constructed for but a slightly increased expense over the cost of standard construction, and at the same time so built that in case of failure of the alternating-motor system the standard direct-current motor system could be put into service without changing any parts. Even holes for the pins for carrying the extra feeders which would be required were provided, as shown.

It will thus be seen that the line and track work were constructed in such a manner that no expense was incurred for any parts which would not be required for standard construction in case it became necessary to ultimately adopt the standard direct-current motor system; the entire idea in the construction of the road being to save first cost and to invest all that was invested in such a manner that all material purchased would be utilized in case either system were adopted, and should the alternating system prove successful the additional investment for a direct-current motor system need not then be incurred.

The working conductor was placed 22 ft. above the top of the rails in order that trainmen, when standing upon the tops of the freight cars going over the road, could not come in contact with the working conductor.

It was planned to operate the entire road from a single 00 trolley wire, and with one rail bonded as hereinbefore mentioned; this amount of copper being sufficient to operate four 40-ton cars at an average speed of 30 m. p. h., with power house located 1½ miles from one end of the line, and operating with from 6,000 volts to 10,000 volts on the working conductor.

The power house is located at one end of the line, owing to the electric company, from which power is purchased by the railroad, having a water power at this point. Current is transmitted to the nearest end of the line over two No. 3 wires. The power is furnished from a 300-kw rotary converter, generating at 380 volts at 25 cycles, the energy from which is stepped up to the working pressure of the line. It was the intention, after experimenting a sufficient length of time to determine the best voltage for the working conductor to have the generators for the permanent plant constructed so as to generate at this determined voltage, and it was for this reason that a temporary rotary converter was first installed to conduct the experiments with.

During the preliminary experimental period upon the apparatus, hereinafter described, all power was transmitted from the above-mentioned power house to a point about 2 miles distant, where were located the car houses in which the preliminary experiments were made.

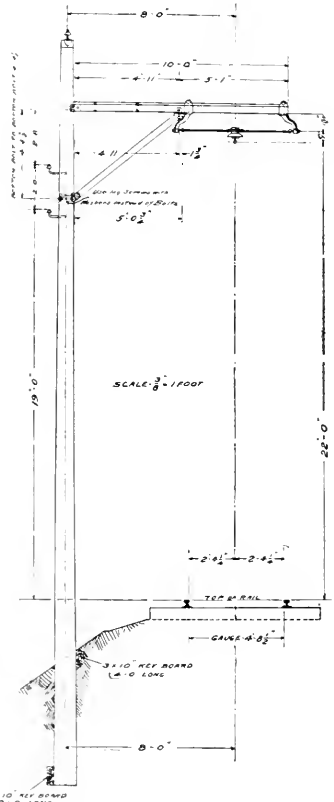


FIG. 1.—TYPICAL STRAIGHT LINE OVERHEAD CONSTRUCTION.

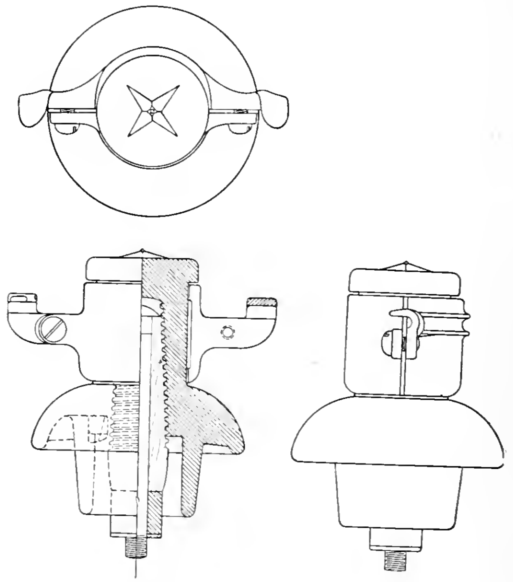


FIG. 2.—SPECIAL INSULATOR USED.

The conditions under which the first application of the system took place having thus been set forth, it may be well, in order to get clearly before the reader, the principles on which the system is based, to quote here the statements made by myself before the Great Barrington Convention on June 19, 1902, as follows:

"The principles underlying the system I advocate, and which I call an electro-pneumatic system, are as follows:

"1. A single-phase or multi-phase motor, mounted directly upon the car, designed for the average power required by the car, and running continuously at a constant speed and a constant load, and, therefore, at maximum efficiency.

"2. Instead of stopping and starting this motor and dissipating the energy through resistances, as is customary with all other systems known to me, I control the speed of the car by retarding or accelerating the parts usually known as the rotor and stator of the motor, by means of compressed air, in such a manner that I save a portion of the energy which is ordinarily dissipated through resistances, and store it to assist in starting the car, helping over grades, for use in switching purposes and for the operation of the brakes.

"3. By this method of control I secure an infinite number of speeds from zero to the maximum speed of the car, which may or may not be at the synchronous speed of the motor, for with the air-controlling mechanism working compressing, the speeds below synchronism are maintained, and by reversing the direction of the air through the controller speeds above synchronism may be attained for reasonable distances. This feature gives to the alternating-current motor the element absolutely essential for practical railway work, for it permits a car or train to ascend a grade at any speed with the motor working at its maximum efficiency and imparting its full torque to the car. When descending the grade the motor may utilize its full power drawn from the line in compressing air, or it may be used to compress air with the stored energy of the train, thereby acting as a brake.

"4. By virtue of the air storage feature each car becomes an independent unit, and capable, in case of loss of current from the line, of running a reasonable distance without contact with the working conductor. This feature will enable a car to work on a high-tension trolley wire or active conductor over private right of way, and allow the active conductor to be stopped where the private right of way ceases, and the car to proceed through a city or town on any tracks, whether electrically equipped or not, until it reaches the outskirts of the city or town, where it can take up the working conductor again on private right of way. This feature is also valuable in switching work, for each car being independent it can leave the main line track and operate over switches or sidings without complicating the yards with additional overhead or third-rail conductors, thus necessitating through-line conductors over main-line track or tracks only.

"5. Since a single-phase motor can be used the motors can be supplied with current from a single overhead wire or third rail, and with a single-rail return circuit, thus permitting the overhead construction, or third-rail construction, to conform to the standard of to-day, except that a much higher working voltage can be used, provided the insulation is taken care of. Furthermore, in steam railway work this system, by virtue of its single-phase features, will only require the use of one of the track rails for the return circuit, thus leaving the other rail for the use of the signal system, which, up to the present time, does not seem to have been satisfactorily solved without the use of one of the track rails.

"6. The current will be taken from the working conductor at any voltage up to the limit of the insulation, and in case this voltage is high (I am building my line for 15,000 volts), a static transformer will be carried upon each car and the pressure reduced from the line voltage to the voltage of the motor, which, in the case under construction, is designed for 200 volts. Where it is unnecessary to utilize so high a line pressure the motor may be designed for the working voltage, and the current fed directly from the working conductor into the motor, thus eliminating the static transformer. When a high-voltage working conductor and static transformer is used, and it is thought advisable to use a working conductor through cities or towns, this working conductor will be supplied with energy through a stationary transformer at each city limit, thus making the working conductor through the cities or towns safe.

"7. By virtue of the speed of the motor and its constant load, either when the car is in motion or when it is standing still, and the motor is compressing air, the variable load now customary in electric railway power plants is eliminated, and the power station works at practically a constant load, thereby eliminating a large part of the investment at present requisite in power station and line construction. Furthermore, by virtue of the air storage feature each car, in the particular apparatus I have designed, is capable at any time when current is on the working conductor, of delivering to the car wheels a much greater torque in proportion to the capacity of the motor than is possible with any electrical system known to-day.

"I believe that by the adoption of this system the following results will be accomplished:

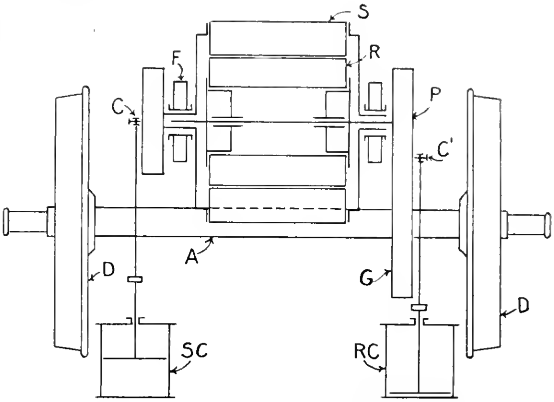
"1. The entire elimination of the present standard system of rotary converter substation plant, together with the maintenance thereon, and the cost of the necessary attendants.

"2. The absorbing and rendering available for useful work in starting, or otherwise, a large percentage of the energy stored in the moving mass, which, under the present methods of operation, is dissipated at the brake-shoes.

"3. A large reduction in the first cost of electrically equipping long-distance railroads, thereby making it feasible, from an engineering and business standpoint, to equip many roads which cannot now be shown advisable, thus opening up the steam railway field to the industry in which we are now engaged."

The following description will explain more in detail the application of the principles of the system and the mechanism of its working parts:

Fig. 3 represents diagrammatically the working parts of one form



R—Rotor.
S—Stator.
F—Frame.
P—Pinion on Rotor.
G—Gear on Car Axle.
A—Axle of the Car.
D—Driver of the Car.
RC—Rotor Cylinder.
SC—Stator Cylinder.
C—Crank of Stator.
C'—Crank of Rotor.

FIG. 3.—DIAGRAMMATIC ARRANGEMENT OF ELECTRO-PNEUMATIC MOTOR.

of the system. The rotor *R* of a single-phase induction motor is geared to the axle of the car, and by means of crank pin, *C'*, secured in pinion *P*, also drives the compressor cylinder *R C*, while stator *S* can freely revolve around the rotor and drive by means of crank pin *C* the compressor cylinder *S C*. Both cylinders are piped to air reservoirs located under the car, and are also provided with suitable valve manipulated from a single controller on the car platform for making them perform their various functions, thus the entire regulation of the speed and power of the car are controlled by the air cylinders, and no other regulating devices are necessary. The cylinder valves are electrically operated, which makes it possible for each cylinder, when driven by the electric motor, to compress air into the tanks, and when operated by compressed air to furnish mechanical energy for moving the car. When, for instance, the cylinder is compressing air the valves work like inlet and outlet poppet valves of a common air pump, while on the other hand if the cylinders are supplied with compressed air each valve is operated electrically by a pilot solenoid connected with the valve seat in such a manner that the energy for moving the valve is supplied by the compressed air, thereby making the valve practically self-actuating. The time of operation of the valves is controlled by a series of collector rings revolving with the engine shaft, and their regular operation is interrupted and varied to suit the requirements by means of the motorman's controller.

When a rotary or turbine type of air engine is used all of the above valves and reciprocating parts are eliminated and the entire controlling mechanism consists of two air valves, operated from a single engineer's valve, which may be located upon the platform of the car or in the cab of the locomotive, and so arranged that one or more units may be operated from the platform of the cab of any unit without the necessity of connecting wires between the units.

Since the motor may be of the simplest types of induction motor without a commutator, and the system does not require the manipulation or breaking of the main current the motor may be designed for any working voltage, and be of any type which will maintain a constant speed when provided with a constant load. This eliminates the necessity of all step-down transformers, resistances or other regulating devices and confines the current to the motors themselves, and as these are below the car floor the danger from the current is reduced to the minimum.

At the same time the air cylinders, in addition to performing all the functions of speed control, give to the machine the independent unit element, and the ability to store the kinetic energy of the train in stopping and utilizing it in starting. On account of these and other features the electric motors of this system can be much smaller in capacity when rated as continuous working motors, than those of other systems not possessing this equalizing load feature, and the capacity of the power house and line can be reduced to about one-half of what would be required with systems where the fluctuating starting loads of the cars are transmitted back to the power house.

In order to better understand the different operations of the system, Fig. 4, showing a speed diagram, has been prepared, in which,

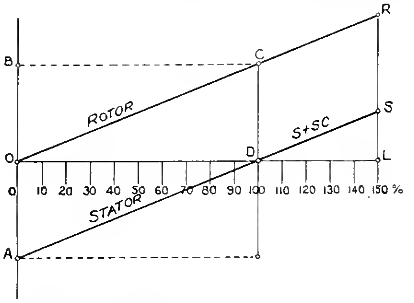


FIG. 4.—DIAGRAMMATIC REPRESENTATION OF OPERATION.

on the axis of abscisse, *O D L*, are represented the different car speeds in per cent of the synchronous motor speed, while the coordinate axis, *A O B*, represents the rotor and stator speeds corresponding to the car speeds shown.

The operation of the car may be divided into the following periods:

1. STANDING IN THE STATION.

Referring to Fig. 3 the rotor *R* is standing still, while the stator *S* runs with full synchronous speed. The stator is then transferring the full energy of the electric motor through crank *C* to the compressor cylinder *S C*, which energy is being delivered in form of compressed air into the air reservoir.

Since the relative velocity between the stator and the rotor is, under all conditions of operation, constant, the speed curves of stator and rotor may be represented by two parallel lines, *O C R* and *A D S* in Fig. 4. The origin *O* of the given co-ordinate system represents the period of rest of the car, and, therefore, indicates zero rotor speed and full stator speed in a negative or downward direction, as the stator is now revolving in the opposite direction from that which the rotor must revolve to drive the car forward.

Let it be further assumed that for an instant *O A* equals the active torque of the stator, then it will be easily understood that *O B*, which equals *O A*, represents the reactive torque of the rotor exerted on the car axle, meaning that if the car is free to move the reactive torque can be used advantageously for the starting and acceleration of the car.

When the car is standing in a station it is held at rest by moving the controller to such a position that the outlet pipe from rotor cylinder *R C* is throttled, thereby increasing the pressure behind the piston to such an extent that it overcomes the effort of the rotor *R* to revolve, thus tending to cause the stator *S* to revolve and at the same time holds the car at rest without the use of wheel brakes.

2. STARTING AND ACCELERATING.

To start the car the air cushion behind the piston of *R C* is removed, and the air, which is being compressed by cylinder *S C*, supplemented by the stored air from the tanks, is admitted to cylinder *R C*, with the controller at the position of maximum cut-off. The rotor then begins to revolve, and as it accelerates the stator slows down by exactly the same amount that the rotor has increased its speed, and as the rotor and car speed increase the controller is gradually moved to a smaller percentage of cut-off, until the car speed corresponds to the full synchronous speed of the motor, at which time the stator comes to rest.

During this period of acceleration the air compressed by cylinder *S C*, instead of being delivered to the tanks to lose its heat, is delivered, hot, directly to the rotor cylinders, thus greatly increasing the efficiency of the combination, as the heat usually lost in air systems is utilized, and the advantages of heated air gained without a reheater, and as the pressure used is low many of the ordinary difficulties in the use of compressed air disappear. If the rate of acceleration is such that cylinder *R C* uses all of the air supplied by cylinder *S C* no exhaust to the atmosphere from cylinder *R C* takes place.

Referring now to Fig. 4, which graphically represents this process, since the electric motor runs always at a constant speed and a constant load, it has a constant torque, and, therefore, the distance between lines *O C R* and *A D S* may be considered as representing the energy delivered by the electric motor.

The length of any ordinate extending from *O D* to *O C* represents the proportionate amount of energy derived from the electric motor, which is applied directly through pinion *P* and gear *G* of Fig. 3 to the propulsion of the car, while the corresponding ordinate extending below *O D* to *A D*, represents the proportionate amount of the energy of the electric motor, which is absorbed in compressing air through cylinder *S C*, which energy, in the form of air, is immediately transferred to cylinder *R C*, and is utilized in accelerating the car.

In practice, however, since there will be a loss in transferring the energy from electrical energy to energy in the form of compressed air and back again into mechanical energy, this loss, whatever it may be, must be drawn from the storage tanks, and the requisite amount of air from these tanks supplied to rotor cylinder, *R C*, in order to maintain the full power of the electric motor upon the car axle during the period of acceleration. Should it be desired to accelerate at a greater rate than the full power of the electric motor is capable of giving to the car the additional energy may be supplied in the form of air from the storage tanks through cylinder *R C*, thus increasing the total energy given to the car during acceleration, in which case this total power would be represented for any given instant by a point above line *B C*.

3. FULL SPEED.

When the rotor has reached full synchronous speed, by the previous operation, this speed can be maintained by moving the controller to another position, which will throttle the outlet pipe of cylinder *S C* until the reaction due to the pressure behind the piston equals the full capacity of the electric motor. An overload or underload may be placed upon the motor by varying this pressure, but under normal conditions of operation cylinder *S C* is provided with an automatic valve, which keeps a constant pressure behind its piston, thus maintaining an absolutely constant load upon the electric motor, and consequently a uniform demand of electrical energy from the line. This uniform load is represented by the parallel lines *O C R* and *A D S* of Fig. 4.

With the controller set at full-speed position the inlet valves of rotor cylinder *R C* are held open and the piston runs free and the electric motor now gives its full power to the car axle, and the stator and its air mechanism will remain at rest as long as the car runs at the speed corresponding to the synchronous speed of the motor.

4. SPEED VARIATIONS.

There are usually certain places on any road where high rates of speed can be maintained for short distances, and as these speeds might be higher than the synchronous speed for which the motor was designed they are provided for as follows:

Assuming that the car is running at synchronous speed the controller may be moved to such a position that the valves of stator cylinder *S C* operate in such a manner as to cause it to act as an engine and revolve stator *S* in the same direction as rotor *R* is revolving. This now causes, owing to the constantly electrically maintained relative difference in speed between the stator and the rotor, an increase of speed of the rotor and car axle, due to the motor automatically working as a magnetic clutch, without mechanical contact, and if the resistance of the car or train is less than the capacity of the electric motor, the air necessary for revolving the stator can be obtained, hot, from the rotor cylinder *R C* without drawing from the tanks, and a speed above synchronism indirectly proportioned to the resistance of the train maintained indefinitely. When the resistance of the train is greater than the capacity of the electric motor speeds above synchronism can be obtained only by supply rotor cyl-

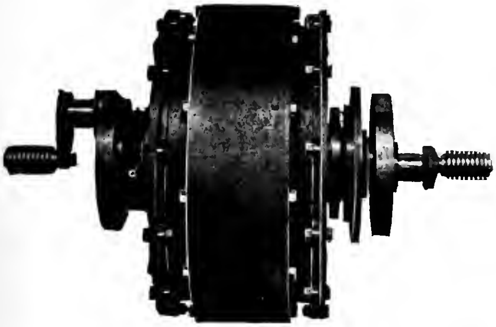


FIG. 5.—OUTSIDE VIEW OF ELECTRIC MOTOR.

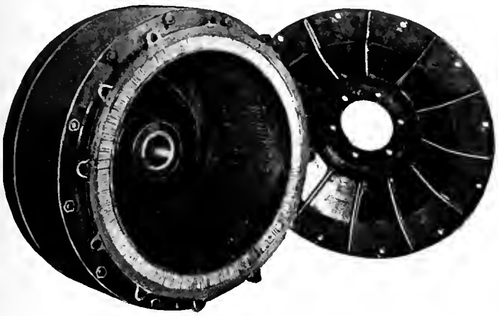


FIG. 6.—INTERIOR VIEW OF ELECTRIC MOTOR.

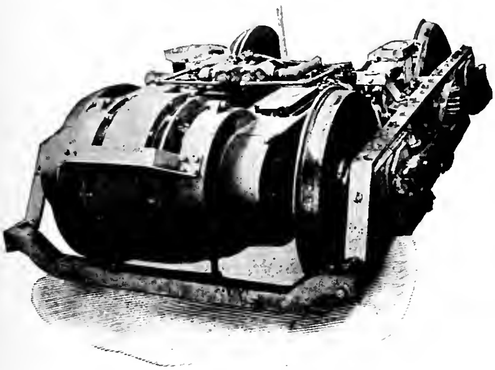


FIG. 7.—VIEW OF FIRST EXPERIMENTAL MOTOR WITH MOTOR FORWARD.

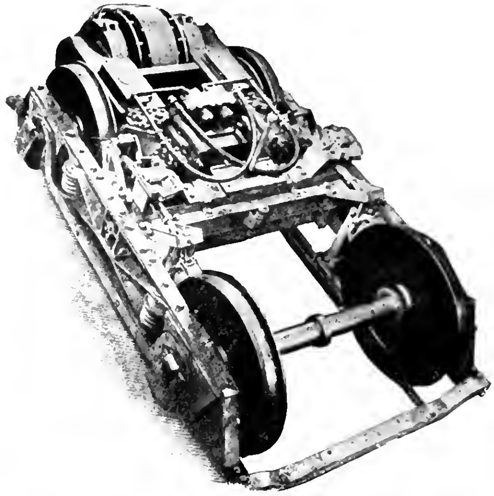


FIG. 8.—VIEW OF FIRST EXPERIMENTAL MOTOR WITH MOTOR IN THE REAR.

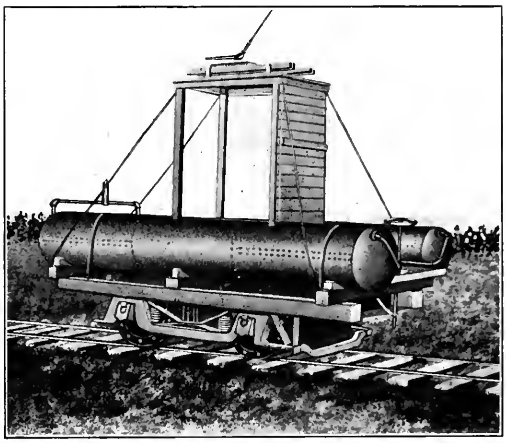


FIG. 9.—FIRST EXPERIMENTAL LOCOMOTIVE.

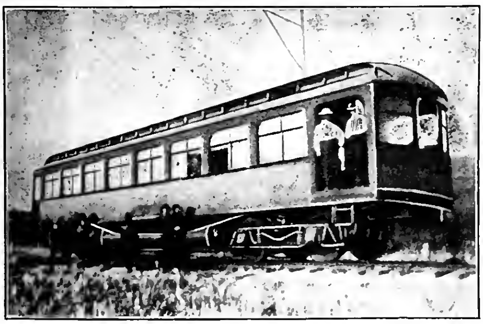


FIG. 10.—PHOTOGRAPH OF COMPLETE CAR.

FIG. 11.—CAR BARN AFTER FIRE.

ARNOLD ELECTRO-PNEUMATIC RAILWAY SYSTEM.

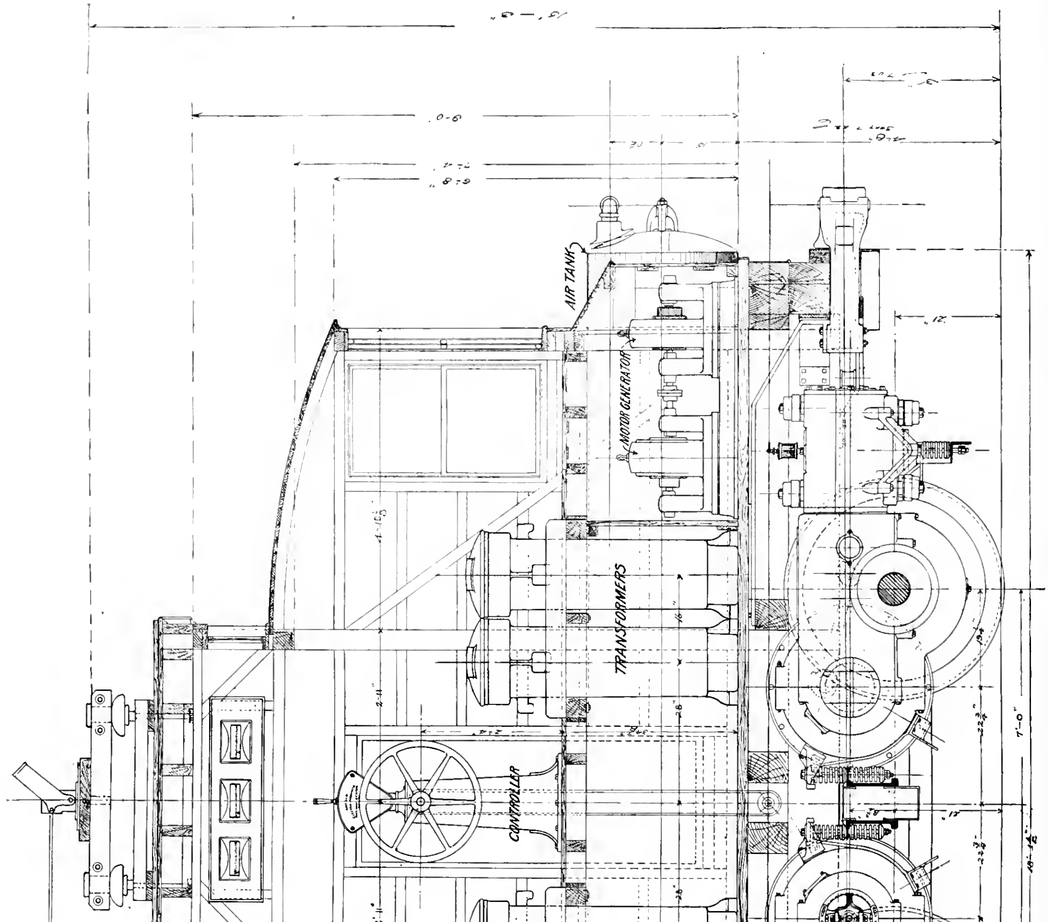


Fig. 12.—Longitudinal Section of Locomotive.

inder R C with stored air from the tanks, and can only be maintained for short distances, or until the storage capacity of the air reservoirs is exhausted. This condition corresponds to the spurts that can be made by a steam locomotive when working above the steaming capacity of the boilers. The distance from the line O D L to that portion of the line A D S above O D L in Fig. 4 represents, at any given speed, the proportionate amount of energy which must come from the tanks, and be supplied through cylinder S C, and the distance from D L to C R represents the total energy given to the car by the combined action of the electric motor and the stator cylinder when operating under these conditions.

The energy delivered to the car can be still farther increased by admitting air into rotor cylinder R C, and allowing it to work as an engine.

5. RETARDATION.

To bring the car or train to rest, instead of applying mechanical brakes to the wheels in the ordinary manner and thereby dissipating the entire stored energy of the car or train in the form of heat, this energy is saved in the form of compressed air, to assist in starting the car or train, by setting the controller in such a position that rotor cylinder R C compresses air and delivers it into the storage tanks. Any desired rate of retardation can be secured by throttling the delivery pipes from rotor cylinder R C, and in practice this pipe is provided with an automatic valve, which releases just before the slipping point of the wheels, thus allowing the motorman to brake as rapidly as he desires without liability of flattening the wheels. Supplemental wheel brakes are provided for emergency, but need not often be used, and the ordinary wear and tear on them is saved. When the car is again at rest the cycle of performance as above given is repeated for the next run.

6. REVERSING.

When it is desired to run the car backward for short distances the electric motor is not disturbed and the power is furnished by the rotor cylinder, R C, by reversing the action of the valves; but if it is desired to run backward for any great distance, the current is thrown off the motor, the stator engine reversed, and the stator brought to speed by the air, when the current is again thrown onto the motor, and the cycle of operation is the same as when running forward.

Fig. 5 represents the exterior of the electric motor, showing the cranks of the stator and rotor, also collector rings for operating the valves of the air cylinders when working as engines.

Fig. 6 shows an interior view of the stator of the motor with the flange removed, the rotor of the motor being of the standard squirrel cage induction type.

Figs. 7 and 8 show, mounted upon a track, two views of the first electropneumatic motor constructed, and upon which the first experiments were conducted, while Fig. 9 shows the same truck and motor placed underneath one of the care constructed for the system, the design of which is shown more clearly in Figs. 10 and 15.

Since the single motor represented in Figs. 7 and 8 was too small in capacity to propel so large a car, it was decided to experiment with an improvised locomotive, consisting of the truck and motor shown in Figs. 7 and 8, carrying suitable air tanks and transformers upon a temporary frame structure. This locomotive, shown in Fig. 9, was the one upon which the trial runs were made and passengers carried on June 15, 1902.

Figs. 16 and 14 show the end and side views of the new electro-pneumatic motor constructed after the preliminary experiments had been made on the first motor. For experimental purposes this truck was fitted up in the form of a locomotive, as shown in longitudinal and transverse section by Figs. 13 and 14, and it was this locomotive that was recently destroyed by fire. In order that the locomotive might operate as an independent air unit upon tracks not equipped with overhead electrical conductor, it was provided with a small storage battery and small motor generator for charging the batteries, and for operating the headlight. These auxiliaries are not necessary for the successful operation of the system, provided the locomotive can always be supplied with electric current from the working conductor, for then the valves can be made to operate from alternating current, and thus eliminate the use of motor-generator and batteries. When, however, it is desired to operate independently of the electric conductor these auxiliaries are necessary, and one set may supply an entire train. It will be seen that the locomotive is also provided with transformers, another auxiliary which is unnecessary in case the motors are designed for the voltage transmit-

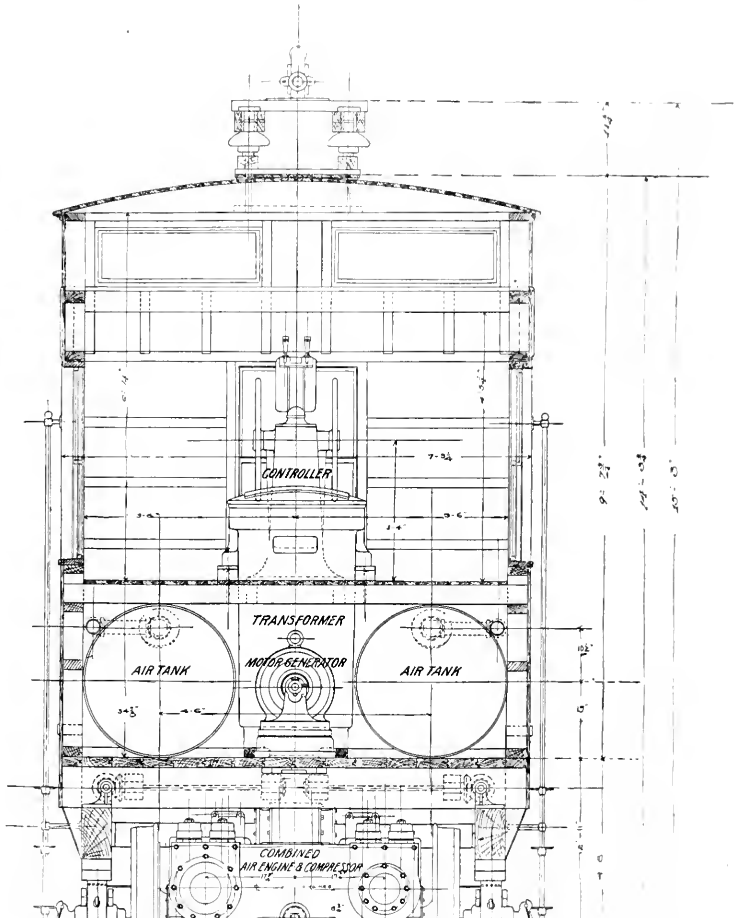


FIG. 13.—TRANSVERSE SECTION OF LOCOMOTIVE.

ted over the working conductor, but in this case transformers were used because the manufacturer of the motors could not be induced at the time they were purchased to build a high-tension motor for railway work, consequently the parts of a standard motor were utilized,

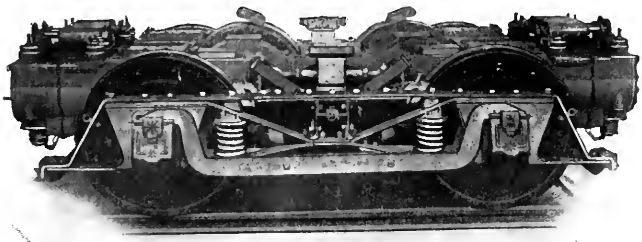


FIG. 14.—SIDE VIEW OF LATEST MOTOR EQUIPMENT WITH TRUCK.

and a pressure of 200 volts adopted for the motors, as this was the most economical voltage that could be used with the particular parts selected. This locomotive was provided with all necessary testing instruments, and had been operated in the car houses for some time, and found to perform all its functions successfully, and would have been placed on the road, and experiments with it would now be in process had it not been destroyed. All that remains of it is shown

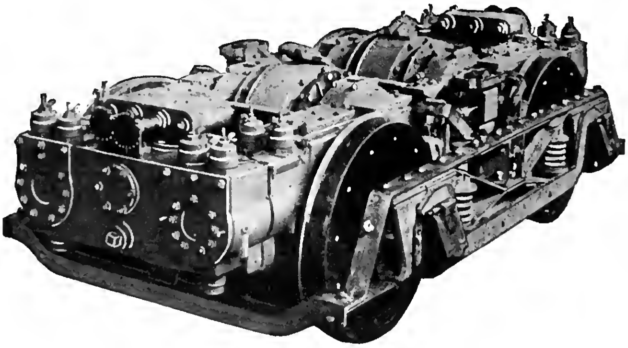


FIG. 16.—END VIEW OF LATEST DOUBLE MOTOR EQUIPMENT WITH TRUCK.

in Fig. 11, taken from a photograph of the site, the lumber shown having been carried to the site after the fire to shelter the machine with.

The Curies and Radium.

In a recent article in the New York *Independent*, about the Curies, Mme. Beinstock tells of the trials which the young French couple had before they gained fame. At the start the material situation of the young couple was not very bright. Neither had any fortune, and with the few thousand francs which they earned it was no easy task to make both ends meet at the close of the year in such an expensive city as Paris. So they went out into the suburbs of the great capital and established themselves in the little town of Bourg-la-Reine, distant two or three miles from the walls; and in order to save the railway fare, husband and wife, in all weathers and at all hours, made the journey by bicycle from their modest lodgings to their laboratory in the dingy old Rue Lhomond, where they have made their important discoveries. When it is known that the road from Bourg-la-Reine to Paris is block paved much of the distance and encumbered in many ways, these goings and comings on "the wheel" were not holiday rides, especially in the case of the frail young wife.

Soon a child came to the struggling couple. The little daughter is now seven years old, in good health, full of life and tenderly cared for by the loving mother. So Mme. Curie is not only a scientist, whose name is well known throughout the world, but a model wife and mother, another and most striking example of the fact that the new woman does not differ in this respect materially from her sister.

The prize of 100,000 francs ($20,000) placed at the disposal of the Parisian press syndicate by M. Osiris has been divided between Mme. Curie, to whom 60,000 francs ($12,000) has been allotted, to enable her to continue her researches as to radium, and M. Branly, who received 40,000 francs ($8,000) for his discovery of the conductibility and non-conductibility of filings under the influence of the Hertzian waves, which rendered wireless telegraphy possible.

Mme. Curie has contributed an interesting article to the January *Century Magazine*, in which she discusses the subject of radium and makes a number of interesting and important statements and deductions based upon her own experiments and observations. The article was in all probability written several weeks ago, since which time, as our readers know, a good deal of new work has been done in the field; but it is none the less well worth reading. Prof. Ernest Merritt, of Cornell University, has also in the same issue an article on the subject, which will also enlighten and instruct the general public.

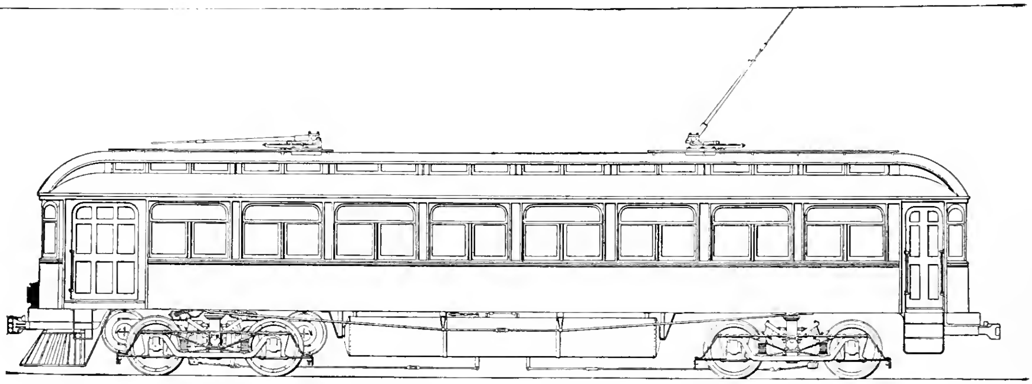


FIG. 15.—DRAWING OF COMPLETE CAR.

Water Power Electrical Generating Plant at Riva, Tyrol.

By FRANZ KOSTER.

RIVA, a city on Garda Lake, in the Tyrol, and much frequented by tourists, possesses a water power electrical generating plant of unusual interest in view of the fact that the total population served, including that of Varone and St. Giacomo, neighboring towns, is less than 8,000. When it was decided to put down a plant several water powers presented themselves for consideration. The city is within easy distance of the Albole, a small stream with a fall of 650 ft., and the Varone, with a fall of 327 ft. As these, however, were already largely occupied for commercial and supply purposes, it was determined to use the Ponale, which, though having a fall of only 200 ft., is larger and more available and from which may be utilized a water power of 2,000 hp.

The station has been erected in two parts; the second, just finished, having been commenced upon the completion of the first part. A third portion will be erected as soon as the necessity for the power arises. The portion first erected contains dynamos and turbines of double the power of those of the first part. The plant was designed and erected by the Maschinenfabrik Oerlikon, of Zurich, Switzerland.

The Ponale, which has a minimum flow of 500 gallons per second, connects Lago di Ledro, a natural reservoir fed from springs, with Lago di Garda, 2,000 ft. lower and some 10.5 miles away. In addition the Ponale is fed on its course by many small tributary springs. The principal power reservoir lies 285 ft. above the level of the Lago di Garda and is firmly constructed of iron and masonry. To this reservoir from a convenient point on the Ponale the water is fed, first through an open canal 115 ft. long, 6.56 ft. deep and 7.25 ft. wide, then through a tunnel through solid rock 787 ft. long, then in an open canal 26.25 ft. long, and finally through another tunnel 50.4 ft. long. These tunnels, which can be entered for inspection and open canals, were required on account of the necessity of carrying the water across ravines and through the mountain "Val de Ledro." From the reservoir the water finds egress into the penstock, which has on its water inlet a strainer-head over which is fitted a removable finely-perforated hood. At one side provision is made for the overflow and a drainage canal.

The penstock leading to the central station is 557 ft. long and of riveted steel plates with a diameter of 2.4 ft.; it is above ground through its entire length, lying on a steep rocky slope and supported on masonry and steel piers built on the native rock. Arrangement is made for the erection of two other similar penstocks when necessity arises, parallel to the present one and on the same foundations. The penstock supports are constructed to allow such slight movement as is caused by expansion. Two expansion joints have been inserted for the necessary purpose. At the foot of the penstock, which is

FIG. 2.—RIVA POWER STATION.

strongly constructed, a branching occurs, leading through a canal blasted from solid rock to the portion of the power house first erected. One branch of the penstock leads to the three turbines first installed, while the other leads to the two turbines in the next room. These branches are provided with double safety and discharge sliding valves, and the turbines may be shut off by by-pass sliding valves.

The power house, which is, as stated, in the immediate vicinity of the Ponale Falls, is 2.17 miles from Riva, and lies 165 feet above the level of the Lago di Garda. It is picturesquely situated on the mountainous slope of the "Val de Ledro." The building is of brick and rough stone work with a roof frame of iron and wood carrying a terra cotta roof. The main floor of the power house is divided into two parts. The original portion contains a room for the three 150-hp. turbines and dynamos, and four rooms for the occupancy of those in charge of the operation of the plant; in the addition is a machine room for the 300-hp generators and a room for apparatus.

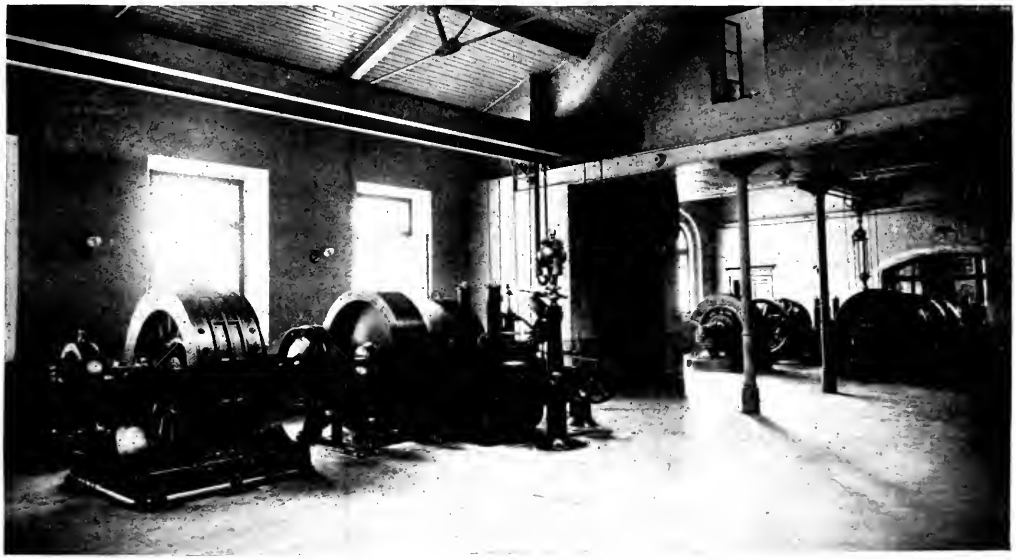


FIG. 1.—VIEW OF INTERIOR OF RIVA STATION.

In the second floor is a room for employees. Each machine room is fitted with a hand-power crane of 5 tons capacity, and the rooms are lighted with incandescent lights. The floors are of substantial parquetry.

Two of the first group of 150-hp turbines are of the Girard type and the third turbine of this group is of the Rusch "spoon-wheel" type. The general arrangement of the three turbines, which make 300 r.p.m., is the same. Each turbine is regulated in two ways—by a hand wheel and by an automatic governor. The hand-wheel regulator through a worm and rack and pinion opens and closes the fly wheel on the shaft between the turbine and dynamo. The three first turbines develop a net efficiency at brake test with full gate of 81.33 per cent and with half gate 80.84 per cent. The 300-hp turbine with full gate shows 82 per cent.

In the portion first erected are three three-phase dynamos of 150 hp capacity each, and in the second a three-phase dynamo of 300 hp. All the dynamos, which are of Oerlikon type, and are connected with their turbines by insulating elastic couplings. The exciter dynamos are coupled direct with the generators.

The diameter between poles of the three first generators is 3 ft.

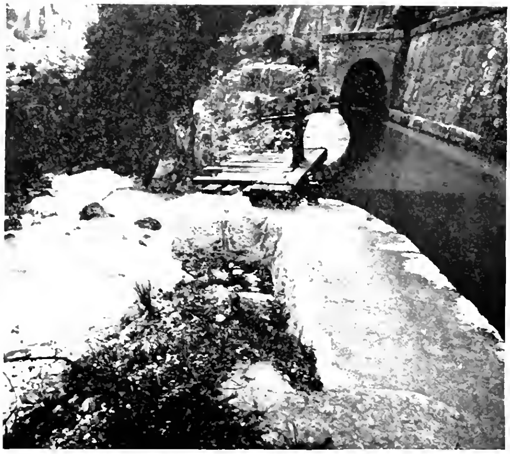


FIG. 3.—TUNNEL ENTRANCE.

FIG. 5.—WIRES ON CLIFF AT GARDA LAKE.

FIG. 4.—OPEN CANAL.

FIG. 6.—TRANSFORMER HOUSE.

gates. The rods of the automatic governor are connected with a hydraulic relay which acts upon a balance valve, thus regulating accordingly the amount of water admitted. The 300-hp turbine in the addition is of the Rusch type, the water being admitted through phosphor bronze passages. The blades of the turbines are Delta metal and interchangeable. Automatic regulation is accomplished by a balance valve responding to a sensitive centrifugal governor. For the prevention of sudden jars an oil dash pot is connected with rods to the governor. The turbine is also regulated by a hand-wheel regulator, through worm and rack and pinion. For each of the machine units the automatic regulation is supplemented by a $3\frac{1}{2}$ in., and the armature has a diameter of 3 ft. 3 in. They have 18 coils, two with 60 windings and the remainder with 59.5 windings of 1-6 in. wire. The 300-hp generator, also of the Oerlikon type, has an armature diameter of 4 ft. 3 in., and 21 coils which have 42 windings of 3-16-in. wire. The diameter of the revolving field is 4 ft. $2\frac{5}{8}$ in. The 14 exciter coils are connected in series and have 130 windings of $\frac{1}{4}$-in. wire.

The conductors pass in a masonry canal under the floor to the apparatus room, which is entirely cut off from the machine rooms. The switchboard is faced with white marble and is mounted on an iron frame work. It is divided into five panels, four at present being in use. In addition there is one general instrument panel. On each generator panel is a voltmeter, a four-pole switch, the starting and regulating apparatus, an exciter ammeter, and a phasing lamp. The general instrument panel carries a suspended voltmeter with switch for measuring the voltage of the three phases, and an ammeter for each phase.

In the switch room, the portion which adjoins the machine room and that which contains the four-pole high-tension switch are separated by a special partition of perforated iron. Above the four-

FIG. 7.—CANDELABRA WITH ARC AND INCANDESCENT LAMPS.

pole switch are the measuring transformers with safety fuses, while below rheostats and carbon cut-outs are arranged. On the other side of the aisle are the machine fuses, and on the north side of the room are eight wire fuses. Of these eight fuses, four are constantly under pressure, the remainder being held in reserve, so that in case of a burning out no interruption of service will occur.

The high-tension mains to Riva do not proceed by the most direct route, as that has been utilized for state telegraph wires. The city is reached by a circuitous route over the rough surface of the mountain side and along the cliffs of the Lago di Garda. The mains are carried on triangular iron brackets whose feet are imbedded in the

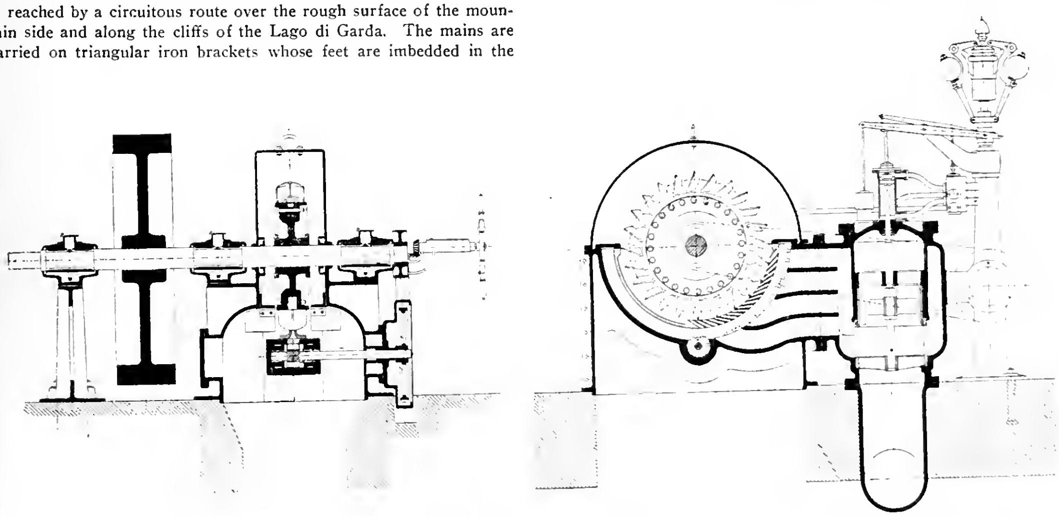


FIG. 9.—SECTIONS OF 300-HP TURBINE.

sides of precipices, and where permissible on iron and wood poles, of which, however, few are used. There are three wires and one neutral wire, each of hard drawn copper and ¼-in. diameter, and supported by double bell insulators. The high pressure mains enter at a tower from which an underground iron armored lead-covered cable of four wires passes to the transforming stations of the city. This cable is laid in sand under tile, covered by earth. At the two points where the high tension circuits leaves the city—one to Tarbole and the other to Varone—a tower again brings the mains above ground. A branch of the circuit to Varone leads to St. Giacomo. The length of the high-tension circuit in the city is 0.62 miles, the length to Tarbole is 3.5 miles, to Varone 1.9 miles and the branch to St. Giacomo 0.2 miles. These branches from Riva are supported

FIG. 8.—PENSTOCK.

on wooden poles and double bell insulators. The poles are 36 feet long and the tops are charred. The mains are fitted with horned lightning arresters.

The transformers are in fire-proof rooms, and each has a four-pole switch for the high-tension, and another one for low-tension, and one each in Tarbole and St. Giacomo. Low-tension wires are carried on wooden poles and brackets on the sides of houses, the wires used being from 3-16 in. to ⅜-in. diameter.

Arc lamps of 800 candle power swing from graceful candelabra or from suspension wires. They are 20 ft. above the street. The exposed incandescent lamps are also mounted on candelabra, on arms or on masts and are of 32 candle power. They are connected between one phase and the neutral wire and are in a 110-volt circuit. The power plant is in constant operation day and night except from noon to two o'clock on Sunday.

The Gas That Failed.

By Alton D. Adams.

THE fact that this year—1904—marks the twenty-fifth anniversary of the commercial introduction of the incandescent lamp would in itself render interesting a review of the growth of that illuminant as compared with gas. But special and peculiar interest is given to such a comparison by the remarkable fact just brought out by the United States Census office bulletin on central stations that such stations alone, regardless of isolated plants, have already overlapped gas in investment, labor employed, gross earnings and other vital features. An extraordinary chapter of industrial history is here revealed and one's thoughts go back involuntarily to the earliest days of the electric lighting art.

Those were years of conflict in the lighting field. Gas companies soon saw their incomes from street lamps dwindling, and their commercial business in danger. Rays of electric lamps had caught the popular eye and fancy. The illuminant that simulates daylight, requires no matches and operates without a flame was in rapidly growing demand. Two particular groups of persons stood ready to turn this situation to their own advantage. These were the purveyors of oil and the exploiters of patent gas processes. The hopes, the aims and the future gains of these persons were summed up in "water gas." All this was in the decade of 1880 to 1890.

Even at the beginning of this period water gas was not a new product. Before Brush gave the electric arc commercial importance, before Edison and his contemporary workers had solved the problem of multiple distribution with incandescents, Lowe and others had reduced the water-gas process to a high degree of perfection. Men with oil and patent rights had for some years infested the offices of gas companies with very moderate success. The makers of coal gas had heard the orators of "water," had considered the high cost of the "inventions," compared the uncertain price and limited supply of oil with the steady market of gas coal, had consulted their satisfactory net profits, smiled and continued as before.

Shortly after the general introduction of the electric light, the gas situation changed. The great field of heating by gas was then almost unknown. Gas managers saw the lighting business, almost their sole reliance, rapidly turning to electric stations, and were troubled. Then the hour of the water-gas man was struck. He became the Moses of the hour. Cheaper gas was wanted and the patented apparatus could supply it; greater candle-power was wanted, and oil would give it, so it was claimed. Competition must be met, so gas managers thought, and water gas was extensively introduced. In this movement of the gas interests Massachusetts hung back. The public and the legislators of that State recognized the deadly qualities of water gas, and its distribution was early interdicted by law. During the decade mentioned, the gas interests made repeated appeals to the Legislature for the privilege to freely make and sell water gas. For a series of years these applications were in vain, but at last the arguments of patent owners and oil venders overcame the real or assumed scruples of legislators, and a bill removing the restrictions on the distribution and sale of water gas was approved April 30, 1890. Since that date the fears as to water gas have proved to be only too well founded, for the deadly stuff has ended the lives of more than 300 victims in Boston alone.

However, the industrial side of the question is all that can be considered here. The great argument for water gas was that it would serve to check the rapid advance of electric lighting, by means of lower prices and higher candle-powers than had prevailed with coal gas. It is the purpose here to test this argument by the hard facts of experience. This may be done in two ways. First, by comparing the growth of the gas and the electric lighting industries since the removal of the restrictions on water gas. Second, by noting the ratio which water gas has held to the total volume sold. Boston has been the proving ground for much the greatest water-gas experiment in Massachusetts, and figures from this field are thus selected in the present case. No better measure of the growth of the gas industry could be desired than the volumes of gas annually sold to consumers, as this avoids any uncertainty due to changes in price. Figures are accordingly given for the cubic feet of gas sold to consumers during each year from 1890 to 1901, in all parts of Boston, except the suburbs of East Boston, Jamaica Plain and West Roxbury. In these suburbs no water gas has ever been sold. Unfortunately, it is not possible to present figures showing the total sales of electrical energy in the Boston territory during this series of years. There are no census figures, unfortunately, to refer to, so far back. The growth of electrical supply may be approximately measured, however, by the number of tons of coal burned each year in electric stations. The number of tons of coal burned yearly by the three largest electrical supply systems in Boston, which generate most of the energy sold in the city, are, therefore, given. It should be borne in mind, however, that while the cubic feet of gas sold form an accurate measure of the expansion of that industry, the same cannot be said of the weight of coal burned in electrical supply, because the delivered energy has increased faster in amount than the fuel consumed. Consequently, the showing for the electrical industry is less favorable than are the real facts. Delivered energy has increased in amount faster than the coal consumed because electric stations have been much improved in efficiency since 1890. For the fiscal year ending on June 30, 1890, the relative amount of water gas was small, because no gas might then be distributed that contained more than 10 per cent. of carbonic oxide. Notwithstanding the removal of restrictions on water gas in 1890, the total volume of combined coal and water gas sold did not go up immediately, but on the contrary declined a little. During each of the four following years the figures for total sales of all gas ranged below those of 1890, and in 1894 the volume sold was 93 per cent. of that in the earlier year. This falling off in the total sales of combined coal and water gas took place in spite of the fact that water gas, of which only 193,000,000 cu. ft. were sold in 1890, reached a volume of 1,378,000,000 ft. in 1894. Meantime the coal consumed by the electric stations increased from 24,589 tons in 1890 to 50,374 tons in 1894, touching 53,675 tons in the "expansion" year that ended June 30, 1893. In other words, during four years after the legal restriction on water gas was removed, the total sales of both coal and water gas declined a little, but the coal consumption at electric stations more than doubled. For the fiscal year of 1894 water gas rose to 90 per cent. of the total sales in the Boston territory, without increasing the combined output of coal and water gas, or checking the rapid extension of electrical supply. In the following year the gas situation changed. What water gas had not done and could not do, boost the total gas output, was accomplished by other means. Under date of June 19, 1894, one of the large Boston gas companies issued a circular offering a $17 gas range free, connected in position, to any of its customers, this range to become the absolute property of the customer after the exclusive use during one year of the company's gas. This move naturally evoked competitive measures on the part of the other gas companies. Though these gifts of gas stoves were prompted by material competition, they did what could have been done in no other way, aside from a large reduction in prices; that is, they caused a rapid increase in the volume of gas sold. Under the stimulus of free stoves the volume of annual gas sales rose from 1,524,000,000 ft. in 1894 to 2,271,000,000 ft. for 1896. There need be little uncertainty as to the use to which this increased volume of gas was put. In 1894 the number of gas stoves in use at Boston was so small that the gas commissioners did not record it in their report. On June 30, 1895, the number of these stoves had reached 23,881, and by the like date of 1896 the number was 49,610. In view of these figures for stoves and of the previous uniformity of gas sales, it is clear that the increased volumes of gas during these two years were mainly devoted to heating. While the gas companies were enjoying the expensive luxury of business obtained by the payment of "chromo" premiums, the electric lighting industry was slowly expanding on a more conservative basis. From the middle of 1894 to the middle of 1896, the period of two fiscal years, the total volume of gas sold increased 49 per cent., and the weight of coal burned by electric stations 17 per cent. By the end of June, 1896, the gas interests had grown tired of giving away stoves and the practice was soon thereafter discontinued. When free stoves could no longer be had, the expansion of gas sales came to an abrupt end. During the three years following 1896 the total volume of annual sales of gas established in that year was hardly maintained. Compared with the 2,271,000,000 ft. of 1896, the volume for 1899 was 2,269,000,000 ft. Water gas formed much the greater part of the total output from 1894 to 1899, but it was powerless to expand the volume of gas sold, as shown by the stationary condition of the industry during the three later years of this period. If water gas could not bring about larger total sales of gas or even hold what had been gained by the gifts of stoves, neither could it check the onward swing of electric lighting. From 1896 to 1899 the consumption of coal at electric stations increased 28,162 tons, or 50 per cent. of the weight burned in the earlier year, while the gas industry was vainly trying to maintain its record. This year of 1899 is a good point from which to look back over the record of the gas and electric industries since 1890.

Volumes of gas sold in the Boston territory and the volumes of water gas:

Year.	Cubic feet, total.	Cubic feet water gas.	Percentage of total. coal.	water.
1890	1,627,336,951	193,352,779	88	12
1891	1,507,756,807	561,891,635	63	37
1892	1,527,604,172	902,625,048	51	59
1893	1,594,531,897	1,170,658,199	27	73
1894	1,524,864,297	1,378,106,905	10	90
1895	1,869,378,991	1,815,289,524	3	97
1896	2,271,327,822	2,077,223,942	9	91
1897	2,288,566,862	2,080,759,737	9	91
1898	2,258,640,970	2,184,781,672	3	97
1899	2,269,367,070	2,194,963,361	4	96
1900	2,397,835,462	1,804,888,902	25	75
1901	2,553,229,570	955,723,749	63	37
1902	2,700,792,329	1,200,163,970	56	44

During the nine years, gas has had two of rapid increase and seven years of nearly stationary output. Compared with 1890 the fiscal year of 1899 shows an increase of total gas sales, amounting to 39 per cent. In the same nine years electric lighting has had two years of nearly stationary output and seven years of rapid increase. While the volume of gas sold gained 39 per cent., the weight of coal burned at electric stations went up 242 per cent. The rate of increase of annual fuel consumption in the electric plants has thus been 6.2 times as great as that in the volume of gas yearly sold. Meantime the aggregation of patent gas processes and oil accomplished a purpose, but did not check the electric industry.

Tons of coal burned by the Edison, Boston and Suburban electric lighting systems of Boston:

Year.	Tons.	Year.	Tons.
1890	24,589	1897	60,566
1891	31,645	1898	70,578
1892	47,683	1899	83,872
1893	53,675	1900	80,489
1894	50,374	1901	80,058
1895	51,162	1902	65,131
1896	55,710		

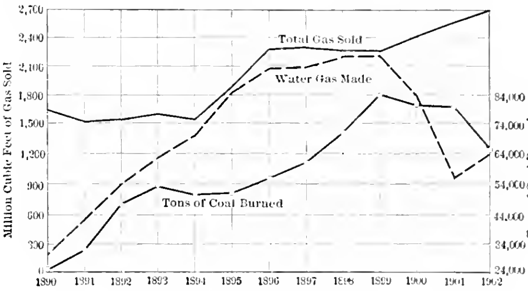
Water gas, starting with only 12 per cent. of the total volume of gas sold in 1890, increased rapidly to 90 per cent. of the entire volume in 1894. From the fiscal year last named to that of 1899 inclusive the percentage of the water gas made to the total product sold was never below 90, and in two instances stood at 97.

During these five years water gas substantially displaced coal gas in the local field, but not in one of them did its brilliant illuminating power or alleged low cost of manufacture check the expansion of electrical supply. In only two years out of the five was the total volume of gas sales materially raised, and then the increase was due to gifts of gas stoves. These stoves appear to have raised the annual consumption of gas about 750,000,000 ft., which would leave the volume of gas yearly burned for illumination just about stationary from 1890 to 1899, inclusive. Now a stationary consumption of gas for illumination in the face of an increasing population means an actual decline in the use of gas per capita for that purpose. It is highly probable that this is just the situation which the Boston gas interests have to face. For the decade from 1890 to 1900 the increase of population at Boston was 25 per cent. If the fifty odd thousand gas stoves now used in the city are doing much baking, it seems hardly probable that illumination by gas has kept pace with the population.

Consideration of the years 1900 and 1901 has been reserved until this point, because they present several new and interesting conditions in the gas and electric field. For the first time during the eleven years under consideration, gas sales show a substantial gain without the aid of an artificial stimulus, like gifts of gas stoves. This gain in the volume of gas sold for 1901 was 12 per cent. over the volume for 1899. Strange to tell, however, while the total volume of gas was going up, that of water gas, the cheap, brilliant illuminator, went rapidly down. From 96 per cent. of the total volume of gas sold in 1899, water gas fell to only 37 per cent. of the like volume for 1901.

This is not the time to explain or guess at the inside working of gas deals. A consideration of the exact causes that lowered the percentage of water gas from 1899 to 1901 would be as much out of place here as would the causes that raised it from 12 in 1890 to 97 in 1895. Of prime interest from the electrical point of view is the fact that a gas, which was introduced with much noise about what it would do to electric lighting, has failed to maintain the advantages formerly gained by coal gas, and failed even in the struggle with coal gas to hold the Boston field against the latter. It is the irony of fate that water gas, from which so much was expected, should be in a rapid decline during the only two years since its general introduction when the volume of gas used for illumination shows any material gain. A glance at the figures and curve for coal burned at electric stations from 1899 to 1901 seems primarily to indicate that at last the long and rapid expansion of electrical supply has been checked. The tons of coal burned, which stood at 83,872 in 1899, were down to 80,058 in 1901. Instead, however, of a failing prosperity, electric lighting in Boston has enjoyed the double advantage of increasing business with a declining fuel consumption during the two years in question. The higher economy of fuel has been effected by marked changes in electric generating stations. To a large extent the generating equipment of 1899 was that of 1890. Comparatively small, simple engines, working non-condensing, and many belted dynamos, did a large part of the work of electrical supply in the Boston field during the year ending June 30, 1899. Under these conditions a rather large consumption of coal per unit of energy output was inevitable.

During the fiscal year of 1899 the Boston Electric and the Edison systems had in use 81 engines and 215 dynamos. In the year of 1901 nearly all the work of these systems was done with less than



GAS AND COAL CURVES.

24 engines and 85 dynamos. These engines all worked condensing and both the engines and dynamos had average capacities much beyond those of the earlier year. A reduction in the amount of coal burned by the electric stations during 1901 from the weight consumed in 1899 was thus due to increased economy of operation, and not to failing business. Further and conclusive proof of this fact is found in the figures for incomes from sales of electrical energy in the Boston field during the years under consideration. For the fiscal year of 1899, the combined incomes of the Boston Electric, Edison and Suburban Companies from the sale of electric light and power amounted to $1,900,052.82, and the corresponding sum for 1901 was $2,348,207.14, an increase of 23 per cent. over the former year. This increase is almost double that of 12 per cent. recorded for the rise in the volume of gas sales between the same years. While electrical supply was making this latest gain, completing two decades of unparalleled expansion, there was a shrinkage in sales amounting to 57 per cent. in the volume of the gas that failed.

Russian Telephones.

The Russian and German post-offices have arranged to construct a telephone line between Berlin and St. Petersburg, via Edtykuhneu, on the German frontier, and Wilna, in Russia. The construction will begin in 1904.

Long Swiss Road.

Two engineers of Zurich, Switzerland, Messrs. Grote and Westermann, have recently applied for a concession to build an electric railroad in the Bernina Pass, Canton of Graubünden. This new road will run from St. Moritz to Pontresina, thence over the Bernina Pass via Poschiavinatal, to Tirano, where it will connect with the Veltlin electric road, a branch of the Adriatic Railroad Company. The new road will have a length of about 40 miles.

Telephone Spring Jack Decision.

We are indebted to Mr. F. F. Sapp, of the North Electric Company, Cleveland, for the following clear digest of the recent decision in regard to telephonic jack springs noted last week:

Some two years ago the Western Electric Company entered suit against the North Electric Company, at Cleveland, upon the following patents, covering the construction of spring jack switches: 357,538, Charles E. Scribner, February 8, 1887; 488,033, Scribner & Warner, December 13, 1892, and 552,729, Charles E. Scribner, January 17, 1896. The second patent, that to Scribner & Warner, is one which has long been considered to be one of controlling importance in the telephone field, and the well-known features of the type of spring jack manufactured by the North Company were confidently asserted by the Western Electric Company to be plainly an infringement on the sweeping claims of this patent. These claims have frequently been sought to be evaded or avoided by manufacturers of telephone apparatus, but relating as they do to the employment of long and short springs for controlling the two limbs of a telephone circuit, the evasions, to say the least, have been doubtful.

The other patents relate more particularly to features of construction of the strip of jacks. The first, the "early Scribner patent," discloses a spring jack switch fully assembled, and insertible in, and removable as a unit from, the comb-like strip or frame of rubber, which is bored and slotted to receive within its body, a number of such jacks. The parts of this jack, corresponding exactly to similar parts of still earlier spring jacks, are punched from sheet metal, assembled in parallel planes, and secured together with rubber insulators, by means of a transverse screw and pin, to form a complete jack, which is fastened at its rear by "a single screw" passing through a laterally extending ear or lug into the edge of the rubber frame or strip.

By reason of this arrangement, the patent states: "On removing the screw of any jack it is evident that the jack may be removed, and all parts of its parts thus made accessible for adjustment or repairs."

Obviously, the thin metal punchings described are lacking in the strength necessary to withstand ordinary service, but the patent further says: "Being, however, connected together and supported by the rubber frame, as before described, they will be sufficiently rigid to be durable and effective for the purposes for which they were designed."

Four claims, 1, 2, 3 and 5, were declared upon. The first, second and last, relating to these individual jacks in combination with the slotted rubber mounting frame or comb-like support formed to contain said jacks, and the third claiming the completely assembled jack, but separate and apart from the frame. The principal reference relied upon by the defendants was the well-known type of spring jack shown in the expired patent to Richard V. Freeman, No. 309,218, dated December 16, 1884, under which suit was brought some years ago by the Bell interests at Detroit. A number of other references were offered in evidence relating to certain features of the Scribner construction. In the Scribner & Warner patent another type of spring jack is shown, designed for specialized use in a single portion or section of a multiple switchboard. It has two springs of different lengths, adapted to engage separate corresponding contact parts upon a switching plug, provided for insertion in the jack. The two springs have normal inner contacts, from which they are separated by inserting the plug.

In this patent in suit, a tubular test piece is permanently connected with the longer of the two line springs in the jack, as stated in the patent: "In order to make the contact between the sleeve of the loop plug and one of the springs more certain and to adapt the plug for use in multiple switchboard systems" while the end or tip-contact, of the plug is of smaller diameter than the sleeve, as in prior patents, in order that the longer spring "may be so adjusted as not to form contact with said tip," although no advantage or function is mentioned as being attained thereby.

The first and third claims were relied upon by complainant; the first setting forth, not in a spring jack but very broadly, in "a circuit-changing device," an admittedly old combination of elements, as is shown by the file wrapper, including two springs, their normal contact pieces, and the tube or guide, in combination with this old two-contact plug, having its tip smaller than the sleeve; a feature previously adopted to prevent its making contact with and closing circuit through the frame of the early individual jacks. In the third claim is set forth the combination with two springs, here specified as being of different lengths, of the "guide in front of said springs," and a plug having two terminals, one upon the tip, whose size is not specified, and the other upon the sleeve. Both claims are somewhat amplified by the recital of functions accomplished by the elements thereof, but without in any way confining the alleged invention to spring jacks, or any other specific form of circuit-changing device. Two patents of Charles E. Scribner, 383,013 and 427,123, were employed to show the strong probability that no joint inventorship actually existed with respect to the features broadly claimed in this patent in suit, while that of Trayer & Kugler, No. 377,788, of February 14, 1888, clearly discloses the use of long and short springs in an earlier spring jack switch.

The last patent in suit, Scribner, 552,729, also describes a specialized form of spring jack adapted for use in a single portion of the multiple switchboard, and was designed in part to accomplish much the same purpose as was the device of the last patent in suit considered.

The patentee says that he has provided a spring jack "whose switch contacts shall be accessible for testing to determine the insulation and continuity of the circuit wires." This he accomplishes by the use of a rubber mounting plate of distinctive character, recessed to contain the inserted spring jacks; each of the receiving grooves provided therein being forwardly expanded or enlarged to afford ample space for the extremities of the four springs of the inserted jack. Rubber insulating tongues or washers, as in the early Scribner patent, electrically separate the several springs; all of said parts being laterally bored to receive two insulating pins for securing the jack parts together, prior to individually mounting the jacks in the grooved plate, by means of two side screws inserted rearwardly in the rubber frame, and bearing upon the rear of the said jack parts. The patent further states that each jack "essentially comprises," among other parts, two short thimbles, *d* and *e*, forming "the usual 'local' contact pieces which are connected with the annunciator for the purpose of restoring it and for testing purposes."

Claims 2 and 4, declared upon, relate to the grooved strip or plate of insulating material, with jacks comprising, respectively, the line springs, and the line and inner contact springs, separated by interposed tongues of insulation, inserted on edge in the recesses or grooves; both of said claims omitting, however, all reference to either of the two thimbles; one being necessary in a jack for multiple switchboards for testing purposes.

Claim 8 specifies simply a partial spring jack, comprising the duplicated line and contact springs, together with their interposed rubbed tongues, and the connecting transverse insulating pin extending through each of the parts.

Against this patent, among others, was cited the one to Scribner & Patterson, No. 489,571, showing substantially the frame or strip for mounting springs flatwise therein, while patent No. 458,258, granted August 25, 1901, to the well-known French inventor, L. A. Berthon, sets forth a strip of spring jack switches having characteristics very closely approaching those set forth in the claims declared upon.

At the hearing of this suit at Cleveland in November last, the complainant found it expedient to dismiss as to claims 1 and 2 of the early Scribner patent, and claim 8 of the last patent in suit. Judge Francis J. Wing, having had the case under advisement since then, filed an opinion December 21 dismissing the bill of complaint at the cost of the Western Electric Company, thus scoring a victory for the North Electric Company and for the independent interests upon three separate patents previously considered of prime importance.

New York Traction.

The managers of the Metropolitan, or Interurban Street Railway interests of New York City, have recently intimated their desire to compete for the building of further subway traction systems on the Island of Manhattan. President Belmont, of the Interborough Underground and Manhattan Elevated, intimates that a transfer arrangement covering all this vast travel might be preferable. The Metropolitan will change from horse to electricity some 40 miles of track during 1904.

Methods of Signaling and Operating in Telephone Exchanges.—III.

By KEMPSTER B. MILLER AND CHARLES S. WINSTON.

WHEN a subscriber calls for a private branch exchange, the connection is established in the reverse order from that just described, the main office operator ringing down the drop at the private branch end of the trunk by the same operation that she would use in calling a regular subscriber. The private branch operator then listens in on the circuit, and obtains from the calling subscriber the particular branch exchange connection he desires.

The matter of supervising a private branch exchange connection has been the subject of much discussion and final disagreement.

There can be no disagreement as to the proper supervisory signal of the regular main exchange subscriber, for when connected with a subscriber in a private branch exchange he will always have the supervisory signal of the plug connected with his line under his control during a connection, no matter what system is used. The only point to be decided then in regard to the supervisory arrangements is, how shall the branch exchange subscriber clear out or re-signal the office?

On considering this point we find that three different methods have their advocates, and each has been put into commercial use to a considerable extent.

The first of these methods is to place in the control of the private branch subscriber during a connection, the regular cord circuit supervisory signal at the main office only, so that this lamp will light at the main office when the subscriber hangs up his receiver, in exactly the same manner as if he were on a regular subscriber's line entering the main office direct. Upon both subscribers hanging up their receivers the main office operator would pull down the connection, and in doing so the removal of the plug from the private branch exchange trunk jack would light the disconnect lamp at the private branch exchange, after which the private branch operator would pull down the connection.

From the standpoint of clean operating at the main board, this scheme is perhaps best of all. It is found, however, that this arrangement is not desirable from the standpoint of the private branch subscriber, and also has its disadvantages in regard to the city subscribers who desire connection with the private branch exchange. As illustrative of this point, it may be said that a main office subscriber will often call up a certain member of a business firm through its private branch exchange; on stating his business this person, so called, will at once recognize that the business may be best transacted in another department, whereupon, instead of being able to signal the branch exchange operator direct by moving his hook up and down, he is obliged to tell the person who desires to transact the business to call up another line in the private branch exchange. This necessitates the calling party beginning all over again at the main office, and securing the connection perhaps over another trunk line.

This fault is eliminated in the second of the three methods in which the private branch exchange subscriber has within his control during a connection, a lamp at the private branch board only, the action of his hook causing no effect whatever at the main office. Under this condition a disconnection is effected when both subscribers hang up, by the private branch exchange operator first pulling down the trunk connection in response to the lighting of the lamp under control of the private branch subscriber, thus lighting the supervisory lamp at the main office. The main office subscriber having also hung up, the subscriber's operator at the main office sees both lamps lighted and pulls down the connection. It will be seen that the operation at the main office is thus rendered in nowise special, the subscriber's operator receiving both supervisory signals in exactly the same manner as if two local lines had been connected, the only difference being that instead of both supervisory lamps being operated directly by the movement of the subscriber's hooks, one of them is operated by the action of the private branch exchange operator in pulling down the connection.

With this arrangement a private branch exchange subscriber who has been called and who desires to have the calling party put in connection with another person in the private branch exchange, has only to move his hook up and down to signal his own private branch operator, whereupon she will complete the connection with the calling subscriber and whatever other private branch exchange line is designated. Another advantage of this second method of supervisory signaling is that if the branch exchange subscriber desires to signal for another connection, after the close of a conversation, he can at once secure the attention of the private branch operator and have her attend to it for him, hanging up his own receiver until she secures the party wanted. This system has the disadvantage of requiring a somewhat more complex cord and trunk circuit at the private branch exchange.

In the third method, used to a large extent by both Bell and Independent companies, the private branch subscriber has within his control the supervisory signal at *both* the private branch exchange and the main office, thus when he hangs up his receiver both lamps light, thus sending in a disconnet signal directly to the main office and to the private branch office simultaneously. Under this arrangement some confusion is liable to occur by both operators coming in on a circuit at the same time in response, for instance, to the private branch subscriber's action of moving his hook up and down. In doing so he usually desires the attention of the private branch operator, rather than of the main office operator, and the main office operator may notice this at once and cut her telephone out of the circuit. If the private branch subscriber desires to have the party with whom he is connected, connected with another line in the private branch exchange the main office operator is not likely to pull down the connection in response to the movement of his hook, because the main office subscriber will not have hung up his receiver, as he will be waiting for the new connection.

This method of having the signals at both the main office and the private branch office under the control of the private branch subscriber, has an advantage in point of simplicity and first cost, as the circuits are very simple, and it has a further advantage in that it tends to clear the main office cord circuits quicker after a connection than in the second method described.

All things considered, from an operating standpoint only, it is probable that the second method, where the private branch subscriber controls a supervisory lamp at the branch exchange only, is best. It is not, however, quite so simple as the third method, and therefore the item of first cost and maintenance enters as an offset.

There appears to be no definite standard for the operation of private branch exchange systems established by the various Bell companies, as, apparently, the different operating companies have their own ideas which the manufacturing company follows. There seems, however, to be a tendency among these companies to adopt the method of operation in which the private branch subscriber's supervisory signal goes to the private branch operator alone, the disconnect signal at the main office being given when the private branch operator pulls down the connection. However, the system which now appears to be standard for the Chicago Telephone Company, employs the third method, having the supervisory signals of the private branch subscriber go simultaneously to the main office and to the private branch operator.

In this latter system the arrangement of the signals is somewhat ununusual and is of interest. The private branch exchange trunks terminate as usual in the main switchboard in the same manner as any subscriber's line. At the private branch exchange they terminate in a jack and lamp, the lamp being under the control of a locking relay, which is operated by the calling generator from the main exchange, but which, when operated, locks by means of an additional coil, energized by current from the local common battery at the private branch exchange. In operation, therefore, the main exchange calls the private branch exchange by ringing on the trunk line in just the same manner as if the call was being sent on the regular city line.

Instead of having supervisory lamps associated with each plug of a pair, there are no separate supervisory lamps on the private branch exchange board, but in lieu thereof the calling lamp of each line is made to serve, it being, after a connection is made, put under the control of the subscriber on its line. Thus the lamp serving as a line lamp when a subscriber takes his receiver from its hook, goes out when the operator plugs in. However, the act of plugging in by the operator changes the circuit of the lamp so that it will again light when the subscriber hangs up, to again be put out when the operator pulls down the connection. This double use of the line lamps is perfectly permissible in small boards because the lamp is always adjacent to a plug when the connection is made. Its lighting, therefore, leaves no doubt in the mind of the operator as to which plug and cord requires her attention. This would not, however, be possible in a multiple board.

The method of supplying current for talking and signaling purposes to private branch switchboards has been the subject of much thought, and the usual practice is now, unless the private branch board is very close to the central office, to install a separate storage battery at the private branch exchange, and to charge this over the trunk lines when not in use.

In the system of the Chicago Telephone Company, just described, this battery is normally fed to the cord circuits on the private branch board through retardation coils in the usual manner, so as to serve when two private branch subscribers are talking together. If, however, a private branch subscriber is connected through a trunk to the central office he draws his talking current directly from the main office battery over the trunk lines, a locking key being provided for each circuit by which the operator may cut off the battery from the pair of cords when so used.

In some of the private branch exchange systems installed by the Kellogg Company the private branch operator is provided with the regular pairs of cords and plugs for making all connections, each cord and plug being provided with a supervisory signal the same as in larger common battery exchanges. The trunk line terminates on a private branch board in a jack and an ordinary ring-down drop, this drop being manually restored by the operator in response to a ring from the central office; otherwise the operation of the system is the same as that of the Chicago Telephone Company, except that the act of cutting off the battery from any cord circuit is accomplished automatically rather than manually. This battery is normally connected with each pair of cords and plugs; but as soon as the operator inserts the plug in the trunk jack a relay is operated which cuts off the battery from the cord connected with the trunk jack, thus allowing the signal connected with that cord to be operated by battery from the main office.

In most of the Kellogg systems, notably those of the Home Telephone Company, of Los Angeles, the third method of conveying the clearing-out signals is used, where both the main office and the private branch exchange operator receive the private branch exchange subscriber's clearing out signal simultaneously. In these systems the trunk line ends in a plug and a drop, the operator connecting a trunk to any private branch line by inserting the plug of the trunk into the jack of the private branch line.

The trunk line is in this case provided at the private branch end with a supervisory signal in the form of a lamp, this lamp, together with the supervisory lamp of the cord used at the central office in connecting with the other end of the trunk line being under the control of the private branch subscriber during a connection. We believe that this plan of terminating the private branch end of the trunk lines in plugs is also largely used by the various Bell companies. It, of course, necessitates a change of cords by the private branch operator when a trunk connection is to be made, as she usually answers a local call by inserting one of the plugs of a pair of local cords into the line jack.

As between the ring-down drop, and the lamp as means for receiving trunk calls at the private branch board, it is difficult to see why the latter is desirable. As a rule, the private branch exchange operator has very little to do, and on account of the reasons already mentioned, simplicity in her apparatus is very desirable. For this reason it appears that if an ordinary ring-down drop offers any advantages in simplicity over the locking relay and lamp, or if the same is true of the termination of a trunk in a plug rather than in a jack, it is advantageous to have the private branch operator give a somewhat less artistic signal or make a few extra movements for the sake of this simplicity.

Sometimes in private branch exchange work it becomes desirable to use party lines, and to afford means for the different parties on a line to call each other without calling the branch office, or to call the branch office without calling the other stations on the line. This is often desirable in large institutions extending over considerable territory. It affords the advantages of a private line between various departments in combination with that of city service. In giving such service as this in connection with the modern exchange system, it is customary, while supplying all current for talking purposes from a common battery, to resort to magneto calling between the stations of a line. Thus each station is provided with the usual common battery talking and call-receiving apparatus, and with a magneto generator adapted to be bridged across the line when operated. In order to prevent the line signal at the private branch exchange being operated by the current from the magneto generator, a differential line relay is used, having one winding in each limb of the line. Any current sent over the metallic circuit of a line will therefore not operate this signal, and thus any subscriber on the line is enabled to call any other, the same as on any bridging-bell party line. In order to enable any subscriber to call the central office, a push-button key is provided which grounds the live side of the line, thus causing the operation of the line relay and lighting the line signal.

It is sometimes necessary in very large institutions to provide two private branch exchange switchboards, as where the same firm has different buildings in different parts of the city. Where this is the case it is better to provide trunk lines directly extending between the two private branch exchange offices, in order to prevent the necessity of having calls for connection between subscribers in the two different exchanges being handled through one or more of the city offices. Where the two private branch exchanges are very large it is probably better to use one-way trunks, the same as between two offices in a city exchange. Where, however, the exchanges are comparatively small and the number of trunk lines few, it is the best practice to provide two-way trunks in order that either trunk may be used in either direction. Where such is the case the usual arrangement is to terminate each trunk line at each private branch board in a jack and a lamp. When the operator at one end plugs into the jack of the trunk line two lamps, one at each end, light simultaneously. Both lamps are extinguished when the operator at the other end plugs in in answer to the call. The first operator is therefore made aware of the response or non-response of the operator at the other end of the line. As soon as either operator pulls down the connection at one end both lamps light and both are extinguished when the other operator pulls down the connection. It usually requires quite a complicated circuit to produce this result without using more than two wires in the trunk line; but as trunk lines in large cities are expensive the complication is warranted when the lines are of considerable length.

A type of private branch exchange service new, so far as the writers are concerned, has recently come into use to a limited extent on the Pacific coast, or, more specifically, in both Bell and Independent exchanges at Los Angeles. The system used by the Home Telephone Company at Los Angeles (Independent) is, it is thought, the more complete of the two, and is worthy of description. It combines some of the features of the ordinary private branch exchange with those of the ordinary intercommunicating telephone system, wherein each subscriber is enabled to make his own connection without the intervention of an operator. A line is therefore provided for each private branch subscriber, terminating at each station in a jack. Each subscriber's telephone set consists of the ordinary common battery talking apparatus terminating in a plug, and also in a push-button for calling and a battery bell for receiving calls.

Each subscriber may, therefore, call any other subscriber in the private branch exchange by simply plugging into the jack belonging to the line of that subscriber, and pressing the button. So far the system is the same as the ordinary intercommunicating or house system. In addition to the local subscriber's line, however, each trunk line to the main exchange is extended through all of the stations in the private branch exchange terminating at each station, as before, in a jack. Each of these trunk lines also terminates in two jacks and a magneto bell on an attendant's desk, the attendant being provided with a telephone set similar to that of the subscriber, and also with a separate closed circuit plug for the purpose of holding the line. If any subscriber desires a connection with the city exchange he has only to insert the plug of his telephone set into the jack of one of the trunk lines. If the line is busy he learns the fact by hearing the conversation in progress, and in such case is expected to withdraw his plug. If, however, the line is not busy the operator at the main office responds in the usual manner, as the line lamp belonging to the trunk line is lighted. The subscriber calling then gives his order directly to the main office operator, and the connection is completed in the usual manner. An incoming call from the main exchange rings the bell on the trunk line at the attendant's desk. The attendant plugs into one of the jacks of that line and answers, inquiring what party is wanted. Learning this, she usually plugs into the other jack of the trunk line with the holding plug, which keeps the circuit of the trunk line closed, and therefore prevents the clearing out signal being sent. She then inserts her telephone plug into the jack of the line of the subscriber wanted and calls him. When he responds she tells him that he is wanted on trunk line No. 1 or No. 2, as the case may be, and he inserts his plug into the jack of that trunk line, after which the operator may withdraw the holding plug. When the private branch subscriber hangs up, the disconnect signal is sent directly to the main office in the same manner as if he were on an individual line.

Such a system is employed only where the services of a special operator are not required at all times. The stations are generally all within reach of the sound of the bell on the attendant's desk, and therefore, if the attendant is not present any subscriber may respond when he hears the bell by plugging in directly into one of the trunk line jacks. If there are more than one of these he can usually tell which one by the sound of the bell.

Such a system is not universally adaptable, and is only applicable where a few stations are required and where a comparatively high-grade class of subscribers is to be found. Such a system would be rendered practically unusable if two of the subscribers, finding themselves on the same line at the same time, were not willing to give way to each other promptly. It will be interesting to watch the development of this class of service in the future, as, from its popularity when installed, there appears to be some reason for its existence.

Wireless Telegraph Theory.

In a paper read before the Nantes Congress of the Association Francaise pour l'Avancement des Sciences in 1898, Prof. Blondel presented a simple method of representing the disturbance of the ether produced by a vertical antennæ. This consisted of a polarized hemispherical wave, the electric lines of force being circular meridians and the magnetic lines of force circles of revolution. In a paper read before the congress of the same association held at Nantes in 1902, Prof. Blondel returned to the subject, prefacing the paper with a statement that various English and American authors had given different representations of waves, figuring them as elliptical tores of constant height sliding on the surface of the earth and increasing only in diameter (Fig. 1).

Prof. Blondel considers this view to be erroneous and resulting

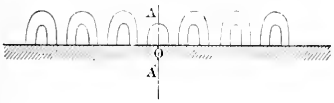
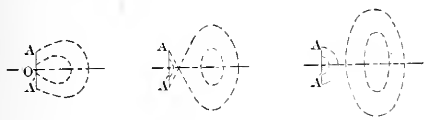


FIG. 1.

from an incomplete interpretation of the theoretical results of Hertz, on which they state they base their conclusions. It is easy to show, on the contrary, that the representation of the field in the vicinity of the antennæ which accords with the work of Hertz, is in perfect harmony with the production of long-distance spherical waves.

Prof. Blondel reasserts that the antennæ-earth system is equivalent to a Hertz oscillator of double length ($A\,A'$, Fig. 1), attained by adding to the antennæ, $O\,A$, a symmetrical portion, $O\,A'$, formed of its electrostatic image with respect to the surface of the earth, which latter plays the rôle of a conducting surface (the hypothesis of a perfect conductivity of the earth is evidently only approximate, but sufficient for the elementary theory). The field in the vicinity of this rectilinear oscillator ($A\,A'$, Fig. 2), is analogous to that



FIGS. 2, 3 AND 4.

which Hertz investigated around a small rectilinear electrical oscillation.

This field is formed by a series of loops which close on themselves and then are detached and proceed perpendicularly to the wire of the oscillator and constantly expanding. The substitution of a finite rectilinear exciter for the small oscillation does not modify the phenomenon qualitatively, still giving us loops describing circles of revolution representing the field of force.

The manner in which the loops become detached can be deduced from the figures of Hertz as Prof. Fleming has pointed out, and may be explained with reference to the diagrams of Figs. 2, 3 and 4. The positive and negative charges, or electrons—to use the latest terminology—proceed in an inverse sense toward the opposite extremities of the exciter, but remain bound by lines of force, as in the case of any mass of electricity decomposed in its electrons. During the first part of this movement the electric lines of force form loops of increasing dimensions, as is shown for a given case in Fig. 1, then the propagation is subject to a reflection at these extremities and the loops close little by little (Fig. 2); next, owing to the inertia of the electrons, these pass beyond the position of equilibrium, O, and the lines cross, as shown in Fig. 3; finally after crossing, they separate into distinct loops, as is shown in Figs. 3 and 4, and the detached loops continue their course as free waves. The presence of the earth permits only the continuation of the upper halves of the loops.

But it should not be understood that the loops proceed by a simple movement of translation while retaining their form (Fig. 1), for the lines of force tend to spread out in all directions; they increase in height in the same time that they propagated along the earth, at which they touch practically normally as on any conducting surface. At the same time they curve toward the vertical axis of the antennæ, as in the case of experiments with Hertzian fields at small distances. The propagation of lines of electrical force should then, I believe, be represented in the form drawn in abridgement in Fig. 5. I say "in abridgement" because the spherical form is not, in

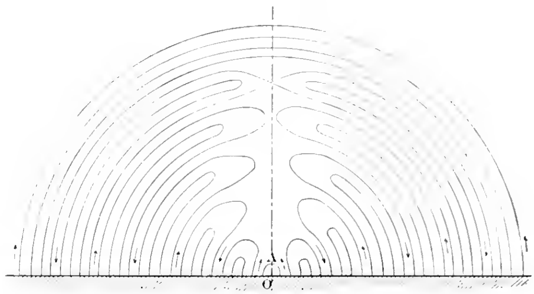


FIG. 5.

fact, attained as rapidly as that figure indicates, which is a simple diagram having no pretensions to mathematical exactitude.

This figure shows that little by little the loops in spreading out end by joining on the axis of figure and finally become perfectly spherical. From that moment the propagation will be purely transversal and with the velocity of light. Before attaining the limiting distance beyond which the waves are spherical, the field follows laws much more complex; the speed is not that of light, the lines of force oscillate as Hertz has shown, and the phenomena are complicated and difficult to analyze; for ordinary purposes, however,

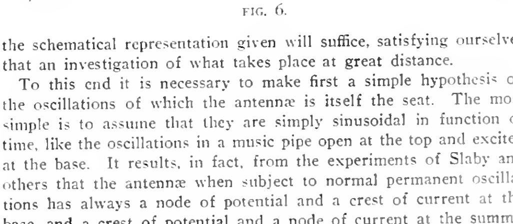


FIG. 6.

the schematical representation given will suffice, satisfying ourselves that an investigation of what takes place at great distance.

To this end it is necessary to make first a simple hypothesis on the oscillations of which the antennæ is itself the seat. The most simple is to assume that they are simply sinusoidal in function of time, like the oscillations in a music pipe open at the top and excited at the base. It results, in fact, from the experiments of Slaby and others that the antennæ when subject to normal permanent oscillations has always a node of potential and a crest of current at the base, and a crest of potential and a node of current at the summit (Fig. 7). If we neglect, lacking other recourse, the perturbations at the extremity where the wave reflections are produced (and experiments seem to give this right, for in charging the form at the extremity and adding there small spheres or plaques or various kinds of points, no change in the length of wave is appreciable), and if we neglect also the variations of the capacity and of the linear inductance along the antennæ, the equation of the current can be written in the following elementary form:

$$I = I_0 \cos \frac{\pi z}{2H} \sin \pi \frac{Vt}{2H}$$

in which I is the current at the point z and at the time, t; I_0, the amplitude of I; z, the height of the point considered, H that of the

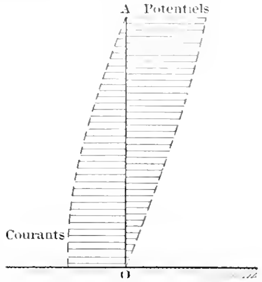


FIG. 7.

antennæ and V the velocity of light. This being assumed, an approximate calculation can easily be made showing the manner in which the energy is distributed on a spherical wave at great distances.

The paper of Prof. Blondel develops in detail mathematical expressions based upon the above assumptions. The result shows that the forces in the field vary as a function of the angle Θ_0, the angle between the direction of an element of current and a vector which is perpendicular to the electrical and magnetic forces, as is shown in the expression.

$$\frac{\cos\left(\frac{\pi}{2} \cos \Theta_0\right)}{\sin \Theta_0} \qquad (1)$$

On the other hand, the energy varies perpendicularly to the radial vector of Poynting, or according to the expression,

$$\frac{\cos^2\left(\frac{\pi}{2} \cos \Theta_0\right)}{I_0^2 \sin^2 \Theta_0} \qquad (2)$$

It is easy to see that the reception depends upon the energy received by the antennæ; this is evident for thermic or other analogous receptors which integrate the energy received in unity of time, but is equally true for receptors of the coherer type, which are sensitive to electric shock received upon the arrival of each train of waves. In fact, one ordinarily defines the condition of coherence by the voltage necessary to produce it; but it is evident that in order to obtain the soldering of metallic particles there is also necessary a certain minimum quantity of electricity; that is, it is the product of the current by the potential that determines coherence. Now, two antenna of equal height can give rise to an equal e.m.f., but that which has the largest surface gives rise to the largest quantity of electricity and produces consequently the better effect at the receiver, as may be readily determined. It is, therefore, the energy received by the antennæ in the form of electric and magnetic lines of force which affects the reception. The sensitiveness may be considered as proportional to the radius vector, the expression for which, $r = r_0 - z \cos \Theta_0$, forms part of the calculation above referred to.

It is thus seen that the effect of waves decreases inversely as the square of the distance and not inversely as to the distance according to the theory of Taylor, which has recently been criticised by Prof. Fessenden. On the other hand, if we consider in function of the angle Φ, the curve corresponding to the factor (2), we obtain relative values represented by the vectors of Fig. 6. The following table indicates these relative values in function of the radius directed according to the horizontal taken as unity:

$\Theta_0 =$	0	.019	.0176	.185	.312	.482	.667	.836	.956	1.0
	0	10	20	30	40	50	60	70	80	90

We see that the energy decreases rapidly as we arise above the horizon; the preceding theory, therefore, accounts for phenomena observed by various experimenters. In France, in particular, Capt. Ferrié has received signals in a balloon at heights of some hundreds of meters above the earth and distinctly observed the rapid decrease of reception with height. In addition, it is quite evident that the curve of distribution preserves the same form at all distances; but the further one is away the less can he be from the earth to receive perceptible signals, since the energy decreases in absolute value.

This theory, which assumes the earth to be a perfect conductor, applies directly to transmission over the surface of the sea; it is, however, only approximate in the case of propagation over earth only slightly conductive, which then is to be considered a semi-dielectric. When the waves propagate themselves to great distances the curvature of the earth intervenes; but it does not interfere with the propagation, as we know from the propagation of waves along conducting bodies; the waves turn in in such a manner as to follow the surface, as has been shown by the experiments of Sarrasin, de la Rive, Blondlot and others.

To resume, the simple application of known properties of Hertzian waves are sufficient to explain in a satisfactory manner all the phenomena observed without it being necessary to attribute to waves new or mysterious properties. In this note I have confined myself to rendering clearer the interpretation of the phenomena, and to explain how, notwithstanding the very complex conditions and the difficulty of analyzing what passes in the vicinity of the antennæ, the propagation at great distances resolves itself simply to that of hemispherical waves, as I showed in 1898.

Hemispherical waves are polarized waves; it is for this reason that they do not propagate energy in an equal manner in all angular directions, and present a maximum effect toward the horizon and no effect toward the zenith.

Transportation in Brooklyn.

The December Grand Jury of Kings County, Brooklyn, N. Y., has filed a presentment on the street railway system, which it considers wholly inadequate. A local body of electrical commissioners with power to secure remedies is demanded. The presentment says:

The third-rail question, one which affects our people to the greatest degree in view of the many accidents which it causes, thanks to the careless methods of the companies as far as relates to the repair of their rolling stock and electric appliances, is, we are assured, receiving the careful attention of the heads of the corporation. It is possible that in time, when a method will be found cheap enough to be attractive which will lessen the perils caused by that means of electric traction, the management will adopt it, if it ever becomes convinced that it will prove cheaper than the eventual payment of damage suits resulting from accidents. But here, again, there is no one empowered to make them adopt the safety device, be it ever so perfect.

It is readily seen that as there are no laws to govern the case, no ordinances to be enforced, no authority whose province it is to enforce them, cars will continue to be overcrowded, the service will continue to be irregular, people will continue to be subjected to freezing temperatures and drafty vehicles; the lack of headlights on trains, the electric current of the third rail, defective insulation due to slovenly repairs in the machine shops, will continue to kill and maim people, and there is no redress but the verdict of "accidental homicide" on the part of the coroner, or at best a verdict for damages on a case where the negligence of the corporation is too flagrant.

In order to afford some remedy, the few laws and ordinances which have been enacted must be complied with, and freed from any ambiguity which makes their execution impossible. Others af a stringent nature, though perfectly fair and reasonable, providing severe penalties for infraction, must be passed by the competent authorities, Legislature, or council, under the clause of the public welfare and safety, and their enforcement should be intrusted to a local body of electric railroad commissioners.

To this end, we, the December Grand Jury of the Borough of Brooklyn, call upon the proper authorities, municipal assemblies or State Legislature, or both combined, to give us without undue delay, a proper code of laws specifically enacted to govern the local transportation companies. These laws, while protecting fully the franchise rights of the transportation companies, and enacted with due fairness to all, must clearly define the rights of the citizens, and regulate the mutual relations of both in the process of transportation.

The Effect of "Wireless" on Improvement in Wire Telegraphy.

By JOSEPH B. BAKER.

IN the summer of 1902 there was a controversy in the columns of THE ELECTRICAL WORLD AND ENGINEER between Messrs. Delany and Barclay, that constituted the latest chapter in the old dispute between the supporters of conservative methods of handling telegraph traffic and the believers in the application of more modern and speedier methods of transmission to the benefit of the public service. In an article in these columns in the issue of July 19, 1902, the present writer drew attention, first to the apathy of the telegraph companies, expressed by their indifference to the progress that had been made in rapid telegraphy systems; and, secondly, to the unquestionable fact of the existence of practical systems for enormously increasing the transmission capacity of existing lines—systems that are far beyond the experimental stage and quite ready to be put into use. In this communication it is sought to show how the present aspect of these two related facts, truer than ever as they are to-day on their own merits, is affected by the work that has been done in the last few years in the art of telegraphing without wires.

Marconi and the earliest workers in space telegraphy were soon obliged to realize that the matter of signalling through space meant dependence upon a new set of *natural* phenomena. They were able to signal only by the application of electric energy in a form natural and proper to the sending circuit including an elevated conductor, whereby a distant similarly arranged receiving elevated conductor and circuit upon which could impinge a minute fraction of the original energy borne by the ether as a non-conducting medium of propagation, was made to reproduce the signals. Only by such application of electrical energy, namely, the generation of Hertzian waves by oscillating currents natural and proper to the circuits of the terminal apparatus, could signalling without a connecting line be effected over more than moderate distances. This is illustrated by the facts that the electrostatic induction method of Edison, being dependent upon what may be called forced ether strains due to current flow between capacity area and ground at unnaturally low periodicity, was not effective beyond very moderate distances; while the free discharge at the spark gap of Marconi's vertical wire, whereby the wire, situated favorably for disturbing the ether surrounding it, had its electric charge set into natural vibration, has been developed in a comparatively few years to the point of transatlantic signalling under favorable conditions.

The early observed fact that a receiving antenna and circuit similar to such apparatus at the sending end constituted a pair of stations capable of working through distances very great compared to the distances that could be covered by dissimilarly arranged stations, was the first step toward modern syntonic space telegraphy. Experimenters in "wireless" had to attack the problem of tuning, not at first, indeed, or even as yet for the sake of rapid telegraphy by the new method, but for the sake of being able to signal at all. In a word, the development of the new art left no escape from the fact, held in abeyance as long as wire telegraphs were the only ones in use, that the signalling energy should be of a form proper to the apparatus and medium of propagation used. The desirable in wire telegraphy, the scientific method of signalling, hitherto neglected and despised by telegraph companies satisfied with crude and primitive methods, became for "wireless," wherein the connecting "line" was absent, an absolute essential of commercial operation. The wire telegraph works, to the satisfaction of vested interests controlling it and of an unenlightened public, by an electrical use of the wire as crude (in comparison with what might be gotten out of the line by adapting the constants of the terminal apparatus and the frequency of the signalling electromotive forces to the constants of the line) as communication by hammering on the end of a steel rail to be heard at the other end compared with conversation by telephone.

"Wireless" work and achievements now place existing systems of rapid telegraphy, the work of some of the best brains in this country, in a new light: and show more clearly than before the advantages—hitherto absolutely ignored and wasted—inherent in the having of a conductor, connecting the sending and receiving stations, able to give direction to the wave-borne signals. Such a connecting wire is easily able, also, to become a main-traveled road for many sets of signals, each set transmissible at a speed so far in excess of that attained by the present handwritten "Morse," as to be in a wholly different class, by the simple plan of using the transmission line as it should be used; that is, the plan of applying the signalling energy in a form natural and proper to the electrical constants of the line and its terminal apparatus. These considerations, in the eyes of workers in wireless telegraphy, suggest improvements of incalculable value in wire telegraphy. The having of a conducting line to carry the signalling impulses with but little loss (comparatively speaking) directly to the receiving station, reduces the realization of these improvements to a simple matter of providing multiple-tuned sending apparatus and corresponding receiving apparatus, in the use of which the capabilities of a single wire become at once so exalted over its present use by "Morse" as to make this single wire more than the equivalent of a heavy pole line with each wire quadruplexed.

All this raises the question: Can the telegraph companies continue to resist progress in rapid telegraphy? With a public gradually becoming enlightened upon the whole broad subject of electrical waves, and welcoming the rapidly spreading use of machine telephone operation with its revolutionizing effect on that important traffic; with the existence of practical rapid telegraph systems already many years old and comprising the work of men of the most unquestioned eminence in applied electricity as well as in the narrower field of telegraphy; and finally, with the existing lines coming to be recognized by an enlightened public as being entirely capable of use in the carrying of an enormously greater business with correspondingly lower rates than at present, will it be much longer possible for conservatism and indifference to public need to maintain outworn and primitive conditions?

Telephone Transmitters.—III.

By ARTHUR V. ABBOTT, C. E.

THE perfection of the solid back marked an important era in the development of the transmitter. It was so successful that since its completion the American Bell Telephone Company have discontinued the use of other forms and have gradually replaced those of earlier construction with the solid back, until now it is rare to find any other in use. Since the original design of Mr. White there has been little change in the solid back, excepting in minor matters of detail, and when the patent situation became such as to invite the more courageous of independent telephonists to undertake the manufacture of transmitters, the first effort was to copy the solid back in an attempt to produce a model which should equal it; so the majority of transmitters upon the market are more or less close imitations thereof. In most respects the attempt has been made to keep each transmitter as near as possible to the original type without patent infringement, but some builders have shown considerable ingenuity in changing the details of construction and some have even gone so far as to entirely depart from the fundamental principles. Transmitters, therefore, can be divided into three classes:

1st. The solid backs, or those which are, to all intents and purposes, copies of the White.

2nd. The elastic cell transmitter, in which there is no secondary flexible diaphragm, but the receptacle containing the carbon is made of elastic material (such as a ring of felt) and the diaphragm is pressed directly against this ring. Such instruments are described more forcibly than elegantly by the term of *"Cornplaster"* transmitters.

3rd. Double diaphragm transmitters.

Considering the first class, the transmitter manufactured by the Kellogg Switchboard & Supply Company is a prominent example. A full-size section through the Kellogg transmitter is shown in Fig. 17. In Fig. 18 the rear cap is removed. In Fig. 19 the instrument is entirely dissected and in Fig. 20 a front view of the diaphragm is shown. The section of Fig. 17 shows the instrument to consist of a solid face plate, *a*, which is almost exactly similar to that of the White instrument. A hard rubber mouthpiece, *a*, is threaded into a hole into this plate. There is a perforated partition just in front of the diaphragm, the object of which is to prevent injury to the transmitter from the too curious, who often like to investigate a telephone by poking it with a lead pencil. Across the base plate and bolted thereto a substantial brass bridge, *h*, is placed. As shown in Figs. 18 and 19, this bridge differs from that used in the White instrument in being perfectly straight. The diaphragm, *b*, Fig. 17, is made of aluminum essentially the same size and thickness as that used in the White transmitter, but possesses a distinct feature in that the receptacle to hold the front electrode and the granular carbon is formed in the diaphragm by pressing a cup-shaped depression in the center.

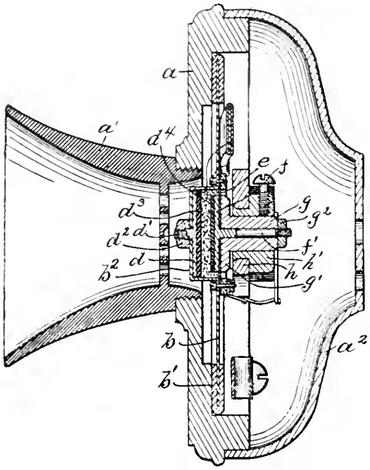


FIG. 17.—SECTION OF KELLOGG TRANSMITTER, FULL SIZE.

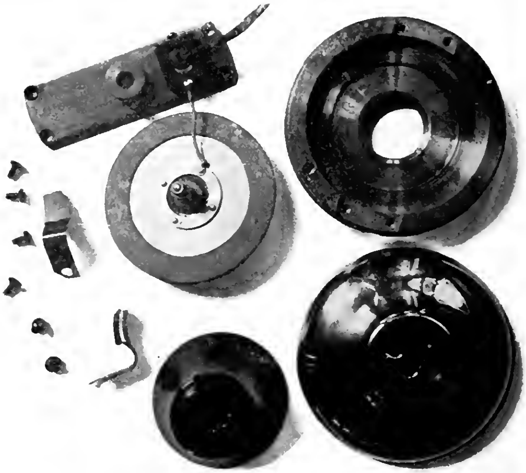


FIG. 19.—KELLOGG TRANSMITTER DISSECTED.

This construction is shown clearly in Figs. 19 and 20. The front electrode, d^3, Fig. 17, is a thin, flat piece of carbon highly polished and brazed to a brass disc, *d*, furnished with a short, small stem, d^1. This is inserted in a hole drilled in the center of the bottom of the cup pressed in the diaphragm and by means of the nut, d^2, the electrode is clamped in its place. The rear electrode, d^4, in Fig. 17, is formed of a similarly shaped disc of carbon about ⅛ in. less in diameter than the front electrode. It is also brazed to a brass disc provided with a shank, f^1, placed in the center of a circular mica disc, *e*. On the outside of the mica disc a brass nut, *g*, is slipped over the shank, f^1, and clamped by means of the nut, g^2. The necessary amount of granular carbon is placed in the cup, the rear electrode inserted; the mica washer then covers the entire opening of the cup. A thin aluminum ring is then placed over the mica washer and riveted. This hermetically seals the electrodes and enclosed carbon. The shank of the brass disc, *g*, is then inserted in the bridge and clamped in its proper place by a set-screw. By this design the rear electrode is clamped firmly against the bridge, but the entire cup containing the front electrode and carbon vibrates with every motion of the diaphragm. So the first essential difference between the White transmitter and that of the Kellogg Company is that in the White instrument the carbon receptacle is fixed and in the Kellogg instrument it is movable. It is claimed that this motion of the carbon receptacle is efficacious in preventing packing, because the carbon is constantly in motion. This has not conclusively been proven, and it is doubtful if the motion of the diaphragm is sufficient to be of material aid in stirring up the carbon granules. There is much evidence to show that prevention of packing is more a matter of mechanical design in obtaining the relative, proper sizes of electrodes, diameter of carbon receptacle, thickness of layer of carbon and proper sizing of the individual granules, than to any method of stirring up the transmitter in order to release the granules from a clamped position. The circuit of the Kellogg transmitter is very

FIG. 18.—KELLOGG TRANSMITTER, CASE OPENED.

FIG. 20.—KELLOGG TRANSMITTER DIAPHRAGM.

FIG. 21.—GROUP OF TRANSMITTERS.

similar to that of the White, inasmuch as the diaphragm is connected to an insulating binding post placed upon the bridge, to which one of the line terminals is attached. This affords electrical connection

FIG. 22.—AMERICAN TRANSMITTER WITH COVER REMOVED.

FIG. 23.—AMERICAN TRANSMITTER DISSECTED.

with the rear electrode. The front electrode is insulated by the mica washer and the rubber ring which encloses the diaphragm. Therefore, by connecting the other line terminal with the transmitter case, circuit is obtained through the carbon granules.

Not only in the general principles of construction, but also in exterior conformation the various transmitter manufacturers, have closely adhered to the design of the first solid back. This is evidenced by Fig. 21, showing a group of six well-known transmitters, of which the following is a list:

A. Swedish-American transmitter.
B. Wilhelm "
C. Intensifying "
D. Manhattan "
E. Century "
F. Ericcson "
G. Williams "

These instruments and a few other models will be described somewhat more in detail.

The American Transmitter.—The transmitter manufactured by the American Electric Company is shown in Fig. 22, with the cover removed, and in Fig. 23 entirely dissected. It consists of a heavy face plate carrying an aluminum diaphragm, cushioned by a rubber strap. Across the face plate a brass bridge is screwed, as shown in Fig. 22, the capsule being included between the diaphragm and the under side of the bridge. The cover of the transmitter is a hemispheric case of spun brass fastened by two specially-formed nuts, which prevent its removal excepting with the aid of a particular tool which will fit the nuts in question.' In Fig. 23 the bridge is removed and turned upside down. The capsule containing the granular carbon consists of a thin spun brass cup, over the face of which a mica diaphragm is placed, and the entire capsule closed by spinning a brass washer over the mica and the edge of the cup.

Lighting at the St. Louis Fair.

The contract for lighting the World's Fair, which has been awarded to the General Electric Company, is the largest exposition illumination contract ever let. It provides for supplying the Exposition with 300,000 incandescent lamps at 13.6 cents each, or a flat outlay of $40,800. This contract for lamps followed the completion of sketch plans for lighting the exhibit places, grounds and architectural features belonging to the Exposition proper, but is exclusive of state, national and private concession buildings. The detail plans are now being drawn.

To give an idea of the distribution of these lamps, it is stated that 12,000 are to be placed on the Palace of Education alone. The classical outline of that building eliminates brilliant color effects, but furnishes a splendid setting for night effects produced by electric lights.

It has been decided to place on each of the monumental standards which dot the main avenue of the Exposition, on the border of the waterways, 24 incandescent lamps. Each of these standards has four cast-iron pendants, on each of which there will be six lights. The "Pike," or Midway, will be furnished with sufficient lights to render it brilliantly illuminated. Each of the standards along the central avenues will hold 24 lamps, so distributed that 12 will hang on each arm of the supporting post.

The lamps contracted for will be used exclusively for exterior lighting. The interior of the exhibit buildings, which will be closed at sunset, will be lighted with arc lamps, the chief object of this lighting being for patrol purposes.

The western half of the north facade of the Educational building has been equipped with lamps. This is merely a test section, installed for the purpose of trying the effect of lights between the columns. Results of the tests have proved satisfactory in every way

Cleaning Third Rail.

Cleaning the third rail appears to have been done successfully by the Grand Rapids, Grand Haven & Muskegon Railway Company, which has an exposed rail and is operated through an open country. A solution of chloride of calcium poured on the third rail has instantaneously removed a covering of ice or sleet, and, moreover, protected the rail so that it has not covered again with ice for at least three hours. These tests have also shown, it is said, that the solution will not injure either the steel rail or the copper bonding. Three cars on that line have been equipped with reservoirs, located in the motorman's vestibule, from which tubes extend to a point directly over the third rail. In this reservoir the solution is placed. A stop-cock regulates the flow of the fluid.

Mr. George Westinghouse.

One of the customs of the Westinghouse Electric & Manufacturing Company is to have an annual reunion at its works of all the district managers, and a social feature of these occasions is a dinner where the visiting delegation meet in familiar converse with the principal members of the technical and other staffs of the works. At such a meeting several weeks ago Mr. F. H. Taylor, second vice-president, took occasion to make some remarks having for a subject Mr. George Westinghouse, in which he presented a character sketch intended to meet the interest of those present who did not know Mr. Westinghouse intimately, or who might know only of his activities in the field of their own work. The remarks naturally were not intended for publication, but realizing the interest they would have to our readers as an intimate portrait presented thus informally by a close business associate, we requested a copy for reproduction in our columns. Having finally overcome the reluctance to publicity for remarks delivered under the circumstances, we are enabled to give below Vice-President Taylor's address, which we believe will be read with much interest.

GEORGE WESTINGHOUSE:

Mechanic;
Inventor;
Tireless organizer;
Financier;
Friend of labor;
Founder of enduring industries.

What all the world knows needs only to be mentioned to you who are his associates in business.

The revolution in railroading wrought by the developed air brake;

The appreciation of an opportunity that recognized the importance of the discovery of natural gas in the Pittsburg district and controlled its development;

The resourcefulness and ingenuity which won the great victory at the World's Fair in Chicago;

The courage that triumphed over the difficulties of a financial crisis;

The power that has grown so fast as to keep ahead of the unparalleled increase in the industries started but a few years ago, and now appalling in their size and extent;

The executive ability that has been the controlling factor in the Westinghouse interests, which have become so numerous that no one here in an hour's time could write out a list of them and have it complete.

These interests have grown so large and the number of responsible officers has become so great that Mr. Westinghouse is not as intimately known to you as I should desire, and as I am sure he himself would desire if it were possible.

Some of the peculiarities which have aided him to acquire his present position may be illustrated. For example, it is unusual for an inventive genius to be so perfectly open-minded to the inventions of others. I sometimes think he is as happy over the discoveries of other minds as though they were his own. (He has found a means for the development of new inventions all his life.) Great intellects have worked for him, been encouraged by him and been protected by him. I name at random: Shallenberger, Tesla, Scott, Parsons, Nernst, Ruud, Cooper Hewitt, Thomas, Davis, Bremer, Lamme, Wurts, Lange. His mind is constantly reaching out into the future, and after one has been much with him it becomes practically impossible to live altogether in the present, because there is brought to view at every turn possibilities of new things yet undeveloped which are to serve future generations at a time when the world has advanced far beyond its present stage. The imagination is constantly stimulated and interest kept alive by the new principle that is struggling on towards definite shape.

There is always present the evidence of good will toward every one; a quick appreciation of the good points of other people. In the course of his life he has been forsaken by friends who lacked courage to follow him, and in its main crisis he was greatly hampered by heart-breaking incidents of this kind. Yet no one has ever heard him say an unkind word of any who differed with him. His foresight is phenomenal. The industries in this country have grown up even faster than seemed wise to a great many who were associated with him. They did not see the value of what he was doing as clearly as he saw it, and time alone has justified the thoroughness with which plans have been laid, buildings designed and executed. Energy and expense have not been spared upon any of the works. They have been developed in such a way that they can be extended forever.

No sooner had provision been made for this country than many of his closest friends were startled by a move upon Europe and the markets of the world. Some men have charged this move to a mere ambition to plant his name in Europe. They wondered that he should tax his resources and take upon himself the tremendous strain which has finally resulted in the great organizations and plants in England, France, Russia and Germany.

The associates who questioned his wisdom did not have his foresight and did not see that these things were necessary for the protection of the initial developments in the United States. I give no importance to my own judgment in this matter, but Mr. Westinghouse knew that the foundations here would have been insecure had not the foreign field been entered during his period of maximum activity. We shall live to see all the effort justified, and the Westinghouse interests the world over fitting together and helping one another.

After all, what is the ultimate aim of it? Men work for wealth, for social position, for the esteem of professional associates, for the applause of the world. These things may be nominated ambition and of that all men must plead guilty.

In the case of Mr. Westinghouse the aim is not immediate wealth. He has done his work too thoroughly to have that as his goal. From my closer observation of him I should determine that he meant to leave a monument upon the earth that shall be strong enough to stand alone without consolidation with other interests, and that shall bear his name for a hundred years. Napoleon's words to his brother when he was made ruler of Spain were: "My one word of advice to you—be master," and I anticipate that the Westinghouse interests will be master of anything they associate with during the next century. By that time the appreciation of what Mr. Westinghouse has done for the world will be clearer and more just than it is to-day.

Great men cannot be compared one with another. They are moulded by circumstances and no two are alike any more than two great trees are alike, yet no man is truly great who lacks certain essential qualities: First, he must at all times be just, and in the case before us this quality has prevailed. A great nature shows itself by being kind and considerate. The underlying sweetness of his spirit is illustrated by the watchword that he uses among all his interests—a constant repetition of a plea for harmonious action. Other virtues are shown by the cleanness of his life. You who have, at times, worked for other kinds of men must know the power that comes to those who work for a clean man, and one who demands soundness of thought and expression. He is never satisfied with surface appearances, but seems to look right through to the heart. His mind is so quick that he sees the essential point in a complicated situation even before the story can be fully told to him. Once determined upon his course, he is not to be laughed out of it, frightened out of it, nor bought off.

The boundless hospitality of his home has been often mentioned, but when one has had the opportunity repeatedly of seeing him there, he is impressed with the uniform cheerfulness of the man and of his sustained interest in every detail of household life. I saw somewhere a letter from a wife written upon the birthday of her middle-aged husband. In the letter this sentence appeared: "To me, you will always be my young lover." This one sentence defines Mr. Westinghouse in his home.

To one associated with him in business, it has often seemed that to be loved of the man is an aim worthy of a life of devotion to his interests.

I have referred to the fact that all men have their ambitions. Every one here is anxious for a broader field, and I am sure will attain to it. Yet every one of us has arrived at an age when we can make a fairly good estimate of our probable attainments. This is our annual dinner and it is a good time to take an account of stock. My judgment is that there is in our organization an opportunity for every man to be satisfied. For myself, first of all, I want a conscience void of offense. Next, I want to leave some record in the world for my family. I should like to be remembered as one who has accomplished something. I, too, want to leave a monument. My ambition is not for popularity nor for fortune. I am satisfied if I leave my children the inheritance that their father had been able to catch something of the spirit of a great leader, and that he had been somehow useful in perfecting that leader's work and in developing his plans. For me it shall be enough that I served under George Westinghouse; that I was counted one of his efficient lieutenants.

CURRENT NEWS AND NOTES.

A NEW ELECTRICAL DICTIONARY.—An electrical dictionary is now being prepared in France, which will be published in three volumes, each of 700 to 800 pages. Prof. J. Blondin, of the Sorbonne and editor of our French contemporary, *Eclairage Electrique,* will be the author.

A CORRECTION.—In the article by Prof. R. A. Fessenden, appearing in our issue of November 14th, the statement on the sixth line below the cut showing a mast, should be "12 or 13 interfering stations," instead of "135 interfering stations."

LONG DISTANCE RECORD FOR ELECTRIC AUTOMOBILE.—The world's record for long distance run by an electric automobile, on one charge, has been established, according to a Washington dispatch, by Mr. F. B. Whitney, clerk of the House Committee on Naval Affairs. On December 23rd, Mr. Whitney made a run of 121 miles in 10 hours and 32 minutes—an average speed of 12 miles an hour.

STORAGE BATTERY SEPARATOR.—The only electrochemical patent granted on December 22nd refers to a separator for storage batteries, invented by Mr. Hugh Rodman. About a year ago Mr. Rodman patented the use of a wooden diaphragm between each pair of plates of a storage battery, the diaphragm having acid wells. The object of this separator was to provide free circulation of the acid from the top to the bottom through vertical grooves or wells cut on the sides of a wooden sheet. While any kind of wood may be used, yet porous or fibrous wood is preferable. In that patent it was stated that diaphragms of wood possess unique and remarkable properties which adapt it for the purpose, and the properties mentioned there were efficiency, durability and capacity. These separators have evidently found extended use in practice, and it has thereby been discovered that where the wood comes in contact with the peroxide of lead of the positive plate, the nascent oxygen causes deleterious rotting of the wood. In his new patent Mr. Rodman therefore provides means for keeping the wood from coming in contact with the lead peroxide. These means may, for instance, consist in a sheet of rubber, or the grid of the positive plate may be provided with projections which touch the wooden diaphragm, while the active material does not come in contact with the wood. The inventor states that the term "wooden" is intended to include such materials as paper and other cellulose fibre products.

ROWLAND'S EXPERIMENT.—Several years ago M. Cremieu, as the result of experiments, questioned the accuracy of Prof. Rowland's epochal experimental proof of Maxwell's great hypothesis on the identity of electromagnetic and luminous undulatory transmission. This proof consisted in demonstrating experimentally that if a static discharge were to move with the velocity of light, it would have the effect of a current. At the suggestion of Prof. Rowland, Mr. Harold Pender made experiments at Johns Hopkins University with the method of Cremieu, but got results which corroborated instead of contradicted Rowland's proof. With the hope of reconciling these contradictory results, M. Henri Poincaré undertook, in the fall of 1902, to bring about a collaboration between M. Cremieu with Pender, and at the suggestion of Lord Kelvin, Paris was chosen as the most favorable place for the proposed joint experiments. The Carnegie Institution furnished the funds necessary to defray the personal expenses of Mr. Pender, the expenses of actual experimenting being met by the Institute de France. The result of the work was communicated in the form of a joint paper to the Société Francaise de Physique, a translation of which appears in the current issue of the *Physical Review.* The work of the two experimenters, as described in this paper, is a beautiful example of scientific investigation, the result of which was to confirm absolutely the accuracy of Prof. Rowland's proof. The joint experiments disclosed a fundamental inaccuracy involved in the experimental apparatus of M. Cremieu due to the kind of dielectric employed, which exercised a screening or neutralizing effect due to the very considerable charges absorbed by the particular dielectric employed in an essential part of the experimental apparatus.

LETTERS TO THE EDITORS.

A Singing Vacuum Tube.

To the Editors of Electrical World and Engineer:

SIRS:—It may perhaps prove of interest to your readers to know of a certain phenomenon which the writer observed recently during some experiments with Röntgen-ray and cathode-ray tubes. Possibly some of your readers may have observed similar phenomena, or can suggest explanations other than those which have occurred to me.

Over a week ago, during some experiments, I had the misfortune to perforate the target or anode of one of my Röntgen-ray tubes, and this, in addition to destroying its focusing power, caused the vacuum to lower as the occluded gases in the platinum were driven out. The tube was one of the Queen self-regulating type with the platinum plate of the anode backed by nickel. I laid the tube aside and ordered a duplicate, intending to send the damaged tube to be repaired. A few evenings thereafter (December 24, 1903), I was on the point of packing this latter tube in a large cardboard box filled with excelsior when it occurred to me to try it once more and see if its vacuum had changed and to what extent. After heating the target or anode red hot I laid the tube down upon the closed cardboard box, taking up the new tube and placing it in the holder. Suddenly I heard a low but very clear musical note corresponding to *A* on the musical scale, and which I found came from the damaged tube. On placing my hand on the tube at various parts I could feel it vibrating violently.

I timed the duration of the sound on three separate tests and the musical note lasted respectively 5, 15 and 7½ minutes; in other tests made since it has lasted from 5 to 17½ minutes. Sometimes the tube did not start when first laid down, but invariably tilting and letting it fall back lightly would start it up. Sometimes after it had stopped I could start it again a second or third time without connecting to the coil. The pitch of the sound was always the same save on two occasions, when several persons were talking near the tube; the pitch then varied, but when the room became quiet it resumed its usual pitch. The amplitude of the sound varied, but could usually be heard plainly in an adjoining hall or room from 20 to 30 ft. distant. It should be noted that at the time the tube was singing, the induction coil, which was supplied from the street direct-current lighting circuit of 117 volts, was not running, nor was there anything else near to affect the tube either by an electrical or mechanical vibration; besides, the box and excelsior packing were a perfect cushion. I found that the tube laid on a table or a box sang just as well, and when I placed a long steel needle between my teeth, allowing the point to touch the bulb, the sound immediately ceased, but started up again each time the needle was removed.

By reason of the fact that it was necessary first to warm up the platinum plate by the cathode stream, and as the anode tube was not only perforated but part of its edge expanded away from the nickel backing, one would naturally be led to think the phenomenon was akin to the well-known "Trevelyan Rocker" effect described in most books on Physics, in which the vibrations produced by a heated brass rocker resting on lead give out a clear musical note, although it is impossible to detect the rocker vibrating. Whether the phenomenon is due to the Trevelyan effect or whether instead of a thermal action the musical note was caused by the air between the platinum and nickel plates which was forced through the perforated anode or not I am at present unable to state; but having observed in the *Sun* of December 20 a cablegram from London referring to some experiments in that city, the dispatch stating that a vacuum tube which had been lighted up continued to remain illuminated for ten days after it had been disconnected from the electrical circuit, I have wondered whether it were possible that the conditions of vacuum and perhaps other characteristics of the London vacuum tube and the Röntgen-ray tube were such that after the energy supplied electrically had set the tubes going, they may have been so extremely sensitive that they responded to some etheric vibration which kept them active until they got out of step. In the case of the Röntgen-ray tube, this would soon occur, as the conditions were changed by the cooling of the electrode. Such a stimulation by vibrations in the ether has been suggested by Mme. Curie, Edison, Lord Kelvin and others as one of the theories to account for the phenomena of radioactive substances such as radium, which acted as a transformer. Is it not possible that the light in the vacuum tube and the sound in the Röntgen-ray tube might have been similarly kept going? The writer was particularly interested in the statement cabled from London, as he has frequently called the attention of friends to the curious effects produced upon a vacuum tube presented by Mr. D. McFarland Moore in 1896, and which has ever since been hanging in my laboratory, which tube would flash up at times long after the coil had been stopped and the tube disconnected. It was this sensitiveness to Hertzian waves which led the writer to suggest years ago the use of the vacuum tube as a receiver in connection with wireless telegraphy.

New York. William J. Hammer.

Theories in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs:—I have just read with much interest the letter printed in your issue of October 31st from Professor Fessenden, and I was pleased to note the allusion which he was kind enough to make to my publication of 1898, which preceded that of Mr. Taylor. I agree in part with the views of Professor Fessenden, but am not in a position to judge completely since I have not at hand the paper printed in the *Transactions* of the American Institute of Electrical Engineers in 1899, to which he refers. I would only observe that in my opinion there is no need to invent any new kind of wave, as Professor Fessenden appears to do, in order to explain phenomena which the simple theories of Hertz interpret sufficiently well. To render clear my views on this subject, I enclose herewith a short note which I presented last August at Angers before the Association Française pour l'Avancement des Sciences, for the purpose of rectifying the erroneous ideas put forth by Mr. Taylor and others, and to complete the earlier communication, which was not sufficiently full.

As will be seen from this note, it is sufficient to consider the earth as a conducting surface (which is quite true in the case of the sea, and an approximate hypothesis in the case of the earth) along which the lines of force glide, in order to explain very simply the propagation of waves and the hemispherical form they assume. Still more, the very simple formulas that can be established by means of this hypothesis show that the energy received by an antennae is a maximum at the surface of the earth and decreases rapidly at distances therefrom; and that it diminishes inversely as the square of the distance, as in all cases of spherical propagation.

The electromagnetic theory such as I have developed it should not be made to bear the burden of errors resulting from a misapprehension thereof. If Mr. Taylor, who starts with entirely correct ideas, ends by finding a decrease of energy in inverse ratio with the distance, this is merely because he attributes to half waves a constant height and does not permit them to acquire their natural development in space. Experiments made in balloons by several Frenchmen, notably by my friend Capt. Ferrié, of the Engineers, have shown that propagated waves can be detected at very considerable heights. If Professor Fessenden has found this height very limited it is, I believe, simply because the energy decreases rapidly as the distance from the earth increases, as indicated by an energy curv which figures in my note; but one should not confound the lack of sensitiveness of apparatus with the lack of existence of waves.

The researches of Professor Fessenden do not appear to be any more conclusive (at least until I have read his complete publication) as concerns the necessity of adding a metallic conductor of half a wave length beneath the antennae; experiments which we have made in this connection in France have shown that it suffices to have very large metallic surfaces in communication with the earth; indeed, the earth connection may be entirely replaced by a very large metallic capacity. In the experiments, for example, of Capt. Ferrié, he found that a large metallic capacity may be placed at the summit of a tower, using suspended antennae without earth connection, and signals received over a certain distance. The earth serves with respect to the antennae only as a large capacity to store the oscillatory charge constantly passing between the capacity and the antennae in a manner to give rise to sufficient current to affect the indicating circuit.

Nor does it seem to me that sufficient account is taken of the very great sensitiveness which can be obtained with a coherer of gold or pure silver filings, when employed in the manner which I indicated in 1898 (*Comptes Rendus*, April 23, 1900) in combination with a potentiometer. This disposition enables the voltage necessary to produce coherence to be reduced to a very small amount, and permits the voltage of the potentiometer to be put in series with that of the antennae; under these conditions the slightest e. m. f. produced in the antennae suffices for coherence, and one has thus a filings coherer of very considerable sensitiveness, and much greater than ever obtained by Marconi. In France we have experimented with several of the later receiving systems, such as those of Solari and Marconi (hysteresis receivers) without obtaining as great sensitiveness. This does not prevent me from recognizing the interest presented by the employment of the telephone; indeed, I think I was the first to indicate this interest in 1898, when I made it a subject of communication to the Académié des Sciences, May 21, 1900. The arrangement of Prof. Fessenden, which we have not yet been able to test, will indeed be welcome if it involves a sensitiveness as great as he gives us to hope.

Having re-read the article by Mr. A. Frederick Collins on the very interesting discoveries of Professor Fessenden, I beg here to point out that his system of syntonization by groups of waves, described in the patent to which Mr. Collins refers, is anticipated by an application which I have filed for a United States patent along the lines of my English patent of May 3, 1900; and his arrangement for the continuous production of waves recently described appears analogous to one for which I was granted a British patent, July 11, 1902.

These claims, which I make here incidentally, are not intended to detract from the scientific merit of the researches of Professor Fessenden, to which I render homage; and I shall be particularly happy to see published with more detail the curious experiments on the propagation of wave to which Mr. Collins refers briefly. The scientific world will certainly be much interested, and the result will probably be a great progress in our ideas concerning the propagation of waves, regardless as to what will be the final conclusion.

Paris, France. André Blondel.

[A translation of the non-mathematical portion of the Angers paper to which Prof. Blondel refers is printed on page 41. The letter of Prof. Blondel was also accompanied by two reprints from the *Comptes Rendus*, one entitled "On Syntony in Wireless Telegraph" and the other, of which M. G. Dobkevith is joint author, entitled "On the Maximum Sensibility of Coherers Practically Used in Wireless Telegraphy." The first-mentioned refers to a communication deposited in the archives of the Academie des Sciences, August 16, 1898, in which a method of syntonization is proposed consisting in tuning the transmitting and receiving stations, not to the frequency of the oscillations proper of the antennæ, but two artificial frequencies much lower and entirely arbitrary and independent of the antennæ—namely, the frequency of the charges of the antennæ and that of a selective telephone, such as the monotelephone of M. Mercadier. A vacuum tube replaces the usual relay, and in shunt relation thereto is the telephone. In series with the latter is a battery of a strength not sufficient to break down the resistance of the vacuum tube, yet sufficient to produce a current at each passage of an oscillatory current in the tube. The telephone is thus affected at each emission of a signal from the receiving station, and the sound is determined by the number of charges per second given to the sending antenna. At short distances the vacuum tube can be dispensed with and the telephone placed in series with the receiving antenna. An advantage of this method is that the note of the sound in the telephone can be varied by varying the frequency of emission at the sending station, and by employing a telephone tuned to a given sound, selective telegraphy is possible. It suffices to maintain the frequency of the spark coil interrupter constant and equal to that of the receiver. The vacuum tube employed in the experiments was an ordinary Geissler tube having large electrodes almost in contact, but spontaneous decohering devices, such as the carbon coherers of Hughes, Tommasina and others may be used.

The theoretical interest of this method resides in its analogy with the synchronization of a pendulum by periodic shocks, which has been so ably investigated by M. Cornu. Each group of waves of high frequency, rapidly damped, acts *en bloc* as a simple percussion on a telephone diaphragm of slow vibration, which latter is sinusoidal owing to the effect of inertia. Consequently there should be no difficulty in applying at the receiving post the ingenious multiple telegraph arrangement of M. Mercadier. Finally, the principle of mechanical elasticity at the receiving station can be replaced by that of electrical elasticity, as follows: The detector may be mounted in series with the antenna or in shunt with a circuit containing a telephone, an inductance if necessary, and a battery shunted by a condenser. The capacity of the latter is fixed by the frequency of the charges of the sending antenna, so that the circuit is always in resonance, or rather, in pseudo-resonance, with the sending station; the signals will then be selected by any telephone, or to reinforce the effect, by a telephone tuned to the same frequency. The receiving circuits of different frequency can be connected to the terminals of the same tube, but it is preferable to have separate tubes and antennæ.

In this manner a station may communicate simultaneously with any number of other stations, and the different signals only be received by the respective stations tuned thereto.

The second paper relates to a method of increasing the sensitiveness of filings coherers by lowering the critical voltage of decoherence. Critical voltage is defined as the voltage which, applied continuously, prevents the tube from decohering quickly upon shock, its value for each coherer depending on the nature of the metal of the electrodes and of the filings and the degree of oxidation. The conditions to be fulfilled for maximum sensitiveness are that the battery e.m.f. be kept below the critical point; that the e.m.f. produced by the waves be greater than the critical e.m.f.; that to obviate deterioration the current established at the instant of coherence should be below a certain maximum—one milliampere in general; and that to decohere sharply, the current passing through the tube after a shock should be but a small fraction of the preceding current that is, a small e.m.f. applied should produce a large relative variation of resistance. Thus the sensitiveness with a given antenna is increased by lowering as far as possible the critical value by the employment of filings only slightly oxidizable, and placing in circuit a battery of low e.m.f. and a relay of low internal resistance. We can then eliminate the supplementary resistance added in series with the relay to reduce the current, and thus raise to a maximum the relative variation of resistance produced in the cohering and decohering of the tube. The arrangement is still more perfect if instead of a battery a potentiometer across an accumulator cell is employed. The adjustment of the coherer may be made by changing the length of the column of filings by adding filings from a chamber connected to the tube, or vice versa, the effect being to vary the pressure between the various particles of filings.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-Phase Motor.—Corsepius.—An illustrated description of a single-phase motor without commutator, which starts under load. The author refers to the well-known property of the single-phase induction motor that it will not start by itself, but when once started continues to revolve and will give out power, and it makes no difference whether it is started in one or the other direction. The reason of this phenomenon is that the rotation of the motor causes a distinct change in the magnetic conditions; the apparent reluctance of any two portions of the stator winding is not the same, the difference being greatest when the two portions are displaced by one-half pole distance. The author, therefore, divides the stator winding into two equal portions, which are displaced from each other by 90°, in the same way as is usually done in single-phase motors. His motor, however, has two rotors, a main rotor, *a*, and an auxiliary rotor, *b*, shown in Fig. 1, in which *c* is the stator. The main rotor,

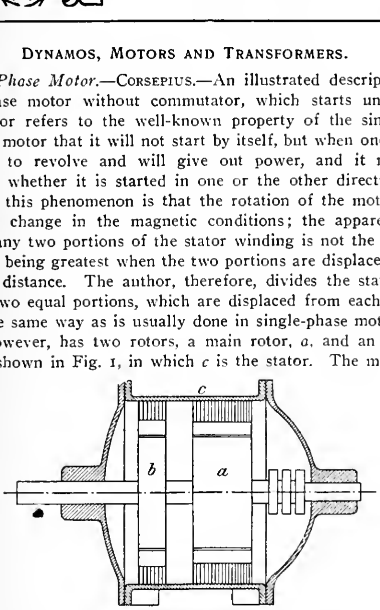


Fig. 1.—Single-Phase Motor.

a, is rigidly mounted on the shaft and its winding is connected with step rings, while the auxiliary rotor, *b*, is loosely placed on the shaft and is provided with a short-circuited winding. When the motor is started, *b* rotates without load and *a* starts then with torque. The auxiliary rotor, *b*, is provided to produce the change in the magnetic conditions, above referred to. To start the rotor, *b*, it is, of course, necessary to apply one of the usual starting devices; for instance, a small resistance. The author gives some data on a small experimental motor of this type, in which the stator part that surrounds the main rotor and the stator part that surrounds the auxiliary rotor are provided with their own individual windings; *e* and *f* in Fig. 2 are the windings surrounding the auxiliary rotor, *g* and *h* those surrounding the main rotor; *e* and *f* are first connected in series to the supply circuit, a small resistance being connected in parallel with *b*. The auxiliary rotor then starts. The small starting resistance is then removed, and the windings, *g* and *h*, are also connected to the supply circuit, whereby the points, *m* and *n* are connected with each other. It will be seen that this gives a network arrangement like the Wheatstone bridge; *g* and *h* are constant; *e* and *f* vary; hence an alternating current passes between *m* and *n*. The currents, *g* and *h*, are different at any moment, while their effective values can be equal. The currents, *g* and *h*, have, therefore, not the same phase. In the tests of the experimental motor the following results were obtained: The motor, when in operation, while giving 2.4, 4.62, 6.83, 7.95, 9.05 hp, took 48.5, 57.0, 68.4, 72.6, 78.4 amp., respectively. When starting under the same loads it took 48.0, 65.6, 86.2, 97.0, 97.0 amp.—*Elek. Zeit.*, December 10.

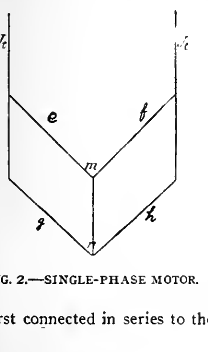


Fig. 2.—Single-Phase Motor.

Starting Torque of Three-Phase Motors with Variable Number of Poles.—Behn-Eschenburg.—A communication on results of tests of two types of three-phase motors, built by the Oerlikon Company, with short-circuited armatures, for four speeds, obtained by a variation of the number of poles. The results for one machine are as follows: This is a 240-volt motor for a normal rating of 7 hp at 250 and 500 revolutions, and about 10 hp at 750 and 1,500 revolutions. The frequency is 50 and the weight 500 kg. The number of poles is 24 or 12 or 8 or 4; the starting current, 58, 60, 150, 116 amp., and the starting torque 25, 10, 18, 7.5 kg, respectively. For normal operation at 50 periods, the torque is 20, 10, 10, 5 kg, the speed 220, 470, 740, 1,470 revolutions, and the current 25, 19, 28, 25 amp.—*Elek. Zeit.*, December 3.

Design of Direct-Current Machines.—Fynn.—A continuation of his illustrated serial in which he says that the choice of winding rests between the form-wound coil and the hand-wound barrel winding, avoiding all soldered joints for any number of wires per slot per layer. Form-wound coils are only of distinct advantage in cases where the conditions of work are extremely severe and may cause a break-down within a few months from the start, however good the insulation and workmanship may be. He claims that a hand-wound armature is much less liable to a break-down than a formed coil. In the same issue he gives in a communication his reasons for advocating the rotation of the commutator opposite to the inclination of the brush.—Lond. *Elec. Rev.*, December 11.

Testing of Generators by Air Calorimetry.—An account of the discussion of Threfall's British institution paper which was recently abstracted in the Digest. Esson thinks that the method involves so many difficulties that it was rather a test of the ability of the experimenter than of the machine. Glazebrook gave some information on the use of the Pitot tube method for determining air pressures. Mordey was much interested in the method of measuring the air currents, since the measurement of the quantity of gas passing through very large pipes for the supply of very large gas engines may soon become very important, and Threfall's results with a Pitot tube show that greater confidence can be placed in this method than appears at first sight. Threfall in his reply claimed that the method was not at all difficult, since anybody who can read a thermometer can apply it. A careless man will get a wrong result whatever method he uses. His method is, however, not a quick test, since one must wait until the temperature equilibrium is fixed, and in the case of his 3,000-kw alternator it took about six hours in order to obtain consistent results. There was some discussion concerning the increase from no load to full load of the iron losses or unascertainable losses. Esson contributed it to losses in the completely laminated poles of the generator. Mordey in other tests had found an enormous increase in these losses in machines with toothed armatures and in machines without laminated fields; that increase of losses was thus probably entirely due to the unequal distribution of the magnetism, to the toughening of the lines and the increase of eddies in the field and to the hysteresis of the armature itself.—Lond. *Elec.*, December 4.

REFERENCE.

German Dynamos.—Guilbert.—The first part of what appears to become a very long and fully-illustrated serial on the construction of dynamos in Germany. The author gives details of the most typical machines exhibited at the Duesseldorf Exposition and discusses alternators. In the present installment a 2,000-kilovolt-amp. alternator of Lahmeyer and a 350-kilovolt-amp. alternator of Schorch are described.—*La Revue Tech.*, November 25.

Lights and Lighting.

Ionic Theory of the Electric Arc.—Stark.—An elaborate investigation applying the ionic theory to the phenomena in the electric arc. To simplify matters, the author starts from the mercury arc, which is longer than the carbon arc, and distinguishes four distinct parts, viz.: the brilliant brush issuing from the white hot depression in the cathode, the dark space, the positive light column and the anode layer. The glow discharge does not necessarily involve the evaporation of the cathode, but the arc light does. It is not essential that the anode should emit vapor. In all gaseous discharges one has to distinguish between electrons, positive atomic ions and molar ions. In the Bunsen flame negative electrons play a very prominent part. In the electric arc, with its higher temperature, they are even more predominant. This is shown by the susceptibility of the arc to magnetic deflection and the readiness with which it follows every variation in the current, owing to the great nobility of the electrons. The impact of the electrons produces positive and negative ions from neutral molecules at the anode and in the positive light. The converse only takes place in the glow discharge, whereas in the arc the negative electrons are produced from the cathode by electrification, and not from the gas by ionization. The ejection of electrons from the interior of the cathode is partly favored by the presence of ultraviolet light, but most of all by the high temperature of the cathode. This high temperature produces in the interior of the metal an electric force driving the electrons toward the anodes. Concerning the old question as to the counter e.m.f. of the arc, the author says that there is a counter e.m.f. in the arc when the anode is very hot and it represents the sum of the internal e.m.f. of the anode and cathode, but is much smaller than the minimum tension. The latter is not due to the counter e.m.f., but to the fact that a minimum of work must be done at the cathode in order to produce the radiation of negative electrons in sufficient density.—From *Ann. der Physik* No. 12; Lond. *Elec.*, December 4.

Photometric Tests of Street Lamps.—An abstract of a report by Bradley on tests of street illumination. The most interesting item seemed to be the comparative costs of candle-power per year, working out at 18.8 cents for the arc lamp and 18.24 cents for the Sugg high-pressure incandescent mantle lamp. It is pointed out, however, that the information is very scanty. While it is said that the tests on the gas lamp were taken at three different angles, these angles themselves are not given. Again, there is nothing to denote how long the mantles have been in use, and considering the variation in the illumination of the incandescent mantle, especially when used as street lamps, it is of importance whether the candle-powers are averages of periodic tests or to know to what conditions they refer. —Lond. *Elec.*, December 4.

Power.

Hydroelectric Plants in Austria.—Some notes on recent developments. The municipal electric station of Innsbruck has recently been opened which gets its power from a hydraulic plant at the River Sill, 11 km. from the city. When completed, there will be six turbines, each of 2,500 hp, and coupled to a 10,000-volt alternator. In the main sub-station near Innsbruck the voltage is reduced to 2,000. The current will be used for lighting, power and traction. In Kruman, in Bohemia, the water power of the Moldan River has been utilized, 6,000 to 7,000 hp being available at the turbines. There are three 2,500-hp turbines, each coupled to a three-phase generator running at 420 r.p.m., and giving 2,500 kilovolt-amp. at a power factor of 0.7, the voltage being 15,000. The current is transmitted to two paper mills in which motors aggregating 2,000 hp are used. The voltage is reduced to 300 volts in the mills by three three-phase transformers aggregating 1,800 kilovolt-amp. The balance of the power is used for lighting and power purposes in towns in the neighborhood.—*Elek. Zeit.*, December 3.

Yorkshire Power Plant.—An illustrated description of the first of the four generating stations of the Yorkshire Electric Power Company. This plant is in course of erection and has a capacity of 6,000 kw. A three-phase system at a frequency of 50 cycles has been selected, the generating voltage being 10,000. There are four generating units, each consisting of the Curtis steam turbine and a 1,500-kw alternator. Each set is arranged with a vertical shaft with the generator above the steam turbine. The generator has six poles and is designed for normal full-load output of 1,500 kw with 100 per cent. power factor at a speed of 1,000 r.p.m. The full-load current is 86.5 amp. and the voltage between terminals 10,000. Three turbine sets, each of 150-kw capacity when running at 2,000 r.p.m., are provided for supplying power for excitation and auxiliary purposes. These turbines are of the Curtis type, arranged with a horizontal shaft. The voltage supply for excitation and power is 220 volts.—Lond. *Elec.*, December 4.

REFERENCES.

Water Powers in British Columbia.—Jacobs.—An illustrated description of some important hydroelectric plants in British Columbia. It is also pointed out that many important water powers are still unused, the development of which would promise good returns, for instance, in the Rivers Fraser, Columbia, Kootenay and Elk.—*Eng. Mag.*, December.

Niagara Falls.—Buck.—A fully-illustrated description and statistical article on recent developments in Niagara power.—*Cassier's Mag.*, December.

Electric Power for Charging Metallurgical Furnaces.—Kueppers. —A detailed illustrated description of a crane, installed in a metallurgical plant in Russia, for discharging the various furnaces. For moving the crane as a whole and for its traversing movements electric power is used, while for lifting the blocks to be charged into the furnace hydraulic power is applied.—*Elek. Zeit.*, December 3.

Mechanical Stokers.—Gay.—An illustrated paper read before the (British) Society of Engineers in which the author gives a summary of the present situation of mechanical stokers for electric stations.—Lond. *Elec.*, December 11.

Traction.

Conversion of Cable to Electric Traction.—An illustrated description of the methods of conversion from cable to electric traction in St. Louis. The line upon which this change was made does a large business and it was considered necessary to make the change without interfering with the traffic. First a 9-in. girder rail for the electric road was set about 6 in. outside of the cable rail. The paving and the old cable slot rails were then removed. The tops of the cable yokes were broken off and a 6-in. rail for the electric track was mounted on the inside of the cable yoke. The old conduit was then filled in with broken stone. Temporary connections between the old and the new construction were made.—*St. R'y Jour.*, December 5.

REFERENCES.

Paris.—Letheule.—A very fully-illustrated description of the Metropolitan Railway of Paris.—*Eng. Mag.*, December.

Trolley Harp and Wheel.—A description of a new device, one feature of which is a guard placed before the wheel to permit the latter to slip under obstructions.—*St. R'y Jour.*, November 28.

Installations, Systems and Appliances.

Durban.—An illustrated description of the electric light and tramway system of Durban, which is a seaport of Natal in South Africa.

The traction plant consists of four 250-kw, 500 to 550-volt generators, while the lighting plant consists of three 350-kw and one 500-kw generators.—Lond. *Elec. Rev.*, December 11.

Exeter.—An illustrated description of the new electricity works at Exeter in which the two-phase system is used with three 400-kw and one 100-kw generators, the voltage being 2,200 per phase. There are two sub-stations.—Lond. *Elec.*, December 11.

REFERENCE.

Isolated Plants.—MOSES.—An article in which the author suggests organization and records for a moderate-sized isolated electric plant. —*Eng. Mag.*, December.

ELECTRO-PHYSICS AND MAGNETISM.

Permeability of Iron Powder and Iron Wire.—ZENNECK.—An experimental comparison of the change of the magnetic permeability of iron wire and iron powder in alternating fields. In an iron wire the permeability depends largely upon the frequency, and at a frequency of 1,000,000 per second it is about 1/10 to 1/30 of its normal value in a steady field. This is often explained by the supposition that at such high frequency the magnetization can no longer follow the field. This supposition seems, however, questionable, since a similar inability is not shown by iron powder (or at least to a much smaller degree), its permeability being nearly the same at a million periods per second, as it is in a steady field.—From *Ann. der Physik*, No. 12; Lond. *Elec.*, December 4.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Oxygen and Hydrogen.—An illustrated description of the Schuckert system for the electrolysis of water. A cast-iron trough contains the electrolyte, which is a 20-per-cent. solution of potassium hydrate, and the iron electrodes, which are separated by strips of a good insulating material, extending from the top downward about three-fourths the depth of the cell. Between these separating plates and enclosing the electrodes are suspended iron bells which collect and carry off the developed gases.—*Electrochem. Ind.*, December.

REFERENCE.

Rôle of Formation Heats of Alloys in Electrolysis.—RICHARDS.—A theoretical note in which the author shows how to apply the numerical values of the formation heats of alloys in calculations of the e.m.f. corresponding to the dissolution of the alloy.—*Electrochem. Ind.*, December.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Recording and Analyzing Wave Forms of Alternating Currents.—HOSPITALIER.—A very long illustrated paper read before the (British) Institution of Electrical Engineers. After some brief introductory remarks on the methods of direct observation by the oscillograph of Blondel and Duddell and the rheograph of Abraham, he discusses at length the indirect stroboscopic methods to which he believes belongs the industrial future, since they have a wider field of application and permit of the direct recording of the phenomenon to be studied upon a strip of paper in the way that is not possible with the direct methods in which recourse is always had to photography. He describes briefly the following forms of stroboscopes, the arcoscope, the stroboscopic transmission dynamometer, the stroboscopic eye-glass and the differential stroboscope. He then describes in detail his ondograph, the object of which is to register directly upon a band of paper, by means of ink, the representative curves of periodically and rapidly varying electrical phenomena, such as e.m.f., current, power, etc. A synchronous single-phase alternating-current motor is actuated directly by the source of electrical energy of which the e.m.f. or current or power is to be recorded. A train of gearing is provided which imparts to a revolving commutator such an angular velocity that when the motor has made a certain number of revolutions, the commutator will have made an equal number, increased or diminished by one. In his commercial instruments a four-pole motor is used and when the motor has made $\frac{n}{2}$ revolutions, corresponding to n periods, the commutator has completed $\frac{n-1}{2}$ revolutions, with a regular and uniform retardation. The commutator consists of a cylindrical block of insulating material, carrying a tube of brass suitably cut to shape, with 3 brushes raised upon it (Fig. 3). The object is to put a condenser, *C*, successively in connection with, first, two points, *u* in the circuit in which the e.m.f. or current is to be recorded; secondly, the measuring apparatus, *E*. During the first operation the condenser, *C*, becomes charged, and is discharged through the measuring instrument, *E*, in the second. For recording the power curve the contact maker is reduced to a simple conducting bar, which, once in each revolution and by means of two brushes, closes the circuit through the fine-wire bobbin of the recording instrument. The condenser, *C*, may be regulated by means of plugs in order to regulate the sensitiveness of the apparatus. For differences of potential and current, the recording measuring instrument, *E*, is a moving coil instrument; for power curves it is an ordinary wattmeter. The main current passes continuously through the fixed primary bobbin, while the movable fine-wire bobbin is placed in the circuit which is periodically connected by the rotating commutator to the difference of potential which determines the second factor of the power. Regulation is effected by introducing resistance into the fine-wire circuit. In the commercial instrument the recording cylinder makes one complete revolution for every three periods recorded. Each of these three curves registered corresponds to 1,000 actual periods and 999 impulses. One complete period takes up a length of 4 in. on the cylinder. The ondograph allows the frequency of an alternating current to be determined with accuracy, since it is only necessary to determine by means of a chronometer the time occupied by the recording cylinder in making one complete revolution. As this time corresponds to 3,000 periods, this number divided by the duration of one complete revolution in seconds gives the frequency in periods per second. The recording apparatus comprises two distinct parts—the directing arm and the recording pen. The former is a rigid lever attached to the measuring apparatus, with the extremity the more remote from the axis of rotation terminating in a pin which works in a groove provided upon the lever carrying the pin. This pin, during the recording process, describes the path that would be taken by the pen of the ordinary recording instrument during the rotation of the cylinder carrying the paper. The recording pen consists of a lever of great length, so arranged that one of its extremities turns upon an axis parallel to that of the recording instrument, but removed from it by a distance approximately equal to the difference in the lengths of the two levers. The other extremity is provided with a groove engaging with the pin of the directing arm, and carries the recording pen at a point a little beyond the groove. In the commercial ondograph the directing arm is 7 in. long, while the lever carrying the pen is double this length. It will thus be understood that while the pin describes an arc of a circle with a short radius, the pen describes one of a long radius. By giving sufficient length to the lever the arc may, within the limits of the width of the cylinder, coincide sensibly with the tangent at the middle point of the arc. Thus, the point of contact of the pen with the paper is but very slightly removed from a generatrix of the cylinder, and the registration is effected with perfect regularity throughout the whole extent of the cylinder. The ondograph may also be used to study a rectified or continuous current. For this purpose the synchronous motor is replaced by a direct drive, effected by establishing an unyielding mechanical coupling between the ondograph and the shaft of the machine to be studied. In a new type of apparatus which he calls the differential ondograph permitting the retardation at will of the period recorded, it is easy to register phenomena occupying from 1/2000 to 1/3000 of a second, but this instrument is intended more for laboratory and research work than for industrial use. A great number of applications of the instrument is described and curves are reproduced showing distorted wave forms of currents from commercial alternators. In order to analyze an alternating-current wave form it is first necessary to determine the

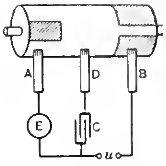


FIG. 3.—COMMUTATOR.

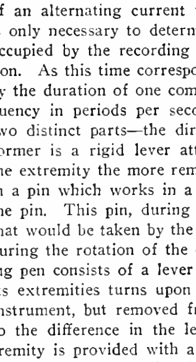


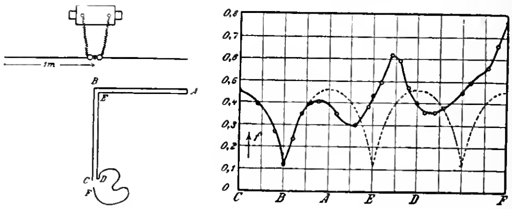
FIG. 4.—CURVE OF HARMONICS.

order of the highest harmonics present. This may be done in two different ways. In the first as large a capacity as possible is connected to the periodic potential difference to be analyzed and the curve of the charging current of the condenser is recorded by connecting the ondograph to the terminals of a non-inductive resistance included in the circuit through which flows the charging current of the condenser. This resistance should be as small as possible. By this method the *n*th harmonic is magnified in proportion to its order, *n*, and an indented curve is obtained in which the number of teeth indicates the order of the highest harmonic with the greatest clearness. Fig. 4 shows clearly the discovery of the 15th harmonics in the e.m.f. of a Paris supply current, a harmonic that the sinusoidal-looking potential difference would not have enabled one to predict. In the second method a circuit formed of a highly inductive coil, having as long a time constant as possible, and a non-inductive resistance, is connected to the terminals of the difference of potential to be analyzed. By using the ondograph to record the instantaneous values of the potential difference between the terminals of the self-induction, an indented curve is obtained analogous to that found by the other method. When the order *n* of the highest harmonic is once known, it is easy to trace the fundamental wave and all the harmonics with their several amplitudes, actual or enlarged in a given proportion, as well as their difference of phase relative to the curve under analysis. For this purpose he uses the method of Pupin, which consists in forming a resonating circuit for each of the harmonics.—Lond. *Elec.*, December 11.

Measuring Small Inductances.—STROUD AND OATES.—A description of an apparatus for measuring small inductances. The essential feature is the use of what is substantially an electrodynamometer with laminated iron cores, or it may be briefly described as a moveable coil D'Arsonval galvanometer in which the permanent magnet is replaced by an electromagnet, with a laminated iron core, actuated by a 100-volt alternating current. The solid iron core inside the moving coil of the ordinary D'Arsonval type, is in this instrument also replaced by a laminated one. The instrument is used just like an electrodynamometer when it is arranged for measuring the conductivity of electrolytes. The field magnet is placed across the mains and the highly-insulated movable coil is used to replace the galvanometer in the bridge. The key must be in the battery circuit and under no circumstances should it be in the galvanometer circuit. The apparatus may be used for measuring an inductance with certainty to something well under 1/10 of a millihenry. By adopting a specially sensitive arrangement the author succeeded in reading down to 2 microhenrys.—From *Phil. Mag.*, December; Lond. *Elec.*, December 11.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Multiplication Rod for Measuring Wireless Telegraphy Waves.—SLABY.—A long illustrated article in which he first describes the fundamental experiment on which his "multiplier" for wave measurements is based. Fig. 5 shows an oscillating system generating waves of a quarter wave length of one meter. The waves are received by the loop, *C B A D*, of a length of 4×1 meters. The investigation of the total loop with the spark micrometer gave the same voltage curves across for *A B C* and *A E D* with nodes at *B* and *E* and maximum amplitudes of oscillation at *A* and *C D*. The voltages at *C* and *D* were exactly equal and of the same phase. When a wire, *D F*, of two meter length (one-half wave length) is added, the voltage at the terminal, *F*, is much increased. If the wire, *D F*, is wound in form of a coil, a further appreciable increase of voltage is observed. Whenever a point of maximum oscillation of a conductor is connected with a coil of one-half wave length, the voltage at the free terminal of the latter is increased several times. This is why he calls such a coil a "voltage multiplier." He found later that the addition of such a coil and the form of its connection, as shown in Fig. 5, destroys the symmetry of the oscillation, the dotted line in Fig. 6 representing the symmetrical wave form and the full line, the voltages actually observed along the points, *C B A E D F*. Moreover, the greatest increase of voltage is observed at the terminal *F* if the length of the coil, *D F*, is not exactly a half wave length, but a little smaller. The author then gives some theoretical notes on the condition of resonance. Any earthed conductor of any form may be set into the condition of resonance if the point of the impressed oscillation equals 2π times the square root of the product of self-inductance and capacity of the conductor. This product, which is the deciding factor for resonance, is called by him "oscillation capacity." If it has the right value, there will be resonance whatever the value of the real electrostatic capacity may be. To produce a strong action into the distance, it is preferable to make the electrostatic capacity large; hence, the self-inductance small. On the other hand, for measuring waves, as for instance by the multiplier, it is preferable to make the electrostatic capacity small and the self-inductance large. For this reason the multiplier must be a wire wound in coil form. The wire will be the more suitable for this purpose, the smaller its diameter and the thinner the insulation; for the latter he has found silk insulation very good, but a very thin layer of cellulose-acetate to be still better. The coil is preferably wound on a glass rod which is provided at one end with a metallic coating. Direct-connection of the multiplier with the oscillating system under test, as in Fig. 5, is unsuitable on account of the distortion of the form shown in Fig. 6. The author has, however,



FIGS. 5 AND 6.—WIRELESS TELEGRAPH WAVE MULTIPLIER.

found that such a multiplier coil is brought into the condition of resonance by simply holding it near the oscillating system at a certain distance. The end of the multiplier, which is provided with a metallic coating, is held in one hand of the observer and thus artificially earthed; in the other hand one holds a short, thick earthed metal rod and moves this along the multiplier coil. At a certain position it will be observed that sparks appear at the free end of the multiplier rod; this indicates that the portion of the multiplier coil between its free end and the point where it is touched by the short, thick metal rod is set into vibrations corresponding to the condition of resonance. By artificial means the sparks can be made more easily visible. For practical use he has three multipliers, of 1, 2, 4 cm. diameter for measuring quarter wave lengths between 25 and 50, 50 and 100, 100 and 200 meters, respectively; the length of each rod is 80 cm., and the diameter of the silk-insulated copper wire 0.1 mm.—*Elek. Zeit.*, December 10.

REFERENCE.

Automatic Telephone Exchanges.—MERK.—A rather long communication on the disadvantages of the automatic telephone exchanges, reference being particularly made to an American system. He thinks the main point of inferiority, compared with ordinary exchanges, is the excessive use of an enormous amount of expensive apparatus. He believes that this is not necessarily involved in the design of automatic exchanges, and that in the arrangement of the latter it should be endeavored to approximate more the design of ordinary exchanges. In the automatic exchanges of the present day, the experience obtained in many years' practice in ordinary exchanges has not been taken advantage of.—*Elek. Zeit.*, December 3.

MISCELLANEOUS.

German Electrical Industries.—An article on new industrial amalgamations either completed or in progress, referring especially to the combination of the Allgem. Elek. Ges. and the Union Elek. Ges. The Austrian branch of the Siemens & Halske Company and the Austrian Schuckert Company will also combine. Another amalgamation is that of the Bitterfeld Electrochemical Company and the Rheinfelden Electrochemical Companies. The Berlin-Hagen Accumulator Works Company, which controls the Tudor type of storage battery in Germany, proposes to absorb the Pollak Accumulator Company, of Frankfort.—Lond. *Elec. Rev.*, December 11.

REFERENCE.

Training Apprentices.—DOWNTON.—An illustrated article in which, as an example of the methods of training apprentices in an engineering works, the system and methods of the Westinghouse Electric & Manufacturing Company are described.—*Eng. Mag.*, December.

New Books.

NOTES ON ELECTRIC RAILWAY ECONOMICS AND PRELIMINARY ENGINEERING. By W. C. Gotshall. vi + 252 pages; illustrated. New York, 1903. McGraw Publishing Company. Price, $2.

The electric railway art, while it is still undergoing radical and striking changes in its essential engineering, has long since emerged from the stage at which a writer in dealing with the subject finds it necessary to go back to the beginnings of history or to indulge in apologetics for explaining the rudiments. In other words, the broad principles of electric traction are as well established, although not so well understood, as those of steam traction; and what has been really required of late is a differentiation in the treatment of the theme. The motors, and the power plant, can be dealt with quite independently and regardless of each other, while neither is in any particular sense related to the engineering of the track and roadbed, or to the economics of the system as a whole. It is, of course, true that there is underlying these topics a deep and close relationship, but the man who would now deal with them all fully and adequately within the covers of one book must lay out a plan encyclopædic in its method and execution. A good deal of such work along the electrical engineering side has already been done, and one could cite standard books which can be studied with profit, and which are an absolute necessity to any engineer working in this field, but so far as we are aware, excepting perhaps an admirable earlier brochure by Mr. E. E. Higgins, there is nothing to compare with this masterly discussion by Mr. Gotshall.

The subject is not only novel but the point of view is also original, and the style of approaching the theme is really something different from what one has previously encountered in electrical literature. We do not know of anything quite the same in electric lighting, in its analogous treatment; and it would be well indeed if the now expanding field of telephony could be subjected to such keen and critical analysis, although some of the articles by Mr. Abbott in our pages have outlined economical considerations too often neglected in that department. Mr. Gotshall happily has looked at the subject first of all not simply as an electrical engineer enamored with armature windings and enthusiastic on rotaries, but as a civil engineer and also as a railroad builder whose broad range of vision compasses these subjects as a whole, and who while not neglectful of these very important points, relegates them to their proper place in determining not merely the style of equipment that is best for the road as seen from the viewpoint of electrotechnics, but that which is best and inevitable when the subject is studied by the banker, the promoter, and that ultimate beast of burden, the investor.

It is remarkable how many lines of study and topics Mr. Gotshall's exposition of the subject opens up. We have the field work not only in its relation to the physical contour of the country through which the road must pass, but the more subtle and more difficult surveys of a sociological character based upon the population tributary to the system, its wealth, its industries, its habits of travel and other data. Passing from these points in regard to cost of construction, the author deals with the operating expenses and the income, and in one valuable chapter the results furnished by existing systems are applied to other possible schedules and conditions. Human judgment is always liable to err, but a given set of facts applied to a given problem ought to work out pretty much the same all the time, and Mr. Gotshall's "template," if it may be so termed, is one to which anything at all corresponding can be fitted and tested. We imagine that Mr. Gotshall's remarks on the risk of employing the percentage of gross receipts method will surprise as well as instruct a good many people. In other chapters of the book also Mr. Gotshall deals with relative construction and operating data, and in a closing chapter the general principles laid down as to proposed installations and their permissible cost are illustrated by an assumed case which represents actual conditions.

In this connection it is well to premise that the keynote of the book is that struck by the modern development of high-speed interurban electric railroading. It would be a mistake to suppose for a moment that the ordinary street railway now limits the scope of electric railway work, and Mr. Gotshall has pushed his practical theorizing boldly into the new domain of interurban work where questions of high speed and low speed and their relative cost and yield are so pressing and so vital. Indeed, a book like this lies at the foundation of the change which is now going on, on short steam roads or short stretches of main lines from steam to electricity, and his analysis of the subject is as applicable to such work as it is to any new interurban road which it is proposed to make electric from the start. The book indeed concludes with a set of complete specifications for the construction of such an interurban system operating over its own right of way. In this field Mr. Gotshall, as those familiar with his career are aware, is peculiarly at home, and the reader realizes that he is being instructed by one who has studied his subject *au fond*.

A remark made at the beginning of this review is not to be misunderstood, for it should be added that the book embraces a great deal of intelligent discussion of such things as motor equipment, rolling stock, storage batteries, power plants, etc., but these are not treated as though they were the "whole thing," but are regarded in their proper place of subordination in a book whose theme is economics. A work of this kind is a good example of intellectual pioneership, which counts as much for the art as a whole as a radical new invention.

The Beginnings of an Industrial City.

Formerly the idea of a town springing up almost over night was entirely associated with the new West, and even now few know that in recent years staid old Western Pennsylvania has been the scene of some of the most notable examples of a Aladdin-like transformation of a countryside into a flourishing town or even city. Jeannette and Charleroi, each with a population now not far from 10,000, are examples of the Western Pennsylvanian method of systematic town founding, by which in the course of a few years farm land is covered with the streets and buildings of a thriving city.

The only likeness with Western town upbuilding is, however, in the element of magical growth. In a thickly settled section where the struggling limits of one town elbow those of neighboring towns, the conditions leading to the creation of new population centers are naturally different from those incident to homesteading. In Western Pennsylvania the making of a new town is purely the result of very definite industrial conditions. The expansion of an industry giving rise to congestion in its old district; increase of cost of living in large communities with its effect on the pay-roll; labor troubles, and above all, desirability of radical changes in manufacturing methods that necessitate the building of a new plant—these are some of the factors that have led to the remarkable town-founding movement in Western Pennsylvania. Yet another striking difference between the Eastern and Western new town is, with respect to its layout and the character of its buildings. Chance does not preside in the location of the different quarters with respect to each other, but the situation of the manufacturing, business and several classes of residential sections are carefully and definitely decided upon while crops are yet growing on the site; and the buildings instead of reflecting the crude ideas of new settlers are architecturally and in modern conveniences thoroughly up to date.

The latest example of one of these new towns is Trafford City, now well underway at what was formerly Stewart Station, about 17 miles east of Pittsburg, and which forms the latest contribution of Mr. George Westinghouse to the material wealth of the section of the country that owes so much of its industrial supremacy to his organizing genius.

The industrial conditions to which Trafford City owes its existence are the result of a situation brought about by the tremendous growth of the manufacturing operations of several of the great Westinghouse interests using foundry products in large quantity. To meet the demands, additions to foundry departments of works long ago ceased to suffice, and until recently the deficiency in castings was supplied from a number of foundries more or less distant from the works, one in fact being located in Cleveland, Ohio. Some months ago the industrial organization known collectively as the Westinghouse Companies, which includes among others the Westinghouse Electric & Manufacturing Company, the Westinghouse Air Brake Company, and the Westinghouse Machine Company, purchased through a subsidiary organization—the Westinghouse Foundry Company—600 acres of land in convenient proximity to the great factories of the Westinghouse Machine Company and Westinghouse Electric & Manufacturing Company, at East Pittsburg, all of which are now connected together and with Trafford City by a private railway of standard railroad gauge permitting the hauling of the heaviest loads that may ever require transportation.

In an article which appeared in these columns some weeks ago, the foundry plant was described in detail, and the present object is to deal more particularly with the town itself. In picturesque old European feudal towns, it is the castle on an eminence which dominates the landscape, the habitations of the retainers clustering beneath in humble array. At Trafford City the real dominating factor—the works—is unobtrusively located in apparent lowly subordination to the living quarters, which are ranged above on terraces giving an inviting prospect over surrounding valley and hill; and owing to the distance to the eastward of the Pittsburg manufacturing district, the atmosphere is free of the smoke which hangs over Pittsburg like a pall. Indeed, had one sought an ideal location for a suburban residence district his steps would have been halted at this spot.

Employers in the Pittsburg district have not been noted for displaying a yearning toward the domestic comfort of employees, as witness on every hand the rough-battened, unpainted houses, characteristic rather of a mining camp than of one of the oldest and, industrially, one of the richest sections of the United States. Mr. George Westinghouse has been an exception in this respect, and while indulging in no experiments toward the betterment of the conditions of the workman's life of the kind that has met with such dire results at Pullman and Dayton, he has ever been solicitous of the welfare of his employees. By these he wishes to be regarded as a friend, but in the manly sense, not as a condescending patron or misjudged as a doctrinaire looking on them as a class to be "elevated."

At Trafford City everything possible has been done that promised to conduce to the domestic comfort of employees, but done in such a manner that one with the most sensitive American spirit could find no cause to feel that he was being patronized or "elevated." The rents, and the prices of buildings offered for sale, are placed on the same basis as if the town were a commercial enterprise, with the difference, however, that the returns on the capital employed are fixed at a point corresponding to an investment in low interest-bearing securities; and the still further difference that owing to the building operations being on a great scale, the cost of houses has been a minimum, and when sold the figure is based on cost price.

The houses are of several different classes, intended to meet the means of any wage-earner, but in every case equal care appears to have been given to the architectural features. All houses are built of brick, and pleasing facades have been obtained by tasteful architectural design apparently involving little or no increased cost in construction. The architect has been particularly successful in the design of the blocks of buildings accommodating two families. A separate entrance at the ground floor for the second story is so skillfully worked into the design of the facade that the appearance of an apartment house is entirely suppressed. The interior layout in this case is no less successful, and the finish, while not expensive, is of a kind to appeal to the neat housewife. Yet the rent of these tasteful homes is even below that of a couple of rooms in a dingy, unhealthy city flat, ranging from but $10 to $12 per month.

Another class of dwellings consists of detached houses of two stories and finished attic, with pleasant yards. We were about to say that these are apparently intended for the more prosperous class of employees, but the rent charged—ranging in the neighborhood of $17 per month—is only about that paid by the average mechanic for vastly inferior quarters a few miles away in the city. In this case the occupant has the option of renting the house or purchasing it outright on the basis of a small payment monthly. Here again are apparent the advantages incident to building operations on a scale sufficient to justify the services of competent architects. There is an absence of the evident straining for effect so characteristic of American middle-class architecture, a light and home-like appearance being obtained by attention to proper proportions and a skillful handling of window and door details.

One of the interesting and the most original features of the town is Trafford Inn, which combines the functions of a hotel, bachelors' quarters and casino. The building is handsomely constructed of pressed brick with stone trimmings, and its interior arrangement is on the bachelor club plan. The Inn will serve as a home for well-to-do employees who have no families, and the charges are fixed at a sum just sufficient to meet expenses. In fact, the rates are such that a bachelor can here reside in dignified state for a sum little or no greater than that paid in a city for hall hedroom boarding house accommodations. On the first floor is a large reading-room, which can be joined to the large dining-room alongside to form a large hall for meetings and entertainments, and the basement is given up to a large billiard room and bowling alley.

The streets of the town are paved with brick and the sidewalks provided with flag stones. The plans for the town include a park system. Though but portions of the site are as yet occupied, what has already been done indicates that in due time a town will be reared on these terraced hills which will vie with the handsomest in the country, and be a Mecca for those who would study an interesting social and economic side of modern industrial development.

English Test of De Forest Wireless Telegraph System.

The British General Post-Office Department has recently tested the De Forest system between Holyhead and Howth, a distance of 64 miles, and using masts 180 ft., which were erected for wireless telegraph experiment two years ago. The De Forest apparatus was installed at the invitation of the post-office officials, under direction of Dr. De Forest and W. M. Horton, his chief assistant, and has now been in successful operation for several weeks.

FIG. 1.—MAST AND ANTENNÆ.

Power at both stations is furnished by small Fairbanks-Morse gasolene engines, belted to a 1-kw, 60-cycle, 500-volt alternating-current generator. The transformers, condensers, tuning helixes, keys, etc., are, as in the standard De Forest apparatus; electrolytic responders are used and telephone receivers. A speed of 30 words per minute was attained during these tests.

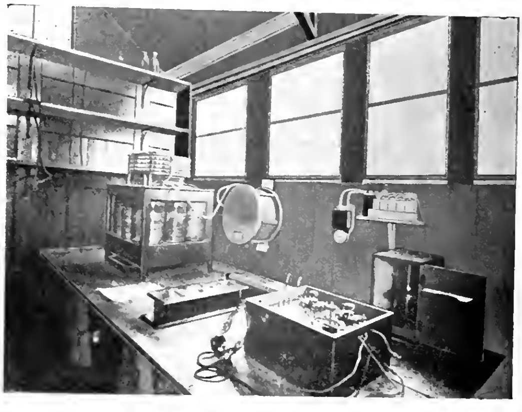


FIG. 2.—VIEW OF INTERIOR OF STATION.

At the invitation of Mr. Gavey and Mr. Lamb, secretary, the General Post-Office officials of the Netherlands Postal Telegraphs were present at the test of December 1, including Mr. De Braum, engineer-in-chief; Mr. Nerstrasz, assistant engineer, and Mr. Kiveron, technical adviser. Several of the officials themselves transmitted and received aerograms with the apparatus and expressed themselves as highly pleased with the facility with which the apparatus could be operated and the messages read.

Westinghouse Turbo-Electric Apparatus for Manila.

An important export order has just been closed with the Manila Construction Company, an American corporation conducting operations in the city of Manila, P. I., for a complete power equipment for the city traction system. The order was secured through Westinghouse, Church, Kerr & Co., and comprises the following machinery: Three 750-kw. Westinghouse turbo-generator units, two compound engine exciter units, one motor-driven exciter unit, three 500-kw. rotary converters, one 300-kw. rotary converter, four 250-kw. oil-insulated transformers, a complete switchboard, one series booster. This booster is mounted on the extended shaft of one of the rotary converters. The car equipments will comprise ninety double outfits of one Westinghouse type, and ten double outfits of another type using standard Westinghouse controllers.

The first turbo-generator unit will be delivered in about nine months. The turbine will operate at 150 lbs. steam, 26-inch to 27-inch vacuum, and 150 degs. superheat. It is fitted with the usual by-pass for securing an overload capacity of 50 per cent. It is also equipped with a quick-closing throttle valve. The turbo-generators will furnish three-phase, 60-cycle current at 380 volts; part of the current will be converted to direct current by the power house railway substation, and the remainder will go to transformers for supplying the high-tension distributing system. The transformers are oil cooled and connected in the two-phase, three-phase, or Scott system for three-phase transmission. The turbine machinery will also furnish current to the local light and power system.

German Three-Phase Transformers.

In the industrial development of polyphase systems in this country it has been customary until recently to provide a single-phase transformer for each phase whenever voltage transformation was required, while on the other hand it has been the custom abroad to install polyphase transformers. The Allgemeine Electricitäts Gesellschaft, of Berlin, which, with its chief engineer, Mr. von Dolivo-Dobrowolsky, has done important pioneer work in the development of three-phase alternating-current engineering in Germany, has built three-phase transformers for many years. A brief description of

FIG. 1.—PARTS OF TRANSFORMER.

the latest types of oil-cooled, three-phase transformers built by this company will, therefore, be of interest.

All these transformers of capacities between 1 and 50 kw are oil-cooled, since it has been found that a much more compact construction can thus be obtained than with air cooling; other things being equal, an oil-cooled transformer has a higher efficiency and a smaller voltage drop than an air-cooled transformer of the same dimensions. Moreover, since oil prevents the windings from coming into contact with air, there is no danger of oxidation. This is a point which does not seem to be sufficiently appreciated by electrical engineers in general. In a Franklin Institute paper of Mr. C. E.

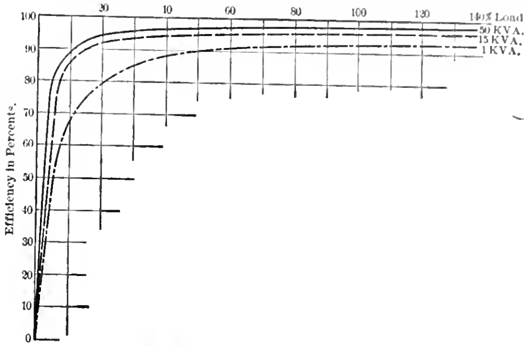


FIG. 2.—EFFICIENCY CURVES.

Farrington on the chemical problems involved in the production of a perfect insulating material for electric machinery, the author points out that while electricians like to claim that their apparatus is well ventilated, they forget that "well-ventilated" also means well oxidized.

All these transformers are built as core transformers with the three cores in one plane. The cores are made up of thin iron sheets covered with paper. As few bolts as possible are used passing through the laminations, and the number of accessory cast-iron parts is restricted as far as possible in order to reduce the losses due to eddy currents, etc., to a minimum. Fig. 1 shows the method of building up the transformer.

The smaller sizes (up to 7 or 12 kilovolt-amperes) and for voltages up to 6,000 on the high-tension side, have concentric windings, the high-voltage winding being at the outside. In the larger sizes the windings are subdivided into smaller coils, the high-tension and low-tension coils being placed alternately side by side on the core. The transformers for 10,000 volts on the high-tension side are built altogether with concentric windings, but the outside high-tension winding is subdivided into a number of smaller coils. As insulating material specially prepared paper is used with a thickness of 0.1 to

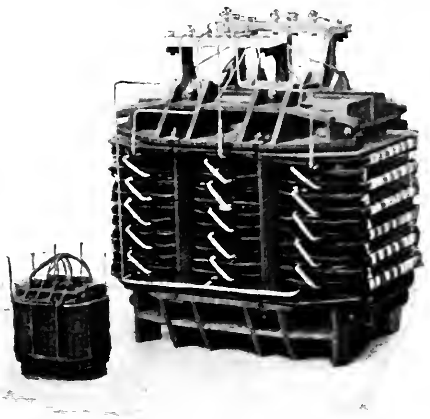


FIG. 3.—METHOD OF BUILDING UP.

0.5 mm., several layers being placed above each other. A thickness of about 0.2 mm. stands 8,000 to 9,000 volts.

The increase of temperature, guaranteed for continuous operation, is 40 to 45° C. in the oil at the top. In general it takes about 15 hours of continuous operation until the maximum temperature is attained. The temperatures of the copper are at the highest 8 to 10 per cent., those of the iron about 5 per cent.

There are three different types of A.E.G. polyphase transformers, namely, for use up to 6,000 volts and for 1 to 50 kilovolt-amperes (type A.D.O.) up to 3,000 volts and for 1 to 52 kilovolt-amperes (type B.D.O.; and up to 10,000 volts for 5 to 50 kilovolt-amperes (type C.D.O.). A diagram giving the efficiency of the first-mentioned type of transformers of three different sizes, as function of the load, is given in Fig. 2.

TYPE ADO.

Primary voltage.	Secondary voltage.	Capacity in kilovolt-amperes.	Efficiency in per cent at full load, $\cos\phi = 1$.	Voltage drop in per cent at full load, $\cos\phi = 1$.	Iron losses in per cent.	Weight in ky of the complete transformer with oil.
2000	250 to 50	1	92.5	3.3	4.8	160
3000 to 4000	250 to 50	1	91.2	4.0	5.5	160
2000	250 to 50	5	95	2.8	2.4	285
3000 to 4000	250 to 50	5	94.8	2.9	2.6	285
6000	250 to 50	5	94.4	3.2	2.7	285
2000	550 to 50	10	96	2.3	1.8	420
3000 to 4000	550 to 50	10	95.6	2.5	2.0	420
6000	550 to 50	10	95.4	2.6	2.2	450
2000	550 to 100	20	96.7	1.9	1.5	610
3000 to 4000	550 to 100	20	96.4	2.2	1.6	650
6000	550 to 100	20	96.2	2.2	1.6	650
2000	550 to 100	50	97.2	1.5	1.1	1240
3000 to 4000	550 to 100	50	97.2	1.5	1.2	1270
6000	550 to 100	50	97	1.6	1.3	1270

TYPE BDO

Primary voltage.	Secondary voltage.	Capacity in kilovolt-amperes.	Efficiency in per cent at full load, $\cos\phi = 1$.	Voltage drop in per cent at full load, $\cos\phi = 1$.	Iron losses in per cent.	Weight in ky of the complete transformer with oil.
3000	550 to 50	9	95.4	2.6	2.3	340
3000	550 to 100	52	97.2	1.6	1.2	1270

TYPE CDO.

Primary voltage.	Secondary voltage.	Capacity in kilovolt-amperes.	Efficiency in per cent at full load, $\cos\phi = 1$.	Voltage drop in per cent at full load, $\cos\phi = 1$.	Iron losses in per cent.	Weight in ky of the complete transformer with oil.
10,000	550 to 100	10	94.75	2.4	3.15	435
10,000	550 to 100	50	96.9	1.7	1.55	1390

The above tables give details of the behavior of the three different types.

High Potential Switches.

Fig. 1 is a view of a three-pole, double-break oil switch designed and made by the Hartman Circuit-Breaker Company, of Hansfield, Ohio, for installing on the back of a panel, and to be used on circuits up to 11,000 volts. The view shows the switches in the "off" position with one of the switches enclosed in an oil tank. Each pole of the switch is immersed in a separate tank, which is entirely independent of the adjacent ones and can be readily removed without in any way interfering with the adjacent others. The tanks are lined with insulating material, which is formed in such a way that there is just sufficient space for the free vertical movement of the switches, and the quantity of oil used is thus reduced to the minimum.

A feature of this oil switch consists in the use of the laminated or brush form of contact, which greatly increases the current-carrying efficiency of the switch and also entirely prevents "freezing" or sticking at critical periods. These contacts are protected by final arcing plates, which, with the corresponding plates on the terminal blocks, are removable and can be readily replaced should they become burned away in the course of time. The form of contact which is used and the isolation of the switches in separate compartments gives the switch a very large breaking capacity.

The movable parts of the switch are controlled by means of specially-treated wooden rods, which are fastened at their upper ends to a common cross-bar. They are held in normal position by means of a toggle lock. The switch is opened by giving the handle a slight turn in the direction opposite to that taken in closing. This will cause the toggle to move past the center and the switches will then open free of the controlling handle, thereby producing an absolutely quick break.

In Fig. 2 the switch is shown with automatic overload attachment. There are usually two tripping coils provided for a three-pole breaker, but it can be constructed with a tripping coil in each line. In all cases the operation of any one tripping coil will break all lines.

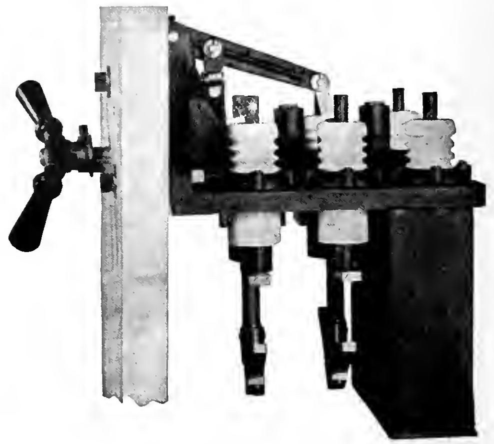


FIG. 1.—THREE-POLE, DOUBLE-BREAK OIL SWITCH.

The distinctive feature of this overload attachment lies in the fact that the tripping coils are energized by current from the high-potential circuit, and the use of series transformers in connection with the circuit-breaker is entirely avoided. The tripping coils, instead of being located on the front of the panel, as is commonly the case, are mounted by means of special porcelain insulators on the

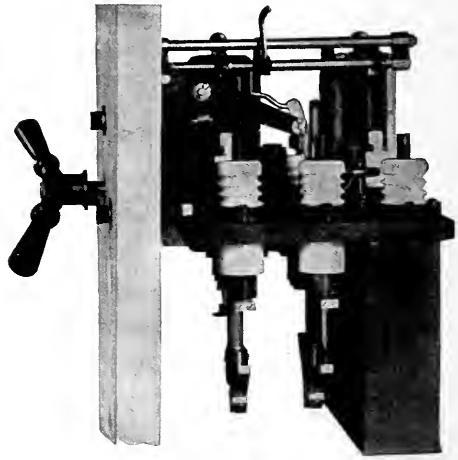


FIG. 2.—AUTOMATIC OVERLOAD ATTACHMENT.

carrying frame itself. They are separated from each other by barriers of insulating material, and the method of insulation throughout is of the highest order. The overload attachment has other distinctive features, one of the most important of which is that it cannot be held closed while an overload exists on any line.

This apparatus is also constructed with remote electrical control, to be installed apart from the switchboard and to be opened and closed from a distance. The operating current may be derived from the exciters, a storage battery or any convenient source of direct-current supply at from 110 to 500 volts. The remote control attachment is said to be very reliable and to add but little to the cost of the installation.

Alternating-Current Signals on Electric Roads.

An interesting system of automatic block signals has been perfected and brought forward by Mr. S. Marsh Young through the Pneumatic Signal Company, of Rochester, N. Y., which is now introducing the invention. Mr. Young, who is well known to our readers, has worked out carefully a method, the details of which are given below, and which have been studied by one of our staff under conditions of actual operation.

The essential features of this system are: 1. The use of alternating current for signaling, and the employment of the traffic rails for the signal circuit as well as for the return power circuit. 2. The use of a special bond for connecting the sections of adjacent blocks around the insulated joints, and also cross-connecting the tracks, which offers little resistance to the direct current, but effectually chokes back the alternating currents. 3. The use of special relays at the entrance of every block, which control the operation of the signals. Fig. 1 shows the arrangement of the apparatus as employed in the demonstration last week. By reference to the cut it will be seen that *X* represents the block rail, *Y* the common rail, *L* the alternating-current transmission line conveying power from *A C*, the alternating-current generator at the station, to the signaling apparatus on the line. The signal blocks are represented in their order as 1, 2 and 3. *T* is the transformer furnishing current for the track circuit to block No. 1, and *T'* performs the same service at block No. 2. *R* and *R'*, respectively, are the relays governing signals *S* and *S'*, while *I J* indicate the insulated joints in the block rail, around which the special bond is utilized, and B_1 and B_2 are similar bonds, which make the block rail

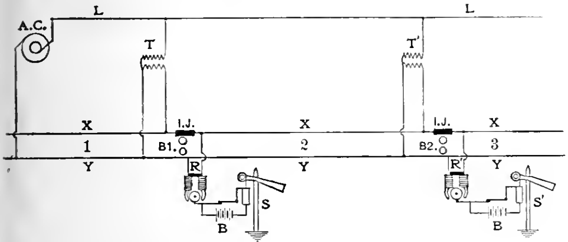


FIG. 1.—DIAGRAM OF TRACK CONNECTIONS.

(*X*) electrically continuous. Fig. 2 shows that portion of the signal mast carrying the case containing the operating mechanism, which can be readily understood. The door of the case is represented open in the cut, thus exposing the mechanism to view. It should be mentioned in this connection that the operation of the system is not limited to the use of this type of apparatus. The operating mechanism consists principally of an electric motor with a train of gear wheels, and an electrical control for making and breaking the connection between the motor and the blades. The motor is entirely enclosed, the commutator end having a glass shield. The power is transmitted through a train of gear wheels.

The principle upon which this system is based is that while it is impossible to keep two direct currents of different potentials separate on the same conductors, an alternating current may be introduced to perform one of two given functions, and if proper apparatus is supplied to keep each current from interfering with the instruments designed to be operated by the other current, the track circuit becomes feasible and practicable. The apparatus must, of course, become operative only under the influence of one current, and must remain inoperative in the presence of any other current, and while it may be called upon to afford a path to the direct current, it must effectively choke back the passage of the alternating current. By this arrangement one current may be used to operate the car, and the other to operate a track circuit to control the signals without interference or interruption.

On a direct-current road, an alternating current is impressed on the direct-current line for signaling, and a road employing alternating current may also be operated if the power current and the signal current have different characteristics. In the test the road employed direct current at 500 volts, and the signaling circuit carried alternating current at 300 volts, which was reduced at the transformers to 3 volts.

In the main power station and in each substation a small alternating-current generator should be placed to provide this alternating current, and in the experimental work on the Sodus Bay Railway a motor-generator was employed. As each block only requires about 20 watts for track circuit purposes, a double-track road, 15 miles in length, with 1-mile blocks, would only require a 1-kw. machine. A No. 10 wire is carried along the entire length of the road for furnishing the alternating current to the signaling system.

It has already been mentioned and shown in the diagram how the divided traffic rail is made continuous electrically as a return path to the direct-current generator, and the other traffic rail is uninterrupted. The track is divided into blocks as it is on steam roads, although but one of the traffic rails is broken for block signaling purposes. The other rail is used as a return for both direct current and alternating current. To one end of each block is fed alternating current transformed to the proper voltage, and at the other end of the block the relay is connected across the two track rails. Between the relay and the track is interposed one of the special bonds, preventing the relay from being affected by the direct current. Between the ends of adjacent block sections are also placed bonds, which offer a free path for the direct current to return to the station, but effectively choke back the alternating current and likewise prevent its escape into adjacent blocks, thus making the operation of the signals in each block independent. While the two traffic

FIG. 2.—OPERATING MECHANISM.

rails are of the same direct-current potential, there is maintained between them a difference of alternating-current potential for the operation of the track circuit of the signal system, but this does not interfere with the operation of the motor circuits. Cross-bonding between the traffic rails or between the block rail and the feeder return is accomplished by the use of devices similar to those used across the ends of the blocks.

In the Rochester exhibition the road was divided into two blocks, one of about half a mile in length controlling the operation of the signals shown, and the other a short block to show that there was no interference between blocks, and that the direct-current return was made continuous through both rails of these blocks.

In the station the motor-generator was operated from a 500-volt trolley circuit, and generated a 300-volt alternating current of 100 cycles. The number of cycles employed was determined by practical considerations wholly, the adoption of this particular standard, for instance, being occasioned by the desire to strike a mean between the ordinary lighting circuit as well as to prevent synchronism between the current-operating signal apparatus and that which will probably be used on the roads employing alternating-current motors.

A No. 10 copper wire runs the entire length of the road, and feeds the primaries of transformers located at the farther end of each block. These transformers are of 100 to 1 ratio, and the secondaries are connected directly across the rails, which sets up a difference of potential between the rails of about 3 volts. The secondaries of these transformers practically take the place of a primary battery on the steam railroad track circuit.

At the entrance to the block was shown one of the relays of special construction, which are only susceptible to the action of alternating current of a proper frequency, while current of different frequency does not affect it. The relay is also independent of any difference of track-current potential that may exist between the rails.

In the demonstration, as has been mentioned, one rail was uninterrupted through the entire length of the road, the other being divided up into blocks corresponding to the signal locations, and insulated by means of standard insulated joints, the same as are employed in steam railroad work. Up to this point the system would present an insulated rail for signaling purposes, owing to the insulated joint between the sections, but this divided rail is made continuous electrically by means of the bond, which is one of the essential features of this system. This bond bridges the insulated joint, and its design and construction are such that while it presents a perfectly free passage for the direct current around the joint it chokes back the alternating current, and thus keeps each block perfectly independent. Similar bonds are placed across the traffic rails in each block.

The signal shown was of the electric motor semaphore type, and operated from the 500-volt trolley line. The resistance, consisting of five incandescent lamps, was interposed between the line and a storage battery of six cells. These lamps were utilized to illuminate the blade, and the storage battery performed the double function of operating as a reserve in case the trolley circuit was cut off, and also enabling the signal circuit to be broken between the points of the relay. The electric motor operated at 12 volts, and took 5 amperes for 5 seconds to pull down the semaphore arm. It was held down by means of a mechanical clutch, taking about .02 of an ampere.

One of the features of the system shown was that even after the insulated joints between the blocks were broken down by a special arrangement, making the polarity of adjacent blocks opposite, the current from one block would rotate the relay in the direction opposite to that which it which normally take, upon the signal circuit, and produce a danger signal. This relay is in reality an alternating-current motor without brushes. Its armature is connected to traffic rails, and its field is energized from the same source of alternating current. It will thus be seen that a car, entering the block and short-circuiting the secondary of a transformer supplying current for that block, will cut off the current of the armature, and thereby cause it to assume its normal position, which opens the local signal circuit.

In operation it was shown that where there was no car in the block the track circuit was completed from the secondary of the transformers through one rail, through the relay and over the other rail back to the transformer. This circuit, when completed, holds the relay points closed, and closes the local signal circuit, which holds the signal to clear. The entrance of a car into a block short circuits the transformer, thereby de-energizing the relay and opening the signal circuit, causing the signal to go to danger. Any interruption to the track circuit from any cause will rob the relay of its current and will result in a danger signal.

It has been the aim of the inventor to have the system so arranged that no possible combination or failure of parts can produce a clear signal when a danger signal should be shown. For instance, the breaking down of the insulated joints between the blocks will result in the giving of a danger signal, and direct-current from any foreign source cannot affect operation, while the presence of stray alternating currents will also fail to operate the relay.

Where electric motor semaphore signals are used, six small cells of storage battery are connected through a resistance to operate the signal motor. The battery also provides a reserve which will operate the signals while the motor current may be off. The battery is charged with about ¼ ampere continuously.

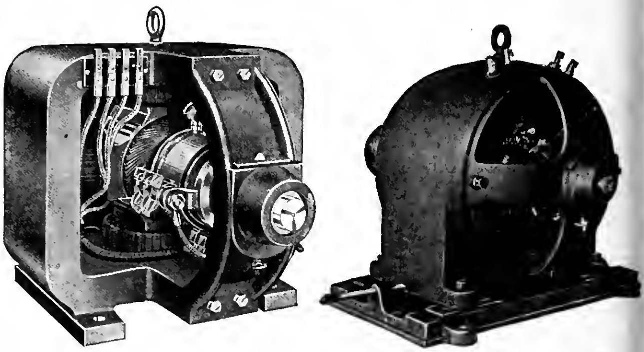
"Ideal" Universal Motors.

The type of direct-current motor illustrated herewith, manufactured by the Ideal Electric and Manufacturing Company, Mansfield, Ohio, is made in sizes ranging from 2 to 35 hp, and in three styles—open, semi-enclosed and inclosed. They can be used for belting, coupling or gearing to the driven machine or shaft, and mounted on the wall, floor or ceiling; the mounting, moreover, can also be changed at the convenience of the user.

The armature core discs are made of very thin armature sheets,

FIG. 1.—ARMATURE.

reannealed after being punched, and then coated with an insulating compound. They are built up directly on the shaft and provided with ventilating openings parallel to the shaft through which air can pass to ventilating ducts between the discs and outer ribbed flange, thus providing thorough ventilation through the entire core and windings. The winding consists of form-wound coils, the smaller armatures being wound with round wire and the larger ones with flat copper strip; the coils are independently insulated, dipped in a special insulating compound and thoroughly baked before being put in place on the armature core, where they are retained in the slots by surface bands. The commutators are made from rolled copper bars insulated



FIGS. 2 AND 3.—UNIVERSAL MOTORS.

from each other by the best grade of amber mica segments. The segments are of unusual length and depth, allowing an ample margin for wear and insuring cool and sparkless commutation. The flanges are of cast iron, insulated from the segments with solid V rings. The commutators are easily removed from the armature shaft.

Exceptional care has been used in the design of the mechanical features, as rigid construction is an important factor in the satisfactory performance of this part of the machine. The brush holders are clamped on the stems close up to the point of brush contact, the brushes being of composition graphite and carbon, and fed toward the commutator through a milled trough in the face of the holder. The brushes are held firmly against the face plate by means of a flat phosphor-bronze spring, brush tension being provided by means of a finger actuated by an adjustable spring. The holder is very simple in design, aside from being reliable in its operation. The brushes operate without vibration, and the machines are practically noiseless in service. The brushes can be readily and independently adjusted, and any brush can be quickly removed while the motor is in operation. The brush contact area is in all cases ample, the current density being at the minimum consistent with economical design. After the brushes are properly set no shifting is required and the motor operates without noise or sparking. The machines are designed to operate at their full rated capacities without the temperature of the armature or field windings rising more than 30° C. and to operate at an overload of 25 per cent, for a period of two hours, and 50 per cent overload for two to three minutes without injurious heating or sparking.

High Power Westinghouse-Parsons Steam Turbines.

The Westinghouse-Parsons steam turbine was commercially introduced in this country several years ago, the sizes then built being of 600 hp nominal capacity, direct-connected to 400-kw, polyphase generators. Subsequent development has been so rapid that within a period of four years turbines of 5,500 kw, or 7,500 hp, nominal capacity, have been designed and are under construction. These machines will have a continuous overload capacity of 11,000 hp, in one self-contained unit, and thus rank among the world's largest prime-movers. Recently marine work has been contemplated by the builders and the near future may be productive of turbines of still greater power, although of slightly different arrangement necessary to adapt the present type to marine usage.

The 5,000-kw turbo-generating unit illustrated herewith is representative of the general type which will be constructed for large powers. This type embodies the experience acquired in the construction and operation of a large number of machines. The principle of operation as well as the general relation and arrangement of rotating and stationary elements characteristic of former types has been employed. The largest machines, therefore, find their direct prototypes in the original design adopted, thus in a measure vindicating the wisdom of adherence to the design of maximum simplicity, viz.: the horizontal single-cylinder turbine.

The most distinguishing features of the new type are the extreme compactness and low speed secured. These features have been practically prescribed by the necessity of minimizing the cost of power building construction for larger station capacities.

The space occupied by the 7,500-hp turbine is approximately 27 ft. 8 in. by 13 ft. 3 in., and the height to the top of the hand railing is 12 ft. This is equivalent to .049 sq. ft. (less than one-twentieth sq. ft.) per electric horse-power capacity, or 20.2 hp per sq. ft. of floor area required. For the complete unit a rectangular area of 47 ft. 4 in. in length and 13 ft. in width is required, which is equivalent to .084 sq. ft. per electrical hp-capacity, or 12 electrical hp per sq. ft. of floor space.

A graphical comparison of floor space required for different types of prime-movers is shown in Fig. 2. In all cases a complete unit is taken as the basis of comparison. This point of relative economy of space is well illustrated by Fig. 3, which represents, in plan, the comparative space occupied by the 5,000-kw Manhattan Railway (New York) engine type units and the 5,000-kw Westinghouse-Parsons turbine units.

In point of speed, the new type fulfils the demand for a unit operating at moderate speed. The 3,000-kw units operate at 750 r.p.m., the 2,000-kw unit at 1,200 to 1,560 r.p.m., and the 1,000-kw unit at 1,500 to 1,800 r.p.m., depending upon the frequency desired. These speeds, although not comparable to engine speeds, do not impose much greater stresses upon the rotating parts, and in addition secure the great advantage of reduction in the bulk, weight and cost of the unit.

The accompanying plan and elevation of the 5,000-kw unit shows the general arrangement of the main cylinder body, bearings and auxiliary parts. The unit rests upon a single bedplate cast in two sections, secured by shrunk links. To the bedplate, which is heavily ribbed to secure rigidity, are bolted the pedestals, generator casing and turbine body, but the bedplate itself is not secured to the foundation by other means than the weight of the unit. Steam and exhaust connections are made beneath the floor level.

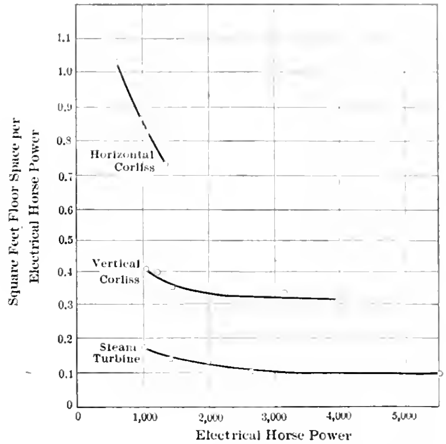


FIG. 2.—COMPARATIVE FLOOR SPACE OCCUPIED BY PRIME-MOVERS.

In the smaller machines of this type the cylinder barrel and both journals are cast in a single casting, thus largely minimizing machine work. In the large machine, however, the barrel is cast in two sections united by links, the outboard section carrying the journal and worm casing, and the inboard section the journal and exhaust opening which extends through the bedplate. As in former types, linear expansion and contraction of the turbine are provided for by a sliding foot. The inboard journal pedestal is bolted securely to the bedplate, but the outboard pedestal is free to slide between parallel machined ways. The main body of the casing is heavily lagged with non-conducting material, secured in place by sheet steel casings.

Leakage of air from the atmosphere into the exhaust spaces of the casing at the entrances of the shaft is prevented by frictionless packing glands. No oil is employed and in consequence the condensation from the turbines is pure distilled water.

In shaft construction great rigidity has been secured with minimum use of metal. A central steel quill carries the entire rotating parts, both blades and balance pistons. Hollow forged steel ends are

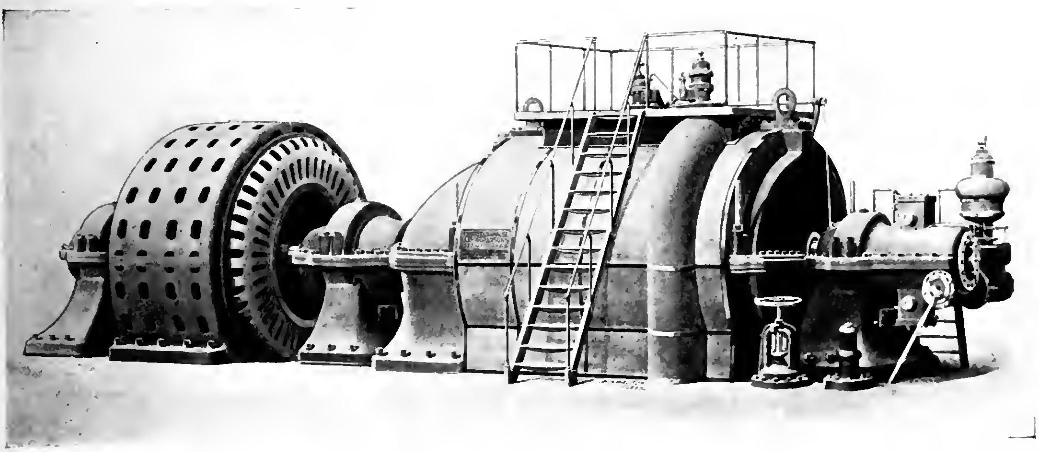


FIG. 1.—5,000-HP STEAM TURBINE.

forced into the two ends of this quill under hydraulic pressure, and are, in addition, secured by arrowhead links. High-pressure steam is conveyed to all parts of this quill structure in such a manner as to eliminate stresses and consequent distortion due to highly superheated steam.

Power is transmitted to the generator shaft through a flexible coupling which is housed partly by the turbine and partly by the generator inboard journal. The coupling is split at the junction of the two shafts, so that by removing one bearing cap and the coupling bolts, either section of the unit may be lifted out without disturbing the adjustment of the remaining section. In the smaller sizes the engagement surfaces of the coupling consist of the squared or hexa-

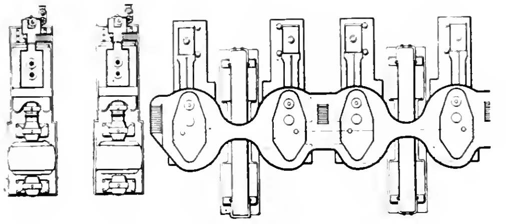


FIG. 3.—COMPARATIVE SIZES OF TWO TURBINES AND TWO RECIPROCATING ENGINES.

gonal ends of the shafts, but in the larger machines a crow-foot sleeve is keyed to each shaft and the power is transmitted by an outside quill engaging the crow-feet. Thus great flexibility is secured, together with the greatest facility in dismantling.

The journals in the larger machines are of the solid self-aligning type, similar to that employed in generators and cross-compound engines. The departure from the familiar oil-cushioned journal employed in the small machines is occasioned by the speed reduction secured. The journal shells are babbitt-lined and are split horizontally, the two halves being united by bolts with shim adjustment. Oil from a central system is introduced at the center under slight pressure, thoroughly flushing all parts. Axial adjustment is provided by metal shims arranged in quarter-box fashion. The diameter of the shaft at the journal of a 5,000-kw machine is 15 in., strikingly small in comparison to the 34-in. shafts required for a cross-compound reciprocating engine of corresponding capacity.

Longitudinal adjustment to preserve proper side clearances is secured by a thrust bearing located next to the outboard bearing. The bearing is not subjected to longitudinal thrusts from the action of the steam and is consequently of small size. The two half shells are advanced in opposite directions by graduated set-screws, so that the actual running clearances are measured in thousandths of an inch. Once set, these adjustments are permanent and do not require frequent "taking up."

Steam enters the turbine successively through an automatic quick-closing throttle, hand throttle, strainer and the main admission valve. A circular port surrounding the entrance to the initial stage conveys this steam to all points so as to avoid stresses incident to more localized admission of highly superheated steam.

An important feature of the steam distribution system is the provision of a by-pass valve. This valve admits high-pressure steam to the second stage of the turbine on overloads in order to increase its capacity up to 50 per cent. in excess of full-rated load. By properly proportioning the by-pass steam to the overload on the turbine, maximum economy may at all times be secured, together with reserve overload capacity. This results in a slight rise in the economy curve on heavy overloads, resembling in some respects the engine economy curve on loads exceeding that of maximum economy. The turbine, however, only suffers in economy at heavy overloads, while the engine economy decreases progressively from 75 to 80 per cent. of full-load capacity.

The main admission valve consists of a double-beat poppet valve, operated by a small piston, this in turn being controlled by a small pilot valve directly actuated by the governor mechanism. The valve admits steam to the turbine in puffs, the duration of which are proportioned by the governor to the load upon the turbine. This intermittent method obviates the throttling of steam to accommodate loading and secures the highest economy by using at all loads steam at boiler pressure.

At the extreme outer end of the turbine shaft is mounted a worm driving a short horizontal cross shaft. This shaft drives at one end the oil pump and at the other the governor through bevel gearing. An eccentric provides the reciprocating motion necessary for the valve mechanism.

The governor is of the fly-ball type, with 90° bell crank ball levers mounted on knife edges and fitted with roller contacts. The governor sleeve and spring is mounted on ball bearings, and adjustment of the spring tension may be made while the turbine is running, thus affording a most simple and convenient means for paralleling alternating-current generators and dividing the load proportionately between them.

At the extreme end of the outboard pedestal is mounted an auxiliary speed limit governor. It is likewise of the centrifugal type and may be set to release, at any predetermined speed, a small plunger valve, which controls with high-pressure steam the operation of the quick-closing throttle before mentioned. This is normally held open by means of an overbalanced differential piston. At the moment the speed limit operates, the excess pressure is removed and the throttle closes. This device is employed purely for insuring absolute immunity from accident from excess speeds, due to the possible disablement of the governor mechanism.

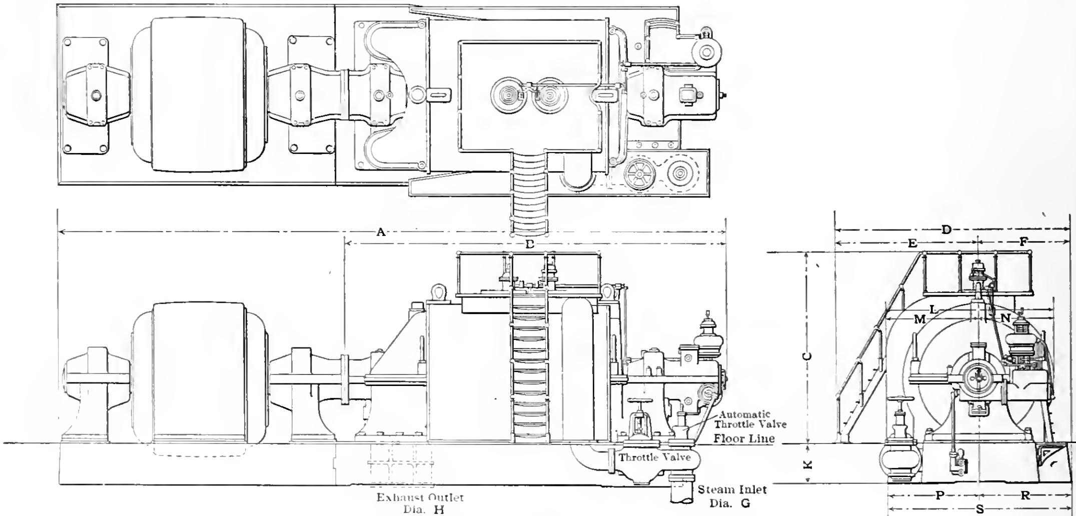


FIG. 4.—PLAN AND ELEVATIONS OF 5,000-HP. TURBINE.

Copious lubrication is supplied to all journals by means of a plunger pump driven from the worm shaft. The warm oil returning from the bearings passes through a copper coil cooler in the bedplate and thence to a reservoir from which the pump draws its supply. The cooled lubricant is circulated at slight pressure, sufficient to insure positive flow. At no point is oil under high pressure employed for preventing erosion of rubbing parts, bearing areas being sufficient for supporting the weight of the rotating parts.

In general construction the 5,000-kw turbo-generators conform to those now building for smaller machines. The field or revolving element is built from a solid cylinder of steel slotted for the reception of the bar windings, and provided with ventilating openings corresponding with openings in the laminations of the stationary element. The generators may be wound for high voltage if desired, in order to avoid the use of step-up transformers in a system of power transmission at voltages ranging up to 15,000.

The 5,000-kw turbo-units here illustrated will be employed in heavy electric railway service, which is the most exacting encountered in central station operation. These machines will form the initial equipment of the Pennsylvania Railroad Terminal property in New York City, operating with electric locomotives the heaviest Pullman trains through the tunnel approaches to Manhattan. Three units will similarly inaugurate the power service on the Philadelphia Rapid Transit Subway system now under construction. Eight 5,000-kw units will furnish power to the London Subway system and three 3,500-kw units to the surface system of the same city. These units will operate under 175 pounds steam pressure, high vacuum and 100° to 175° of superheat.

Terminal Freight Telpherage.

The application of electricity to the unloading of steamship freight at terminals is even more interesting than its use in railroad freight yards, and it is necessary that every electrical engineer should be as thoroughly conversant with the adaptation of electricity to the handling of freight or other material as well as carrying passengers. The domain of electricity is continually increasing, and these later applications proclaim an advent into the great field of railway and steamship freight terminal transportation which has formerly been a "terra incognito" to electrical engineers.

It has always been difficult to handle freight to and from the steamboats, especially when side ports are employed. If the load is to be removed from the hatchways in the deck or from the deck itself, the work was comparatively simple, but the side ports have offered the following difficulties: Low headroom, little width and the rise and fall of the river, due either to freshets or tides, the great variety of the shapes and weights of a miscellaneous cargo.

In unloading, the whole cargo has to be moved through these narrow side ports, then into a narrow space, and then comes the utmost effort to prevent congestion. What is desired is not only to get the cargo out as quickly as possible, but just as quickly to convey it to remote locations in the freight sheds or warehouses. This is most easily accomplished by telpherage. The portable electric hoist draws the loaded truck through the port, elevates it quickly and then the telpher transports at the râte of a quarter of a mile a minute. Therefore, it is the result of the trinity of "telpher, trailer and hoist." It is not sufficient to convey or hoist alone, but each is equally necessary, and the combination of the trailer with the other two gives the perfected result. More than one telpher combination is used, and as soon as one truck is hoisted and the telpher moves from the gang-plank, another telpher waiting upon a side switch near the entrance slips in and the process can be made continuous, for as soon as the loaded truck is at the side of the port the hooks of the next hoist are waiting and ready.

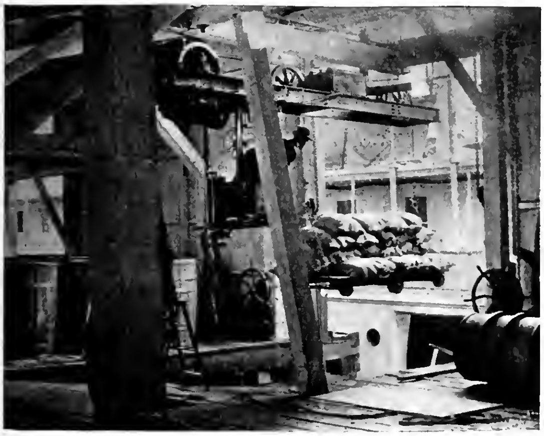


FIG. 1.—RAISING LOAD FROM SIDE PORT OF STEAMER.

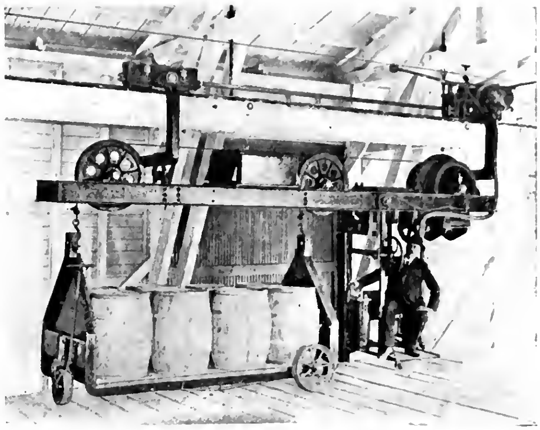


FIG. 2.—BARRELS IN TRANSIT.

In reference to the various views, these are so plain as to need but little explanation. They represent an installation made by the United Telpherage Company for the Old Dominion Steamship Company, of New York, at their southern terminal in Richmond, Va. Fig. 1 shows a load of bags being raised from a side port. Fig. 2 a truckload of barrels passing from the lower to the upper warehouse. Fig. 3 a load of boxes of cheese traversing a curve. Movable cross track can be connected with the side tracks so that every square foot of space can be covered by the telpher. A speed of 1,300 feet per minute is made with loads of 6,000 pounds.

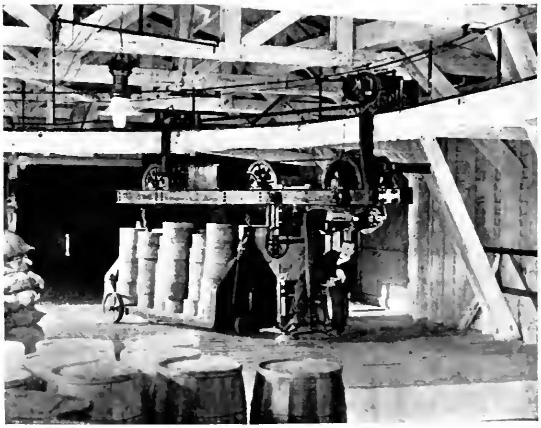


FIG. 3.—LOAD OF CHEESE TRAVERSING A SHARP CURVE.

Alternating-Current Wattmeter Testing Set.

We illustrate herewith a testing set made by the Sangamo Electric Company, of Springfield, Ill., for testing alternating-current wattmeters either in the station or on the consumer's premises, being designed for use on the standard indicating or integrating wattmeter. The purpose of the set is to give a wide range of loads under absolute control with a very small actual expenditure of energy for apparent heavy loads, these being obtained by means of a small transformer forming part of the outfit and enclosed in the same case. For light

FIG. 1.—TESTING SET.

loads, up to 120 or 150 watts, a set of non-inductive resistances and a small water rheostat are provided, also carried inside of the box, each resistance set being standardized for a certain wattage at any desired voltage.

Fig. 2 shows a diagram of connections. The water rheostat is on a third snap switch, and is operated by means of a fibre knob near the front of the box. This rheostat is composed of a heavy glass jar filled with water and made water-tight by rubber gaskets where the brass operating rod passes into it, the rod being moved vertically by

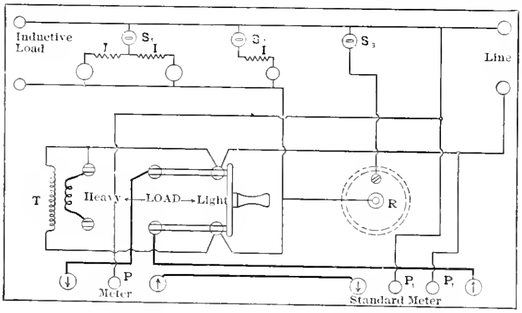


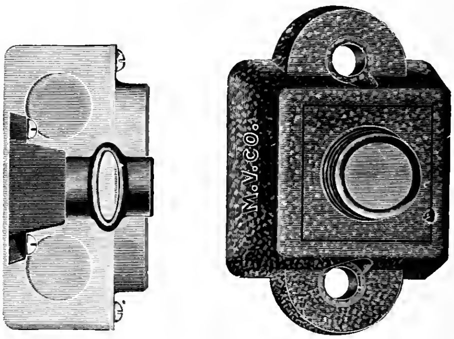
FIG. 2.—DIAGRAM OF CONNECTIONS.

the fibre knob to get any desired load within the range of the rheostat, which is about 5 to 30 watts. On the switch-plate of the set are the three indicating snap switches for the light loads, the various binding posts, the rheostat knob and a double-pole, double-throw switch. For light loads this switch is set in the position marked "light," all connections being then made so that the resistances and rheostat are an actual non-inductive load on the meter tested, the special transformer not being in circuit. For heavy loads, above 200 watts, the switch is thrown over to the position marked "heavy," changing the connections to the various parts of the apparatus. The primary of the small transformer is now in series with the standard resistance and rheostat, which thus become simple controllers for varying the pressure on the primary, giving a range of impressed e.m.f. from a few volts to the full-line pressure.

The secondary of the transformer is wound for two or three volts maximum and large capacity, and is at the same time connected directly to the series coils of the meter and standard wattmeter. These being of very low resistance, the full-load current will flow at from ½ to 1 volt pressure, according to the type of meter under test. Therefore, by varying the primary voltage on the transformer the secondary voltage and current may be varied as desired. The full-line e.m.f. is kept on the shunt coils of the meter under test and the standard in both positions of the switch, and as phase relations are said to be maintained correct by the special construction of the transformer, large loads are obtained with the switch in the "heavy" position with actually less power, so it is claimed, than is used for resistances on light loads. For inductive load, binding posts are provided for connecting an arc lamp, motor or reactance coil, the main switch being set in the "light" position, as the actual load must be used for this purpose. To facilitate the inspection of the water rheostat, the switch-plate is hinged at the back, being held in front by three knurled screws, which, when removed, allow the plate to be swung back without disturbing any connections. The various binding posts are marked with small plates near them, and the only part of the apparatus which needs attention is the water rheostat, which should be inspected occasionally to see that it is full enough, and that the rod is fairly clean.

Insulated Fixture Stud.

A new method of installing a fixture is provided by the Robb insulated fixture stud, which is shown in the accompanying cuts. With the old style the whole would usually project some four inches from



FIGS. 1 AND 2.—FIXTURE STUD.

the back of the box. With the Robb stud and "hickey" only, suppressing the insulating joint, the projection from the back of the box is only about two inches, with the appearance shown in Fig. 2. It allows the use of flat backs on all electrical brackets, as illustrated,

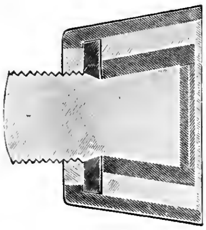


FIG. 3.—FIXTURE STUD.

and affords opportunities for taste and originality in design. As shown in Fig. 3, the device is insulated internally with pure mica, so that not only is the work of putting up fixtures simplified and economized, but a high degree of protection is assured. The appliance is made by the Mitchell-Vance Company, of New York City.

British Westinghouse Annual Report.

The British Westinghouse Electric & Manufacturing Company's fourth annual report issued to the stockholders under date London, December 17, says, in part: "The directors submit herewith the balance sheet for the year ending July 31, 1903, together with profit and loss account to that date, which shows a profit of £107,609.7.6. This includes about £60,000 special discounts allowed by the American companies on orders executed at Pittsburg. It was felt by the American companies that these discounts should be made in view of the fact that the Manchester factory could turn out only about one-third of the electrical apparatus needed for its orders and had, therefore, to purchase the balance from the Pittsburg factories.

"An interim divided at the rate of 6 per cent. per annum upon the preference shares has been paid. After providing for debenture and loan interest and the further items set out on the profit and loss account, a balance remains of £47,106.8.1. Out of this sum the directors recommend the payment of a final dividend at the rate of 6 per cent. per annum on the preference shares, absorbing £45,961.13. carrying the balance, £1,144.15.1, to reserve. This being the first year during which the company's works have been equipped it has not been thought necessary to make any provision for depreciation of buildings and machinery.

"The total authorized share capital of the company has now been issued. Under the provision of the articles of association, the directors have created a further £450,000 4 per cent. debenture stock to rank *pari passu* with the £787,500 previously created; £50,000 of this further debenture stock has already been issued. In order to make provision for maintaining a sufficient supply of stock at the company's works and for other purposes to meet the requirements of the increasing business of the company, the directors will propose to the meeting that an additional 100,000 6 per cent. preference shares of £5 each, ranking *pari passu* with those already existing, shall be created. Arrangements have been made under which the subscription to these shares will be assured. The works at Trafford Park are now employing over 5,000 hands. The following particulars are given as indicating the growth of the company's business: Orders received during the year ending July 31, 1901, £738,000; ending July 31, 1902, £932,000, and ending July 31, 1903, £1,657,114. Among other important contracts obtained during the past year are those with the Admiralty, the Midland Railway Company, the Metropolitan Railway Company, the North Eastern Railway Company, the Underground Electric Railways Company of London, the Buenos Ayres Western Railway Company, the Buenos Ayres Great Southern Railway Company, the De Beers Consolidated Diamond Mines, the London County Council, and the Corporations of Aberdeen, Bath, Bournemouth, Glasgow, Hackney, Ipswich, Liverpool, Salford and Dunedin, New Zealand, and the Savoy Hotel Company, London." It will be recalled that details regarding the major portion of these contracts have been exclusively noted, at the time of placing, in these pages.

The circular issued to the shareholders says, in part: "It has been thought advisable to postpone the annual general meeting until about the middle of January in order that the chairman, Mr. Westinghouse, who is detained in America, may be able to arrive in England and preside."

New High Voltage Oil Fuse.

The high-voltage oil fuse described below will appeal to superintendents of power houses as a means of protection against the damage to switchboards and machines caused by short circuits. This fuse is especially adapted to high-voltage lines and is very simple in construction.

The fuse consists of a glass tube with outwardly flanged ends, a fibre cap at each end being fastened to fibre collars which are held in position by the flanges on the glass. A brass rod fastened to each cap connects the fuse wire, which is made in the form of a link. The glass tube is filled with transformer oil to just above the upper extremity of the fuse wire, rubber washers and discs preventing the oil from leaking out. When the fuse blows, this oil immediately fills the gap caused by the broken fuse wire and forms an effective insulation which will prevent arcing on the highest voltages.

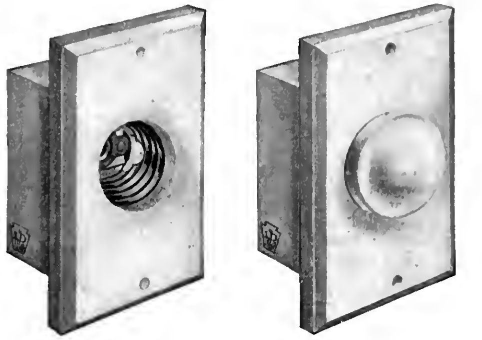
Tests have been made on this fuse by one of the most important plants in Canada, and these tests were evidently of a satisfactory nature, as they have decided to equip their plant with them for 50,-000 volts.

One of the tests is worthy of mention. In order to make a thorough test of its current capacity they used a piece of No. 10 copper wire in place of the ordinary fuse wire and short-circuited the fuse on 2,200 volts with good results. The fusing point of No. 10 copper wire is 300 amp., which on 2,200 volts makes a current of 660 kw. The Anyun Lamp & Electric Company, of Buffalo, is the manufacturer.

Wall Box Receptacle.

A new wall box receptacle is the latest addition to the "P-K" line, made by the H. T. Paiste Co. It is constructed in one piece of porcelain, which prevents any grinding, and affords a "finish" to the plate that never tarnishes or changes. It takes any Edison attachment plug, which makes it available for immediate use in the many places where such a plug is already wired.

As the result of long experimenting, the concern is able to furnish



FIGS. 1 AND 2.—WALL BOX RECEPTACLES.

these receptacles and porcelain cap attachment plugs to match in five most artistic special finishes. Each receptacle is furnished with a special dummy plug which takes the place of the attachment plug when the latter is not needed, thus preserving the neatness of the receptacle.

The two illustrations show the device at a glance. Fig. 1 is a view of the receptacle ready for use and Fig. 2 shows it with a dummy plug in place.

Light and Power in Electricity Building, St. Louis.

Prof. W. E. Goldsborough, chief of the Department of Electricity, has issued data as follows in regard to the light and power service in Electricity Building, St. Louis Exposition:

Regarding the matter of electric service to be available in the Electricity Building during the time of the Exposition, arrangements have been made to supply the following service for commercial use in the above building, namely: 104-volt, 25-cycle, alternating current, 1 and 3-phase; 104-volt, 60-cycle, 1 and 2-phase; 6,600-volt, 25-cycle, 1 and 3-phase; 2,200-volt, 60-cycle, 1 and 2-phase; 2,200-volt, 60-cycle, 1 and 3-phase; 110-volt, 220-volt, and 500-volt, direct current.

For distribution of the above service the following plans have been adopted: 104-volt, 25-cycle, 300-kw available and distributed over entire building; 104-volt, 60-cycle, 100-kw, available and distributed over entire building; 110-volt, 220-volt and 500-volt, direct current, 100-kw, available and distributed over building; 6,600-volt, 25-cycle, 100-kw, available at transformer space only; 2,200-volt, 60-cycle, 50-kw, available at transformer space only; 2,200-volt, 50-cycle, 50-kw, available at transformer space only.

Should any exhibitor require service covered by the last three items it will be necessary for him to wire from his space to the transformer space located in the northwest corner of the Electricity Building. In addition to the service mentioned above, we will have at the transformer space a limited quantity of 340-volt, 25-cycle, one and three-phase, and 400-volt, 25-cycle, one and three-phase. These two items are for supplying current to rotary converters and motor-generators installed in the transformer space.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There is more strength to the stock market, and a demand for high-grade dividend-paying shares of companies of established credit, as well as for bonds. The United States Steel securities were strong on the better impressions prevailing as to the outlook in the iron and steel industry. Not a little attention was paid to high-grade industrial dividend stocks, such as General Electric. Brooklyn Rapid Transit was a feature, there being further intimations that the money is being raised to carry out improvements in its terminal facilities and power plants with the aid of capitalists interested in other local traction concerns. The transactions in B. R. T. aggregated 156,200 shares, the range of prices being between 50, the lowest, and 53¾, the highest, the closing figure being 53⅛—a net increase of ⅜ point. General Electric and Westinghouse common stand at the head of the list of electrical securities in the matter of net gains, the former closing with a gain of 6 points and the latter 9⅝. General Electric touched 173, but reacted and closed at 171½, the lowest figure being 164½. Westinghouse showed considerable activity, 8,900 shares having changed hands. This stock reached 170 and closed at 168, the lowest figure of the week being 157½. Westinghouse preferred remained practically steady throughout the week, closing at 193, this being, however, a net loss of 2 points. Metropolitan Street Railway closed at 123⅛, ex. div., this being a gain of 3⅛ points. American Telegraph & Telephone gained 1 point, closing at 126, and Western Union ¼, the closing price being 86¼. Following are the closing quotations of December 29:

NEW YORK.

	Dec. 21	Dec. 29		Dec. 21	Dec. 29
American Tel. & Cable	80	80	General Electric	164	176
American Tel. & Tel	125⅝	128⅛	Hudson River Tel	..	..
American Dist. Tel	24	24	Metropolitan St. Ry	122¼	125⅜
Brooklyn Rapid Transit	50⅞	54	N. E. Elec. Veh. Trns	..	..
Commercial Cable	..	..	N. Y. & N. J. Tel	..	..
Electric Boat	15	15	Marconi Tel	..	25
Electric Boat pfd	40	40	Western Union Tel	..	86⅛
Electric Lead Reduction	⅝	1	Westinghouse com	157	175½
Electric Vehicle	5¼	5¼	Westinghouse pfd	180	190
Electric Vehicle pfd	8	9			

BOSTON.

	Dec. 21	Dec. 29		Dec. 21	Dec. 29
American Tel. & Tel	125¼	128	Western Tel. & Tel. pfd	*81	78
Cumberland Telephone	*115	*114½	Mexican Telephone	1⅞	1½
Edison Elec. Illum	220	232	New England Telephone	122	121
General Electric	165	176	Mass. Elec. Ry	18	20
Western Tel. & Tel	7½	7½	Mass. Elec. Ry. pfd	75	75¾

PHILADELPHIA.

	Dec. 21	Dec. 29		Dec. 21	Dec. 29
American Railways	43	43½	Phila. Traction	..	97¾
Elec. Storage Battery	54	54	Phila. Electric	6	6
Elec. Storage Battery pfd	54	54	Phila. Rapid Trans	9¾	8⅝
Elec. Co. of America	8	8⅛			

CHICAGO.

	Dec. 21	Dec. 29		Dec. 21	Dec. 29
Central Union Tel	..	..	National Carbon pfd	92	92
Chicago Edison	..	..	Metropolitan Elev. com	16	17
Chicago City Ry	160	155	Union Traction	5½	6½
Chicago Tel. Co	..	..	Union Traction pfd	25½	*29
National Carbon	20	20½			

*Asked

WESTINGHOUSE BUYS ROAD.—$2,000,000 6 per cent. notes of the Westinghouse Electric & Manufacturing Company have been issued for the purpose of paying in part for the Lackawanna & Wyoming Valley Rapid Transit Railway, which runs from Scranton to Wilkesbarre and other points in Pennsylvania. The road is 42 miles long. In addition to the issue of notes the company took money out of surplus earnings, about $4,000,000, to complete the payment for this property. Westinghouse interests say that the property is worth a great deal more than was paid for it. The object in purchasing this road is to demonstrate what can be accomplished by using electricity for motive power in the transportation of both freight and passengers. The company will begin at once to equip this line with the latest electrical apparatus. It is officially stated that as soon as the Westinghouse Company has equipped the road with electrical equipments arrangements have been already made to sell the property. It is presumed that the company which stands ready to take the property is one of the anthracite coal roads. If the Westinghouse Company deems it advisable to sell the road after it has been electrically equipped and in operation the transaction will show a substantial profit to the Westinghouse Company. The road was purchased from a Philadelphia syndicate and the purchase price has not as yet been stated.

WASHINGTON-BALTIMORE TROLLEY.—It is stated that the high-speed electric railway between Washington and Baltimore, with a branch to Annapolis, Md., already constructed from Washington to Laurel, Md., is to be completed. Cleveland capitalists are at the head of the company. Some time ago it went into the hands of receivers. It was announced that a proposition will be submitted to the creditors for their approval. It is expected that at least $2,000,000 will be required to complete the property, and about $250,000 is needed to provide for debts due. An underwriters' committee has undertaken to prepare a plan for completing the property, and in the meantime calls have been made upon the underwriters to protect their interests by advancing pro rata the sum of $250,000. The plan contemplates the formation of a syndicate, mainly of receipt holders. To facilitate efforts looking to the completion of the property, it is proposed to bring into the control of the committee the receipts representing bonds and stock and all the outstanding bonds and stock not represented by receipts, and to bring into the same control the various committees and boards authorized or elected by holders of stock, bonds, or receipts. The road will be thirty-one miles long.

DIVIDENDS.—The directors of the Mexican Telegraph Company have declared the regular quarterly dividend of 2½ per cent, payable January 14. The directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable January 7. The directors of the E. W. Bliss Company have declared the regular quarterly dividend of 2½ per cent. on the common and 2 per cent on the preferred, payable January 2. Directors of the Philadelphia Company declared a dividend of 1½ per cent. on common, payable February 1, as registered January 2. It is the regular quarterly dividend. Directors of Westinghouse Electric have declared a quarterly dividend of 2½ per cent. on the preferred and assenting and non-assenting stocks, payable January 11. Hall Signal directors have declared the regular quarterly dividend of 1½ per cent on the common stock, payable January 1.

CINCINNATI GAS & ELECTRIC.—President Kenan reports a good business in 1903. At the end of the Company's fiscal year next spring there will be left after the payment of all dividends and fixed charges a large sum for a surplus fund. This will be a remarkable showing in view of the fact that at the last annual meeting there was a deficit of about $65,000. For the past month the net earnings of the comapny amounted to $26,000 over November of 1902. The increased output of gas for December, as compared with the first 15 days of December last year, was 10,966,000 cubic feet. During the first 15 days of the month the company had applications for 170 new gas connections, as compared with 61 for the same period last year. There was sold thus far this month 117 gas ranges; none last year. There have been secured 106 new electric light consumers, who will use 3,395 incandescent lamps. The company has now 417,785 incandescent lamps in use, as compared with 344,776 this time last year, being an increase of 21 per cent.

B. R. T. EXPENDITURES.—It is stated that the management of Brooklyn Rapid Transit Company has placed the financial needs of the company before the principal owners of the property, and these owners have canvassed the situation well enough to secure definite knowledge that from $15,000,000 to $20,000,000 of cash can be obtained by the company as it needs it, on a 5 per cent basis as a maximum rate. With this knowledge the company is preparing to go ahead with its contemplated improvements. Details of the plans for raising the money will be worked out from this time on. The company appears badly in need of new equipment in various directions.

MEXICAN TELEPHONE reports as follows:

	1903.	1902.		1901.
Sept. gross	$23,024	$20,907	Inc.	$2,117
Sept. net	11,925	9,548	Inc.	2,377
Seven months gross	158,958	139,937	Inc.	19,021
Seven months net	$80,119	$63,131	Inc.	$16,988
Surplus Sept. 30	4,759	4,302	Inc.	457

CUMBERLAND TELEPHONE.—The Cumberland Telephone Company reports for the month of November as follows:

	1903.	1902.	Changes.	
Gross	$314,563	$271,650	Inc.	$42,913
Expenses	177,987	170,960	Inc.	7,027
Net earnings	$136,576	$100,689	Inc.	$35,887
Charges	2,741	23,960	Dec.	1,219
Surplus	$13,834	$76,728	Inc.	$37,106

NORTHWESTERN TELEPHONE EARNINGS.—The Northwestern Telephone Company reports annual gross earnings of $902,802 to State Auditor Iverson, of Minnesota. Of this amount, the State received 3 per cent. as imposed by law, which amounted to $27,084.07.

ILLINOIS TUNNEL COMPANY.—It is announced that the Illinois Tunnel Company has practically completed its plan of taking over the Illinois Telephone & Telegraph Company. The 5 per cent. bonds of the telephone company, amounting to $5,000,000, have been redeemed at 110, and stock to the same amount has been taken up at par. The tunnel company has a capitalization of $30,000,000 in 5 per cent. bonds, and the balance of the bonds will be issued from time to time in extending the underground tunnel railway and freight distributing project. The Illinois Tunnel Company's aim is to act as a steam railway terminal. In doing this, it is expected to carry mail between the post-office and the railways, deliver coal, packages, freight, and all kinds of merchandise.

TWIN CITY RAPID TRANSIT BONDS.—It is announced that the Twin City Rapid Transit Company's directors have authorized an issue of $10,000,000 5 per cent. gold bonds of 1928. At the present time only $3,500,000 will be issued. Of this amount $1,000,000 is to cover expenditures on power plants, sub-stations, equipment and other improvements made in 1903. Another $1,000,000 is to be expended next year to finish the power plant and sub-stations. The remaining $1,500,000 will be used to complete two additional lines between St. Paul and Minneapolis and for the extension of other suburban lines.

MERGER IN PITSBURG.—A merger of the electric lighting and power plants in the coke regions and the Pittsburg, McKeesport & Connellsville Railway system has been effected, and an application for a charter for the combined interests will be made at Harrisburg December 31. It is said the capitalization will be considerably over $5,000,000. The new company, which will be known as the Western Pennsylvania Railways Company, will be in control of the entire lighting, power and street railway system of Westmoreland and Lafayette counties, as well as part of the trolley system of Allegheny County.

TELEPHONE FORECLOSURE.—Judge Swan, of the United States Circuit Court, at Detroit, on December 24, confirmed the foreclosure sale of the Michigan Telephone Company, to N. W. Harris, who represents the syndicate of bondholders and who bid $4,100,000 for the property at the sale of November 5. The petition of Charles Flowers and Samuel T. Douglass, the latter representing the minority stockholders' protective committee, asking that the sale be set aside, is dismissed. The cases will be appealed to the United States Court of Appeals in Cincinnati.

TELEGRAPH EARNINGS.—The Central & South American Telegraph Company reports for the December quarter $286,500 gross and $189,500 net; total surplus, $884,567 against $775,578 last year. The Mexican Telegraph Company reports $129,000 gross for the quarter, $104,500 net; total surplus, $1,430,052, against $1,204,529. The earnings of both companies show a steady growth year by year.

Commercial Intelligence.

THE WEEK IN TRADE.—The principal features were strong and exceptionally active markets for speculatively dealt-in staples, and fair re-orders from jobbers. Business in wholesale lines continues dull, which, however, is usual at this period of the year. Other notable features were the exceptional ease in the money market and the sustained better feeling in iron and steel. The events in industrial lines are the ending of the Colorado coal strikes and the gradual downward adjustment of wages in coal, coke and iron and steel to meet changed conditions of supply and demand. The year is, however, closing in many lines with a rather more cheerful sentiment than appeared possible some time ago. A more confident tone has been brought about in the structural steel market by the reaffirmation of prices for billet, plate and structural steel. Much buying is not expected, however, until after the new year, although Chicago reports that some good quantities of rails have been taken up. In coal a record production, 60,000,000 tons, of anthracite is noted, prices being steady throughout the year. This output is 13 per cent. more than that of the previous record year. 1901. The prices for raw textiles are a drawback, with which the cotton manufacturing trade is struggling. Eastern mills not well supplied with cotton are buying sparingly. In copper extreme dulness prevailed throughout the week, and practically no business was transacted. There is no demand, and consumers are slow in coming into the market. Prices are unchanged at 12⅜@12⅝c. for Lake; 12¼@12½c. for electrolytic, and 12⅛@12⅜c. for casting stock. The business failures for the five days ending with December 23, as reported by *Bradstreet's,* aggregated 243, against 239 the week previous, and 166 the corresponding week last year.

BRITISH TROLLEY RAILS.—A cable dispatch from London, of December 20, says: A rather striking effect of the tariff reform agitation is the determination of the London County Council to revise its policy in regard to the equipment of tram lines, and, instead of ordering rails from Belgium, from which country the lowest bid came, it will buy from a British firm. "The decision," said a member of the Council, "indicates how powerful are the forces working in favor of tariff reform." The decision of the London County Council not to buy Belgian rails is the final outcome of a long controversy. The subject came up on December 8, and a motion to refer the matter to the Highways Committee was adopted. In moving the resolution Col. Rotton said the workingmen of England required to have as much work as they could get during the coming winter, and therefore the question of sending work abroad became a burning one. From information he had received, said Col. Rotton, he found that the wages paid by the firm which was manufacturing the Council's rails were—for foremen, 9d. to 2d. per hour; for what were known as first hands, 6d. to 9d. per hour, and for laborers and all others, 3½d. to 5d. per hour. Were these, he would ask, the rates which were imposed upon English contractors? The Council, said Col. Rotton, had sent two contracts to Belgium representing a total sum of £75,619, about 50 per cent. of that would be paid to the workmen, the other half going for profit and material. That meant that £37,879 had been lost to English workmen. At the rate of 30s. a week that amount would have given employment to 25,610 men for one week, or 485 men for a whole year. Therefore, 485 men had, by reason of this contract, been unemployed for one year in the steel trade of England.

GAS AND ELECTRICITY.—An official of the New York Consolidated Gas Company is quoted as follows: "I wish we had all realized ten years ago how this city would have grown by this time. I think we would have enlarged our plant much more than we did, and those of us who have been interested in the consolidation of the various gas companies would certainly have provided for much more extensive business than we did. This is particularly true with reference to electric lighting. The earnings from our electric light plants alone are becoming the most important part of our business. The consumption of gas for fuel purposes is also becoming a greater factor than ever before. With the incoming municipal administration there is no doubt that our present differences with the city in regard to lighting can be satisfactory adjusted."

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended November 20 and since December 20 compares as follows:

	1903.	1902.	1901.
Gross output	96,963	93,487	88,497
Returned	32,297	36,838	27,510
Net output	64,666	56,649	60,987
Since December 20:			
Gross output	1,020,941	994,422	867,323
Returned	441,013	420,682	352,173
Net output	579,928	573,740	315,150
Total outstanding	3,730,248	3,099,346	2,467,966

CUSTOMS RULINGS.—It has just been held by legal authority that cable bought in England by the Commercial Cable Company and brought from Hawaii, must pay duty. General Appraiser Hay has handed down a decision on the classification of retort graphite and retort carbon, which are byproducts in the manufacture of gas from bituminous coal. They had been assessed at 35 per cent., as articles in chief value of carbon, but Mr. Hay sustained the contention of E. P. Earle, of New York, the importer, for classification as coke at 20 per cent.

SCHIEREN LEATHER BUILDING.—The Cruikshank Company has sold for Roosevelt Hospital 30, 32 and 34 Ferry Street, New York City, old four-story buildings, on plot 72.5 by 48.5. The buyer is ex-Mayor Charles A. Schieren, the well-known leather manufacturer, who already owned the adjoining property at the southwest corner of Cliff and Ferry Streets, and who will now carry forward the building operation, which he has had under consideration for several months.

OTIS ELEVATORS FOR LONDON HOTEL.—The London interests of the Otis Elevator Company have secured a contract for the equipment of the new Savoy Hotel extensions. The installation, including the eight Otis elevators in the existing buildings, will be one of the largest of its description in Great Britain. The present contract calls for nineteen elevators, comprising five large passenger, four baggage and ten service.

LIGHT AND POWER EQUIPMENT FOR MEXICAN MINES.—La Maria Mining Company, which is engaged in extensive mining operations in the vicinity of Morelia, State of Michoacan, Mexico, is in the market for considerable equipment, including machinery for a lighting and general power plant for its mines. Julio Ambrosino, of Morelia, is the controlling factor in the enterprise.

POWER & MINING MACHINERY COMPANY has issued a circular in regard to its recent changes. The officers are B. Guggenheim, president; Cyrus Robinson, vice-president; H. C. Holthoff, vice-president; Burdett Loomis, Jr., vice-president; B. T. Leuzarder, secretary; L. P. Feustman, treasurer; Hawley Pettibone, consulting engineer. The circular says: We beg to call to your attention that the Loomis-Pettibone Gas Machinery Company, after the recent increase in capital, has now been merged with the Holthoff Machinery Company, of Milwaukee, Wis., under the new corporate name of Power & Mining Machinery Company. We are making extensive improvements and additions to our Milwaukee plant to meet the increasing demand for the American Crossley gas engines, Loomis-Pettibone gas apparatus and Holthoff mining machinery. We shall continue, under Mr. Holthoff's personal supervision, the manufacture of mining, smelting and milling plants and machinery. The Loomis-Pettibone gas producers have established for themselves a world-wide reputation as the only gas producers successfully generating a fixed gas for power and metallurgical work from either anthracite or bituminous coals, coke or wood. The Crossley gas engine, of which there are over 50,000 in operation, and which we are now building as the American licensees, we believe to be the best gas engine on the market. The economies assured by our guarantee to produce power with a consumption of one pound of good bituminous coal per brake hp-hour, or with two and one-half pounds of wood, cannot fail to be of interest to all users of power, for whatever purpose.

HUDSON RIVER POWER LAKE.—A lake larger than Lake George, in which enough water may be stored to maintain the Hudson River at a normal height during the low-water period, is one of the results which the incorporators of the Hudson River Electric Power Company, of Queensbury, expect will follow the completion of their plans. This company was incorporated December 28, at Albany, with a capital of $1,000,000, and having for its purpose the development of the power and resources of the falls of the upper Hudson, and for the distribution of electric power as far west as Utica and Syracuse, and as far south as Hudson. It is expected that the company will build the immense storage reservoir in the Sacandaga Valley, for which the engineers of the Hudson River Water Power Company have been planning for the last two years. The dam and power station will be built at Conklingville, and about 600 pieces of property will be flooded, as well as several small hamlets. The law department of the company has been searching titles and getting options on property for several years, and it is anticipated that by the time permission is asked of the Legislature to construct the dam, the company will own every piece of property to be flooded.

EQUIPMENT FOR APARTMENT HOUSES, ETC.—Percival Robert Moses, 35 Nassau Street, New York, has secured the contract for the equipment of a six-storied hardware factory, which is under construction by Charles E. Ring on Kent Avenue, Brooklyn. The engine will be of 150-hp capacity, from the Fitchburg Engine Company. It will be direct connected to a 75-kw C & C generator. The boilers will be built by the Bigelow Company, 15 Cortlandt Street. Several motors have yet to be purchased. Mr. Moses is to act as engineer regarding the electrical and refrigerating equipment to be installed in the 12-story apartment hotel being built at Sixty-ninth Street and Broadway by the Construction & Spencer Realty Company, McCreery Building, Forty-second Street. It has not yet been decided what equipment will be installed. Plans are now being drawn up, however. An apartment hotel to be built at Eighty-ninth Street and Central Park West, will also be installed with a complete electrical steam and refrigerating plant under the supervision of Mr. Moses.

CURTIS TURBINE FOR MEXICO.—The plant of the Monterey Electric Light & Power Company is to be remodeled and considerably enlarged. The electrical engineering and contracting firm of J. G. White & Co. will undertake the work. Contracts have just been let for the major part of the new equipment, which will have a capacity of about 1,000 kw. A 500-kw Curtis turbine has been ordered. This will be the first large sized steam turbine to be installed in the Southern republic. Two 240-kw belt-driven alternators, one 125 engine-driven exciter generator, and two 7½-kw belted exciter generators, transformers, etc., have also been requisitioned for. The contract was awarded to the General Electric Company, which will also supply 150 fan motors. The boilers will be of Babcock & Wilcox build.

SOME C & C FOREIGN ORDERS.—The C & C Electric Company, 143 Liberty Street, New York, has recently taken various Manchurian, Mexican, Cuban and British orders. A 20-hp slow-speed direct connected motor has been ordered by H. B. Roelker, 41 Maiden Lane, for driving ice machinery in Manchuria. A 30-kw belted dynamo and switchboard has been requisitioned for shipment to Monterey, Mexico, for lighting purposes. A 13-kw generator—belted type—and two motors of 5-hp capacity each have been ordered for light and power use in Cuba. Several orders for motors have come in lately from C. R. Heap, of London.

ELECTRIC TRACTION FOR PROGRESO, YUCATAN.—An electric traction system is to be constructed at Progreso, the prosperous seaport of Yucatan. The United Railways of Yucatan, which operates several steam railroads, has been granted a concession by the municipal authorities. Lines are to be built on all the principal streets. Progreso, which has a population of about 20,000 inhabitants, possesses no means of locomotion to the business center, not even a hack line. The export commission house of Thebaud Brothers, Broad Street, New York, acts as purchasing agents for the United Railways.

EQUIPMENT FOR SAO PAULO.—The daily press reports that the General Electric Company had secured a contract for further equipment for the Rio Tiete water-power plant of the Sao Paulo Light, Tramway and Power Campany, Limited, of Sao Paulo, are premature, as the matter has not yet been decided. The contracts, which will include generators and water turbines, will probably be let shortly after the holidays through the New York offices of the Sao Paulo Company, 29 Broadway. Mr. F. S. Pearson is the principal New Yorker interested.

ELECTRICAL EXPOSITION IN WARSAW.—An electrical exposition is planned to be held in Warsaw, the capital of Poland, between May and September, 1904. The exhibition is to include a special section to be devoted to new inventions. Foreign firms are invited to take part. It is anticipated that exhibits will be allowed to enter Poland free of duty. Interested parties can secure further information from the committee, Philharmonia Building, Moninski Street, Warsaw.

ISAAC L. RICE COMPANIES TO MOVE.—The Consolidated Railway, Electric & Equipment Company, the Consolidated Railway, Lighting & Refrigerating Company, the Railway & Stationary Refrigerating Company, the Lindstrom Brake Company, the Electric Launch Company, the Electro-Dynamic Company, the Electric Boat Company, the Holland Torpedo Boat Company, and Isaac L. Rice himself are about to move their offices from the American Society Building to the Hanover National Bank Building.

MEXICAN TRACTION SYSTEM EXTENDED.—The line of the Campania de Ferrocaniles del Distrito Federal, which are controlled by the Mexico Electric Tramway, Limited, Mexico City, are to be extended. A road is to be built between Tlalpan and Tulpulco and Kochimilco, suburbs of Mexico City. These lines will aggregate about twenty miles. Construction will begin next month. The equipment will be purchased in the United States.

MACHINE SHOP EQUIPMENT.—The Shaw Electric Crane Company, of Muskegon, Mich., has secured a contract for a crane of 30-ton capacity, for installation in the machine shops of the Canton-Hankow railway, which the American China Development Company, 320 Broadway, of which William Barclay Parsons is president, is building in China. A large contract for machine tools, etc., was recently placed with Wonham & Magor, Morris Building.

DEAL IN PENNSYLVANIA.—The electric lighting and power plants in the Connellsville coke region and the Pittsburg, McKeesport & Connellsville Railway system are to be consolidated, and a new company with a capital of $5,000,000, to be known as the Western Pennsylvania Railway Company, will be organized to take over and run the properties.

AMERICANS AFTER MEXICAN WATER POWER.—Americans propose to construct an extensive water power plant in the vicinity of Morelia, State of Michonacan, Mexico. C. C. Place, A. D. Henderson and J. H. Wilcox, all of Oswego, N. Y., are the principal parties interested in the project. They have just returned from a trip to the southern republic.

LIGHTING EQUIPMENT FOR SYDNEY, N. S. W.—Mackenzie, Quarrier & Ferguson, 114 Liberty Street, has secured an order for a 150-hp Harrisburg simple engine, which is to be direct-connected to a General Electric generator of 100-kw capacity for lighting service in Sydney, New South Wales.

CHICAGO GAS ENGINE PLANT.—The Scudder Electric Company, of Chicago, Ill., has just placed an interesting contract with New York concerns. It calls for three 100-kw, C. & C. generators, direct-connected to Nash gas engines, operating on natural gas, for installation in a small, block-lighting, central-station plant.

CONTROLLERS, ETC., FOR ENGLAND.—The Electric Controller & Supply Company, of Cleveland, has secured some fair-sized British orders for its specialties through its London offices, 47 Victoria Street.

EXPORTS AND IMPORTS.—Details of eleven months' commerce of the year 1903 are just made public by the Department of Commerce and Labor through its Bureau of Statistics. They show an increase in practically all of the great groups into which the Bureau of Statistics divides the exports and in all of the groups into which it divides the imports. Agricultural products, as a whole, show an increase of $74,000,000; products of the forests, $10,000,000; products of the mines, $8,000,000; manufactures, $5,000,000, and miscellaneous articles, $2,000,000. In the single group, fisheries, is shown a slight decrease of a little more than $1,000,000. The figures for the month of November show a marked growth in exports of manufactures, the total for the month being $34,093,639, against $30,513,512 in November of last year. Agricultural products also show a marked increase in the month, the figures for November, 1903, being $114,172,255, against $83,035,850 in the same month of last year. The increase in agricultural exports occurs chiefly in cotton, of which the value of the month's exports is unusually high. The increase in exports of manufactures is distributed through many articles, but does not occur, as had been expected, in iron and steel. Possibly one reason is that the gain in bulk does not yet offset the lower prices at which such exports have been made. Total exports for the eleven months are $1,309,000,000 and imports $917,784,000.

MAIL TELPHERAGE IN ENGLAND.—A syndicate has been formed to develop in England the telpherage method of transmitting mail. A syndicate has been formed with a capital of £150,000, divided into 60,000 6 per cent. cumulative preference shares of £1 each, and 90,000 ordinary shares of £1 each. Two-thirds of the amount wanted will be raised in Italy and France, and one-third only in England. The syndicate is formed to take over the patents from Count Taeggi Piscicelli, the inventor, and to develop the system. The directors are the Duc D'Uzes, the Duc de Morny, the Marquis Des Cars, the Comte de Pradere, Sir Theodore Fry, Mr. Charles Edwards, Mr. Henry S. Saunders (a director of the Marconi Company), Count Piscicelli, and Mr. William Digby—the two last joining the board after allotment. England, Italy, France and Spain are represented on the directorate. The Count has nothing more nor less than the later telpherage system introduced of late so successfully by Mr. H. McL. Harding and the United Telpherage Company, who have now three or four score industrial plants in operation. In addition to using telpher motors, it is proposed also to stamp the letters in some way automatically at the drop boxes, but that seems quite an unnecessary refinement.

POWER PLANTS FOR SWITZERLAND.—Among the power stations which are now being built in Switzerland that of Lucerne, in Engelberg-Obermatt, takes a prominent place. Numerous bids were received for this work, and after careful selection by a committee of experts, the plan of the Oerlikon Company was accepted as the best. In consequence, this firm has received the contract for the apparatus for the power station at Obermatt and the substation at Lucerne. The capacity of the station will be 14,000 hp, and current will be transmitted to Lucerne at 27,000 volts over a 18½-mile line. In the Lucerne substation the potential will be reduced to 2,600 volts for transmission to surrounding, districts, including the entire canton of Obwalden. Current will also be supplied for the Lucerne-Engelberg Railway. Several weeks ago the great power station of the Compagnie Vaudoise des Forces Motrices des Lacs de Joux et de l'Orbe was put in operation. This power station will supply over 190 villages in the canton of Waadt with light and power. It will have a capacity of 10,000 hp, deriving its energy from the Lac de Joux Falls near Vallorbe. The alternators will generate directly 13,000 volts at which potential the current will be transmitted.

AUSTRO-GERMAN DEALS.—With regard to consolidations noted in our Digest this week, Mr. J. H. Worman, United States Consul General, at Munich, writes under date of November 5: "A fusion has taken place between the different electric companies of Austria and Germany. The Schuckert Company, of Nuremberg—which was one of the largest industrial enterprises for electricity in Europe, and maintained its branches not only in various cities of the Empire, but also in Austria, with headquarters in Vienna—effected early this year a union with the Siemens & Halske Company, of Berlin, and now a fusion has taken place between the Siemens & Halske Company and the Austrian Schuckert works, so that it may be said that there is at present one trust controlling the trade of both Germany and Austria, for it is proposed to bring under the control of this new combination all the enterprises for electricity in Austria and, of course, in turn, in Germany under one general trust. The capital of this new trust, as far as it covers the control of Austria, is estimated at 18,000,000 crowns ($3,654,000)." That will not go very far for a trust to cover so much ground.

GERMAN CABLE.—The fourth cable line to connect New York City directly with Continental Europe will be completed next year. There is already a German cable starting from the island of Borkum near the mouth of the Ems and extending to this city by way of Fayal in the Azores. The second line takes exactly the same route and has been completed as far as the Azores. The route has been illustrated in these pages. The German Government agreed to pay to the German Atlantic Telegraph Company $178,500 if the line was completed to the Azores by January 1, 1904. In spite of the very unfavorable weather conditions on the Atlantic during the past few months the line has been laid to the Azores and is now in operation between Borkum and Fayal. The second half of the line is now to be laid and the German Government has agreed to pay the company a certain sum if it is completed between the Azores and New York by January 1, 1905.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "Chloride" and "Exide" accumulator, has recently completed arrangements with the trustees of the estate of W. G. Warden, by which the company acquires the entire property situated on Allegheny Avenue, between Eighteenth and Twentieth Streets. The main building on Allegheny Avenue is a seven-story and basement brick structure, having two wings, and containing over 280,000 sq. ft. of floor space. Aside from this building, there are 16 other structures utilized for the different processes of manufacture by the company. The property covers over three acres of ground, and has a frontage on Allegheny Avenue of nearly 600 ft., and is bounded by the Philadelphia & Reading Railway and a branch of the Pennsylvania Railroad, thus giving unusual facilities for the handling of freight and express.

SALES OF TELEPHONE APPARATUS.—Among last week's switchboard shipments reported by the American Electric Telephone Company, of Chicago, are the following: Towner, N. D., one 100-line express; Adair, Ill., one 100-line express; Glenwood Junction, Mo., one 100-line express; Wessington, S. D., one 100-line express; Fairbault, Minn., one 50-line express; Whiting, Iowa, one 100-line express; Kremlin, Okla., one 100-line express; Auburn, Neb., one 540-line installed express; Pleasant Hill, Mo., one 200-line express; Yates, Mo., one 100-line express; Sargent, Mo., one 100-line express; Espyville Station, Pa., one 100-line express; Salisbury, Mo., one 100-line express; Savannah, Mo., two 200-line express; Wolsey, S. D., one 100-line express.

POWER IN SWITZERLAND.—The Motor Aktiengesellschaft für augswandte Elektricitaat of Baden, Switzerland, writes us: "With reference to your article on the Beznau hydro-electric plant in your export issue of November 7, we beg to inform you that the plant in question is owned and operated by our company. We may add that we have installed in Switzerland besides some minor plants the well-known plants at Spiez on the Kander (6,500 hp.), and at Hagneck on the Aare (5,200 hp). We are owners of some important water rights in the north of Italy, the utilization of which we are at present engaged in preparing."

ELECTRICAL EQUIPMENT & SUPPLY COMPANY, of Pittsburg, Pa., will start formally in business on January 2, with headquarters at 215½ Fourth Avenue. It will handle the detail apparatus and supplies of the Westinghouse Electric & Manufacturing Company, General Electric Company, Marshall-Sanders Company, and New England sockets and supplies, and the Shelby incandescent lamp. This list is already being enlarged. The officers of the company are J. H. Waugh, president; Thomas Watson, vice-president; C. G. Hussey, secretary and treasurer.

RAWSON ELECTRIC COMPANY.—It is stated that the Rawson Electric Company, of Elyria, Ohio, manufacturer of telephones and supplies, contemplates erecting a large factory that will employ 300 men. It will also manufacture telephone switchboards and other apparatus. The organization will probably take the form of a consolidation between several independent telephone manufacturers and patentees. Chicago men are prominent in the negotiations which have so far taken place.

MARINETTE IRON WORKS MFG. COMPANY, Marinette, Wis., has built and occupied quite a large factory at Chicago Heights, comprising one machine shop, 60 by 150 ft., one machine shop, 100 by 250 ft.; foundry, 100 by 200 ft.; blacksmith shop, 40 by 60 ft.; pattern shop, 40 by 50 ft.; pattern storehouse, 40 by 50 ft.; power house, 40 by 60 ft., and other smaller buildings, the entire plant being of brick and stone construction.

JAPANESE TRACTION PROJECT.—The construction of an electric railway between Kioto, the ancient capital of Japan, with a population of some 350,000, and Hiogo, another prominent city, is projected. The length of the line will be upwards of fifty miles.

BALL ENGINE ORDER.—The Hocking Valley Railroad has recently placed a contract for three direct-connected units. The Ball Engine Company, Erie, Pa., will furnish the engines.

General News.

THE TELEPHONE.

ELDORADO, ARK.—The Smith Local Telephone Company contemplates remodelling its long-distance lines. One hundred and fifty subscribers are furnished with service, the rates being $1.50 to $2 a month.

EUREKA SPRINGS, ARK.—On the death of the proprietor of the Eureka Springs Telephone System the management of the exchange passed into the hands of his executrix, Mrs. Emma F. Van Allen. She writes us that it is her plan to put in a number of party lines, and to erect a new 100-drop switchboard in the hope of increasing the number of subscribers. A 200-drop Telephone Mfg. Company's switchboard has been operated at this exchange.

FRUITVALE, COL.—The Fruitvale Nutrial Telepbone Company has been incorporated with a capital stock of $1000. The directors are W. J. S. Henderson, D. L. Howard and others.

MACON, GA.—The City of Macon has made a new contract with the Southern Bell Telephone Company by which the latter pays a license of $250 and furnishes free telephones to the city, which will amount to $570 annually.

EGAN, ILL.—The Leaf River & Egan Telephone Company is preparing to build a line through this city.

ATKINSON, ILL.—Henry County Telepbone Company has increased its capital stock from $2500 to $15,000.

CHICAGO, ILL.—The Automatic Telephone Company has increased its capital from $3,000,000 to $5,000,000.

CARTHAGE, ILL.—The East Carthage Telephone Company has been incorporated with a capital stock of $21,000. Directors: O. W. Cutler, C. G. Wright and others.

FAIRFIELD, ILL.—The Egyptian Telephone & Improvement Company has been incorporated with a capital stock of $2500. The incorporators are C. M. Brock, Luke Whitson and J. H. Morian.

COLLINSVILLE, ILL.—The Central Union Telephone Company has a force of men stringing a new telephone line from Centralia to Collinsville, Ill., where connection will be made with St. Louis.

EAST ST. LOUIS, ILL.—The management of the Wabash Railway Company is stringing wires along the right of way for a telephone service. The telegraph system will be kept intact, but it will not be used between local stations except in emergency.

MARION, IND.—The Central Union Telephone Company will spend several thousands of dollars in making improvements in this city.

BLOOMFIELD, IND.—Wm. Hawkins, of Freeman, has asked the town council for a franchise to establish another telephone system at this place.

WORTHINGTON, IND.—The Greene County Telephone Company has been incorporated with a capital stock of $10,000. Directors: W. H. Beatty and others.

DENVER, IND.—The Denver Mutual Co-operative Telephone Company is the name of a new company recently organized by the citizens of this place. The company has contracted for an exchange of business with the Peru Home Telephone Company. The new company has 75 subscribers to begin with.

SAN PIERRE, IND.—The Starke County Telephone Company has incorporated with a capital stock of $5000. The company will install telephone lines and exchanges in Starke, Laporte, Jasper and Pulaski counties. The principal exchange and office will be in San Pierre. Henry A. Smith, T. J. Weinkauff and William Swetzer are the incorporators.

INDIANAPOLIS, IND.—The progress made in telephony in Indiana is shown by the tax record in the Auditor of State's office. Eight years ago there were in the whole state 5677 telephones, independent and Bell together. To-day there are 80,000 independent and 22,000 Bell telephones in the state. That means one telephone for every 25 inhabitants.

CRAWFORDSVILLE, IND.—The Home Telephone Company is arranging to install a new 200-line section to its switchboard. The company will put in a new transfer system on the entire board. Four hundred applicants have been denied service during the past four months on account of inadequacy of the switchboard. The directors are considering the feasibility of putting in about 100 new cables to all parts of the city.

TERRE HAUTE, IND.—The Terre Haute Electric Company is constructing a new system of communication between the interurban cars on the Clinton electric line and the train despatcher of the road, whose office is in the car barns in this city. Instead of having telephones at the switches, as most electric lines have, each car is to have a telephone and when communication is desired a car can be reached at almost any place along the line.

LOGANSPORT, IND.—The Logansport Home Telephone Company has announced an increase in its rates for business telephones from $18 to $30 per year. This increase, however, does not affect subscribers who signed for five years' service when the system was still in course of construction. The company's managers say they have expended a large amount of money in making extensions and improvements and in securing long distance service for the benefit of patrons, and the amount of their investments and the additional cost of maintenance render it necessary to make the increase. The company cites the ordinance which provides that after the company has installed 1000 telephones within the corporate limits it shall have the right to charge for business telepones at the rate above mentioned. The company has now 1700 telephones in service in the city.

WEST UNION, IA.—O. W. Rogers will build a telephone line here in the Spring from West Union to Clermont.

WEBSTER CITY, IA.—The Stratford Independent Telephone Company, which proposes to install a plant in this city, will begin work January 1.

BOXHOLM, IA.—The Grant Township Mutual Telephone Company, of Boxholm, has been incorporated with a capital stock of $10,000. Alfred Sunberg is president and Axel Westeen is secretary.

ELECTRIC LIGHT AND POWER.

TEMPE, ARIZ.—P. E. Fuller, of Mesa, has prepared plans for the power plant of the Tempe Canal Company. The probable cost of work is $200,000.

COMPTON, CAL.—The Compton Water & Lighting Company has been incorporated with a capital of $25,000 by E. E. Moore, C. I. Mason, W. S. Davis and others, all of Compton.

SHOSHONE, IDA.—The Shoshone Electric Light & Power Company, Ltd., of Shoshone, has been incorporated to construct, operate and maintain an electric light and telephone system; capital, $25,000. Directors: Robert Hays, of Pocatello, Frank R. Gooding and Fred W. Gooding, of Shoshone, and others.

STERLING, ILL.—The local electric light company in the spring will expend about $15,000 in improving its hydraulic plant.

SHELBYVILLE, ILL.—The Shelbyville Water, Light & Heat Company has been incorporated with a capital stock of $50,000, for the purpose of establishing a plant in this city. The incorporators are C. C. Scovil, W. H. Beem, Max Kleeman, G. C. Bolinger, I. S. Storm, B. W. Kerr and W. S. Middlesworth. The franchise of the present water company, against which a heavy judgment was rendered at the last term of the Circuit Court and the plant ordered sold by Master in Chancery, expires in August, 1905, and it is the new company's purpose to be ready to do business by that time.

GIRARD, KAN.—The plans and specifications of E. H. Ricksecker, of Chanute, for the electric light plant have been adopted, and he has been employed as consulting engineer.

GALENA, KAN.—W. G. Sargent, of Joplin, Mo., is reported to have purchased water power and mills on Spring River, and the same will probably be developed for electrical purposes.

HANCOCK, MICH.—The City Council has entered into a three years' contract with the Houghton County Electric Light Company to furnish street lighting at $86 per lamp per year.

THREE RIVERS, MICH.—The Three Rivers Light & Power Company has purchased a large strip of land on the Portage River and has commenced excavations for a new channel to give the water a better fall to the power house.

KALAMAZOO, MICH.—C. H. Frisbee, of the Kalamazoo Valley Electric Company announces that his company will, in the spring, begin the erection of two new dams on Kalamazoo River, one near Ceresco and another near Plainwell, to have a combined capacity of about 6000 horsepower. The probable cost will be $500,000.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company has nearly completed the erection of a dam and power house on Flat river, about 1½ miles north of the village of Lowell, which is 18 miles east of Grand Rapids. The company's business has increased so rapidly that its four plants are insufficient and it is now operating auxiliary dynamos on the power of the municipal lighting plant and some of the local factories. The new plant near Lowell will put the company in good shape to handle all its business and much more. There are two dams, about a quarter of a mile apart. The upper dam includes a number of headgates in a heavy concrete and masonry wall which regulate the flow to the lower dam. This headwater has an eight-foot fall. Below this a turn in the river is cut off by a 35-foot canal cut through a hill, and giving a fall of 22 feet. The main dam is erected at the mouth of this canal, where it enters the river. A circular wall of masonry is utilized at this point. Here two modern headgates 9 feet in diameter and 65 feet in length are located, and in these will be placed the 10 turbines. The power plant is a modern fireproof building with concrete floors and steel roof. It will be equipped with two generators of 450-kw capacity. There will be no transformation at the plant, but the high tension wires will be carried to Grand Rapids, where, at the city limits they will enter conduits extending to the Grand Rapids plant of the company. Here the current will be stepped down to about 220.

MEXICO, MO.—The Mexico Electric Light Company, recently purchased from Macon men by local capitalists, is buying new machinery and adding to the plant in anticipation of installing 24-hour service.

WARRENSBURG, MO.—At a meeting of the City Council the city attorney was instructed to draft an ordinance, submitting to a vote of the citizens of Warrensburg a proposition for public ownership of an electric light plant.

COLUMBIA, MO.—At a meeting of the City Council it was decided to buy the water and light plant owned by the Columbia Water & Light Company. A committee consisting of six business men of Columbia and two experts was appointed to appraise the value of the plant, the city and the company agreeing to accept the decision of the committee.

SEDALIA, MO.—Messrs. James Green, George Blackford, Horace S. and Moses Rumsey, all of St. Louis, Mo., representing all of the shareholders in the Sedalia Gas & Fuel Company and the Sedalia Electric Light & Power Company, voted at a called meeting, held at Sedalia, Dec. 14, to sell the franchises, rights and properties of the two companies to Joseph Clarke and Horace Rumsey. This sale was in furtherance of a merger plan, which practically consummates and by which the Sedalia Gas Company and its plants and the Sedalia Water Company, with its electrical interests and power plants, are consolidated under one management.

RED LODGE, MONT.—The city council has under consideration a proposition to bond the city to raise funds for the installation of an electric light plant. The matter will probably be submitted to a vote of the citizens in the near future. The establishment of a power plant on Rock Creek is also planned by the promoters.

BURLINGTON, N. C.—Electric light bonds amounting to $30,000 have been sold.

CADIZ, OHIO.—The Cadiz Electric Light & Power Company has increased its capital stock from $15,000 to $20,000 and will make improvements to its system.

MANTUA, OHIO.—The Mantua Electric Light & Power Company is installing its new plant and it is expected that it will start operations in the near future.

THE ELECTRIC RAILWAY.

SANTA BARBARA, CAL.—The Edison Electric Company has been granted a franchise to operate an electric railway between Santa Barbara and Summerland, 8 miles south of Santa Barbara.

STAMFORD, CONN.—The New York & Stamford Railway Company will build 50 miles of additional trolley lines in Westchester County. One line will extend to the Fairfield Golf Club, near Greenwich.

BOISE, IDA.—The franchise and holdings of the Boise Rapid Transit Company have been purchased by Cyrus Pierce, Howard Butcher, Jr., and J. W. Anderson, of Philadelphia, for a consideration of approximately $95,000. The new owners of the system have announced their intention of greatly improving and enlarging the service, and will construct a line through South Boise as far as the towns of Star and Pearl.

CHICAGO, ILL.—The Indiana-Chicago Air Line has completed surveys for an electric railway from South Bend to Chicago, by way of Michigan City. A spur from East Chicago to Indiana Harbor is already in operation. This line will connect with sections already built east of South Bend, and within a year it is expected that through trains will be run from Cleveland to Chicago by electric power. Both passenger and freight service are being provided for. The line is controlled by the Stone-Allen-Hanna syndicate of Cleveland, of which Luther Allen is president. The power house for the system between South Bend and Chicago will be located at Michigan City.

INDIANAPOLIS, IND.—The Dayton & Western Traction Company, of Indiana, has filed articles of incorporation. The capital stock is $10,000. The Indiana directors are H. C. Starr and J. R. Robinson, of Richmond. The company is the Indiana branch of the Ohio company of the same name.

VINCENNES, IND.—The following officers have been elected for the Vincennes, West Baden & Louisville Traction Company: Thomas H. Adams, of Vincennes, president; A. Norvale, of Cincinnati, first vice-president; Smiley N. Chambers, of Indianapolis, second vice-president; Fred Chapelle, of Petersburg, secretary; J. O. Davis, of Petersburg, treasurer. It was decided to issue bonds to the amount of $1,500,000, which will be taken by the Municipal Bond & Security Company, of Cincinnati. A trust company of Indianapolis and one at Cincinnati will act as trustees for the road.

LOUISVILLE, KY.—At the regular annual meeting of the stockholders of the Louisville & Eastern Railroad the present officers were re-elected. The proposed extension of the line to Shelbyville was discussed, but nothing definite was decided upon. It was decided to devote the profits of the past year to improvements, instead of paying dividends. A new station will be built at Pewee Valley, which will cost several thousand dollars.

BANGOR, ME.—Plans are now being made for the construction of two important electric railways—one from Bangor to Dexter, a distance of 35 miles, and the other from Rockland to South Thomaston and Owl's Head. The former is to be built by the recently incorporated Eastern Traction Company, of Bangor, capitalized at $180,000, with Forest J. Martin, Charles W. Mullen, Fred T. Dow and H. Franklin Bailey, of Bangor, and W. H. Waterhouse and E. B. Weeks, of Oldtown, as directors. Contracts have been closed for the rails, and ties for the Rockland, South Thomaston & Owl's Head line, and estimates are being made on the electrical equipment and construction. This line may be extended to Port Clyde and Tenant's Harbor, St. George.

MIDDLEBORO, MASS.—At the first corporation meeting of the Plymouth, Carver & Wareham Street Railway Company these officers were elected: Henry S. Griffith, Carver, president; William S. Kyle, Plymouth, vice-president; James B. Collingwood, Plymouth, secretary and treasurer.

FALMOUTH, MASS.—The Cape Cod Street Railway Company held a meeting here a few days ago, at which it was stated that the plans of the company for building its proposed line had been unavoidably delayed. The company will now have to petition the Legislature for an extension of its charter, and will be obliged to ask the Selectmen of Falmouth to extend its franchise in that town.

ALPENA, MICH.—Surveys are now being made for the electric railway which J. W. Boynton proposes to build from South Bend, Ind., to Alpena.

ATLANTIC CITY, N. J.—The Central Passenger Railway Company has applied to the Council for a franchise to construct a crosstown electric railway running from the beach ends of Virginia and South Carolina Avenue to Adriatic Avenue.

NEW YORK, N. Y.—The Jamaica & South Shore Railroad Company, Queens Borough, New York, has been incorporated, capital, $500,000. Directors: W. F. Brown and Joseph Kenny, Brooklyn; F. E. Haff, Long Island City, and H. A. Howarth, New York. This is a re-organization of the New York & Rockaway Railroad Company.

PENN YAN, N. Y.—The amended incorporation papers of the Lake Keuka & East Side Electric Railroad Company show that the capital stock will be $130,000. The directors for the first year are James T. Harris, Joseph C. Harris and Charles H. Hanscomb, of New York; Morris F. Sheppard, William H. Fox and Charles H. Sisson, of Penn Yan; David H. Hoover, of Keuka Landing; Frederick Crosby, of Crosby's Landing, and J. Monroe Shoemaker, of Elmira. The road will run from Penn Yan along the eastern shore of Lake Keuka to Keuka Landing, 12 miles from Penn Yan, and eventually it will be extended to Hammondsport, making the total distance 22 miles.

HAMILTON, OHIO.—The Cincinnati, Dayton & Toledo Traction Company is having preliminary plans prepared for a large central power station to operate the entire system from Dayton to Cincinnati, together with the Hamilton city lines. Current will be distributed through high-tension lines and sub-stations, following the most modern practice. At present the system is operated by five power stations with direct-current equipment. The station will be erected in Hamilton, which is about the load center of the system, and it is probable that present station buildings will be used for sub-stations.

NEW INDUSTRIAL COMPANIES.

THE INTERSTATE RAILWAY TRACTION COMPANY, of Dubuque, Ia., has been incorporated with a capital of $50,000; capital in Illinois, $5000.

THE VESTA STORAGE BATTERY COMPANY, of Portland, Me., has been incorporated with a capital of $1,000,000. Capital in Illinois, $2000.

THE ONE RAIL TRACTION COMPANY, of New York, has been incorporated by Louis J. Somerville, Brooklyn; Harry T. Stresser, Jersey City, and Alfred H. Wilmot, Brooklyn.

THE BUFFALO ELECTRIC CONTRACTING COMPANY, of Buffalo, N. Y., has been incorporated; capital, $5000. Directors: L. Y. Mayer, Joseph B. Mayer and J. J. O'Leary, Buffalo.

THE CINCH CLINCH ELECTRIC SUPPLY MFG. COMPANY, of New York; capital, $200,000, has been incorporated. Directors: J. F. Jacobs, Brooklyn; C. V. Ware and I. H. Lehman, New York.

THE WILMINGTON WATER & LIGHT COMPANY, of Wilmington, Ohio, has been incorporated at Camden, N. J.; capital, $125,000. Incorporators: S. S. Holbrook, G. H. B. Martin and J. F. Cotter.

THE AMERICAN TELEGRAPHOPHONE COMPANY has been incorporated at Washington, D. C., by Stilson Hutchins, Lee Hutchins, Z. R. Babbitt and William J. Dante; capital stock, $5,000,000.

THE OMAHA LIGHTNING ROD & ELECTRIC COMPANY has filed articles of incorporation, the capital stock being fixed at $20,000. The incorporators are S. M. Elwood, B. W. Yoho, J. K. Chalfant and Fred Craff. It will manufacture lightning rods and electric machines.

THE KINGS COUNTY AUTOMOBILE COMPANY, Brooklyn, N. Y., has been incorporated to manufacture automobiles; capital, $10,000. Incorporators: H. Aufderheide, H. W. Palmer, Brooklyn, N. Y.; P. Schissel, Forest Park, L. I., N. Y.

THE WALDORF AUTOMOBILE COMPANY, of New York City, has been incorporated to manufacture automobiles; capital, $500. Incorporators and directors for the first year: F. W. Chapman, L. O. Weilbacher, H. R. Weilbacher, New York City.

THE AMERICAN AUTOMOBILE & POWER COMPANY has been organized at Sanford, Me., to deal in automobiles and machinery; capital stock, $500,000; $50,000 paid in. The promotors are Chester I. Campbell, Samuel E. Ward, Henry C. Long, treasurer, Boston; Everett M. Goodall, Fred B. Averill, Sanford, Me.

LEGAL.

VERDICT FIVE CENTS.—Constable John Small has won a suit for five cents against the Chicago Telephone Company, because the latter did not return five cents on failing to make a connection on a slot machine. The court decreed that the company must return the nickel and pay the costs, which amounted to $7.40.

RIGHT TO MAINTAIN A BRIDGE TO CONNECT ELEVATED LINES.—Judge Honore, of Chicago, has decided that the Union Elevated Railroad Company has the right to maintain a bridge to Rothschild & Company's store from the State Street station. The store and the loop company asked that the city be restrained from tearing down the bridge, and the court made the injunction against the city permanent.

STORAGE BATTERY LITIGATION.—The Electric Storage Battery Company, of New Jersey, has applied to the United States Court for an injunction to prevent the Dayton & Muncie Traction Company from using certain electrical devices on which it claims patent rights. In the complaint it is charged that a regulation system for electric railways and electric power, for which the Electric Storage Battery Company has exclusive rights, is about to be introduced into the traction company's power houses, and it asks that it be prevented.

THE DEADLY NON-GROUNDED LOW TENSION CIRCUIT AGAIN.—The Oshkosh Gaslight Company and the Oshkosh Electric Light & Power Company, Wis., have settled for the death of Olive Oaks, a young girl who was killed while turning on an electric light in her home last year, by paying her parents $1400, suit having been brought for $5000. A cross of wires during a sleet and wind storm grounded a 3500-volt circuit through Miss Oaks as she stood on an iron heating register in the act of turning a switch. The plaintiff based suit on the alleged defect in wiring.

DAMAGE BY ELEVATED ROADS.—In New York City, the Cooper Union has just had a large award in its favor against the Manhattan Elevated for damages. The amount is $130,000. In Boston, the first verdict in the numerous damage suits brought against the Boston Elevated Railroad Company was returned recently in the Superior Court for Suffolk County, a jury deciding against the road and fixing damages at $9938. This suit was brought by a trustee of buildings situated near the elevated structure in the South End to recover $30,000 for alleged injury to property through noise, dust, and invasion of the occupants' right to privacy consequent upon the operation of trains. Other suits to recover damages of more than half a million dollars are pending.

MULTIPLE VOLTAGE DRIVE.—The Bullock Electric Mfg. Company, by Mr. L. Lowenberg, secretary's office advises us as follows: "The Bullock Electric Mfg. Company's claims to the exclusive rights under the Ward Leonard patents to install multiple voltage system of electric drive for operating machines is sustained. This decision was rendered by Judge Kirkpatrick, of the Circuit Court, Dec. 2, 1903, in the suit of the Bullock Electric Mfg. Company, of Cincinnati, Ohio, vs. the Crocker Wheeler Company, of Ampere, N. J. This system provides the only successful means of operating and controlling motors driving machinery which requires variable speeds. This opportunity is taken of warning intending purchasers of multiple voltage apparatus that the Bullock Company will vigorously protect its rights under the patent."

Obituary.

MR. JOHN H. GRAHAM.—The many friends of the senior member of Graham Bros. Company, Hudson Street, New York City, are grieved to note his death on Dec. 13, after a long and busy career, largely devoted to electrical industries. Until the last few years he had been constantly engaged in the electrical field since 1877 and took a keen interest in its development. In the year named he was with Mr. (now Sir) Hiram N. Maxim. He was connected with the Brush Electric Company, 1879-80; the old United States Electric Company; the Schuyler Electric Company and the Waterhouse Electric & Mfg. Company; and then engaged in the construction and repair business. He was of a cheerful and sunny disposition and was widely esteemed. He was a Mason. During the past few years, his health declined rapidly. The body has been cremated in accordance with his wishes.

Educational.

FREE LECTURES.—The New York Board of Education is continuing next year its admirable free lectures under Dr. H. M. Leipziger, and the courses for January and February include lectures on electricity by Messrs. W. W. Ker and Mr. T. I. Jones, who have courses of eight and eleven lectures on the subject.

COLUMBIA UNIVERSITY, N. Y.—A number of investigations of considerable interest are being carried on in the newly established Phœnix laboratories for advanced research in physics at Columbia University. Professor Nichols is occupied with several investigations on the behavior of a charge of static electricity in the magnetic field and the possibility of producing a drag in the lines of static force. Dr. Pegram is working with Professor Nichols on his investigations, and is also studying the ionization of gases by heat, and studying various phenomena connected with radium and other radio-active materials. Dr. Davis is continuing his investigation on the effect of ionization on the radiation of luminous gases, and is also working with Mr. Hendren on the rate of re-combination of ions in high vacuo. Dr. Davis and Mr. Wheeler are investigating the minimum velocity of cathode rays necessary to produce x rays. Professor Parker, Dr. Day and Messrs. Fountain and Blake are also carrying on electrical investigations. Mr. Trowbridge is investigating the peculiarities of the electrodeless discharge at very low temperatures, in an endeavor to throw some light upon the peculiar phenomena which accompany the passage of certain meteors, whose trail remains visible for a long time after the stone has actually passed. Miss Stone, of the department of physics at Vassar College, who devotes her Saturdays to work in the Columbia laboratories, is continuing her investigations on thin platinum films deposited by the cathode discharge in vacuo. She has succeeded in developing some very interesting phenomena that promise to have an important hearing upon the structure of the cathode discharge.

Personal.

CAPT. W. L. CANDEE, joint manager of the Okonite Company, has returned from a short trip to Europe.

MR. H. WARD LEONARD has, we regret to state, been confined to the hospital at Bronxville, N. Y., on account of trouble with one of his eyes. It is hoped and believed that he will soon be convalescent.

MR. T. F. MANVILLE, president of the H. W. Johns-Manville Company, started for the West on Dec. 22, and before returning to New York will visit the company's branches in Milwaukee, Chicago, St. Louis and New Orleans.

MR. SAMUEL PUTNAM AVERY offers, in memory of his son, Henry Ogden Avery, a prize of $50 for an electrolier, suitable for a newel-post in the hall of a public library. The design must represent a single female figure, draped.

MR. I. STERNFELD, the recently appointed general manager for G. & O. Braniff, Mexico City, which represents the Westinghouse interests in the Southern Republic, is at present in New York at the export offices of the Westinghouse Company, Hanover National Bank Building.

MR. W. J. BRYAN, former Democratic candidate for the presidency, has been touring Europe amongst the royalties with great eclat. He contributes to the *New York Journal* an article on the marvellous benefits from municipal ownership. What Mr. Bryan does not know on the subject would fill a library.

MR. EMILIO DYSTERUD, general manager of the Monterey Electric Light & Power Company, who has been in the States for several months past, will leave very shortly for home. The plant is to be remodeled and largely added to. Mr. Dysterud, while here, may be found at the Federal Electric Company, Washington Life Building.

MR. A. W. BUCKS has taken the management of the Chicago office of the Electric Machinery Company, of Minneapolis, Minn. This office is at the Ellsworth Building, 353 Dearborn Street. The apparatus he will handle comprises direct current motors and generators, and inductor type alternating current generators.

MR. W. J. WILGUS, fifth vice-president of the New York Central Railroad, has just returned from a six-weeks' trip through England, Scotland, France, etc., studying electric railway practice and particularly railroad terminal facilities. He does not appear to admire the methods of the Paris Underground any more than he does the jagged skyscraper outline of New York thoroughfares.

MR. H. L. SHIPPY, of John A. Roebling's Sons & Company, who has recently been ill with appendicitis has recovered we are very glad to say, and has so far convalesced as to be able to visit his office last week. For his friends, his return to health and strength has been one of the pleasures of Christmas and all have joined with special heartiness in wishing him a happy New Year.

MESSRS. H. HINE and Leonard C. Curtis, who have been in New York for several days past conferring with Mr. Charles A. Coffin, president of the General Electric Company, and John Hays Hammond, regarding new power transmission projects of the Guanajuato Electric Light & Power Company, in which concern all are largely interested, have left for Colorado Springs whence Mr. Hine will go direct to Mexico.

PROF. A. G. BELL.—Private dispatches received from Prof. Alexander Graham Bell state that he expects to return to Washington from Genoa on Jan. 15 with the remains of James Smithson, the English founder of the Smithsonian Institution. Prof Bell offered three years ago to bring the remains of Smithson here at his own expense, and renewed the offer last Spring. The action is taken with the sanction and authority of the Regents of the Smithsonian Institution. It is expected that there will be no opposition to the removal of the body. The removal of the remains at this time is desirable because a stone quarry has encroached on the English Cemetery at Genoa to such an extent that it has become necessary to move the bodies buried there.

DR. C. H. SHARP.—Dr. Clayton H. Sharp, engineer of the electrical testing laboratories of the Lamp Testing Bureau, New York City, has returned from an interesting trip to Europe, where he visited all of the principal electrical laboratories. Dr. Sharp gathered a mass of data and information which will enable him to fit up the new laboratories of the company at 80th Street and East End Avenue with the most complete and up-to-date apparatus and by the best methods known. He carried with him a number of carefully prepared standard photometer lamps, which were compared by the principal photometrists of Europe with their authorized standards, and found to be in extremely close agreement with the best of them. The Lamp-Testing Bureau will probably occupy their new laboratories in January, 1904.

HON. WILLIAM I. BUCHANAN, who was recently appointed by President Roosevelt to the post of Envoy Extraordinary and Minister Plenipotentiary of the United States to Panama and who left about a fortnight ago on a special mission to that part of the world, will return within the next few weeks for the purpose of taking general charge of the various Westinghouse interests in Europe. Mr. Buchanan was appointed in 1894 United States minister to the Argentine Republic, and served there until 1900, when he returned to this country and became director-general of the Pan-American Exposition. After his duties at Buffalo had ended he went back to the Argentine Republic to settle up some affairs for the United States. Until recently he has acted as South American agent of the New York Life Insurance Company.

MR. C. H. WILLIAMS.—A report that will be one of the most prominent and most useful features of the 27th convention of the National Electric Light Association, to be held in Boston next May, will be that of Mr. Charles H. Williams, of Madison, Wis., editor of the "wrinkle department." Mr. Williams has sent out to members a circular letter, asking each of them to make at least one contribution to this report, in the shape of a description of some method not in general use in connection with the manufacture, distribution or sale of electric energy, by which some difficulty has been overcome or some result obtained. A few sample "wrinkles" were sent with the letter, showing the general character of information desired and the style in which it should be formulated. A good many replies have already been received, and Mr. Williams is encouraged to believe that his report will be very successful.

MR. CHARLES R. PRATT has opened an office at 160 5th Ave., New York, as consulting engineer. He intends to work along the lines of general electrical engineering, while making a specialty of elevator and escalator work as well as advising in new ventures as to shop cost of construction of new apparatus and cost of machinery, machine tools, etc., to be installed. Mr. Pratt's long connection (24 years) as superintendent and engineer of some of the largest machine shops in the country has given him valuable knowledge in this line. Mr. Pratt was with the Sprague Elevator Company for years and aided in the development of the Sprague elevator, which is in such general use to-day. For the last few years Mr. Pratt has been with the Marine Engine & Machine Company, Harrison, N. J. His work in the electric elevator field has been highly successful and has besides given him an intimate insight into the solution of electrical problems.

DR. GEORGE F. KUNZ, who has been making a careful study of radium, was puzzled by the first report which came to him concerning "solium." The phenomenon described from Paris did not seem to him to be natural, and he was not one of those who spent much time searching for the new element in this country. Instead, he caused an investigation to be made, and he has just received word which confirms what he has believed all along to be the case, that there is no such element as "solium." "I have just received an answer to some questions sent by me to Paris," says Dr. Kunz, "and I am not surprised to learn that 'solium' is not an element, but a hoax. Research has been made by M. Guillaume, director of the International Bureau of Weights and Measures, and the admission has been made to him that the 'discoverer' of 'solium' merely took advantage of the wide interest in radio active substances to perpetrate a joke on the world at large."

MR. F. E. KINSMAN, in a letter to the *New York Times* on third rail dangers, says: "The cheapest and at the same time the most practical plan consists of returning the current by the furthest away traffic rail, reinforced by such return feeders as circumstances require. They need be no larger than the "third rail," nor any more heavily bonded than is now provided for the outgoing "third rail," thus eliminating the use of the traffic rail nearest the "third rail" as a return conductor. Insulating it sectionally increases the safety factor of this arrangement. It will be readily seen that the chances of a short circuit between the "third rail" and the return conductor are thus reduced by the square of the distance, which in the present practice would be between five and six feet. A person cannot step or reach across this space without unusual effort. The tools of the workmen should not be long enough to bridge this distance. The dropping of a piece of metal across the near-by rail would produce no dangerous effect, unless there was a car in the section while the accident occurred, which is unlikely, owing to the disposition to avoid the track near a moving train. The arrangement also admits of train signaling and control along the lines now being considered without use of alternating current."

Trade Notes.

PITTSBURGH TRANSFORMER COMPANY, of Pittsburgh, Pa., has issued a charming "Pretty Girl" calendar for January, the name of Mr. A. H. Mustard, New York agent, appearing on the copy that reaches us.

MR. RUSSELL HOWLAND, the advertising expert, etc., has moved from 150 Nassau Street, New York City, to 120 Liberty Street, in order to secure more room and be near many of his clients in the machinery district.

THE PHELPS COMPANY, Detroit, Mich., the maker of Hylo lamps, is putting out a colored glass sign which reads "Electrical Supplies," and is lit by one of its self-flashing sign lamps. A very attractive effect is thus produced.

G. M. GEST, the conduit contractor, etc., has issued a large and handsome calendar for 1904, the illustration on which is a double manhole built by him for the Louisville, Ky., Railway Company. The background card is a Pompeian red.

COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., has just issued a very interesting little folder giving the exact figures of cost for properly installed isolated plants of 65,100 and 140 incandescent lights, so that a man can tell in advance what an equipment is likely to cost him.

LAMPS ON WILLIAMSBURG BRIDGE.—The incandescent lamps (20,000 in number) used to illuminate the new East River bridge at the opening last week were furnished by the Munder Electric Company through its sales agent, C. J. Purdy.

LOOMIS-PETTIBONE GAS MACHINERY COMPANY, of 52-54 William Street, New York City, has recently opened branch offices as follows: Boston, State Mutual Building; Pittsburgh, Farmers' Bank Building; Chicago, First National Bank Building.

MANHATTAN ELECTRICAL SUPPLY COMPANY, New York and Chicago, has issued special new price lists and trade literature, including clearance lists of the New York store, electrical portable lamps of handsome design, and other specialties.

THE MECHANICS SUPPLY COMPANY, 96 Peter Street, Quebec, Canada, is introducing at a trivial price two charming little novelties for the new year, one being a tiny wrench and the other a dainty hammer. Both of them "work" perfectly. They are well made and heavily nickeled.

AUTOMOBILE WORK.—The Edison Electric Illuminating Company, of Boston, has recently issued a most interesting bulletin giving an account of the recent round trip with an Edison battery automobile, between Boston and New York. Another bulletin gives a list of charging stations available all over New England.

AUTOMATIC TELEPHONY.—Contractors will be interested in the descriptive matter issued by the Electric Appliance Company, Chicago, telling of its latest things in telephones of all kinds. Circulars can be had for the asking, giving full details of the new Dinsmore automatic telephone for inter-communicating work.

STANLEY AND NORTHERN.—The Stanley Electric Manufacturing Company and the Northern Electrical Manufacturing Company announce that they have established branch offices on the Pacific coast with headquarters at 69-75 New Montgomery Street, San Francisco, Cal., and sub-offices at the Pioneer Bldg., Seattle Wash., and the Douglas Bldg., Los Angeles, Cal.

THE MONSON BURMAH SLATE COMPANY, of Portland, Me., has received the highest kind of endorsement for its slate, both as to durability and adaptability for all electrical appliances and for the beauty of its finish, it being of uniform color and unfading black. The slate which it furnishes has a very high insulation test and is wholly free from moisture, absorption and metallic substances.

PASS & SEYMOUR, INC., Solvay, N. Y., have in press an edition of 25,000 catalogues to be distributed on Jan. 1, 1904. Anyone interested in the P. & S. specialties should drop a postal card to the firm when a copy will be mailed promptly. This catalogue shows a number of valuable and useful additions to the P. & S. line, as they have brought out many new specialties during the past year.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., reports a very gratifying business for the outgoing year of 1903, and asserts its belief that 1904 will witness still further improvement and development of its already immense business. The company states that it will continue to push with vigor the same specialties with which its name is already so well identified: viz. "Okonite" and "I. X. L." wires, "D. & W." enclosed fuses and safety devices, "Pittsburgh" transformers, and "Columbia" lamps.

THE WEBSTER CHEMICAL COMPANY, St. Paul, Minn., is manufacturer of Crystal Chemical Coloring, a compound for artificially coloring incandescent lamps. The material has been on the market for a number of years and the maker claims that it has never known of a case where it has not given complete satisfaction. It is said to remain good for a long period of time. Very pretty colors are secured, in addition to which there are opal, white and ground glass effects. The use of this compound is a convenient method for securing an attractive illumination without the expense of natural colored bulbs.

THE ECONOMICAL ELECTRIC LAMP COMPANY has issued a circular to supply dealers throughout the country in which the good points of its turn down lamp are attractively set forth. It dwells on the simplicity of the "String Pull" lamp and its positive action, on the saving of current when the smaller filament is burning, and on the fact that the lamps are furnished in various bases for differing voltages. The catch phrase employed by the company "Don't burn your hands" is emphasized by an illustration showing its needlessness when "Economical lamps" are used.

THE SMITH & HEMENWAY COMPANY has contracted with the Page Storms Drop Forge Company to handle the entire marketing on its engineer's wrenches and hereafter the latter concern's New York office will be 296 Broadway, care of the Smith & Hemenway Company, which will look after this end of its business exclusively. In addition to manufacturing drop forged engineer's wrenches, it makes a specialty of making forgings from blue prints or samples, for anyone desiring this class of work. Parties interested or wishing to have forgings made will make their requests known direct to the factory at Brightwood, Mass.

LINK-BELT SPROCKET WHEELS.—The Link-Belt Engineering Company, Nicetown, Philadelphia, has just issued a circular devoted to link-belt case-hardened sprocket wheels. By the company's new process of case-hardening it is stated that the teeth and rims of the wheels are made so hard as to be practically indestructible, at the same time giving them a smooth, uniform and close-grained surface. These wheels are of advantage in all link-belt gearing, but are particularly recommended for use in cement mills, phosphate plants, stone crushing plants and for all work where grit is present. The circular has an illustration showing the depth of chill produced by the case hardening process.

NAVY VENTILATION.—In no branch of government service has the matter of ventilation been given such serious consideration as in the navy. The construction of the modern vessel renders it extremely difficult to secure proper ventilation in some portions below the water line. Noticeable for its novelty, among the various methods used to properly ventilate such places, is the portable ventilating set, consisting of a small exhauster of the "Monogram" type directly connected to an enclosed electric motor. It is very light, moves a large body of air, and is provided with handles for carrying from place to place, enabling the crew to work in any portion of the vessel with comfort, and is but one of the many types of blowers manufactured by the B. F. Sturtevant Company, of Boston, Mass.

INDUSTRIAL RAILWAYS.—In the modern industrial railway equipment where turn-tables are used for out-door work there is always a temptation to set the turn-tables upon too shallow a foundation, the result being that they are thrown out of line by the influence of the frost. In the new plant of the B. F. Sturtevant Company, at Hyde Park, Mass., where special turn-tables of its own manufacture have been very successfully introduced in connection with its industrial system, each turn-table rests at the top of a brick circular well with 8-inch walls extending to a depth of 4 ft. or below the frost line. These walls are set upon hard-pan and the center filled with loose stones providing perfect drainage. The first winter's experience has shown them to be absolutely uninjured by frost.

"IDEAL" ELECTRICAL MACHINERY.—The Ideal Electric & Mfg. Company, of Mansfield, Ohio, has recently placed on the market a complete line of "Ideal" electrical machinery embracing a line of elevator and hoist motors and controllers, a line of universal motors, and a complete line of belted and engine-type dynamos and generators in sizes up to 150 horse power. This company, while apparently new in the field, is backed by men of long years of experience in the design and manufacture of electrical machinery. In its shops at Mansfield it is using individual motor drive applied to the most modern machine tool equipment, and already the demand for its machines has forced the necessity for increased facilities, and a large new brick building with three floors is under way and will be ready for occupancy early in the spring. It is the intention of the company to work into larger units as soon as the proper facilities can be provided.

MILLING MACHINES.—The Hess Machine Company, 15th and Chestnut Streets, Philadelphia, Pa., has just brought an attractive pamphlet on the subject of milling machines and milling cutters for large output. The company guarantees feeds per minute of 10 inches or more in roughing off cast iron the full width of the machine, and on steel forgings and steel castings, four inches or more. The cutters are made on a new principle and do not "hog in" when changing from wide to narrow surfaces at full rates of speed. The machines are designed for direct electric driving by direct and alternating current motors. The pamphlet contains several excellent illustrations of milling machines of different sizes, each being accompanied by a table giving all the principal dimensions, speeds, etc. There is also a telegraph code, a chapter on the Hess Company's cutters for fast feeding closes the pamphlet. All machinists will be interested in this machine as it is evidently a great time and money saver.

ELECTRIC CONTROLLERS.—J. L. Schureman & Co., of Chicago, have issued two handsome pamphlets, Bulletins Nos. 19 and 20, describing respectively their line of electric elevator controllers and self starters and pressure regulators for direct current motors. These contain descriptions, dimension tables and price lists of the apparatus manufactured by the company, which makes a specialty of controllers of various kinds. It will be recalled that the business was formerly conducted under the name of Schureman & Hayen, the partnership having been dissolved July 1, 1903. Subsequently the company's business in electrical machinery was disposed of to the Gregory Electric Company, since which time Schureman & Company have been devoting themselves to the manufacture of controllers exclusively. Although these have been placed on the market for a number of years, no effort has been made in the past to push the line, but an aggressive policy is now being pursued.

FRINK LIGHTING.—In the perfecting of modern buildings, many problems have been solved by the Frink system of lighting, well known in lighting churches and public buildings. Some of the recent installations furnish further proof of its efficiency: Madison Ave. Baptist Church, Church of St. Edward the Martyr, Rutgers Presby. Church, Church of the Incarnation, Church of the Covenant, New York City. Immanuel Bapt. Church, Albany, N. Y. Westminster Presby. Church, Yonkers, N. Y. Church of St. Peter of Alcantara, Port Washington, L. I. First Presby. Church, Wheeling, W. Va., M. E. Church, Morristown, N. J. The New Amsterdam Theatre, probably the handsomest in New York, offers an excellent example of illumination by lights concealed in Frink cove reflectors. The effect is especially fine in the foyer, the fullest appreciation of the decoration of which is made possible only through the skillful handling of the lighting. Progressive merchants everywhere evidence their desire to share the benefits of Frink reflectors by equipping their windows with Frink special patent window reflector; show cases with reflectors especially designed for them and store interiors with special cluster reflectors which are economical and of highest efficiency. Full information concerning any of the above lines may be had by addressing the inventor, patentee and sole manufacturer, I. P. Frink, No. 551 Pearl St., New York City.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 22, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

747,345. SIGNALING APPARATUS; James E. Allison, St. Louis, Mo. App. filed Aug. 30, 1902. Details of a system wherein trains can signal the station agent.

747,354. ELECTRIC WELDING MACHINE; George Baehr, McKeesport, Pa. App. filed Aug. 6, 1902. A machine for electrically welding tubes in continuous lengths.

747,367. FLEXIBLE METALLIC TUBING FOR ARMORING INSULATED ELECTRICAL CONDUCTORS; Wm. H. K. Bowley, London, Eng. App. filed Nov. 17, 1902. A corrugated strip of metal coiled so that each turn is partially overlapped by the next succeeding turn, a strip of metal being wound in the spaces between the corrugations.

747,371. TROLLEY WHEEL; Herbert W. Brockett, Hamden, Conn. App. filed June 23, 1903. Two disks flank the wheel and being of greater diameter than the latter, tend to retain the wheel on the wire.

747,394. TELEPHONE WALL SET; Ernest B. Fahnstock, New York, N. Y. App. filed April 13, 1903.

747,421. MULTIPLE SWITCHBOARD; Carl M. Hedman, Chicago, Ill. App. filed May 22, 1902.

747,446. ELECTRIC LIGHTING ATTACHMENT FOR GAS STOVES; Samuel Lewellen, Philadelphia, Pa. App. filed Dec. 9, 1902. Sparking electrodes are moved at the same time the valve is turned.

747,454. ELECTRIC CONDUCTOR; Victor Lowendahl, Stockholm, Sweden. App. filed Feb. 7, 1903. Masses of granular carbon covered with metal are compressed into blocks to form a carbon brush.

747,470. SUPPORT FOR ELECTRICAL CONDUCTORS; Robert Orr and John Morrison, New York, N. Y. App. filed Jan. 9, 1903. A trolley clip consisting of two connected members each being provided with a wedge-shaped groove, a wedge-shaped wire-gripping clip being secured in the groove.

747,477. RAIL INSULATOR; Leonard M. Randolph, Newark, N. J. App. filed May 4, 1903. A non-porous insulating covering for ground rails, consisting of varnish residue and an absorbent substance pressed into intimate contact with the rail.

747,491. TELEPHONY; Harry O. Rugh, Chicago, Ill. App. filed June 2, 1902.

747,508. REGULATING DEVICE FOR ELECTRIC ARC LAMPS; Aron N. Thorin, Stockholm, Sweden. App. filed Aug. 2, 1902. A roller in contact with the carbon has its axle resting freely against an inclined frame and a spring dog engages the roller in such a manner that it is permitted to move down the incline with the carbon rod at each feeding operation and to finally grip the rod.

747,515. TELEPHONE OR LIKE CABLE; Francis Tremain, Highgate, Eng. App. filed Nov. 1, 1901.

747,528. FUSE AND FUSE-MAGAZINE; William P. Woodruff, Buffalo, N. Y. App. filed June 12, 1903.

747,537. ELECTRICAL SWITCH; George J. Crossland, Mobile, Ala. App. filed July 12, 1902. Details of a circuit closer for operating an electromagnetic railway switch.

747,553. CONNECTOR FOR ELECTRIC CIRCUITS; Wm. H. Kelsey, Cambridge, Mass. App. filed Sept. 24, 1902. A plug having two different styles of contact is arranged to be reversible upon a holder so that either set of contacts can be used.

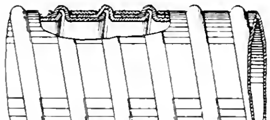
747,571. WINDING DEVICE FOR CABLES TO WHICH MOVABLE ELECTRIC APPARATUS IS ATTACHED; Gregor Ackermann, Biel, and Gustav Engisch, Madretsch, Switzerland. App. filed Nov. 5, 1902. Details of a spring drum arrangement for winding up a flexible cord.

747,595. COIL FOR ELECTRICAL MACHINES; Isaac De Kaiser, Pittsburg, Pa. App. filed May 1, 1903. The coil comprises an inner and an outer concentric portion, wound in opposite directions and having leads projecting from adjacent turns of the outer portion.

747,602. BATTERY TRANSMITTER; John S. Goldberg, Chicago, Ill. App. filed Nov. 17, 1902.

747,607. TROLLEY POLE; Jonah R. Hollis, Brockton, Mass. App. filed Nov. 7, 1902. The trolley harp is pivoted to permit the wheel to swing laterally.

747,609. ROSETTE; Edward J. Hunt, Toledo, Ohio. App. filed June 3, 1903. Details.



747,367.—Flexible Metallic Tubing for Armoring Insulated Electrical Conductors.

747,631. FIELD MAGNET COIL FOR ELECTRICAL MACHINES; Loyall A. Osborne, Pittsburg, Pa. App. filed June 24, 1903. The coil is formed of scrap copper and sheets of heat-resisting insulation between adjacent turns, the structure being inclosed in a hermetically shell.

747,673. ELECTRIC SWITCH; Charles C. Badeau, Swissvale, Pa. App. filed Aug. 12, 1903. Details of an overload switch.

747,686. SYSTEM OF ELECTRICAL REGULATION; John L. Creveling, New York, N. Y. App. filed Feb. 12, 1902. In a train lighting system where the generator is driven from the axle and supplies an accumulator, the generator is controlled automatically by the voltage of the accumulator.

747,696. BRUSH HOLDER; Henry Geisenhoner, Schenectady, N. Y. App. filed Dec. 17, 1900. The springs are mounted in hinged frames so that they can be tilted to one side when the brushes are to be removed.

747,697. ELECTRIC FUSE; Henry Geisenhoner, Schenectady, N. Y. App. filed May 31, 1901. The fusible strip is threaded back and forth through transverse openings in the cartridge, to prevent the formation of an arc.

747,698. DYNAMO ELECTRIC MACHINE; Henry Geisenhoner, Schenectady, N. Y. App. filed Aug. 28, 1901. The space between the teeth of the core is closed by a wooden wedge faced off with cement.

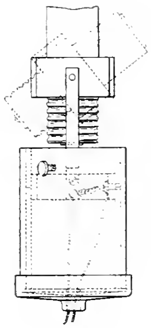
747,706. MAGNETIC CLUTCH; Edward M. Hewlett, Schenectady, N. Y. App. filed June 18, 1902. A stationary member contains the coil and attracts towards its opposite sides two rotary members.

747,707. ELEVATOR; Nelson Hiss, New York, and Harold S. Macaye, Yonkers, N. Y. App. filed May 31, 1902. Means whereby the car may be brought gradually and easily to rest at either end of its normal travel independently of the use of the ordinary controlling handle.

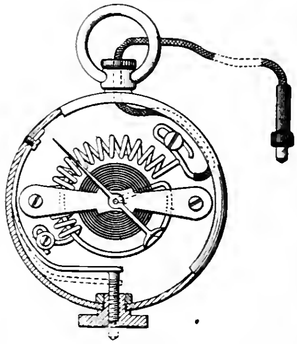
747,755. SPARK OIL; Charles P. L. Noxon, Syracuse, N. Y. App. filed Aug. 20, 1902. The face of the armature of the vibrator is grooved for the purpose of emphasizing the attractive force of the core.

747,763. REGISTERING MECHANISM; William H. Pratt, Lynn, Mass. App. filed Sept. 24, 1901. The combination with an integrating meter of means for registering thereby any excess of the quantity measured over a certain predetermined amount.

747,765. RAILWAY MOTOR; Edward D. Priest, Schenectady, N. Y. App. filed Sept. 16, 1902. Structural details relating to the split motor frame whereby the advantages of a box frame are also obtained.



747,553.—Connector for Electric Circuits.



747,871.—Measuring Instrument.

747,778. EXPRESS OR OTHER ANNUNCIATOR; Joseph H. Rusby, Nutley, N. J. App. filed Nov. 15, 1902. An electric sign containing the names of express companies with suitable switching apparatus for displaying any of them.

747,795. AUTOMATIC APPARATUS FOR CONTROLLING AND OPERATING THE POINTS OF ELECTRIC RAILWAYS OR TRAMWAYS; Thomas B. Stewart, Wm. H. Turner and Rowland E. Dixon, Leeds, Eng. App. filed April 1, 1902. Details.

747,796. APPARATUS FOR CONTROLLING AND OPERATING THE POINTS OF ELECTRIC RAILWAYS OR TRAMWAYS; Thomas B. Stewart, Wm. H. Turner and Rowland E. Dixon, Leeds, Eng. App. filed March 6, 1903. Details.

747,821. STARTING RHEOSTAT; Howard B. Wilson, Schenectady, N. Y. App. filed Aug. 21, 1902. The contact carried by the arm or a rheostat is in two parts, one being of higher resistance than the other, thus dividing the total current into two parts with a resulting diminution of sparking.

747,841. ELECTRIC APPARATUS FOR WELDING TUBES; George Baehr, McKeesport, Pa. App. filed Jan. 31, 1902. A machine in which flat plates are progressively bent into tubular form and the joint electrically welded, with adjustments for different sizes of tube.

747,842. ELECTRIC APPARATUS FOR WELDING TUBES; George Baehr, McKeesport, Pa. App. filed Jan. 31, 1902. The electric heating and welding apparatus is self-propelling along the tube blank to progressively heat and weld together the abutting edges of the blank.

747,847. STREET RAILWAY SWITCHING MECHANISM; Walter J. Bell, Los Angeles, Cal. App. filed May 7, 1903. Hydraulic pistons for moving the switch are locked and released by an electro-magnetic latch.

747,853. RETARDING DEVICE FOR ELECTRIC CIRCUIT BREAKERS; Algernon R. Cheyney, Philadelphia, Pa. App. filed April 16, 1903. A circulatory system for liquid is combined with a solenoid to get proper retardation of the core.

747,871. ELECTRICAL MEASURING INSTRUMENT; Earl C. Eldredge, Springfield, Mass. App. filed Oct. 3, 1903. A pocket volt-meter in which one of the contacts is at the end of a flexible cord, while the other is housed within the case, but can be readily extended when needed.

747,873. COMMUTATOR; Hermann F. T. Erben, Schenectady, N. Y. App. filed Aug. 10, 1901. Structural details.

747,876. INSULATING WIRE; Henry W. Fisher, Pittsburg, Pa. App. filed Nov. 1, 1902.

747,889. ELECTRIC LIGHTING SYSTEM; James F. McElroy, Albany, N. Y. App. filed Oct. 21, 1902. The regulator is controlled by a series of adjusting magnets included in separate lamp circuits, a storage battery being in multiple with the lamps and the dynamo being driven from a car axle.

747,890. BRUSH HOLDER FOR ELECTRICAL MACHINES; James E. McElroy, Albany, N. Y. App. filed March 5, 1903. A construction permitting the spring pressure to be relieved before reversing the holder or follower from its working position.

747,891. IMPLEMENT FOR FILLING WOOD SURFACES; Lewis W. Nelson, Grand Rapids, Mich. App. filed April 9, 1903. An electric heater applied to a heating iron.

747,911. CONNECTION TERMINAL AND PLUG; William W. Dean, Chicago, Ill. App. filed Dec. 26, 1900.

12,185. CONNECTION COUNTER FOR TELEPHONE LINES; Frank R. McBerty, Evanston, Ill. App. filed Jan. 16, 1900.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JANUARY 9, 1904. No. 2.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

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CONTENTS.

THE IROQUOIS THEATRE FIRE.

Last week at the new Iroquois Theatre in Chicago some six hundred lives were lost through what would appear to be criminal carelessness and negligence on the part of those entrusted with the management of that place. The fire which broke out on the stage in the middle of an afternoon performance and swept suddenly through the house, is now under investigation, and we must await the results before attempting to distribute blame. On the face of it, however, there are many obvious points that deserve comment. One of these touches the wild recklessness with which electric lights appear to have been used around the stage. It has been alleged and has not so far been contradicted that one of the pieces of scenery was set on fire on account of the close proximity of a sputtering, unshielded arc lamp which was used for scenic purposes, while it is also stated that an incandescent lamp projector hindered the asbestos curtain from falling its full length to the floor of the stage. We trust these points will be fully cleared up. There is no medium so safe and convenient as electricity for light and power, especially around the stage, yet there is none which is so abused and trifled with. One result of the awful disaster in Chicago has been to close up half the places of amusement as unsafe, and we are heartily glad of it. In spite of all that is said to the contrary, just as sweeping an edict ought to be and could be put in force in New York City. Meantime it is a matter of congratulation that the authorities have ordered an examination of all the electric lighting appliances and facilities in the New York theatres. We trust that the examination will be as rigid and severe as the highest standards of the art can make it, and there is no reason why this inquisition should be limited to New York City.

GAS IN SECOND PLACE.

The public is accustomed to think of gas as still the leading illuminant, but while this is probably true in Europe, in the United States the sceptre of light has definitely passed to electricity. The figures just issued by our Census Office are, indeed, startling. Gas had nearly 75 years' start over its competitor, but it now appears to be decidedly in second place. Yet there is no denying the fact that the introduction of the brilliant electric light has stimulated greatly the use of gas. There are now close upon 4,000 electric light central stations in America, but by the census of 1900 there were then only 877 gas plants, and the number was not growing perceptibly. The gas plants were earning an income of $75,000,000. Last year the central stations earned $85,000,000. The cost of construction and equipment of both was over $500,000,000. Gas employed 22,400 men and electric light 23,300.

But this is only half the story. It is estimated that there are over 50,000 isolated electric light plants in this country, and that they represent as many lamps as do the central stations. New York City has 1,000 of them, and some, like that in the Waldorf-Astoria, would run many an ambitious Western city. Hence, the figures against gas are doubled in most respects. The 20,000,000 incandescent lamps burning nightly become 40,000,000. The 400,000 arc lamps—Shelley's "insistent sisters of the day"—become 800,000. Were it not for the universal use of the gas stove and the prevalence of the gas engine, one marvels what would have become of the illuminant of our fathers.

Such is the pace at which we live to-day that, while millions of people in this country have not yet got up to the stage of "civilization" represented by the use of gas, but when they encounter it casually employ it suicidally, other millions have outgrown and discarded it, and will have none of it even for a curling iron or a chafing dish, let alone for lighting. To put it briefly, the use of electricity for lighting in New York State alone has increased over 2,000 per cent. in ten years, and the use of electricity for power, also from central stations, has increased in the decade nearly 1,200 per cent. And yet the electricians are inclined to think they have only just started in.

Alternating Current Locomotives.

Through what might seem a curious chance, during the past few months several important papers have been read by American electrical engineers before the Canadian Society of Civil Engineers. Why such a body should have been chosen instead of the American Institute of Electrical Engineers as a medium of communication with the electrical engineering profession it is difficult to fathom, particularly since in two instances the communications were the first announcements of radical departures in engineering policy on the part of American electrical manufacturing companies. This recalls a similar instance of some months ago, when one of the most important engineering announcements of several years formed the subject of a paper read before a learned body more interested in a happening of the paleozoic age or a new nebular hypothesis than in such a utilitarian matter as a modern engineering advance like the the steam turbine. Can it be that, for some occult reason, the practice of theatre folks in avoiding urban publicity upon the trial performance of a play is extending to the technical field? A reprint of one of these Canadian papers, read November 19, has just come to hand, the subject being "Some Possibilities of the Alternating-Current, Single-Phase Railway Motor," and the author, Mr. A. H. Armstrong. In the opening paragraphs of his paper Mr. Armstrong pronounces strongly in favor of the new departure in electric traction indicated by the development recently of single-phase alternating-current motors, which he says have a speed torque characteristic even better adapted for railway work than that of the direct-current series motor and, furthermore, providing ample starting torque with any voltage variation liable to occur in practical railway operation. He adds that as these motors can be operated with the single trolley and ground return and, moreover, can be operated satisfactorily on either direct or alternating current, their field of usefulness is much greater than that of their direct-current series motor competitor. He considers that this type of motor enables us to break away from the exclusive field of electric traction with frequent service and small units, and to render possible the operation of freight and passenger trains over regular steam lines.

The paper proceeds to make a comparison in detail between steam and alternating-current locomotive traction with reference to train weights of 250, 500, 1,000 and 2,000 tons, at speeds up to a maximum of 60 to 70 miles an hour. All of the steam data are based as far as possible upon actual locomotive performance sheets; the electrical data relating to the generating station are derived from present generating station practice, which, it is stated, would be merely duplicated in railway practice. The standard electrical apparatus and voltages met with in present everyday practice are only considered, and the results thus do not represent what electrical engineers may confidently expect to be able to do some time even in the near future. The conclusions are that for very infrequent service—that is, five trains per day each way or less—it would hardly pay to equip present steam roads electrically. With more frequent service, however, the saving in electrical operation becomes more marked until at from 15 to 20 trains per day each way the interest earning power of the electrical investment becomes significant. Taking into account, however, that the electrically-equipped road while carrying heavy through freight traffic with an earning capacity of from 4 to 7 per cent. on the investment, can also build up a local traffic, both freight and passenger, with practically no additional cost and showing very large returns, the balance is still more in favor of the electric locomotive. After discussing incidental savings which may be made with the electric system, and which were not taken into consideration in the preceding calculations, the final conclusion of the author is that should all the factors entering into the engineering expense of operating roads by steam and by electric locomotives be carefully considered, the possibilities opened up by the use of alternating-current motors are sufficiently great to warrant its replacing the steam locomotive in many of our railway systems, either in part or for the complete system. As this opinion may be taken to reflect the present policy of one of the great electrical manufacturing companies, which company until quite recently was—if we are to judge by the attitude of members of its technical staff in discussions on the subject—committed against alternating-current traction, the revolutionary change that in the past few months has taken place with respect to the electric traction situation is sharply defined.

Measurement of Current by Copper Coulombmeter.

A matter of considerable interest is the relative value of the two fundamental methods now in use for calibrating standard voltmeters and ammeters. The first method is to use a voltameter, which, by the way, is an unfortunate term, since it resembles "voltmeter" so closely, and the term coulombmeter has consequently been wisely suggested as a convenient substitute. The second method is to use a standard cell. The first method involves the measurement of electric quantity, and thence, with the aid of elapsed time, the mean electric current strength. This measured current strength will serve to calibrate a standard ammeter directly, and will also serve to calibrate a standard voltmeter indirectly, by passing the measured current through a coil of known resistance. The second method involves the comparison of a convenient uniform e.m.f. with the e.m.f. of a Clark cell, through the medium of a potentiometer or equivalent device. In this manner a standard voltmeter may be calibrated directly, while a standard ammeter may be calibrated indirectly, by passing a current from the measured e.m.f. through the ammeter and a standard coil of known resistance.

For the purposes of commercial accuracy, either of these two methods is available. So soon, however, as the highest laboratory standard of accuracy is desired, difference of opinion is encountered as to the relative advantages of the two methods. There are potentiometer advocates, and there are coulombmeter advocates. It is interesting to observe that both methods are similar, in being fundamentally electrolytic. One, however, employs the electrolytic plating bath, while the other employs the electrolytic cell or couple. The theoretical value of the silver or copper coulombmeter method is in the Faraday law which declares that a definite quantity of metal must be removed from the anode and deposited on the cathode, for every unit quantity of electricity passing through the plating bath. The theoretical claim of the potentiometer method is that with the commercialy attainable degree to chemical purity in the substances employed, Clark cells can be reduplicated to a very satisfactory degree of accuracy in e.m.f.

The disadvantage, or weak point of the coulombmeter method is that although in strict theory the anode loses as much metal as the cathode gains, yet in practice there is always an appreciable difference between the loss of the anode and the gain of the cathode. This difference is apparently attributable to secondary chemical actions at the anode and cathode surfaces; but whatever the explanation may be, the discrepancy introduces a certain small element of uncertainty, and it is generally admitted that the same quantity of electricity in coulombs will not produce exactly the same apparent transfer of metal when the quantity is transferred during an hour, as when transferred during a week. The disadvantage or weak point of the potentiometer method is that it is less direct than the coulombmeter method, since the coulombmeter, with a stop-watch and a chemical balance, can give a result that immediately yields the value of a certain reading on an ammeter scale; whereas the potentiometer method involves not only the error of the Clark cell, but also the error of the potentiometer. Moreover, Clark cells may not agree very closely, unless the method of setting them up be uniform, even when pure chemicals are employed; since if the mercurious sulphate solution is saturated or unsaturated makes an appreciable difference in the value of the e.m.f. at a given temperature, as well as in the temperature coefficient of variation in e.m.f.

We are inclined to the belief that if Clark cells or cadmium cells are made up according to uniform and standard specifications, their e.m.f. can be depended upon to within a very small range of variation or error, say 1/30 of one per cent., and that the error of potentiometer comparison can, with sufficient care, be made negligibly small. Consequently, standard voltmeter calibrations by the potentiometer method may be carried with reasonable care to about 1/13 of one per cent. On the other hand, differences in the making up of Clark cells may involve variations in voltmeter calibration of as much as ⅙ of one per cent. in practice. This is about as great a variation as may be found in coulombmeter measurements. Consequently, one method is about as good as the other if no special precautions are taken in regard to the standard cell. If, however, the Clark or cadmium cell can be brought by suitable international specifications to the smallest range of variation of which it is reasonably capable, then we think the potentiometer method will be found superior. At the present time many of our standard instruments in laboratory use are calibrated by the coulombmeter, and many are also calibrated by potentiometer. In many practical cases the limits of desired accuracy are such that either method is equally suitable regardless of the absolute superiority of one or the other.

THE PROGRESS OF ELECTROTECHNICAL EDUCATION.

The condition of electrotechnical education in the United States at the present time is very satisfactory. The ideal condition of technical education is that it should be open to all comers and to every citizen. It should not be stereotyped and forced into any one or two sharply defined forms, but should be multiplied and varied in degree, in time, in expectation and in cost, so that all localities, pursuits, qualifications and purses may be suited. There is no royal road to learning, and there should be built no artificial causeway. The sole conditions on which knowledge and proficiency of any kind are to be had are attention and time; or what is equivalent, effort and perseverence. These will win everywhere, and at all times, so that it is only of importance to throw facility into the line of endeavor. To the artisan belongs the night school, since his daily work forbids him to give attention except at night. The manual training school is open to the young mechanic, with limited means and time for education. The correspondence school is specially adapted to those who, remote from cities, or occupied during educational hours, can devote time to what the teacher and the mail-carrier may provide. All these do very important work for the many. To the favored few are open the higher branches of technical education offered by technical colleges. These are most costly both in time and in money. They represent an investment made by the student in education as vested capital, upon which interest returns are demanded throughout subsequent working life.

No education can expect to flourish in this age, which does not pay as well as interest. We all desire the purely ornamental, but we want only such an amount as shall adorn the stern creations of necessity and use. A few grammes of gold will gild a large mass of less valuable structural material. On the other hand, the education should not only be graded to the student, but the student to the education. The college training may be thrown away upon a student who does not possess technological aptitude. An engineer must be born as well as made. No amount of education can make up for inherent defects in vitality, temperament or specialized mental capacity. There are some students who will learn much in a manual training school and but little from a technical college. The main effort should be to increase each individual's usefulness to the utmost that local conditions will permit. Work and acquisition of some kind should be the rule for all, and the most work, the highest kind of teaching, for the few who can afford and can avail themselves of the greatest development.

In the development of our industrial resources the time has gone by when lesser proficiency will meet requirements. At this time each factory and workshop is virtually in competition with the rest of the world, and only the fitted can survive. Consequently, while empirical methods and the guidance of experience were adequate to technical prominence only a few decades ago, now they are insufficient, and the best scientific equipment must be added to experience in order successfully to cope with the engineering problems of the day. For this reason we see the technical college graduate of the best ability and best training assuming the positions of responsibility, not only in the productive and constructive departments of modern industry, but also beginning to dominate in the administrative and commercial branches. The very best material, brains and training are only just good enough for the purpose of the day. They would be relegated to a second place if yet better vitality, brains, knowledge, training and experience could be obtained. Every year must see more demand for highly specialized students of the best technical training, and the best positions will naturally tend to the possession of those who, other things being equal, have had the best education and training.

At the same time it must be remembered that the great bulk of the people employed in electrotechnical industry, the rank and file of those who produce and who apply, must continue to receive their training, so far as it can be provided outside of the school of practical experience, in the night school, or high school, or correspondence school. In the nature of things many men will attain technical prominence who have never enjoyed the advantages of special training, laboratory teaching, or technical colleges. Such men advance by right and reason of special born abilities. But because one man in the million is a genius as a painter, and becomes eminent as an untaught artist, is no reason why painting should not be regularly taught in special schools, but rather the reverse. The numerous and varied facilities for acquiring technological education in America at this time, as well as the evident endeavor of all classes to improve their education throughout life, is the most encouraging symptom, and progressive evidence of, Western civilization.

The Joint Engineering Building Plan.

With regard to the work of the committee of fifteen on the joint Engineering Building given by Mr. Carnegie at a cost of $1,000,000 and upwards, the American Society of Mechanical Engineers has just issued a most interesting circular on the subject embodying a good deal of new material and data. The chief item is the report of the committee on organization, composed of Dr. A. R. Ledoux, C. W. Hunt and Dr. S. S. Wheeler. We give it below:

Having considered legal advice and taken note of all suggestions received, the committee unanimously advise as follows:

1. The total amount offered by Mr. Carnegie shall be administered as two gifts: one to the Engineering Societies and the other to the Engineers' Club, each to be held and administered independent of the other. The allocation of the fund to be made at once, but the buildings to be designed and erected as one operation: thereafter the respective titles and administrations to be entirely independent.

2. The property represented by land, buildings and equipment of the engineering societies, shall be held and administered by an executive corporate body, preferably under a special charter, to be obtained from the State of New York, each of the constituent societies being entitled to name from its membership three persons to act as incorporators and thereafter as directors.

3. Each society annually to elect or appoint, as their by-laws may prescribe, one of their voting members to serve on the Board of Directors of the Executive Corporation for a term of three years; a vacancy in said board to be filled by an appointment made by the society the retirement of whose representative causes the vacancy.

4. The land and property being held for the societies by an Executive Corporation, the said corporation may, to pay for the land acquired, issue certificates of indebtedness or bonds bearing interest at four per cent., and redeemable on six months' notice, the buildings being a gift from Mr. Carnegie.

5. Each of the constituent societies may purchase and hold an equal amount in value of the said bonds or certificates, but the Board of Directors of the Executive Corporation may authorize any of the constituent societies to hold an additional amount; that is, in excess of its portion, but such excess shall be subject to recall at its par value at any time that the directors of the Executive Corporation may so order, to the end that each society shall have an equal interest in the property of the corporation if it so desires.

The certificates held by each society shall be inalienable unless they are offered to the Executive Corporation at their par value, and such tender shall not be accepted by the Board of Directors within one year thereafter.

6. The property of the Executive Corporation shall be used perpetually as a meeting place and headquarters for the constituent societies, and for such other scientific associations as may be temporarily admitted by the consent of the Board of Directors of the Executive Corporation. Such associations may pay a pro rata share in the expenses of the headquarters, but no profit shall be made from such use.

7. Each of the participating societies shall be entitled to rooms and space in the property adequate to its need, paying its share of the running expenses in accordance with the amount of space occupied; said space to be assigned and a proper assessment therefor determined by the Board of Directors of the Executive Corporation.

8. The excess of receipts over expenditures, if any, shall be used for reducing the subsequent contribution of the several societies for maintaining the building, and for the advancing of engineering arts and science, by and through the participating constituent associations. No dividends shall be declared or profits divided, but a reasonable repair and rebuilding fund may be established.

9. If the income of the Executive Corporation shall be less than the expenditure, the deficiency shall be made good by an assessment on each of the constituent societies, so allocated as to be in proportion to the number of voting members of each society.

An excess of receipts over expenditures may be allocated to the societies in like manner to reduce their annual assessment.

10. Should any of the constituent societies fail or refuse to appoint directors, the remaining members of the board of the Executive Corporation shall administer the property with all the force and effect as though the board contained its full quota of members.

11. Finally your committee, in offering the above suggestions, has had in mind the setting aside of the money used for a building for the Engineers' Club, so that on the completion of the said building the relations of the club and of the engineering societies will terminate. Thenceforward, the constituent societies are to carry through the Executive Corporation the administration of the building and its accessories, leaving the scientific, professional, intellectual and financial activity in each organization entirely independent of the others, and free to develop to any extent and along any line that may be determined each for itself.

The details of the superintendence and administration of the buildings can best be considered after the organization of the proposed Executive Corporation through the procuring of a special charter. As to the above report we may add that the ideas and plans that are being developed involve two separate buildings, even without physical union or means of common access, one for the engineering societies and the other for the Engineers' Club. No objections are raised to this in any respect.

An Edison Medal for the Institute.

In order to celebrate the twenty-fifth anniversary of the introduction and commercial development of the incandescent lamp, the friends and associates of Mr. Thomas A. Edison have taken steps to found a medal which will be entrusted to the American Institute of Electrical Engineers, and which it is proposed to award annually to graduating students in electrical engineering. The Institute, through its council, has already accepted the trusteeship of this fund and the circular which is being issued by the Edison Medal Association announces that it is the intention that the medal shall be awarded each year to the graduating student who shall present the best thesis on some original subject, from the universities and colleges of the United States and Canada which have regular courses in electrical engineering. It will be remembered that Mr. Edison's mother was a Canadian; that part of his own active life has been spent in that country, and that to-day the Institute not only selects some of its officers from that country, but that professors and students are freely interchangeable; considerations which render the inclusion of Canada by the founders of the medal eminently appropriate. It is proposed that the medal shall be executed by some artist of distinction and that if possible a permanent fund of about $5,000 shall be established for its maintenance. To carry this purpose into effect an Edison Medal Association has been organized, and it is proposed to present the medal fund at the annual dinner of the Institute on February 11, at which Mr. Edison will be a guest of honor. It is Mr. Edison's birthday also. The dinner is to be held at the Waldorf-Astoria and there is already every indication that it will be one of the most memorable functions of the kind that the Institute has ever enjoyed. The Edison Medal Association has as its officers Mr. Samuel Insull, chairman; Mr. Charles Batchelor as vice-chairman; Mr. Frank S. Hastings as treasurer, and Mr. Robert Ten Eyck Lozier as secretary. These "old Edison men" are reinforced and assisted by an executive committee of some 30 others, all of whom have been intimately associated with Edison developments, and by a general committee of about 100, all of whom have also at some stage of their careers been more or less closely identified with Mr. Edison's work. The Edison Medal Association has also appointed a dinner committee to co-operate with the Institute dinner committee under Mr. Calvin W. Rice, and has appointed other committees on various branches of its work. The executive committee includes Willie S. Andrews, C. Batchelor, Sig. Bergmann, R. R. Bowker, C. A. Coffin, R. N. Dyer, S. B. Eaton, C. L. Edgar, W. E. Gilmore, W. J. Hammer, C. T. Hughes, F. S. Hastings, S. Insull, E. H. Johnson, F. Jehl, A. E. Kennelly, J. W. Lieb, Jr., H. W. Leonard, R. T. E. Lozier, E. H. Lewis, W. S. Mallory, J. P. Morgan, T C. Martin, J. Ott, J. P. Ord, E. Rathenau, P. Seubel, F. J. Sprague, F. Thurnauer, S. S. Wheeler and F. R. Upton.

A great deal of interest is taken in this movement throughout the Institute ranks and amongst the numerous old associates of Mr. Edison, not only because the first Institute medal will thus be founded, but because one of the great epochs in electrical development will be celebrated. The twenty-fifth anniversary of incandescent lighting is also to be recognized this year at the St. Louis Exposition by the Edison companies; but it has been felt that in its engineering aspects the occasion is one which could be fitly and legitimately used to identify the Institute with the lighting art, and by this representative affair enlarge the sphere of its influence and responsibilities, since the medal is to be put in its charge. The address of Treasurer Hastings is 80 Broadway, New York.

A Combined Steam and Water-Power Central Station at Richmond.

ABOUT five years ago the construction of a power station was begun at Richmond for the Virginia Electrical Railway & Development Company to furnish current as a competitor in the electric railway and the general electric power and lighting business of that city. Water rights along the river at that point had been secured and plans were drawn for a development of 10,000 hp. Owing to the necessity for a continuity of service and in view of the fact that this could not be secured from the river either at low water or in times of freshets, a steam plant was arranged for, equivalent in capacity to the water power. The initial plant, which was completed about two years ago, was only carried for an output of 4,000 hp, but in the meantime the property passed into the hands of the Virginia Passenger & Power Company, which now represents a consolidation of the railway and electric services of Richmond, and during the present year work has been in progress until the full 10,000 hp is now practically available.

Both the hydraulic and the steam ends of the plant are unusually interesting. The former comprehends a long, low dam, provided with flashboards of both the automatic and the non-automatic type, a necessarily small canal to conduct the water to the power house, the limited cross-section creating a comparatively high velocity of flow, and the usually submerged, low-head water wheels. The steam plant includes vertical steam engines of 1,000 hp each, appropriately styled as steeple engines. A specially instructive feature of the station lies in the relative locations of the water and steam machinery and the limitations of their separate or conjoined operation.

The water rights were formerly owned by a flouring mill on Johnson's Island. The design and construction of the hydraulic portion of the first completed part of the station, including the power house, was in charge of Mr. Reuben Shirreffs, M.A.Soc.C.E., as chief engineer, now chief engineer directing a water power development at Great Falls, near Washington. Mr. J. H. Apsey was superintendent for Messrs. Winston & Co., of Chicago, contractors on the dam, canal and power house foundations. The steam and electrical features were designed by Mr. E. J. Willis, M.Am.Inst.E.E., now president of the Richmond Electric Company, of Richmond, who was succeeded by Mr. J. P. Pope. Messrs. Sargent & Lundy, of Chicago, were consulting engineers on the steam plant. Since the consolidation of the local companies, in which Mr. Frank Jay Gould, of New York, has a controlling interest, Mr. William C. Whitner has been retained as chief engineer for the water power developments of the Virginia Passenger & Power Company, and under his supervision the power house has been extended, additional units installed, some changes made in the canal and intakes and a new type of dam designed for the portion of the original work that had not yet been completed when Mr. Whitner was appointed.

FIG. 1.—VIEW OF ENGINE ROOM.

The city of Richmond is situated at the head of tidewater about 100 miles from the mouth of the James River. In the last three miles above navigation the fall of the river is 84 ft. and within nine miles 112 ft. The watershed of the river is 6,900 sq. miles. Mr. Whitner states that the average rainfall is 42 in., and from records of the Geological Survey assumes that it is not advisable to figure that the minimum flow of the James River at Richmond exceeds 700 cu. ft. per second, or 0.1 ft. per square mile of the catchment basin. About 100 cu. ft. per second pass through the Chesapeake & Ohio Canal and are not available for power. In considering the obtainable power in the river, complication exists owing to the fact that diversion has to be made to the Manchester Canal, which supplies water for operating a number of mills located along its bank. This is the property of the company, but the contracts under which water is furnished could not, practically, be changed. It is estimated that 600 cu. ft. per second are disposed of in this way, under a fall of 19 ft. At periods of very low flow, however, the Manchester Canal tenants are only entitled to one-half the water in the river. The James River plant is designed for a head of 25 ft. and assuming a combined efficiency of the wheels and generators of 75 per cent., and allowing for the diversion to the Manchester Canal, the following schedule of power has been prepared by Mr. Whitner. For five months, 8,846 hp; for six months, 6,242 hp; for eight months, 4,012 hp; for nine months, 2,982 hp; for eleven and a half months, 1,065 hp; minimum, 639 hp. This summary shows the necessity, if it is desired to supply 10,000 hp continually from its plant, for the steam engine adjunct. It shows that if 9,000 hp is the demand, the engines would not have to be operated at all practically for five months; that for one month they would have to supply 2,758 hp; for two months they would have to supply 4,988 hp, and so on. For fifteen days they would have to meet practically the entire demand. Of course, it must be remembered that these results are based on the minimum flow, which is not necessarily an annual occurrence.

The dam extends straight across the river at the upper end of Brown's Island. The hand gate house, which controls the entrance of water to the power canal, is a continuation of the dam, extending from the island to the east bank, to a point on the property of the Tredegar Iron Works. In a contract with that company the level of the water in the pond above the dam was fixed at elevation 44.75, and the level of the water in the canal just below the gate house at elevation 43. The contract also stipulated that the elevation of the top of the dam should not exceed 40.5, but provides that movable crests or flashboards can be used, by which the level of the water in the pond can ordinarily be kept at elevation 44.75. It requires that these flashboards shall be lowered or raised in times of high water so as to maintain the water level as nearly at elevation 44.75 as possible. The canal leading to the power house is 2,200 ft. long and the power house, at the end, is located at the river side. The elevation of the tail water at the other side of the power house is ordinarily 17, so that the gross head is 26 ft.

The dam is a concrete masonry structure over 1,700 ft. long, inclusive of a guard wall at the upper end of the channel. The average height of the crest is only 5 ft. above the solid granite bed of the river, on which the dam is built. That a head of 26 or 27 ft. is realized with a dam of this height is indicative of the rapid drop in the river between the dam and the power house. The minimum height of dam is about 8 ft. A higher one would probably have been constructed, except for the reasons mentioned, and the probability that serious damage might come to property above the dam at times of extreme freshets. At intervals of 40 ft. concrete piers 4 ft. wide were built along the top of the dam, 10½ ft. above the crest of the dam, to support the structure for moving the flashboards. Their height was taken to bring them above the highest flood levels, and to them are hinged the timber gates or flashboards. When resting on the dam proper these maintain the desired level in the pond, as will be noted in detail below. The movable flashboards are constructed of heavy pine timber in planking and are faced with cotton duck heavily coated with North Carolina tar as a preventive of leakage.

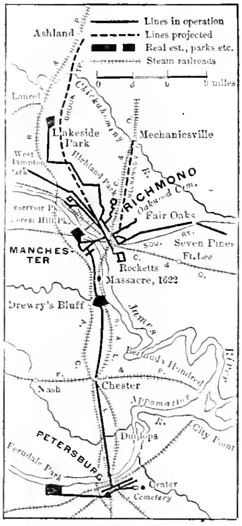


FIG. 2.—MAP OF RAILWAY SYSTEM.

The manipulation of these gates is one of the interesting features of the original design. Timber bridging spans the piers the length of the dam and this carries tracking on which is moved a hand car. The car carries a 3-hp electric motor for hauling up each gate, which is then fastened in its uppermost position, and the car is pushed from gate to gate for this purpose. There are 43 of the dropping crests, all told, each practically 36 ft. long, but the later ones are of an entirely different type. About 1,200 ft. of the dam were completed by the original company, leaving about 560 ft. to be built. This later work has been carried on by Mr. Whitner, who designed the movable crest, which is an interesting feature of the plant. This is designed to be automatic and consists, as shown, of a hinged apron inclined with the direction of flow so that there is a downward pressure on it, due to the presence of water above it. The hinge is at its lower edge, while the upper edge is hung from the end of levers, at the other ends of which is a counterbalance. When the level of the pond rises above the predetermined elevation of 44.51, the weight of the extra amount of water is designed to overbalance the counterweight, so that the apron will descend and lower the rollway crest. It will be noted that the shape of the concrete dam proper at the top is different from that for the old portion on account of the new type of flashboard. The apron consists of 6 x 10-in. pine timbers 9 ft. long, bolted together by iron plates at the bottom and top and strengthened at the top by a 15-in., 42-pound I-beam. There are two levers, one at each end, composed of 12-in., 31½-pound I-beams 15 ft. long, with two lever arms 4 and 10 ft. in length. The apron is suspended from each lever by a heavy chain. The counterweight is a cubical mass of concrete, measuring about 26 cu. ft.

A signal station is maintained at Columbia, Va., about 50 miles upstream, from which reports can be sent to Richmond by telephone of the water level at that point. By this means notices of floods are received twelve hours in advance of a rise at Richmond and men immediately start raising the gates in anticipation of the high water. Of course, with the automatic type of flashboard this is unnecessary.

The upper 900 ft. of the canal is a natural channel, enlarged by an excavation of earth and rock to an average waterway of 1,200 sq. ft. The lower end, or 1,600 ft., has concrete masonry side walls and a smooth lining of concrete on the bottom, the walls to retain the banks, as the width available was limited, and the bottom lining to increase the capacity to carry water, the lower part of the excavation being in solid rock. Its area is about 650 sq. ft. It was estimated that the canal would deliver to the station 5,500 to 6,000 cu. ft. per second with a loss of not more than 12 to 15 in. the whole length. The velocity under these conditions is about 9 ft. per second. To diminish the loss of head as far as possible, an unusual amount of gate area was provided at the head house. There are ten openings, each 12 ft. wide and 8 ft. high. The openings were fitted with heavy timber frames, each of which supports five smaller gates. This division was employed to regulate the supply of water when the river is high, but when the river is low the openings are left unobstructed.

The power house is located, as already stated, parallel to the axis of the canal, so that the forebay is comparatively small, at least where the water has to change its direction 90° before entering the wheel chambers. With the extension of the power house the end canal was enlarged as much as the width of the property would allow and the racks, which were formerly set across the canal, have been put immediately in front of the wheel chambers, increasing the area of flow through them, it is stated, three and one-half times. In connection with them an interesting device has been provided to clean the racks mechanically. The racks are composed of 3½ x ⅜-in. steel bars spaced on 1⅝-in. centers and each rack structure protects an opening 18 ft. wide. The cleaning device comprises a number of large combs, on which the projecting teeth fit in between the bars of the racks, and of endless chains on which the combs are fixed and by which they are moved upward along the rack bars. The comb consists of an angle bar with teeth of ½ x 1-in. iron, pointed, and riveted to the angle on 1⅝-in. centers. The chains are driven at the top by a motor connected to a shaft, which carries the necessary sprocket wheels.

The power house is built on bed rock, and, on account of the great weight of the machinery installed, on the one hand, and the considerable upward pressure of water in extreme freshets, which reach a level of 20 ft. above the boiler room floor, on the other, the foundations have been made unusually massive. The water wheels, which are of the horizontal type, are mounted in pairs, one pair submerged in each wheel chamber. The wheel chambers are arched overhead and support the boiler room for the steam plant. The tail water from the turbines reaches the tailrace through a comparatively long draft tube and across the draft tubes is located the generator room. The shaft from the water wheels extends into this and is directly attached to the generator, and on the other side of the generator is the steam engine, placed also in line for direct connection, when necessary. Under the engine room the entire space excavated is solidly filled with concrete, except for the draft tubes, which are circular in section, 10½ ft. in diameter at the outlet of the wheels, enlarging to 14 ft. at the river wall. The extensive use of concrete masonry is noticeable, as not only the dam, the canal masonry and power house foundations are constructed of it, but the walls and roof of the first portion of the station, the switchbard gallery floor and even the outer shell of the chimney are concrete. Portland cement was used for the most part, except in places where weight only was required, and there natural cement was used. It was stated that the stone from the excavations was unsuitable for stone masonry, and the use of concrete in constructing the building and chimney made architectural effects possible at a comparatively low cost. The foundation work was built in forms and the shaft of the chimney was constructed in the same way. The walls of the superstructure, however, were built of blocks of concrete, previously molded in boxes and laid up in the walls like stone ashlar. This part of the station was built large enough for four units of 1,000 hp each. The extension is designed for six additional 1,000-hp units, so that the capacity will be 10,000 hp.

Six pairs of the water wheels are of the Victor cylinder gate type, built by the Stilwell-Bierce & Smith-Vaile Company. Each is 51 in. in diameter and the pair guaranteed to develop 1,200 hp under a 25-ft. head. The seventh pair of wheels thus far installed consists of Hercules turbines built by the Holyoke Machine Company. The shaft from each pair extends in the usual way to the engine room through an opening in the partition wall. Each generator is a continuous-current machine of 700-kw capacity, built by the General Electric Company. The engines are steeple tandem-compound Allis engines. They are arranged to run condensing or non-condensing and are rated at 750 hp and at best economy are capable of delivering 1,500 hp. The water wheels are controlled by Lombard governors.

The steam engine cylinders are 18 and 36 in. in diameter with a 42-in. stroke, and they are equipped with the Reynolds valve gear and ball governors. A bolted flange coupling effects the connection between the turbines and the generators. The engine fly-wheel, which weighs 80,000 pounds, is mounted between the generator bearings and runs with the generator, whether driven by the turbine or engine. The engines are disconnected by uncoupling the connecting rods from the crank pins. To change from the water to the steam plant, bolts are removed from the couplings and the connecting rod is connected to the crank pin. To change from steam to water the operation is, of course, reversed. It is stated that the change requires about 45 minutes. The reason that the engines have a most economical rating at the comparatively low power is that this machinery is depended on to operate alone but for a small portion of the year. They are intended principally to supplement the wheels in time of low water and to maintain proper speed in the turbines at high water.

The condensing plant presents an interesting combination of two Worthington elevated injector condensers set at different levels. The lower one is operated normally under the head existing between the canal and the river. The second condenser is provided with an electrically-driven centrifugal pump, which has a capacity of 1,600 gallons per minute, to meet the conditions of high water when the natural head may prove insufficient. The condenser plant has a rated capacity of 6,000 hp. It is provided with a double-acting Worthington dry vacuum pump, 10 x 18 x 18 in. in size.

The boiler installation consists of four 1,000-hp batteries of Babcock & Wilcox water tube boilers, each having 252 tubes 4 in. in diameter and 18 ft. long, and three steam drums 3½ ft. in diameter and 20 ft. 4 in. long. They are rated at 500 hp each, on the basis of 10 sq. ft. of heating surface per horse-power and 0.2 sq. ft. of grate surface per horse-power, so that the ratio of grate area to heating surface is 1 to 50. The ultimate steam capacity of the plant is 4,000 hp.

It will be noted from the cross-section drawing of the station that coal is delivered in the railroad cars pushed on a trestle in the boiler room. The coal is readily dumped immediately in front of the boilers and there is storage capacity for about 120 tons. Semi-bituminous coal is used and as labor is cheap and the boilers are not operated continuously, they are hand-fired. The chimney is 11 ft. in diameter and 175 ft. high above the boiler grates. Feed water is drawn from the canal; but there is, also, a connection with the city mains, so that in times of excessive turbidity in the canal the boilers may be kept free from scale-forming water. There are two feed pumps of the Knowles duplex type, 6 x 10 x 12 in. in dimension. The water

FIG. 3.—EXTERIOR VIEW OF HYDRAULIC POWER HOUSE.

is discharged by the pumps through a Berryman feed water heater, 36 in. in diameter, provided with the usual by-passes for both the exhaust steam and the feed water. The only steam passing through the heater is that from the dry vacuum and the feed water.

The steam pressure is 150 pounds per sq. in., and extra heavy wrought-iron flanged pipe was installed for all the steam mains. The Chapman valves are employed, and the high-pressure mains and pipes are drained into the boilers by means of the Holly system. The steam header is 14 in. in diameter and the exhaust header 36 in.

In addition to the machinery described, there are two drainage pumps on the engine room floor with a combined capacity of 600 gallons per minute, furnished to handle any water which may percolate through the masonry during freshets. A 25-ton traveling crane built by the Whiting Foundry Equipment Company spans the engine room.

Being an independent company when the work was instituted, a variety of service was arranged for. The switchboards, which are situated on a gallery running around the engine room, are quite extensive. Direct current is supplied for railway work and for light and power, and for the latter there are two high and two low bus-bars and one common neutral bus on the lighting panels, the Edison system of distribution being employed. Alternating current is also furnished, and besides the generator and exciter panels, the switchboard has 10 railway feeder panels, 10 Edison panels and 2 alternating-current panels. The unusual feature is presented of a water power station situated almost at the center of its load, two-thirds of it being located within a radius of 1½ miles. On this account the three-wire system of distribution was adopted, 235 volts for light and 470 for power, reserving the alternating system for service out-

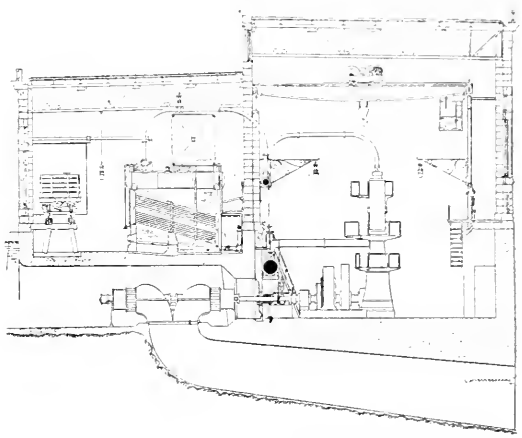


FIG. 4.—CROSS SECTION DIAGRAM OF POWER HOUSE.

side this zone. The voltage for this service is 2,300 at the station, with transformation to 115 volts, for local distribution. The railway current is, of course, delivered at 550 volts. The current is distributed both through underground conduits and overhead feeders. In the former the conductors are rubber-covered lead-enclosed feeders, furnished by the John A. Roebling's Sons Company. The electric controlling apparatus is of standard General Electric manufacture.

The officers of the Virginia Passenger & Power Company is as follows: President, Mr. F. Sitterding, of Richmond; first vice-president, Mr. Frank Jay Gould, of New York; second vice-president, Mr. Augustus Wright, of Petersburg; secretary and treasurer, Mr. Guy Phillips, of New York; assistant secretary and treasurer, Mr. William Northrop, of Richmond. The late construction work, except the extension to the power house, which was erected by Mr. John Mann, Jr., was done by the company's own forces.

A Long Trolley Line.

A telegram from Richmond, Ind., of January 1 says: "If the plans of the men who are the power behind the Columbus, Greensburg & Richmond Traction Company materialize the company will have one of the greatest systems of trolley lines in the world. The plans contemplate not only a line from Columbus through Greensburg to Richmond, but also several long branch lines. One is to run to Louisville. Another is to run into Cincinnati. At Greenfield connection will be made with the Indianapolis & Eastern for Indianapolis. The line to Richmond is not merely to run into this city, but is to extend through the city and east to Cleveland, with Buffalo as its ultimate terminal. This would give the company direct connections with Indianapolis, Louisville, Cincinnati, Cleveland and Buffalo. The third-rail system is to be used except inside the corporations, where it is necessary to resort to overhead construction. The company will make use of private right of way."

The Government Printing Office—The Electrical Equipment of the Largest Printing Office in the World.—II.

DISTRIBUTION, ETC.

IN the first part of this article it was attempted to give an account of the Government Printing Office at Washington, as the largest printing office in the world, and that in which the application of electricity to the various processes of typography finds its most notable example as well as its furthest reach up to date. That part of the article dealt with the building, the nature and extent of the work done in it, the size of the staff employed, the power plant and the electrical generating apparatus. It is now proposed to deal with the distribution of the current and its utilization in running motors, heating, ventilating, lighting, etc. But before entering upon this part of the subject, which embraces the Office as a going concern, which, with the New Year has barely got into full swing, it is appropriate to note the fact that even before there was a new building, Mr. Tapley had to operate his plant for all it was worth, during the trying period of erection. In a rather curious manner, therefore, typically illustrative of the flexibility of electric power, the Office has shown what can be done in building operations with a handy and adequate source of current. For instance, all of the steel structure was raised by electric hoists, and virtually all the brick, mortar and cement and other general building material was elevated in the same way. Electrical pumps were used during the digging of the foundations, for removing the surface water. In the laying of the wood block floor, current was used for heating the mastic which holds the maple onto the concrete flooring bed. Portable saws and other woodworking machinery were supplied with electric drive, and all the planing of the floors was done by specially constructed machines propelled by electric motors. This contract was carried out by Mr. James G. Wilson, of New York City.

Such "distribution" as was required for this special work was necessarily more or less transient and temporary, but from the very first elaborate plans had to be worked out providing for all main and branch circuits in a building of steel, whose iron floor construction is covered with two to four inches of fireproof material, such as concrete, and yet where the work would demand the extension to innumerable points of wires capable of delivering current enough to run extremely heavy machinery. Moreover, two distinct services had to be provided for, light and power, besides which the use of electricity in large volume for elevators, heating, ventilating, etc., made further exactions only to be fully comprehended by a study of the building itself, over whose endless floors one may wander for days, encountering some new application of electricity or electric motor at every turn.

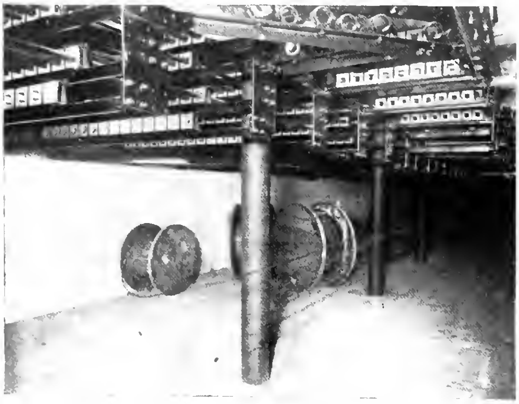


FIG. 12.—CABLE VAULT.

As might be expected, some wiring between floors and walls is enclosed in conduit, as well as at points of emergence around machines, and some idea of the extent of the work involved is faintly indicated by the data given in the report of the chief of engineers, United States War Department, who, by some odd twist of governmental regime, appears to have had the construction of this building under his direction and supervision, although it is obviously one of the most pacific branches of the public service. The figures submitted by Captain J. S. Sewell, United States Corps of Engineers, to General Gillespie, show that up to November 28, the sum of $123,147 had been expended on electric wiring, the work on which, by the way, was done by the electrical force of the Printing Office—a most creditable fact. The scope of the work is also indicated by the material used in the electrical installation, including 13,094 linear feet of terra conduit; 55,068 feet of flexible metal conduit; 14,000 pieces of lead bushing for the flexible conduit; 1,822 iron outlet and junction boxes; 8,248 pieces of enameled pipe; 145,811 fittings of all kinds; 394,375 feet of wire of all classes, or about 75 miles; 1,649 C. S. switches; 91 distributing centers; 1,490 feet of lead tubing and 807 feet of ¾-in. black pipe; 1,490 cut-outs; 2 automatic switches; 1,310 castings of all kinds, and 7 galvanized iron boilers of 30-gallon capacity each, employed with pneumatic door openers. This is no mean bill of supplies.

As a general thing, the column fixtures are the essential feature

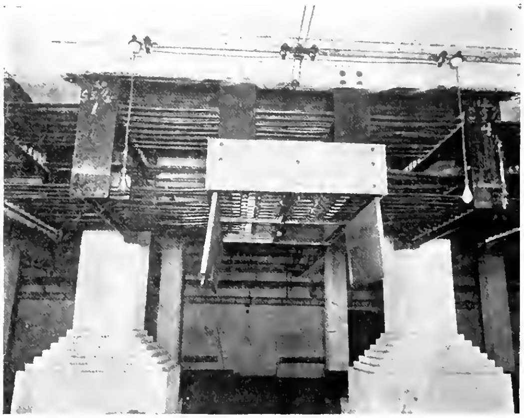


FIG. 13.—LIGHTING DISTRIBUTION CENTER.

of the lighting, but such departments as the composing room and the proof-reading room are a maze of drop lights on flexible cord. Of these applications more anon. It will, however, be readily understood that what is essentially an entirely new system had to be worked out for distributing the electric light and power conductors throughout such a building.

The contract for furnishing some of the wire and cables for the office was made with the Safety Insulated Wire & Cable Company, and amounted to over 100 miles of conductors ranging in size from 1,000,000 cm. to No. 12 B. & S. gauge. The specifications were the most rigid that have ever been received by that company for inside wiring, Article 37 of the contract being as follows: "All rubber wire, both stranded and solid conductors, shall have an insulation of seamless rubber compound, containing not less than 40 per cent. of pure Para rubber, and shall show an insulation test of not less than 1,200 megohms per mile; must be concentric and free from flaws and holes; must have a smooth surface and circular section."

The insulation was guaranteed to stand a rise in temperature of 100 degs. F. above the surrounding atmosphere, and not be affected by either acid or alkaline solutions. It was specified that all wires and cables furnished should be submerged in water for two weeks at a temperature of 76 degs. F., before the insulation resistances were taken. No. 12 wire was used in all cases for circuit work instead of No. 14, as is ordinarily used in commercial installations. The circuit wire was constructed under special specifications drawn by Mr. Tapley, as electrical engineer of the Office, and was designed to withstand not only the exacting electrical heat, acid and alkaline tests, as noted above, but such abrasion as would ensure its safety against rough handling in drawing through the miles of conduits used in the Printing Office. As a special precaution, after manufacture, all of the wires and cables were submerged in water, and an alternating current of 5,000 volts pressure was applied between the conductors and the water. This test showed a factor of safety of fifty times the actual working pressure.

The cable racks shown in the vault extend a considerable distance, and are built up in four tiers and supported, as shown clearly in the cut. All the cast iron and steel parts received either one or two coats of asphaltum paint or japanned finish, and the insulator clamps like all the castings in the work are of a tough, close-grained gray iron. The porcelain insulator blocks are of dense material, glazed and tested to withstand 10,000 volts alternating current without breakdown.

The terra cotta conduit used, furnished by the Potomac Terra Cotta Company, of Washington, D. C., is composed of single duct 24 inches in length, vitrified and glazed inside and out, with exterior dimensions about 4 inches square, and with a hole in the duct 3¼ inches in diameter. Each piece of duct is provided with iron dowel pins. The outlet holes of all tile are 2½ inches. The steel pipe employed is enamel, having a thickness of 1-16 inch evenly applied, leaving a smooth interior wall guaranteed for ten years to be free from cracks and flaking, and with an insulation between metal and enamel equal to 5 megohms. The iron armored conduit of which four or five thousand feet have been used, is ¾ inch with heavy wall. A large amount of flexible iron conduit has also been used, amounting to several thousand feet of ¾ and 1-inch sizes, and it is of the spiralized flexible metallic Greenfield type made by the Sprague Electric Company. A striking illustration of its flexibility is shown in one of the engravings which portrays a run at an elevator shaft, where it has been brought up a lattice column and looped around and across. The circuits thus run through pipe and by means of the vent shafts run to over 1,800 metal outlet boxes, as noted above, all of cast iron with interior insulation, and of a general dimension of 3¼ by 3¼ inches inside measurement, and to switch boxes of corresponding number equipped with C. S. double-pole flush switches made by the Cutter Electric Manufacturing Company, of Philadelphia.

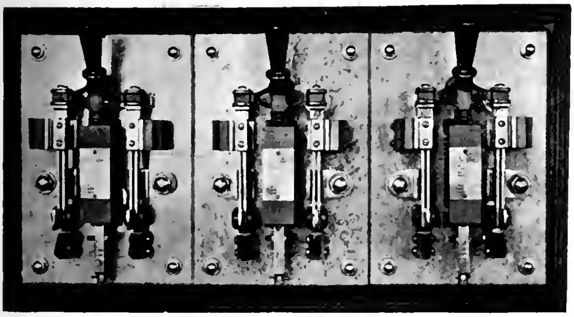


FIG. 14.—DISTRIBUTING CENTER AND CIRCUIT-BREAKERS.

The proper distribution of the electric circuits necessary for supplying both light and power in a modern fireproof structure is a subject that needs much thought and consideration before the final arrangements are decided upon and to the structure itself. This is one of the principal features in the wiring of this building. The general scheme is as follows: There is provided an air space between the ceiling and the fireproof flooring of from 10½ inches, bottom of floor beam to top of ceiling beam to a maximum distance of 19 inches from crown of floor arch to ceiling line. This provides a space where all wires are readily accessible. The selection of the fire proofing and floor construction was finally settled upon as being the best suited to an electrical distribution which has to be constantly changed, that is, there must be means of ready accessibility not only to the power circuits but also to the lighting as well. At the same time the floor construction must not be weakened by having a large number of holes drilled through it, which is necessary as will be seen from the subsequent description of the power and press installation.

The system as a whole might be most properly designated as an open-concealed installation, which is readily to be understood from the illustrations which accompany this article. The auxiliary feeders are all supported upon porcelain insulators carried in specially constructed insulator clamps which in turn are fastened to the three-inch I ceiling beams.

The main feeders come direct from the switchboard to the cable vault where they are carried upon porcelain insulators themselves secured to special iron cable supports thence to the vent shafts which run from the basement to the loft, in which are another type of special insulators fastened to channel iron which are so placed as not to interfere in any way with the main design of these shafts, namely, ventilation of the various floors. It provides, however, a very accessible means of making additions or alterations in either the lighting or power circuits now or in the future without in any way installing new conduits or having to cut the ceiling of the building for such work.

In the basement both in the north and south wings of the building are placed two distributing centers into which the main lighting feeders are connected, from this branch laterally the auxiliary feeders entering ultimately the extreme east and west vent shafts of their respective wings in which they rise to the individual floors, where they enter a specially devised distributing center consisting of three circuit breakers mounted upon a common bus, which in turn is the connecting link of the main floor crib. All floors are wired on the crib system, the center circuit breaker being used as a tie switch, thus allowing double the number of lights to be installed on the crib without any subsequent drop in voltage.

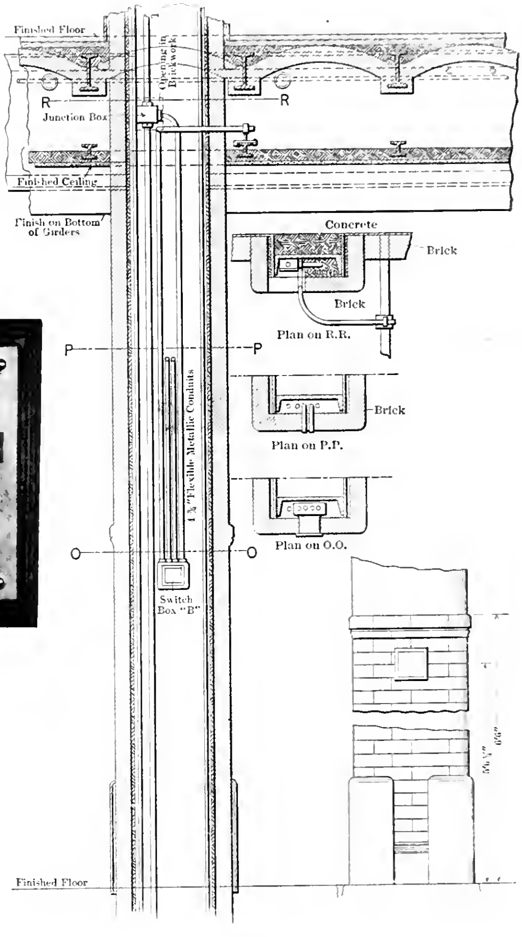


FIG. 15.—SECTIONAL VIEW OF COLUMN, WITH CONDUITS AND SWITCH AND JUNCTION BOXES.

ELECTRIC LIGHTING.

From the main floor lighting crib is made a tap at every column from which the wires are conducted through flexible metal conduit to switches located on the east and west sides of the columns in the building. The switches on the east side control the lights of their respective north and south bays, while the switches on the west side are used for controlling the general illumination, which is obtained by means of 12 lights uniformly distributed around the sides. Two of these lights are used for pilot lighting, which provides sufficient light for the watch force when the Office is not engaged in night work. This pilot system is controlled by one general circuit located in the basement, to which are connected vertical feeders for each column. This pilot circuit is connected to an individual switch on the main switchboard giving the switchboard attendant full control over the lighting system and thus cutting down to a minimum the use of current for this purpose.

The individual lighting throughout the entire building, except in the executive offices, main hall and column lighting as mentioned

FIG. 16.—VIEW IN COMPOSING ROOM.

before is entirely done by means of individual pendant lighting. Each bay, practically 12 ft. by 34 ft., is taken care of by an independent auxiliary crib located inside of the ceiling space to which taps are made wherever lights are desired. Wiring for the individual lighting is figured on the basis of one 16-cp. lamp to every 25 sq. ft. of floor space. In some places, such as composing rooms, this maximum allowance is used, while in others there is not more than one-half of the original proportion in use.

The power circuits are conducted in a similar manner from the switchboard to their respective vent shafts with the exception that there are no distributing centers in the basement, but each power circuit is continuous from the switchboard to its respective distributing center located on the vent shaft near the ceiling of the floor below which it is to feed. The general scheme is for the power circuits to lead up through the floor to the individual motors wherever located while the lighting connections are made to the ceiling of the floor below.

On every floor there are four lateral power feeders extending the entire length of the building from which power is given to individual motors when located within the radius of a few of same. The feeders themselves are in turn connected by ties to the individual circuit breakers located on the distributing centers. The floor girders are 33 inches in depth, extending 10 inches below the ceiling line. Means of providing for these lateral runs through both steel girders and their surrounding fire proofing is accomplished by having the girders punched at the proper place and a steel tubing thoroughly enameled being inserted in this hole and its end projecting 1 inch either side of the fire-proofing of the girders, thus providing continuous porcelain support for the feeders from one end of the building to the other, the supports between girders being special insulator clamps fastened to tie rods 4 ft. on centers. There was installed in the outer walls of the building and in every bay a vertical run of terra cotta conduit having openings inside of the ceiling space and at 6 ft. from the floor at every story. This makes it possible to run wires throughout the entire building with the ability to reach any place desired without having to cut the walls or in any way disfiguring the interior of the building, which is of enameled and white hard-burned bricks.

Mr. Tapley has used throughout the entire installation, with exception of the taps from the auxiliary cribs to switches and their returns, weather-proof wire, thus effecting a saving between rubber and fireproof insulation of a sum sufficient to pay for the cable supports in the basement and vent shafts. This wire being subjected constantly to a warm, dry atmosphere the insulation will be in much better condition ten years hence than had rubber insulation been used for the mains and feeders.

The cost of this system was very much less with regard to both material and labor than had conduit system been adopted. The cost of alterations and additions are practically nothing in comparison to what this would have been had no means been provided of ready access to all wires in the building. In a large institution of this character it is impossible to see ahead three or four years, and thus it becomes necessary to provide some such means as adopted here, unless they were to disfigure the building every time an alteration of lights or of machinery are needed for the benefit of the service. No argument is needed on this score for a careful study of the illustrations shown will demonstrate the great practibility of this system over the ordinary iron pipe installation.

As a general thing, as already noted, the column fixtures are the essential feature of the lighting on all floors, and they are clearly illustrated in many of the engravings as well as in detail. The column fixture is a simple band of metal of plain but graceful appearance, having three lights on each side of the column. It is noteworthy that here as well as in the halls, in fact, throughout the building, incandescent lighting reigns supreme, while, of course, in the halls of the first and second stories, or where the general public has access the fixtures are of a more costly and decorative type, especially at the marble stairway of the front entrance.

Views are also shown of the lighting in the proof-reading and composing rooms, where there is a maze of drop lights on flexible cord supplementing the column fixtures. In the composing room over the type cases, Mr. Tapley has worked out and installed a simple but ingenious device, as shown in one of the cuts, by means of which the possibility of breaking the cord or the lamp is reduced to a minimum. As will be seen the lamp can be slid along a horizontal wire or rod which extends from end to end of the row of type cases, and even if he moves his position only an inch or two, the compositor can at once slide his lamp along the wire and it assumes and keeps the position in which he wants it without any further manipulation or attention. The handle by which the lamp and its shade are shifted about on the supporting wire can be seen over the various type cases.

FIG. 17.—SPECIAL FIXTURES OVER TYPE CASES.

ELECTRIC ELEVATFRS.

One of the most interesting and important parts of the plant is the elevator equipment, to which incidental reference has already been made. The elevator system was designed by Mr. E. R. Carichoff, of the Otis Elevator Company, to meet the special conditions laid down very rigorously in the government specifications. All the elevator mechanism is, of course, installed on the basement floor, and the elevator shafts are designated clearly as to location on one of the plans already published in the first part of this article. The elevator plant consists of thirteen large machines, eight of which are for passenger service and five for freight service, and two form lifts,

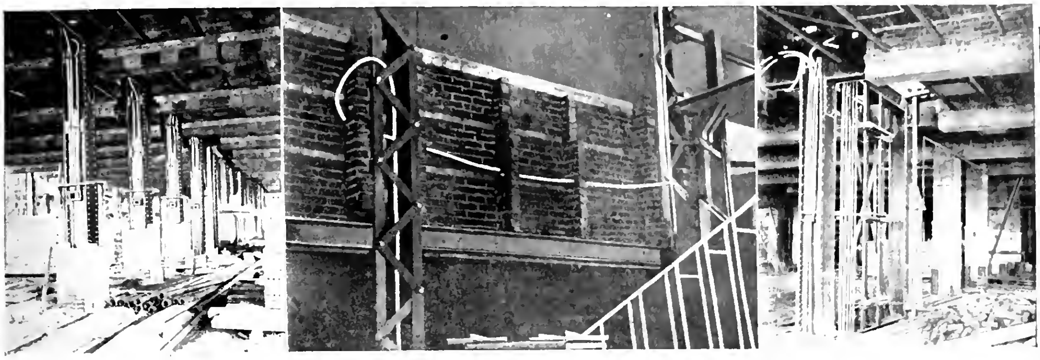


Fig. 18.—Straight Runs of Conduit, Cable Vent Shaft and a Flexible Conduit Loop.

Fig. 19.—Runs of Conduit with Outlet Boxes on Columns.

Fig. 20.—Distribution Crib on Ceiling, and Conduits and Cables in Vent Shafts.

WIRING OF THE GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

which are automatic push-button elevators for carrying forms of set up type. The large machines have a capacity of 5,000 lbs. at 350 ft. per minute, and one of the freight machines is provided with changeable back gears at the drum, which increase its lifting capacity to 10,000 lbs. at a reduced speed.

All of the machines are of the worm-gear drive-winding drum type. The worm gears are cut according to the Hindley form, to insure the maximum contact surface. The two worms are cut on one forged shaft, and interlocking spur gears bolted to the side of the worm wheels take up the end thrust of the worms. The taper ends of the worm shaft and the armature enter the face couplings connecting the motor to the worm shaft—one-half of the coupling forming the brake pulley.

A glance at the cut of the isolated machine (Figs. 22 and 23) shows the substantial character of the construction, and also how readily adjustments may be made of brake tension and for wear of shoes. No live parts are exposed at any time, and the motor may be entirely closed or the covers may be removed as desired.

The wires from the motor to the controller run in flexible loom through insulated water-tight ironpipes and less than one per cent drop of potential occurs between motor and controller. Fig. 24 shows a single controller, the parts of which are mounted on two-inch Tennessee marble supported on angle irons from a cast iron base. The two reversing switches are shown near the bottom. The long coil in the centre operates the fingers for regulating the resistance for starting and stopping, and is controlled in both operations independently by an oil retarder.

FIG. 21.—VIEW IN PROOFREADING ROOM.

The small heavy wire coil at the right, near the middle, limits the input of current, and the small magnet at the left varies the field strength and speed of the main motor. On the upper right corner is placed an independent overload no-voltage circuit breaker, which may be opened by the car at extreme limit of travel or by the operator in car in emergency cases. On the upper left corner of the board is a recording wattmeter, which with the counting device attached to the machine permits readings of energy consumed by the machine and feet traveled by the car.

The two reversing switches and the variable speed magnet are controlled by the car switch which is entirely enclosed, self-oiling, and provided with spring return to off position and lock to prevent accidental movement. A covered stop motion switch on the machine brings the car to a stop at the top and bottom of travel. A centrifugal governor switch on the machine forbids excessive speed. The safety grip for holding the car on the rails is operated by a speed governor at the top of the hoistway, and may be thrown on by the operator in the car. This action controls the switches which immediately stop the machine. The guide rails for the car are cold-rolled steel, and are supported every four feet by reamed bolts. The overhead construction work has no holes in the flanges of beams.

The passenger cars have bronze cages and other parts are made to correspond in finish. Throughout the work is of the highest grade, and the operation of the cars is prompt and at the same time exceedingly smooth.

The scheme of motor connections herewith (Fig. 25) shows that one resistance is used for starting and stopping the motor. It will be interesting to refer to this diagram in detail. When all the switches are down the armature is seen to be on closed circuit of low resistance. It will also be noted that a small quantity of current is allowed to pass through the shunt field by the resistance *F R*. This current is less than two amperes on 110-volt circuit, but is

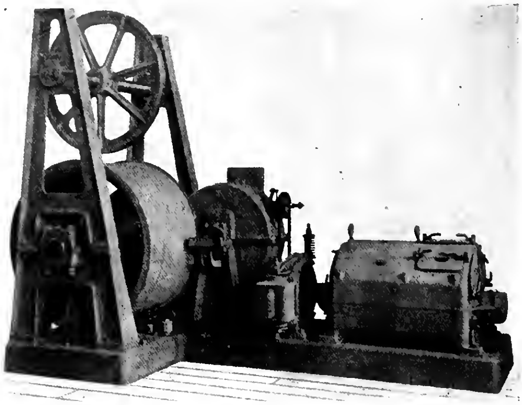


FIG. 22.—VIEW OF SINGLE ELEVATOR.

sufficient in connection with the resistance *S* to provide a dynamic brake for stopping.

Beginning with the switches in this position, the operation may be described as follows: Let the car switch be moved toward up. The first movement sends current from the plus line through the wire - *c* to the car switch, and thence through the contact *U* and the *U* limit to the up magnet, thence through the wire *U*, and bridges 6 and 7 and wire -*c* to - line. The up magnet is now lifted, bridge No. 1 making the circuit from - line to *I*, and bridge No. 2 making the cir-

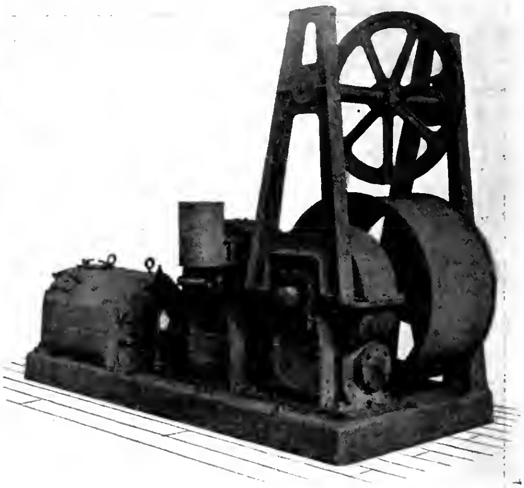


FIG. 23.—VIEW OF SINGLE ELEVATOR.

cuit from - line to *Ro*. The bridge No. 2 being electrically connected to bridge No. 3, connection is also made between the - line and the lines -*B* and -*SF*. Current now passes from - line to the brush *I*, and through the armature to the brush *E*, thence through the regulator brush and resistance to *Ro* and back to - line.

Current also passes from - line through the wire -*SF* to the shunt field and thence through bridge No. 9 to the wire -*SF* and through bridges No. 2 and No. 3 to - line. The brake circuit is also completed from - line through bridges 10, 3 and 2. The regulator circuit is completed through bridges 10, 11, 3 and 2.

Supposing the car switch to remain in the position just described the armature begins to rotate and resistance is cut out by the regulator. The throttle magnet is operated by a series coil in the armature circuit, and should the current become excessive, it lifts breaking the regulator circuit at bridge 11. The regulator then receives current only through the resistance *A. R. T.*, and ceases to move.

When the regulator reaches the top of its movement, it lifts bridge No. 10. This cuts resistance *A. R. B.* into the brake circuit, and resistance *A. R. S.* into the regulator circuit, so that these coils do not become heated. The bridge 10 also completes the circuit to the fast speed magnet, so that if the car switch is now moved so as to send current through contact *F*, the fast speed magnet will be lifted cutting in the field resistance. The motor then runs with increased speed and weakened field. Should the car switch be turned at once to "full speed," the fast speed magnet cannot operate until the regulator has completed its upward movement.

As the car switch is returned to the central position, either by hand or by the action of its own centralizing spring, the fast speed and the reversing switch magnets are demagnetized and fall, placing the armature in a closed circuit of high resistance, the resistance brushes being now at the top of their travel. The regulator is retarded in its descent, so that the resistance in circuit is gradually reduced until the circuits are as shown in the diagram. This action affords a gradual dynamic brake.

It is seen that the reversing switches cannot be operated unless the resistance brushes are at the lowest position where all the starting resistance is in circuit, as soon as one of the reversing switches is energized.

Resistance tubes of suitable capacity are inserted in the operating coils after action, so that the temperature rise is hardly appreciable. This and the mode of winding of coils insures absolute indestructibility. The contacts are of ample capacity, readily renewable as will be seen by a glance at the engraving of the controller. Indeed, some of the elevators have been in operation for a year, and experience so far indicates that the cost of maintenance will be almost nothing.

Reference has also been made to the two form lifts of the "push-

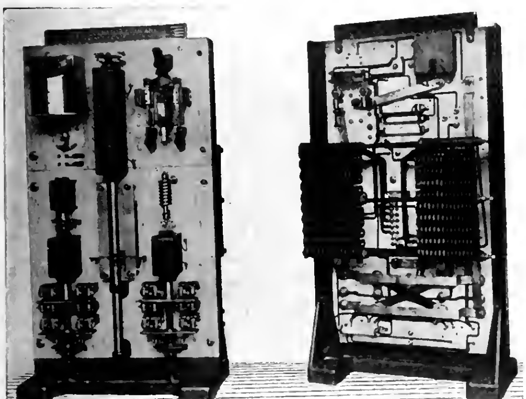


FIG. 24.—VIEWS OF ELEVATOR CONTROLLER.

button" type, operating between the composing room and the pressroom floors. These were also supplied by the Otis Company. On the form lifts exact stops are made from a speed of 300 ft. per minute by the automatic slowing device, which operates only at the landing for which the car is destined. At the same floor a signal lamp remains lighted and the car is held until the load is removed or put on and the door closed, when the car may be directed to any other floor. The total lift is 100 ft. The hoists are provided in permanent elevator shafts, housed in well above the floor, and are each equipped with a 10-hp motor, 110 volts, direct current. The cars are 4 ft. by 6 ft. 6 in., so that a large "chase" can be handled quickly; and it will have been understood from previous passages in this article that the hoists are a material factor in securing the great dispatch with which much of the work is executed.

ELECTRIC HEATING APPLICATIONS.

Perhaps the application of the motors to the presses might be considered next to the elevators, but there are one or two other branches of service of equal interest if not equal scope which fall in place here for treatment. Most striking and noteworthy of these is the use of electric heating. Unless we are greatly mistaken Mr. Tapley has in service one of the largest electric heating systems in the world; certainly the largest that is known in the field of printing and publication. Here again the work is characterized by a great deal of originality and thoroughness, for which the staff, in conjunction with Mr. W. S. Hadaway, Jr., engineer of the Hadaway Electric Heating & Engineering Company, of New York City, must be ascribed great

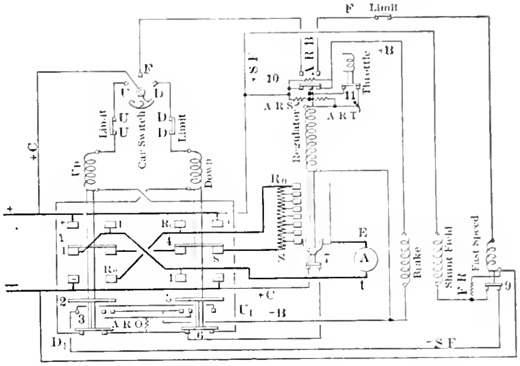


FIG. 25.—DIAGRAM OF MOTOR CONTROL USED ON ELEVATORS.

credit. The uses of electric heat in the office fall broadly into two groups or classes. One of these embraces the foundry and includes matrix drying tables, wax stripping tables, wax melting kettles, case warming cabinets, "builders' up" tool heaters, case warming table, wax knife cutting down machine, "sweating on" machine, and soldering iron heaters. The other class in the bindery includes embossing and stamping press heads, glue heater equipments, glue cookers, case making machines, finishers' tool heaters, book cover shaping machines. This is a remarkable range, but in addition and outside these divisions we find the pamphlet covering machines, the sealing wax melters and some other devices. It is only when one sees such an equipment as has been devised for and brought together in the Government Printing Office that one grasps fully the idea of the extraordinary flexibility and utility of electric heating. Such heating may not yet take care of a big building, but in such special applications as these it cannot be surpassed or equaled for efficiency and economy.

The equipment of these electrically heated appliances in the Office supplants gas and steam in all processes excepting the stereotype melting pots which are heated by gas. Practically all apparatus was made from new designs by Mr. Hadaway with careful attention to mechanical details, and with large factors of safety electrically. The specifications of the controlling appliances were rigid, and necessitated new switch designs giving great strength and durability. The switches, seen on the wall in Fig. 28, are mounted upon slate slabs and protected by iron covers, all connections being soldered to lugs. The slabs are mounted upon iron or slate bases so that every precaution may be taken against accident.

In cases where working temperatures are moderate, the apparatus is operated on 117 volts. Where high temperatures and rapid rates of impartivity are required lower variable voltages are used. These are secured by translating appliances consisting of rotary converters and transformers with several taps on secondaries. The extreme ranges of energy density in various appliances are from 0.75 to 40 watts per square inch superficial area.

The Matrix Drying Tables.—These are employed for preparing the matrices used in printing the *Congressional Record*. The bed is supported upon a massive pedestal to which an apron is attached. The platen is controlled by a heavy double screw in yoke bolted to the pedestal. The bed and apron are heated, each having separate controllers. Great care was necessary to secure a uniform temperature over working surfaces.

Wax Stripping Tables.—After the cases have been used to make electrotype shells, they are put upon the stripping tables which melt

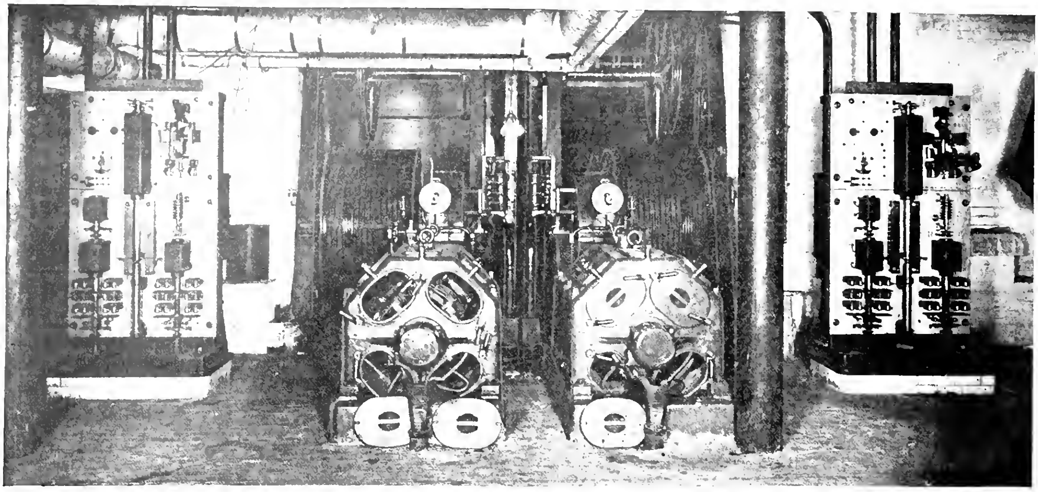


Fig. 26.—View of Double Elevator Equipment.

the wax. The wax is collected in a gutter, which empties into the wax kettles. A variable temperature within moderate limits is desirable according to the amount of work to be done.

Wax Melting Kettles.—The wax is collected in these from the stripping table and freed from graphite and dirt and freshened and tempered. A pair of kettles are placed side by side and attached to a drip pan to facilitate this process. The drip pan is attached to the stripping table on one side and to a pouring table on the other side. The heaters are arranged to give equal temperatures to the walls of the kettles and to prevent scorching and unnecessary destruction of the volatile elements in wax.

Case Warming Cabinet.—Before the cases are put under hydraulic presses, the wax is softened at a moderate temperature so as to give accurate impressions. The warming cabinet is a chamber with racks in which a number of cases may be put to soften the wax. Electric heaters are so distributed as to give a uniformly diffused heat throughout the chamber.

Case Warming Table.—In the case warming cabinet the wax is softened equally throughout. The case warming table is designed to heat the case on the upper surface only so as to secure a firmer backing. A heated plate is placed horizontally above the table upon which the cases rest with the wax films upward. The heating is effected by radiation from a uniformly distributed energy surface.

Wax Knife Cutting-Down Machine.—After the cases have been under the hydraulic presses, the wax is uneven and ragged around the impressions. This machine has a movable bed upon which the case rests. It is then passed under a carefully heated knife, which removes all projections without defacement. This is an instructive example of the greater refinement in processes which has been made possible by electric heating.

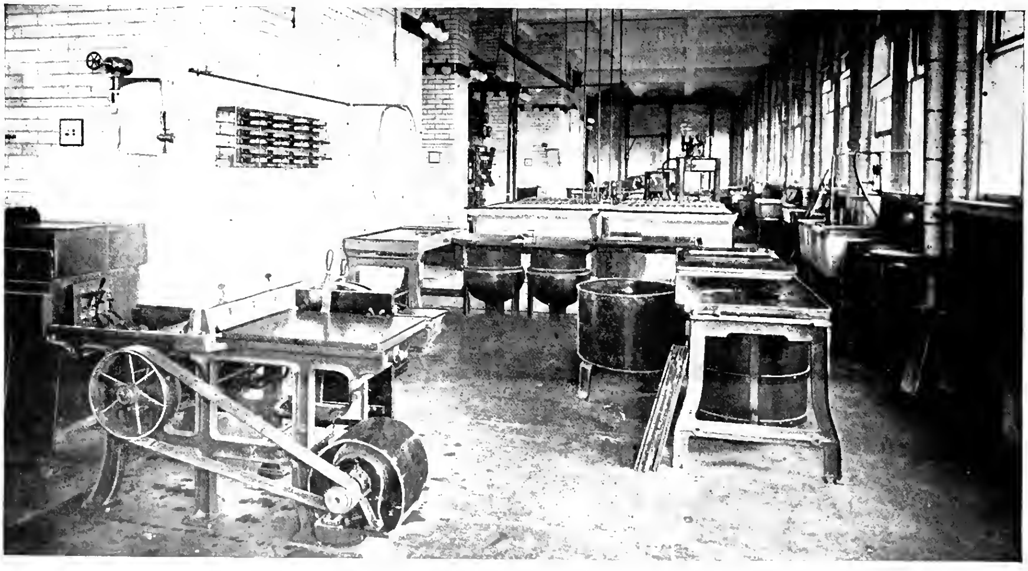


Fig. 27.—Wax Shaver and Wax Heating, Electric Heating Department.

Builders'-Up Tool Heaters.—Before the case is put in the electroplating bath, it is necessary to build up parts of the surface by melting wax to run upon different points. This is done by heated copper tools. These tools are heated upon hooded electric stoves provided with broad tool supports.

Sweating-On Machine.—In some classes of work, it is more desirable to mount electrotypes upon metal backs than upon boxwood blocks. Stereotype metal blocks of equal thickness are heated upon an electric plate with a film of solder and flux between the block and the electrotype. When the solder film is melted, the block is placed under a light press which cools it under pressure. An electrically heated plate makes this process economically possible owing to equal temperatures over the whole surface, so that several electrotypes may be sweated on to their respective blocks at once.

Soldering-Iron Heaters.—To correct electrotypes and insert new letters, it is necessary to use light soldering irons heated very hot. Electric soldering irons with cords attached had been found unsuitable for this work. Soldering-iron heaters capable of running continually at a high temperature were then adopted. The heat is controlled by varying the voltage. The coppers are inserted in pockets to be heated, each heater having two pockets.

Embossing and Stamping Press Heads.—Stamping and embossing require a variable, uniform temperature in the press heads to increase the production to a maximum. The heads have to be strong and the heaters uninjured by shock. Each press is equipped with a heated head and controller complete.

Glue Heater Equipments.—The glue heaters are inserted flush in the benches. The water bath and glue pot are removable. A cover is provided which leaves the bench smooth for stacking books to be bound when the water bath is taken out and the cover put on. A hook is arranged on the bottom of the heater for alternately holding the cover and the water bath, and the glue pot. The heaters are of minimum heat capacity, and heat by conduction and convection in an insulated chamber.

Glue Cookers.—Glue can be prepared in large quantity in these cookers so that there is no need for the men to waste time waiting to make glue in small quantities. Large kettles are fitted steam tight in a chamber built according to low pressure boiler specifications. The apparatus is supplied with water seal, gauge glass, blow-off valves, etc., complete. The heater is designed for maximum working surface so as to be rapid in operation.

Case Making Machines.—Book covers or cases are rapidly glued together in these machines. A large shallow glue pan is heated by a water bath to which electric heaters are attached. These heaters are in sections for facility of control and temperature regulation.

Book Cover Shaping Machine.—The book covers are rounded at the back by machine so as to be smooth and of uniform appearance. In rounding, as for example, the backs, the glue has to be softened so that the case will retain its proper shape. As the rate of working is fast, a high temperature is necessary to secure the proper relation of heat to speed.

Finishers' Tool Heaters.—In gilding and in burning sheepskin for finishing covers of various patterns, tools of varying sizes and shapes are employed. The temperature range is very great. The maximum is high enough for pyrography, the minimum affords a low heat for gilding. Where pyrographic heat is required, small recessed plates are heated very hot upon which tools of varying design are heated

FIG. 29.—VIEW IN ELECTROTYPE FOUNDRY.

by conduction. These heated plates are controlled by variable voltage. In addition, removable plates are provided to accommodate the several patterns of tools employed. It may be noted that in the branch bindery at the Library of Congress, the heated plates are placed vertically above each other in an insulated chamber, with projecting flanges for supporting handles. Variable temperatures in the chambers are secured by varying the amount of heating surface.

Pamphlet Covering Machines.—The pamphlets prepared in infinite number are covered by machines which rapidly glue the backs and place the paper covers on. The backs of the pamphlets are glued by passing over a wheel which turns in a large shallow glue pan.

FIG. 28.—ELECTRIC HEATING DEPARTMENT. FIRST ELECTRICALLY-HEATED MATRIX PRESSES EVER MADE.

The glue pan is of heavy construction and so designed with relation to mass and heater surface as to require no water bath.

Sealing Wax Melters.—These are small heated tools used to melt sealing wax in situ and smoothe the wax so as to prepare it for the seal giving a neat, strong wafer.

Work on this large and unique installation was begun in a conservative way in 1898. Each year, as results became conclusive, small additions in various lines were tried. The sole consideration aside from durability of heating appliances and depreciation factor, was whether a variable controllable temperature increased production sufficiently to pay for the greater cost of the heat required. The answer was in the affirmative, and electric heating appliances have now been used in every process requiring heat excepting the stereotype metal pots.

A great number of heaters are used, and in so large an installation the depreciation of every part of every heater must be considered. Very large factors of safety have been allowed. In high temperature work the energy has been translated to voltages giving maximum mechanical strength to resistances and ensuring effectiveness in operation. This may be likened to the transformations necessary in energy for electro-plating.

An installation representing years of study along this line involves many new features, and it is believed that more attention has been paid to the salient features embodied in this apparatus than in any electric heating installation hitherto made. This treatment of the subject, while it may appear long, is, in fact, very superficial, but is limited by considerations as to the general scope of the present article. As a matter of fact, the electric heating plant of the office is from its novelty and its bearing on a still undeveloped branch of the electrical arts and industries worthy all the space here devoted to the electrical equipment of the office as a whole.

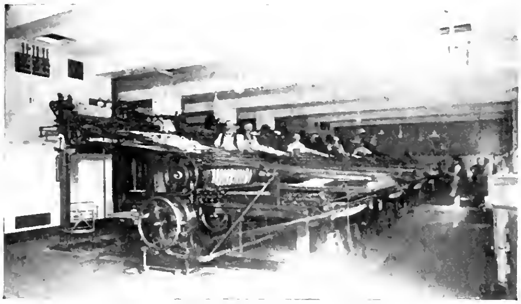


FIG. 30.—A PRESS ROOM SHOWING DISTRIBUTING CENTER AT VENT SHAFT ON WALL ABOVE PRESSES FOR POWER, AND LIGHTING CENTER AT EXTREME RIGHT OF CUT.

Power Signaling on British Railways.

The following from the London *Times* is forwarded by U. S. Consul Mahin, of Nottingham, England: "Three distinct systems of power signaling are now engaging the consideration of British railway managers. These are (1) the all-electric, (2) the electro-pneumatic, and (3) the pneumatic. The first-named system has been adopted by the London & Northwestern Railway at Crewe, and also by the Northeastern Railway Company at its Severus junction box, York, while the Northeastern Railway at Tyne Dock, the Lancashire & Yorkshire Company at its new station at Bolton, and the Great Eastern Railway at Bishopsgate Street goods yard have installed the Westinghouse electropneumatic system. The third system—the pneumatic low-pressure—has been installed on the London & Southwestern Railway, while it is announced that the Northeastern Railway, which has already experimented with the first two named systems, has now arranged for an installation of the low-pressure pneumatic signaling, in order to arrive at the relative merits of the three systems of power signaling on the market. The Great Central Railway Company, which is about to equip its Woodhead Tunnel with the 'Miller' electric signals, has recently placed a contract with the British Pneumatic Signaling Company for the installation of pneumatic signaling in the neighborhood of Manchester."

Annual Meeting of the American Association for the Advancement of Science.

The fifty-third annual meeting of the American Association for the Advancement of Science convened in St. Louis on December 28, under the presidency of the Hon. Carroll D. Wright. After the usual addresses of welcome, the association resolved itself into its various sections to listen to the addresses of the retiring vice-presidents. Prof. E. F. Nichols, the retiring vice-president of the Section in Physics, was unable to be present, and Section B united with Section D, Mechanical Engineering, to listen to Prof. C. A. Waldo, of Purdue University, on "The Relation of Higher Mathematics to Engineering." The essential feature of this address was that calculus should be taught largely through an analysis of its application to practical problems in physics and engineering. In this manner the student had better become acquainted with calculus as a working tool.

The retiring president of the association, President Ira Remsen, of Johns Hopkins University, gave a very scholarly and interesting address on "Scientific Investigation and Progress." He explained how the association was accomplishing its purposes through these migratory annual meetings, where large numbers of scientific men gather for intercourse. This intercourse stimulates thought, the thought leads to work, and the work leads to greater usefulness. He then spoke of the benefits which chemistry is bestowing upon mankind, especially in connection with the raising of food stuffs and the discovery of new medicines and other disease preventives.

On Tuesday and the three following days the several sections listened to the reading of technical and scientific papers by the members. The sections of Physics and of Mechanical Engineering usually have many papers of electrical interest. But at this meeting there seems to have been little of special interest to readers of this journal presented before the Mechanical Engineering Section. Before the Section in Physics, presided over by Prof. E. H. Hall, of Harvard University, there were presented in all thirty-seven papers, about half of which were concerned with electrical subjects. Among the more interesting of these papers the following may be mentioned:

"Iron Losses in Loaded Transformers," by Prof. E. S. Johonnott, of Rose Polytechnic Institute. When a differential coil is added to a Rayleigh phasemeter, it is adapted to the measurement of iron losses in a loaded transformer. It was found that in a transformer having great magnetic leakage, there was an apparent increase in the loss of energy in the iron in the secondary, and decrease in the energy loss in the primary. If a transformer in which there is little leakage has the load in the secondary increased, the loss of energy in the iron and the exciting current and its phase with respect to the induction, remain constant.

"A Simple Alternate-Current Frequency Recorder," by Prof. E. S. Johonnott, of Rose Polytechnic Institute. To one pole of a simple electromagnet is attached a light armature, which is held at some distance from the other pole by a stiff, flat spring. If an alternating current is sent through the coils, it causes the armature to vibrate with a frequency twice that of the current. A smoked-paper recording device may be arranged to receive the trace made by a style attached to the armature, and also the marks from a pendulum or tuning fork. The frequency may then be counted. The current through two incandescent lamps in parallel on 100 volts is sufficient to operate the apparatus.

Another paper was "On the Velocity of Light in a Magnetic Field," by John Mills, of Western Reserve University. The experimenter undertook to measure the acceleration or the retardation experienced by a circular component traversing a magnetic field. The apparatus consisted of a Michelson interferometer. In the path of each beam was placed a tube of carbon disulphide surrounded by a solenoid. The light passed through a Nicol prism and a Bravais double plate. Half of the fringes were thus composed of light circularly polarized in a direction opposite to those of the other half. The formation of a magnetic field produced a shifting of the two sets in opposite directions. The current causing a shifting of one full band (corresponding to a difference in phase of 360°) was observed. On the assumption that the rotation of plane polarized light is the result of a difference of phase between its circular components, the difference of phase corresponding to this value of the current was calculated. It was 368°. The readings for the current giving a displacement of three bands (that is a difference of phase of 1080°) corresponding to a difference of 1101°, calculated.

"A Method for the Determination of Mutual Induction Coefficients," by Augustus Trowbridge, of the University of Wisconsin. If a pair of coils are joined in series and are so placed that the magnetic tubes of force of one thread through the other, the self-induction of the pair is $L_1 + 2M + L_2$. Upon reversing the current through the coil, the self-induction is $L_1 - 2M + L_2$. The coefficient of mutual induction, M, may be found by measuring the two quantities mentioned by means of a bridge method.

"On the Electrical Resistance of Hydrogen-Charged Palladium," by Prof. W. E. McElfresh, of Williams College. This paper will appear in full in the *Transactions* of the American Academy. "A Remarkable Distribution of Carbon on the Bulb of a 'Hylo' Incandescent Lamp," by Prof. Arthur L. Foley, of Indiana University. On the bulb exhibited there are peculiar band and ring deposits, which are dark and of uniform density, while the other portions of the bulb are perfectly clear, the line of separation being as clear as though laid on with a brush. The theory of molecular shadows and the "Edison effect" explains the general character of the deposit, but does not explain the peculiar shapes and the sharp outlines. An attempt to age a number of similar lamps by subjecting them to a high voltage, a uniform deposit quite unlike them are described.

"On the Use of Nickel in the Case of the Marconi Magnetic Detector," by Prof. Arthur L. Foley, of Indiana University. The various forms of sensitive detectors of recent construction were described, and the effect of varying proportion of nickel in the Marconi form was considered.

"On the Charges Given to Surfaces by the Diffusion of Ions, and the Earth's Negative Potential," by Prof. John Zeleny, of the University of Minnesota. Experiments were made showing neutral ionized air in passing through a long tube at first gives a negative charge to the tube, and farther along it charges the tube positively. If the tube is short, only the first effect is obtained, the air itself coming out with a positive charge. Dry carbonic acid gave the same effects, while saturating the gas with water vapor caused phenomena with reversed sign. The results are explained by supposing the charges to be produced by the unequal rates of diffusion of the two ions. These experiments confirm Geitel's explanation of the earth's negative potential.

"On the Differential Telephone," by Prof. William Duane, of the University of Colorado. Two separate coils are wound on the bobbin of a telephone receiver; there are adjusted to have equal resistances and equal self-inductances, and so that their magnetizing effect is zero when equal currents pass through the coils in opposite directions. The coil whose self-inductance is to be measured is connected in series with one coil, and a variable standard of self-inductance in series with the other. A non-inductive resistance is connected to that series having the least resistance, and the two series are connected in parallel and an alternating e.m.f. is applied to the branch points. It will be possible to adjust the several factors of the circuit so that the sound in the telephone vanishes. The unknown self-inductance may be determined to one part in five thousand.

"A Continuous Method of Steam Calorimetry," by Dr. Joseph H. Hart, of the University of Pennsylvania. The continuous method of steam calorimetry here outlined is capable of measuring readily latent and specific heats of fluids with a degree of accuracy seldom attained by other methods, even though they be made with the greatest refinement in the method and observations. If a stream of water at a temperature of T_1 be passed through a worm immersed in a steam bath and emerges at a temperature T_2 the quantity of heat absorbed is $m\ S\ (T_2 - T_1)$, where m is the mass of water passed through and S the mean specific heat of water between T_2 and T_1. If the heat absorbed by the water is obtained by direct condensation of steam alone we have the equation:

$$M\,L = m\,S\ (T_2 - T_1).$$

Where M is the mass of the condensed water and L the latent heat of condensation of steam. If either L or S is taken as known, the other may be readily obtained. Barnes' values of S were taken and a number of determinations of L made to test the efficiency of the method. In the practical development of the method, the process was made continuous. The water in the worm and the condensed water was drawn off constantly and measured. Radiation and conduction entered as important factors in the construction of the calorimeter, but were eliminated or at least satisfactorily accounted for in the amount of condensed water, both by theory and practice. Results were obtained in consecutive experiments, which were concordant to the fifth significant figure.

Perhaps the most interesting event of the meetings was a popular lecture on "Radium and Radioactivity," by Prof. E. Rutherford, of McGill University, Montreal. He had given two scientific papers before the Physical Society, in which he described some new and important phases of his researches on the properties of radium. In his popular lecture he described and illustrated these discoveries, besides giving a general account of the discovery and properties of radium. A golf-leaf electroscope was arranged for projection, and with this the discharging effect of radium was strikingly exhibited, the sample of radium used being thirty milligrams of pure radium bromide. The interposition of a plate of iron two inches thick only slightly reduced the effects. It was demonstrated that when radium is heated there is liberated an emanation which, when conducted through a tube to the electroscope, the latter is discharged. Prof. Rutherford described a differential air calorimeter with which he had verified Prof. Curie's discovery that a gram of radium gives out heat at the rate of a hundred calories per hour. He has proven that this energy resides in an emanation which may be driven off by heating, and which can be condensed by liquid air. This was demonstrated upon the stage. This emanation seems to possess all the energy, and leaves the radium without energy. The emanation seems to be gaseous, possibly is helium, and can be preserved by itself. It gradually loses its energy, while the inert radium regains its former activity. These changes proceed in a geometrical progression, the recovery being about one-half in four days, with a practically complete recovery in a month. It was computed that one gram of radium gives off 6×10^{-6} cubic centimeters of emanation; and that a pound of this emanation would be able to give out energy at the rate of 10,000 hp for six days, an amount sufficient to drive a steamer across the Atlantic. It was suggested that radium might prove useful in the treatment of cancer and of consumption, though at present there is little definite information upon these points. The lecturer referred to the undoubted presence of radium in the earth and in the sun, and suggested that Lord Kelvin's "distressing theory" that the sun's heat would be exhausted in 60,000,000 years might be disproved; and that it might possibly be the presence of radium in the soil which causes an increase of temperature towards the center of the earth. The experimental parts of the lecture, involving the use of the lantern, the induction coil, liquid air and much accessory apparatus were very successful. The entire audience was able to see the luminosity of the radium itself, and its induced radioactivities on various mineral substances. An artificial "spinthariscope" gave a vivid impression of the wonderful sight exhibited by this small instrument.

The American Physical Society held its annual meeting in connection with the association. Twelve papers were read before the society, several of which are mentioned above. The president was Prof. A. G. Webster, of Clark University, who was re-elected president for the coming year.

Among those elected Fellows of the Association (the highest grade of membership) are E. S. Johonnott, professor of Electrical Engineering in Rose Polytechnic Institute; Henry Crew, professor of Physics in Northwestern University; A. S. Langsdorf, professor of Electrical Engineering in Washington University; C. M. Knight, profesor of Physics in Buchtel College, and Bernhard A. Behrend, of Cincinnati, member of the American Institute of Electrical Engineers.

The number of members registered at the meeting was 385; this number does not, however, fairly represent the attendance, for the many affiliated scientific societies were attended by other scientists not included in the above. The attendance at the sessions of the Physics Section was usually about 75. While the Middle West was very adequately represented, there were many prominent members in attendance from the East and New England, as well as from the Pacific coast. Upon the whole, the meeting was very successful, and it was enjoyable and profitable for all present. The local committee of St. Louis provided a most hospitable entertainment for their guests, which was duly appreciated. One afternoon the whole association visited the World's Fair, as guests of the management. After a lunch the members inspected the spacious grounds and the many beautiful buildings now nearing completion.

The next meeting of the asociation will be held in Philadelphia, beginning December 28, 1904. Prof. W. F. Magie, of Princeton, will preside over the Section in Physics and Prof. D. S. Jacobus, of Stevens Institute of Technology, will be the presiding officer of the Mechanical Engineering Section. It is thought that the meeting for 1905 will be held in New Orleans.

Gas Power for Central Stations.

At the December meeting of the American Institute of Electrical Engineers, Mr. J. R. Bibbins in a paper entitled "Gas Power for Central Stations," discussed the operation of electrical generating stations in connection with gas works, and presented in the form of curves and tables much interesting data relating thereto. Owing to limitations of space we are obliged to omit the tabular matter, which is, however, available for reference in the *Transactions* of the Institute.

In opening Mr. Bibbins stated that his object was to offer evidence that present gas-power machinery is suitable for central station service; that a well-equipped gas-power electric plant can operate with far better economy than a steam plant under similar conditions; that its operation is much simpler and requires less running expense for the same results; and that gas works laboring under low load or output factor, can profitably install a gas-power electric generating station, and become its own largest customer, selling both gas and electricity at comparative rates.

The basis of the paper consists of data collected from various electric light and power plants in the United States using gas engines as their principal motive power, a number of which are operated by gas companies.

Tables accompanying the paper gives the data of 15 plants. Of these 12 are located in centres ranging from 2,000 to 25,000 population, and where in most cases the cost of fuel is high. The equipments average 315-hp capacity, and operate a variety of types of generators for arc and incandescent lighting and for railway or general power service. All the generators are belted, the majority directly, but a few through the medium of a jack-shaft, the latter arrangement being employed in order to obtain the desired flexibility of service without installing a number of engines of small size. The other three plants are somewhat larger and generate polyphase power for industrial works. These three plants average approximately 570 brake hp and the units are all direct-connected and run in parallel.

In general, the character of electrical equipment is not all that could be desired for furnishing results of great accuracy; but owing to the more or less uncertain calorific value of the fuel-gas used, errors of a few per cent. in particular cases will not have much effect upon the general result. In any event, the average cost of power charged against the station is the desired figure.

A 65-hp two-cylinder vertical engine of the type employed in the plants reported on has made the following record in fan-blower service: In a period of 8,472 hours, the stoppages were 242 hours, or 3 per cent., 0.6 per cent. of which was chargeable to the engine in changing igniters and setting up bearings. During this period the engine ran, without stopping, 1,157 hours, and was then shut down to repair a broken belt.

In a pumping station located on the Allegheny, a short distance from Pittsburg, five 85-hp engines of the same type operate regularly at full load through the week without stopping, except on Sunday, when the units are shut down in rotation for inspection and repair. Each engine operates from 96 to 98 per cent. of elapsed time. Such service would not be required in central stations, as reserve capacity should be available for use during peak-loads. In the present exhibit, the majority of the plants operate from 18 to 22 hours per day, giving ample time for inspection and repair, even if no reserve capacity were provided.

The skill required for operating a gas plant is apparently no greater than for steam plant. In several instances where the latter have been replaced, the old employees have been retained. In newly established plants steam engineers have invariably taken charge after short preliminary instruction from the builders' erecting engineer.

In one plant weekly inspection of bearings, igniters, and valves were at first carried out. This was found to be unnecessarily frequent and is now done once a month. The cylinders are inspected occasionally throughout the year. This plant, 800 hp capacity, is operated by three day men and one night man, ten hours to a shift.

In cost, the gas-engine equipment is quite comparable with that of a steam plant. The engine itself costs more than a steam engine of corresponding size, on account of the increase in metal required by the higher pressures dealt with. With the cost of condensing machinery charged to the steam-engine, however, this disparity is much reduced. With natural or illuminating gas supply available, the equipment cost would fall considerably below that of a steam equipment of boilers, engines, condensers, heaters, pumps, etc. In the case of a producer gas plant installed to supply the gas engines, the cost of the respective equipments, each of 1,000 hp, is at a parity, although depending somewhat upon the gas storage capacity provided. This, however, amounts to much less than electric storage. For producer gas the former costs in the neighborhood of $7.35 per hp hour and the latter $100. Considering the increase in productiveness of labor which is stated by a prominent gas engineer to be fully 100 per cent. (owing to the fact that one man can handle twice the amount of coal), the advantage, if any, held by the steam plant, disappears.

In economy of fuel, the gas engine admittedly has no rival. The present limit of steam engine practice is 10 pounds water per ihp, or 11 pounds per bhp. With an evaporation of 10 pounds of water per pound of good coal (14,000 B.T.U. per pound), a performance of 1.1 pound coal, or 15,400 B.T.U. per brake hp is realized. The gas engine at present delivers, at full load, a brake hp upon 10.5 to 11 ft. of gas (of 900 to 1,000 B.T.U. per cu. ft., calor,ic value) which is equivalent to 10,000 to 11,000 B.T.U. per brake hp; Fig. 1 shows a typical test-log upon a 550-hp engine of the three-cylinder vertical type, employing the four-stroke cycle. The thermal efficiency shown is the true or "kinetic" efficiency, namely, the ratio of the input to the output, or the thermal equivalent of the work done to the thermal value of the gas.

At full load this appears at 25 per cent., and considering that the theoretical limit of gas engine efficiency is yet only approached, and the fact that the theoretical efficiency of a steam engine working

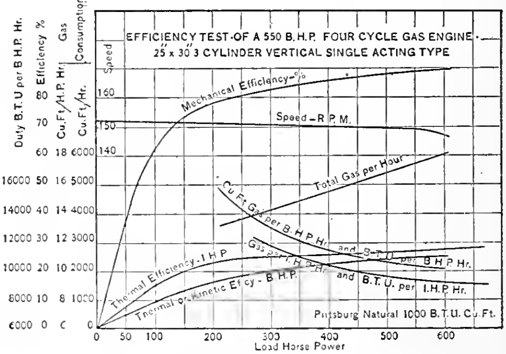


FIG. 1.—EFFICIENCY CURVES OF FOUR-CYCLE ENGINE.

between the usual units of 150 lbs. boiler and 3 lbs. condenser pressure has already been exceeded, there appears to be an encouraging future for internal combustion motors.

Mr. Bibbins summarizes the advantage of the gas engine for central stations as follows:

1. Minimum fuel and heat consumption. 2. Light load efficiency higher than steam engine of corresponding size. 3. Low cost of operation and maintenance. 4. Simplification of equipment. 5. Small number of auxiliaries required. 6. Absence of "standby" losses. 7. Quick starting. 8. Waste heat in jacket water suitable for building heating. 9. Ease of extending equipment. 10. Absence of high pressure except in engine cylinder. No danger from explosion outside, as a mixture of proper proportions is required. 11. Power can be stored during light loads at small cost in the form of gas in holder. 12. Sub-division of units more easily accomplished, yielding higher all-day economy.

An important source of economy in gas plants is the fact that as soon as an engine is shut down all heat losses cease. Also, during operation no heat is lost by the gas in transit from the producer, and the plant is not hampered by inefficient auxiliaries such as steam pumps, condensers, return traps, etc., all of which largely increase the general complexity of the system. Steam pipe and cylinder condensation losses, radiation, leakage in piping, and fuel loss in banking fires, have no parallel in the gas plant. The only auxiliaries required are the igniter generators, and air compressors. The former are negligible as affecting the economy of the station, and the latter operate at full capacity at regular intervals. In cases where artesian wells supply jacket water, a pump is of course required, preferably operated by a motor or small gas engine to which the air compressor may also be belted.

In quick starting, the gas engine fulfils every requirement. The 280-hp pumping units of the Philadelphia high pressure fire system have been repeatedly started cold, brought up to speed and the pumps loaded to the required pressure (300 lbs. per sq. in.) within a period of 40 seconds from the starting signal. In another plant employing 133-cycle high-speed generators, the units are regularly started in two minutes, and this may be reduced to one minute in case of necessity.

A number of plants make use of hot jacket water for heating offices and buildings, ordinary cast-iron or coil-pipe radiators being used for this purpose. One station partly supplies a municipal heating system resembling the Yaryan, thereby deriving direct revenue from a waste product. Part of the return water is sent again through the jackets, the temperature being lowered to the proper degree by adding fresh water from the station supply main. Another station returns hot jacket water to a large cistern where it partially cools and is again pumped through the jackets emerging at a temperature of 200° F. before being discharged into the sewer. As return water from a heating system is also discharged into this well, a small amount of cold water from artesian well or city water system is added from time to time, to reduce the general temperature of the circulating system. In another plant, the jacket water is utilized in winter for warming the water in the gas holders to prevent freezing. This was formerly done by using live steam from a boiler used in making water gas. It is estimated by the manager that a saving of $250 per year is effected. In locations where water is expensive, a small cooling tower may profitably be installed to cool the jacket water which may then be saved.

In the matter of parallel operation of alternating-current generators, the three larger plants noted have been distinctly successful, particularly in view of the variable character of load incidental to large industrial works operated by induction motors. All the units are of the direct-connected type with standard fly-wheels. A spring coupling provides a flexible connection between engine and generator, to absorb cyclical speed variations. The usual copper dampers on the pole pieces assist in preventing hunting. In general. a low frequency seems to be desirable, with high peripheral speed and moderate reactance in the generator to assist in damping current fluctuations. The suddenness of the impulse in a gas engine cylinder offers, to be sure, greater difficulties than in the case of a steam engine, but the remedy has apparently been found.

The following table is given of the calorific values of different gases suitable for gas engine use. The first column gives the calorific value in B.T.U. per cubic foot for the gas itself and the second column the calorific value for the working mixture:

Natural gas	1000	91.0
Coal gas	650	91.7
Water gas	300	88.0
Carburetted water gas	600	92.0
Producer gas	120 to 145	60 to 68
Coke oven gas	600	90.0
Blast furnace gas	90	53.0

The power to be developed by an engine of given proportions does not therefore vary within appreciable limits, except on producer gas and blast-furnace gases, when larger engines are required, or larger cylinders on the same engine frames. The rate of combustion is, however, less rapid with these than with other gases due to the large amount of inert gases such as nitrogen and carbon dioxide present in the mixture. The compression may also be carried much higher without risk of pre-ignition, or "back firing," thus increasing the efficiency of the cycle. With water gas the high percentage of hydrogen occasions quicker combustion and higher flame temperatures with so considerable a tendency to pre-ignition and back firing that this gas is not well adapted to gas engine work.

In water-gas plants a great saving may be made and the gas rendered much more suitable for the operation of gas engines by providing additional holders for the air or blast gas made during the period when the producers are under blast. This gas is equivalent in calorific value to blast furnace gas—90 B.T.U.—and is generally allowed to go to waste. It may, however, be used to great advantage for power purposes, either alone or mixed with a proportion of water gas which it renders less snappy and thereby better suited for use in gas engines. In fact, by this means a gas is obtained similar in many respects to the producer gases made by operating a producer continuously with combined steam and air blasts.

Leaving out of consideration the by-product, or waste coke-oven and blast-furnace gases, as occupying a field of power development somewhat foreign to the subject in hand, producer gas offers at present the greatest possibilities in the field of power for use in manufacturing centres. This is due to its comparative cheapness, simplicity of installation and general efficiency when gas for power purposes is alone considered.

A comparison of the approximate thermal efficiencies of the various processes gives the following results.

Coal gas (without coke)	24%
Coal gas (with coke)	60%
Water gas	60%
Water gas, special quick blast	75 to 80%
Producer gas	80 to 85%

Assuming the calorific value of coal as 14,000 B.T.U. per lb. and the efficiency of the gas-making process 80 per cent., the heat available at the engine is 11,250 B.T.U., which is equivalent to about one bhp. This duty, one bhp per lb. of coal, should therefore be expected from a well-equipped gas-power plant.

The average gas consumption of the stations reported was 39 cu. ft. per kw-hour. In some cases the averages were given for several months' operation, so that the results represent the efficiency of the entire station, day in and day out, with various generating outfits running at varying load factors, and including errors of measurements encountered in every-day operation. Although in some cases "over-dynamoed," the engines are generally underloaded and frequently so much so that good economy could hardly be expected. The average gas consumption per kw-hour is 39.0 cu. ft. Assuming an average calorific value of 625 B.T.U. per ft. for coal gas, water gas, or mixed gas, the heat consumption is 24,000 B.T.U. per kw-hour, 18,200 B.T.U. per electric hp-hour, and 14,500 B.T.U. per brake hp-hour. The average cost of gas charged to the engine is 33.9 cent per M, which is in nearly all cases considerably above the cost in the holder to companies operating both plants, with the result that the gas works realizes a handsome profit from the electric station in addition to the decrease in cost per unit with increased production. This point will be brought out later. Assuming an average production cost of 20 cents per M, the average cost of power is 0.83 cents per kw-hour, equivalent to .0495 cents per brake hp-hour at 80 per cent. combined efficiency.

The comparative cost of steam with gas power is illustrated in two tables. In one two independent stations were operated during 1902, together with the gas works. The cost of coal in the steam plant was 1.38 cents per kw-hour against 0.75 cents per kw-hour in the gas plant, representing a saving of 45.5 per cent., although the cost per M B.T.U. of gas was 3.4 times that per M. B.T.U. of coal. Assuming calorific values of 14,000 and 625 B.T.U. per lb. and cu. ft. respectively, 92,000 B.T.U. were required per kw-hour in the steam station, against 29,100 in the gas station, or a saving in the latter of 68½ per cent. of the former.

In the other table the output was not measured, but the costs indicate the general balance of economy on the side of the gas station. The steam plant started operation on natural gas at 10 cents per M with a minimum of $3,000 per year. It employed boilers fired by gas. One year after starting the gas plant, this minimum was reached and the company is now paying at the rate of over 16 cents per M ft. The saving in total operating cost amounted to 405 per cent. In the face of a 30 per cent. increase in station output, the gas consumption has been reduced by 93 per cent. Previous to the replacement of the steam equipment an economy test was run on the station, throughout 24 hours. The gas consumption at the boilers was 51.09 cu. ft. per ihp, developed at the engines, equivalent to about 86 cu. ft. per kw-hour. All engines were of the simple, high speed type running non-condensing. During the six months ending August, 1902, the total gas consumption of the station, including heating, was 23.8 cu. ft. per kw-hour. Deducting approximately 7.5 per cent. for heating, the net consumption was 21.5 cu. ft., which is about 24 per cent. of that recorded on the steam station. It is equivalent to 12 cu. ft. per brake hp. or a duty of 14,100 B.T.U. per brake hp.

The gross station economy in the case of one plant is shown on curve sheet No. 1. These observations were taken when the station was first started and operating under an extremely low load-factor.. Curve sheet No. 2 shows similar results from another station, which also operates considerably under rating. Both sheets show the decrease in cost of gas at the gas works, due to the increase in works output, necessitated by the electric station. The results may be considered as representative of conditions about as unfavorable to high economy in the prime mover as is usually encountered. Another table gives the operating cost of a plant for six months, during 1902. The average cost of gas is 1.22 cents per kw-hour, and the total operating cost 3.18 cents per kw-hour. Considering this to be a plant of but 135 hp, these results are good.

The above data show in a general way the results that may be accomplished by gas-power plants, even though running under a burden of expense for fuel that would be quite out of the reach of steam plants. It goes without saying that much better results are obtainable in a plant of considerable size of modern design and furnished with reasonably cheap fuel gas

Combined Gas and Electric Stations.—The theory of increase of profits from the operation of combined gas and electric plants is based upon the fundamental principle of reduction in cost per unit with increased output. If the net saving is sufficient to cover fixed charges upon the electric station, the way is clear to reap a double

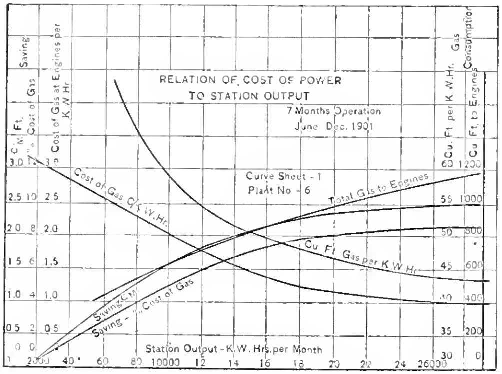


FIG. 2.—RELATION OF COST OF POWER TO OUTPUT.

revenue, one from the electric station operating at a cost far below its steam-driven competitors, and the other from the gas station operating at a lower cost of production than before. The balance may, of course, be applied proportionately to the disbursement of fixed charges on both stations. It is usually the gas station that reaps the profit at the expense of the electric station. An adjustment of gas and electric rates can easily be made to prevent embarrassing competition.

Curve sheet No. 3 shows the cost of coal gas, water gas and mixed gas for approximately 500 gas plants in the United States, from the report o fthe Commission of Labor on Gas and Electric Plants, 1899.

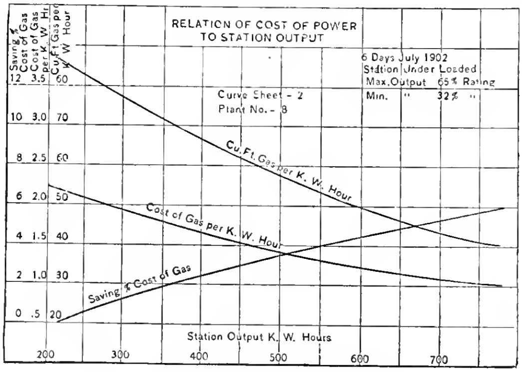


FIG. 3.—RELATION OF COST OF POWER TO OUTPUT.

The curves were determined by the method of moments from a "shot-gun" diagram, and bring out the following points:

1. Cost per unit decreases as output increases, most rapidly in coal-gas plants and less rapidly in water-gas plants.

2. Decrease in cost per unit in small plants of two to ten million per year output is very marked, being greatest in water-gas plants and least in mixed-gas plants.

3. The greatest opportunity for increasing revenue from combined gas and electric station appears to be in the case of small coal and water-gas plants under ten million output. The smaller the plant, the greater the profit.

Curve sheets 4 and 5 represent the saving due to increased production, part of which is traceable to the electric plant and part to consumers. In one plant a saving of 24 per cent. was realized, and in

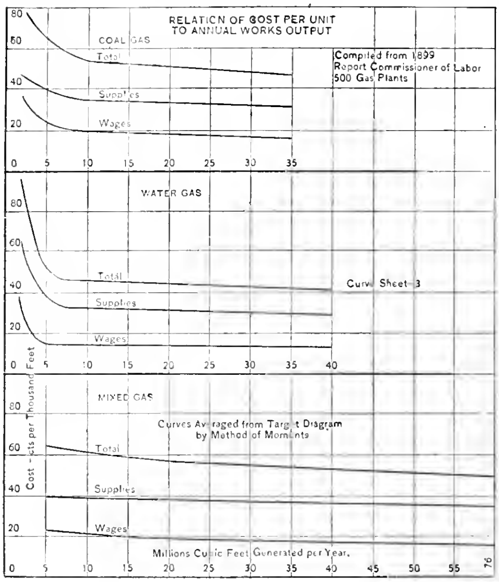


FIG. 4.—RELATION OF COST PER UNIT TO ANNUAL OUTPUT.

still another the remarkable amount of 92 per cent. of initial works cost.

In order to bring out clearly the character of this saving due to increased production, the following case has been estimated along the lines indicated in the preceding paragraph. A ten-million-foot plant has been taken generating gas at 40 cents per M- works cost including coal, bench fuel, labor, repairs, and miscellaneous material, residuals not deducted. Fixed charges have purposely been omitted. The gas is charged at works cost to the electric station. It is assumed that the cost of gas for this plant, previous to absorption of the electric plant, was 50 cents per M, and that the electric plant gen-

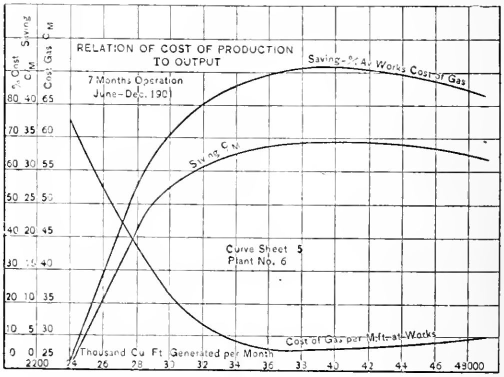


FIG. 5.—RELATION OF COST OF PRODUCTION TO OUTPUT.

erates electricity at twice the fuel cost, 3.2 cents per kw-hour. During normal operation with an output to the electric plant of 30 per cent. of the total amount of gas generated, the total net revenue of the combined works was about $13,300; 45 per cent. of which was due to the electric station and 55 per cent. to the gas station. The operating costs will then amount to 46.4 per cent. of the net revenue.

The comparative market prices for fuel in the case of ten of the above plants averaged $3.63 and $5.10 f. o. b. works for coal and coke respectively, under normal conditions. The corresponding prices during 1902 averaged $4.50 for coal and $7.41 for coke, or an increase of $0.87 and $2.41 over normal for coal and coke respectively.

Comparing the operations of the gas station *per se*, previous to and following the acquisition of the electric station, there is a net revenue of $5,835 and $7,344 respectively, or an increase of $1,509; 25.8 per cent. of the original revenue. Figuring in the saving of 10 cents per M, due to increased production, the total increase amounts to 43 per cent. of the net revenue upon the original gas station.

Considering, finally, the combined works, the increase is $7,449, or 127 per cent. of the original revenue, and adding again the saving 10 cents per M, the total increase is 145 per cent. of the revenue of the original gas works.

Although these percentages will be considerably reduced by the consideration of investment charges, depreciation, sinking fund, etc., the fact remains that the saving due to combined operation is material and should appeal particularly to companies operating independent gas and electric generating stations.

The paper includes an elaborate estimate of the operating cost of a typical gas-electric works having a yearly output of 10,000,000 cubic feet of gas, and supplying customers at $1.25 per 1,000 cu. ft. for gas, and selling current at an average rate of 12 cents per kw-hour. This is followed by ten tables, as follows: Tables giving the data of 15 gas engine electrical generating plants and the cost of operation of eleven of these; comparative operating economy of a 1,250-kw. steam and 685-hp gas engine station; comparative cost of operating steam and gas engine stations on natural gas; operating cost of a 5,000-kw. gas engine station; details of profit from combined operation of a gas engine station and gas works; reduction in cost per unit with increase of production; comparative cost of gas as affected by production; full costs and prices paid for residuals; gas works yields.

A lengthy discussion followed the reading of Mr. Bibbins' paper. Mr. Mershon said that if the paper was intended as a comparison between gas and steam plants, he thought some figures should be given for gas engine installations in connection with gas producers, in comparison with figures for steam plants, taking into account not only economy of fuel but the other charges that should be made, such as deterioration, repairs and interest on investment. He considered that if this had been done the figures would not be so highly in favor of the gas engine, although he was thoroughly a friend of the gas engine, and believed the time was not far off when gas engines and gas producers would be installed instead of steam engines and steam boilers, which state of affairs has already arrived in some other countries. In Germany a great many gas engine plants, including producers, have been installed instead of steam engines, but thus far confined mainly to small plants. In some of these plants an interesting type of producer is used, which is operated on what is known as the "suction principle," the gas engine drawing its charge through the producer; the air in passing through the hot fuel forms a gas, and thus gas is generated only as fast as the engine requires it. Mr. Mershon said that he has seen a number of these plants operating very successfully. The police regulations in some cities do not allow the operation of ordinary gas engine plants, but allowed the installation of the type referred to for the reason that the pressure in the generator and pipe system is lower than on the outside, and there is thus no chance for the leakage of gas. He criticised the statement that the cost of a producer gas engine plant of 1,000 hp is about the same as that of a steam plant of the same size, stating that the cost of the gas plant is considerably above that of the steam plant, and when compared with the steam turbine plant the disparity is much greater. He also disagreed that the cost of operation and maintenance of gas engines is less than of steam engines; from some observations he had been able to make, the cost of maintenance of gas engines is higher. As regards the cost of operation, the gas engine requires a better class of operating attendants than the steam engine. Referring to the table of the calorific value per cubic foot of explosive material, Mr. Mershon said that in European practice the calorific power of the various mixtures employed in the gas engine cylinder is much more equal than shown in the table. In conclusion, Mr. Mershon said that the prices now asked by American manufacturers for large gas engine units are out of all reason as compared with the corresponding price of steam engines, and as compared with European prices.

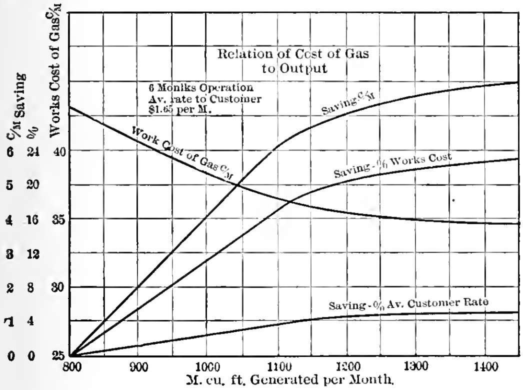


FIG. 6.—RELATION OF COST OF GAS TO OUTPUT.

Mr. Bibbins, in replying to Mr. Mershon, said that fixed charges were excluded for the reason that the idea of the paper was simply to bring out the decreased cost of gas to the gas station due to increased production. He said that he had just been informed by a prominent gas engineer that the comparative cost of gas and steam plants with a fair amount of holder capacity, for the former is about as $125 to $100. Plants on the general suction principle not provided with holders involve the risk of gas of non-uniform quantity in the cylinders. It has been noticed that while at the start quite an intelligent class of attendants is necessary for a gas engine plant, after it has been in operation for some time this does not hold. In the plants referred to in the report the steam engineers have been retained. Mr. H. A. Wagner said that it had recently been his sad duty to replace with a steam plant a gas-engine plant which had been operated for several years by a gas company. There had been three 100-hp alternating units, and the cost of operation became so excessive and increased so greatly from year to year that the gas engine was abandoned in favor of the steam engine. During the last year of operation of the gas engine the cost of producing current was something over 8 cents per kw-hour. The largest single item was that of repairs and maintenance. The engines, however, were not of the latest type manufactured, and doubtless the more modern engines would do much better even after having been operated some years. The experience of this company, however, shows that it is even now a question with gas companies whether it is more economical to install gas engine plants or steam plants. The company in question was using water gas largely and consequently it was necessary to provide a separate producer plants for the gas engines.

In reply to a question concerning the operation in parallel of gas engine driven generators, Mr. Bibbins said that the spring coupling seems to solve the problem to some extent. By means of flywheels of moderate size and spring couplings, generators in each of the three large plants considered in his paper have been able to run under all kinds of load, fluctuating as well as steady loads. The largest of the three plants operates cranes and shop motors, and though the load fluctuates within 100 per cent. almost instantaneously, no difficulty seems to have arisen in operating in parallel.

International Electrical Congress at St. Louis.

We are informed that the State Department at Washington, in response to solicitation from the Director of Congresses at St. Louis, and the President of the American Institute of Electrical Engineers, as well as the Committee of Organization of the Congress, has issued instructions, on December 17, to the American diplomatic officers abroad that they shall invite the various foreign governments to appoint official delegates to the International Electrical Congress of St. Louis in September, 1904. The number of delegates requested to be appointed by each country is in conformity with the precedents established at the Chicago Congress of 1893 and at the Paris Congress of 1900.

Against Municipal Plant.

A special committee of the Common Council of Binghamton, N. Y., has reported adversely on the question of a municipal electric light plant. It is admitted among other things that the item of labor would cost the city 25 per cent. more than it does the present company. The price for lights to the city is $83.95, or $0.021 per lamp per hour, equal to or better than any municipal plant is doing on corresponding terms.

Telephone Transmitters.—IV.

By Arthur V. Abbott, C.E.

The Intensifying Transmitter.—This model is shown assembled, with the cover removed, in Fig. 24; in Fig. 25 the instrument is entirely dissected, excepting the capsule, while in Fig. 26 the parts of the capsule are shown. The foundation of the instrument is a heavy cast brass plate 3¼ in. over all. The diaphragm is of polished aluminum 2½ in. in diameter and .021 in. thick. The rubber strap

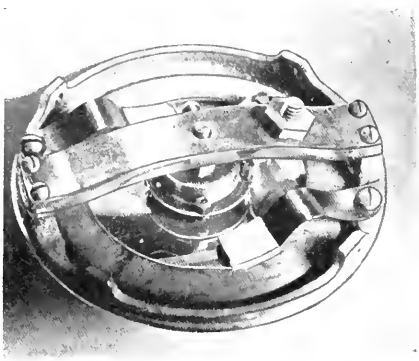


FIG. 24.—INTENSIFYING TRANSMITTER.

which forms a cushion for the diaphragm is 2½ in. long x ¾ in. wide. The bridge is a piece of wrought brass ½ x ⅛ in. thick and secured to the case by four screws. The springs are clock springs .01 in. thick, 5/16 in. wide and 2½ in. long, and bent at right angles. Each spring is tipped with rubber. One spring bears upon the rubber

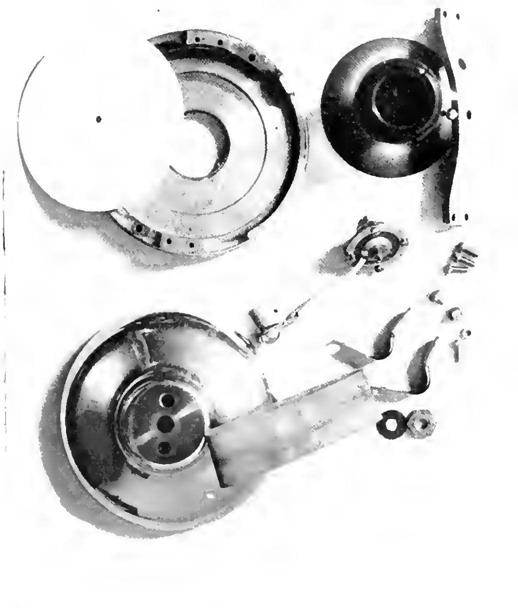


FIG. 25.—INTENSIFYING TRANSMITTER DISSECTED.

strap surrounding the diaphragm, while the other is placed half way between the diaphragm and the capsule. The capsule consists of a spun brass cup ⅜ in. in diameter inside, 3/16 in. deep and .015 in. thick. In the bottom of this capsule the rear electrode is placed, which is ⅝ in. in diameter and is soldered to a brass support that extends to the bridge. The front electrode is also of carbon ⅜ in. in diameter. Each electrode, including the brass supports, is .067 in. thick, giving a space of .07 of an in. between the faces of the electrodes. The front electrode is placed in the center of a mica disc ⅞ in. in diameter, .003 of an in. thick. This disc, as is shown in Fig. 24, is secured to the face of the cup by means of four screws

FIG. 26.—PARTS OF TRANSMITTER CAPSULE.

and a brass ring. The cup is filled with 8 grains of granular carbon. One electrode is connected to the case of the instrument, while the other runs to an insulating binding post upon the bridge and thence by means of a rubber-covered wire to the brass washer that clamps the mica diaphragm.

The Transmitter of the Western Electric Supply Company.—The rear cap of this model is shown removed in Fig. 27, while the instrument is dissected in Fig. 28. There is the usual cast face plate 3¼ in. in diameter over all. The diaphragm is rough aluminum 2½ in. in diameter by .023 in. in thickness. The bridge is 15/16 in. wide and ⅛ of an in. in thickness. It is surmounted in the center by a substantial block of hard rubber 5/16 in. thick, ¾ in. wide and 1⅜

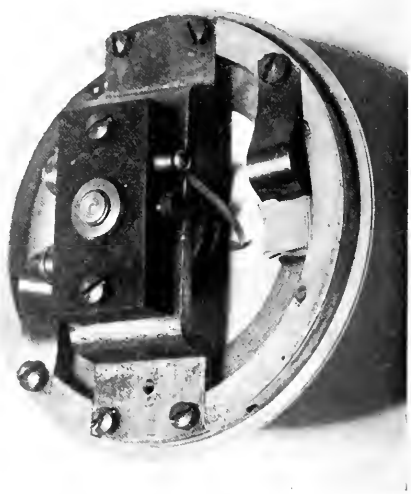


FIG. 27.—WESTERN ELECTRIC SUPPLY TRANSMITTER.

in. long. In the center of this block is a brass bushing which supports the capsule. The leading-in wires run to the rubber block and are thus connected respectively to the front and rear electrodes. The capsule consists of a brass ring 11/16 in. in diameter and ⅜ in. deep. Upon each side of this ring two mica washers are placed ⅞

FIG. 28.—WESTERN ELECTRIC SUPPLY CO TRANSMITTER DISSECTED.

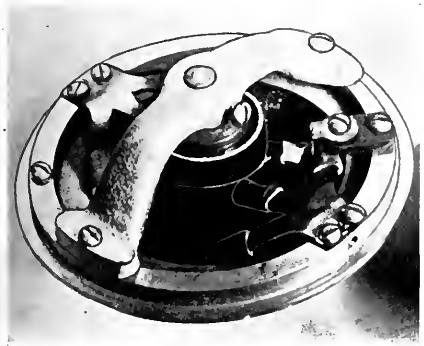


FIG. 29.—CENTURY TRANSMITTER.

FIG. 30.—CENTURY TRANSMITTER DISSECTED.

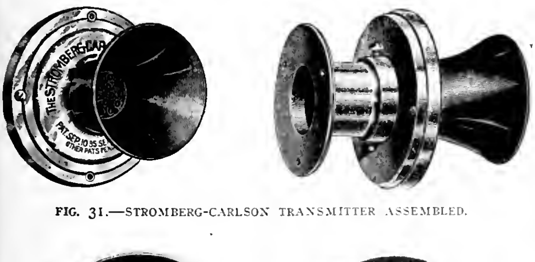


FIG. 31.—STROMBERG-CARLSON TRANSMITTER ASSEMBLED.

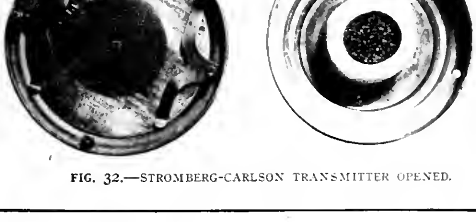


FIG. 32.—STROMBERG-CARLSON TRANSMITTER OPENED.

FIG. 33.—SWEDISH-AMERICAN TRANSMITTER DISSECTED.

TELEPHONE TRANSMITTERS.

in. in diameter and .005 of an in. thick. The electrodes of carbon are each ½ in. in diameter and clamped to its respective mica disc. The discs are then placed upon the ring and over each mica disc another brass ring is fitted and secured by means of four small ears, which are pinched underneath a ledge upon the center ring. Thus, in this model the front electrode can move to and fro with the diaphragm and also the entire capsule is movable through the elasticity of the mica washer that is supported on the rear electrode.

The Century Transmitter.—The transmitter manufactured by the Century Telephone Construction Company resembles in some respects that made by the Western Electric Supply Company. The Century transmitter, however, differs in having its diaphragm made of iron 2½ in. in diameter and .018 thick covered with varnish to prevent rusting. There are two carbon electrodes each ½ in. in diameter, the rear one screwed to a bridge made of cast brass. In Fig. 29 the Century transmitter with the rear cover removed is shown, while in Fig. 30 it is dissected entirely. The capsule is made of a piece of very thin rubber tube, about ⅞ of an in. in diameter and 5/32 in. long. It contains a piece of felt to which two mica discs are cemented. Each carbon electrode is supported by a disc of brass about ⅛ of an in. greater in diameter than the electrode, and after the capsule is filled with 10 grains of granulated carbon the mica washers are cemented to the felt ring, thus

FIG. 34.—SWEDISH-AMERICAN TRANSMITTER, CAP REMOVED.

retaining the capsule in position. In this instrument both the front electrode and the entire capsule can move with the vibration of the diaphragm, but here all comparison of the previously-mentioned transmitter ceases. To check undesirable vibrations of the diaphragm the Century transmitter provides two thin pronged iron springs, as shown in Fig. 30. Each of these is secured to the edge of the face plate by means by two screws, as is shown in Fig. 29.

The Stromberg-Carlson Transmitter.—The first of the so-called "Cornplaster" type transmitters, and one of the widest known models is that manufactured by the Stromberg-Carlson Company, as shown in elevation in Fig. 31, and opened in Fig. 32. This transmitter differs materially from general designs, so far illustrated. It is much smaller and lighter, for the case consists merely of two pieces of pressed brass. The diaphragm is of tin and is secured in the front half of the case by two springs, as shown in Fig. 32. In the center of the diaphragm a piece of wire gauze, which has been gold-plated, is placed, and serves as the front electrode. Upon the rear half of the case there is another piece of gold-plated gauze, forming the rear electrode. Between these two there is a round felt ring which is about two-thirds filled with granular carbon. When the ring is in place the two halves of the transmitter are put together and riveted, so that it is impossible to open the instrument without mutilating it.

The Swedish-American Transmitter.—The transmitter manufactured by the Swedish-American Telephone Company is shown assembled at *A* in Fig. 21. In the bottom of the casting, supporting the transmitter arm, the induction coil for local battery instruments is placed, the terminals of which may be seen in the illustration. Fig. 34 shows this transmitter with the rear cap removed, and in Fig. 33 it is dissected. The face plate is of cast brass, 3⅛ in. in diameter. The bridge is peculiar in that it is a substantial piece of sheet brass, formed in a die, as shown in Fig. 34, thus obtaining one of the stiffest and at the same time one of the lightest designs. There are two springs that are screwed to the bridge piece directly, each of which has two points; thus there are four points of spring contact on the diaphragm to check undesirable vibrations. The capsule is made of two pieces, one being a pressed brass cup, into which a grooved ring, carrying the front electrode, is placed and secured by four screws. The rear electrodes are ¾ of an in. in diameter and the front ⅝ of an in. and the cup is filled with 10 grains coarse granular carbon.

New Telephone Patents.

NOVEL JACK AND PLUG CONSTRUCTION.

Two patents have just been issued for rather novel constructions of jack designed to permit of greater facility of repair than common. In the making of connections both jack and plug are subjected to rubbing and consequent wear, and experience has shown that both must be in time replaced. This is an easy matter with plugs, which are always accessible. With jacks, however, it is an entirely different matter and therefore anything which can extend their life is of value.

Mr. C. M. Hedman, of Chicago, to whom the first of the patents under consideration has been issued, has applied to jacks a removable test ring. This threads into the hard rubber face strip of the jack strip, the end of the corresponding contact spring being expanded into a ring within the face strip drilling to form a stop for the test ring. Whenever a test ring wears out, of course, its replacement by a new one is but a matter of a few moments.

In the second patent, granted to Mr. W. W. Dean, of Chicago, the overcoming of the wear of the jack springs is chiefly considered, the wear being largely transferred to the plugs. This necessitates such a novel type of jack and plug that a clear understanding is best obtained by reference to a drawing of them (Fig. 1). As will be seen,

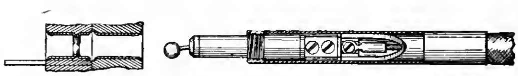


FIG. 1.—DEAN TERMINAL AND PLUG.

the jack consists of two concentric tubes, one behind the other. The forward one, which engages the plug shank, has a smooth bore and flared front as is customary, while the rearward one carries an internal ridge about midway its length. The plug tip is flexibly mounted upon the end of a spring member, and stands normally somewhat off centre. When the plug is inserted, the ridge of the jack engages the plug tip to hold the plug in place. The result of this design is at once evident, for while ordinarily the wear of the jack spring is confined to a single element of its length while that of the plug is distributed over its whole periphery, now the plug wear comes upon a single element and the jack wear is distributed over its whole surface. The Stromberg-Carlson Company has obtained the first of these patents, while the latter has been assigned to the Kellogg Switchboard & Supply Company.

CONNECTION COUNTER.

A connection counter for use where measured service is the custom is the subject of a patent issued to F. R. McBerty, of Chicago. This counter is so designed and so connected to the circuits that it registers one message for each completed connection, and yet fails to register any other manipulation of the line. The counter is so designed and connected to the circuit that it is ready for operation at all times, except during a conversation. At this time it is locked. In other words, the counter responds only to the removal of the receiver from the hook at the answering station, and having once responded it so transfers its own connections as to lock itself against further scoring until after this connection has been taken down. Mr. McBerty has assigned his patent to the Western Electric Company.

BALANCING TRUNKS FOR DUPLEXING.

Of late considerable work has been done toward the use of duplex or phantom circuit working over trunk lines. The chief obstacle in the way of successful working in this way is the difficulty of securing and maintaining the necessary accurate balance of the trunk line to avoid interference. To overcome this difficulty Mr. H. O. Pugh, of Chicago, suggests the extension of the trunk line from the main jacks to an adjustable rheostat, through the arm of which the second circuit, which is to use this trunk, is connected. The operator is supposed then to adjust the rheostat cutting resistance from one side of the top to the other until a condition of non-interference exists. The Illinois Electric Specialty Company has obtained the patent for this arrangement, which patent is confined to the simultaneous connection of two grounded and two metallic lines.

IMPROVEMENTS IN CABLES.

A new design of telephone cable has been patented by Francis Tremain, of England, in which the conductors are arranged in a special manner to permit of the use of two pairs to form conductors of lower resistance. The foundation conductors are ordinary twisted-pair insulated conductors; each has a uniform twist in itself, but there is a variation of pitch of twist in different conductors. Four pairs with different pitches are twisted together to form a strand. These four may, of course, be used to form two pairs, which pairs are inductively neutral to each other, and of which each conductor consists of a fundamental pair of conductors. Thus, for long circuits conductors may be used of half the normal resistance. It is, however, difficult to see what advantage such an arrangement has over two twisted pairs taken in parallel, wire and wire, in which latter case irregularity of resistance due to difference in pitch of twist is avoided. Another patent referring to cable construction is that of H. W. Fisher, of Pittsburg. This relates to a method of wrapping paper insulation about the wires for telephone cables by which the paper strip is caused to crimp. The result is a bulky insulated conductor, a larger part of the volume of which is air space. Such conductors twisted loosely together form a cable with low electrostatic capacity because of the large proportion of air insulation. This patent has been assigned to the Standard Underground Cable Company, of Pittsburg.

TWO NEW LINE PROTECTORS.

A rather novel open-space lightning protector is that of Charles E. Nicholas, of Columbus, Ohio. This consists of a metallic tube surrounding the conductor to be protected and held concentric therewith by insulated bushings. High-potential charges pass to the tube and are thence conducted to ground. An interesting suggestion is the use of such a device let into the cross-arm and serving as both protector and insulator. Another line protector is that of W. P. Woodruff, of Buffalo, and Daniel J. McCarthy, of Wilkinsburg, Pa. These inventors provide a magazine fuse terminal in which a large number of fuses may be stored. As fast as one operates, the melting fuse permits the spring terminals of the device to release the fuse carrier, when a fresh fuse is immediately provided from the magazine. The utility of such a device is questionable. With a considerable capacity to the magazine and a bad heavy current cross it would seem that all the fuses will be quickly blown, even if it can under any circumstances be considered good practice to continually re-fuse a line in trouble without ascertaining that trouble.

BATTERY TRANSMITTER.

Under the above title John S. Golberg, of Chicago, has patented the transmitter shown in section in Fig. 2. The most novel feature

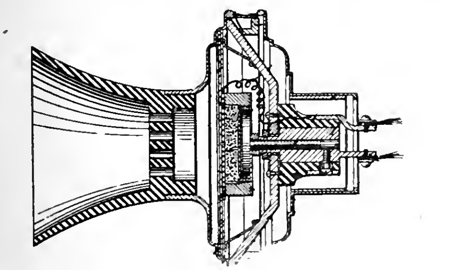


FIG. 2.—GOLDBERG TRANSMITTER.

consists of two spring spiders, one to hold the diaphragm and the second to give an added flexibility to the carbon chamber. The diaphragm spider is shown in section and appears as a truncated cone. This cone shape makes it virtually self-centering. Arising from each leg is a sheet spring finger which engages the diaphragm. The second spider, also of sheet spring metal, is clamped to the rear electrode in a manner such that the ends of the legs bear upon the rim of the granule box. The packing about the rear electrode is felt, which is alone less satisfactory in permitting free motion of the electrodes than when supplemented by the spring spider. The Stromberg-Carlson Company is the assignee of this transmitter.

AUTOMATIC EXCHANGE.

A patent has been recently granted to F. A. Sundquist, of Chicago, for an automatic telephone exchange which is in the nature of an improvement on a system previously patented by him. The switchboard is designed for large systems involving auxiliary switching processes. All parts seem to be well worked out, and the circuits and apparatus comparatively simple. This system has the merit that the work required of subscribers is of a simple nature, and it seems to compare well with existing apparently successful systems.

TELEPHONE WALL SET.

A new arrangement of apparatus box for telephone wall sets is the subject of a patent issued to E. B. Fahnestock, of New York. The novelty lies in an arrangement of the hinge of the swinging front such as to permit of the condenser of the set being slipped out of the box between the cover and the back board through the hinge opening.

The Design of Motor Starting Rheostats.

By ARTHUR H. FORD, E.E.

THE writer has frequently had trouble with motor-starters due to the rush of current, when the final resistance was cut out, being so great as to throw the circuit-breaker or blow the fuse used to protect the motor. An investigation has shown that this is a defect of nearly all motor-starters. Under the usual conditions, when the motor is started light, this is not noticed; but if the motor is required to start a load requiring nearly its full load torque, the shock to the belting and motor is serious, to say nothing of the annoyance of being obliged to set the circuit-breaker or replace the fuse frequently. In many cases the person who starts the motor makes a practice of holding the breaker in, if it is within reach, or tying it fast if it is not. These facts led to an investigation of the problem which resulted in the general solution given below.

The solution is given for a shunt motor on a constant-pressure circuit of unlimited capacity; but is equally applicable to a series or compound motor, provided that the motor resistance is high in comparison with the resistance of the generator and line. When power is first turned on there is a rush of current through the machine determined by the pressure of the circuit and the combined resistance of the rheostat, armature and connections. The armature now begins to revolve at an increasing speed, having for its limit that speed at which the counter e.m.f. required to keep the current down to the value which gives the necessary torque, is generated. If, when this state is reached, one section of the rheostat is cut out, there will be a sudden increase in the current, which will have the same value as if an e.m.f., equal to the fall of potential over the section cut-out, had been introduced into the circuit and its resistance reduced by an amount equal to that of the section cut out. This cycle of action is repeated each time that a section of the rheostat is cut out. In order to get the motor up to speed as soon as possible, the sudden rush of current should be the same for each section of the rheostat cut out and should be as large as safety will permit. This will give a current through the armature which will vary from a maximum to a minimum, successive values of which will be the same, provided the torque is constant or a section is cut out of the rheostat each time the current falls to a given value.

Let n = the number of divisions of the rheostat.
R_a = the resistance of the armature and connections.
R_m = the resistance of any rheostat section.
I = the minimum current through the armature during the starting period.
$I(1 + a)$ = the maximum current through the armature during the starting period.
E = the line pressure.

Under the conditions just stated,

$$Ia = \frac{I\,R_n}{R_a + R_1 + R_2 + R_3 + R_4 \,\ldots\ldots + R_{(n-1)}} =$$

$$\frac{I\,R_{(n-1)}}{R_a + R_1 + R_2 + R_3 + \ldots + R_{(n-2)}} =$$

$$\frac{I\,R_2}{R_a + R_1} = \frac{I\,R_1}{R_a}$$

from which $R_1 = a\,R_a$

$R_2 = a\,(R_a + R_1)$

$R_n = a\,(R_a + R_1 + R_2 \ldots + R_{(n-1)})$,

giving as the general expression for the resistance of any rheostat section,

$$R_m = a\,R_a\,(1 + a)^{m-1} \qquad (a)$$

When current is first turned on,

$E = I\,(1 + a)\,(R_a + R_1 + R_2 + R_3 + \ldots + R_{n-1} + R_n)$

from which $E = I\,R_a\,(1 + a)^{n+1}$ (b)

Equations (a) and (b) enable one to calculate the number of steps and the resistance of each, provided that the starting conditions, resistance of armature and connections, and line pressure are known.

An application of this method to various machines (assuming Ra to be twice the armature resistance, I the full-load current, and a to be .5) shows that starting rheostats should have about nine sections.

The Adoption of Direct Current Traction on the New York Central Railroad System.

Considerable space has recently been given in these pages to the eventful and historical determination of the New York Central Railroad to adopt electricity for the operation of virtually the whole of its train service at the New York terminal and within a circle whose radii extend at least 35 miles out from the Grand Central Depot. This decision by one of the oldest and greatest of the steam railroad systems in the United States has naturally attracted attention everywhere and aroused the most profound interest. The action of the New York Central Railroad Company in adopting the report in favor of electricity from its commission organized under Vice-President Wilgus to investigate the subject, is one fraught with such momentous consequences alike to the public and to the engineering profession and industries that even the slightest light which can be thrown upon it is of value. In fact, it would be difficult to overestimate the importance of the event, which easily takes its place as the most significant in the history of electrical engineering in 1903.

The readers of ELECTRICAL WORLD AND ENGINEER will remember that the contracts given out by the New York Central Railroad Company embodied two startling innovations and one not less interesting evidence of conservatism. In the first place it has been decided to operate the generating plant by steam turbines, and in the second place it has been decided to operate a very large part of the traffic, namely, that embracing all through trains, with electric locomotives of not less than 2,250 hp each. Striking as the boldness is in these two developments, it is considered by some engineers as offset by remarkable prudence amounting even to conservative timidity in adhering to the direct-current method instead of pushing boldly forward and adopting at once alternating-current apparatus. Under the circumstances we have deemed it desirable to ascertain if possible what the reasons may have been for adopting the direct current in the New York City zone. Neither the railroad company nor its commission has hitherto been willing to give out any official statement upon this interesting subject, but we believe we are justified in submitting below a brief summary of what may be accepted authoritatively as the considerations which led directly to their action. The result of our inquiries on the subject is such as to throw a flood of interesting light upon a great many new points, although it is possible that in some respects we do not fully appreciate or adequately present the force of all the arguments which have compelled resort to direct current at the present time.

The reasons for the action of this great corporation, it would appear, may be divided into two classes, namely, those of policy and those of engineering technique. The word policy in this respect is one of large meaning, but the idea is that the system adopted should leave the widest latitude for the possible future interchange of equipment with other analogous local systems. The New York Central Railroad in determining to minimize as much as possible the inconveniences to the public in this work, has at once realized that as other rapid transit lines in this city are and will be equipped with direct-current motors, its work must be in harmony with theirs. The adoption of the direct-current system, therefore, while leaving optional the selection of the best method of the future handling of the transportation service would facilitate rather than hinder changes which would have now to follow the change in operation and in financial conditions. On the other hand, the employment of the alternating-current system, individual and unique so far as the New York Central road is concerned and not corresponding with the local systems into which it must inevitably interweave itself, would prevent such harmonious action. At a time of extraordinary transition in all the transportation arrangements of New York City, it would have been in all probability a serious and an irreparable error for the New York Central Railroad to have adopted that which is not only newest in the art, but unrelated to that which is already standard and in use in and around New York City. We have ourselves no knowledge or intimation as to the plans and ambitions of the New York Central officials as to the local systems, but such reasons of policy as we have hinted at can certainly be postulated as amongst the prior considerations on the subject governing their action.

With regard to the technical reasons, we have, as our readers are well aware, presented recently in these columns, a vast amount of matter with regard to the advantages of the alternating-current method of traction, and have set forth in great detail the single-phase work of such leaders in this field as Arnold, Lamme, Finzi, Winter-Eichberg, Ward Leonard and others. In view of so much work of promise for the future and of such an elaborate presentation of the alternating-current arguments, we have been particularly anxious to ascertain the technical reasons why the direct-current system appears to the experts and the commission entrusted with the subject to have determining advantages over the alternating-current system at the present stage of development. We hardly know whether the matter of cost should be considered a technical one or not. At this stage of development between the two systems it has undoubtedly been one with serious effect on the matter. The board under Mr. Wilgus, it would appear, found that there was a great uncertainty as to the relative costs of the installation of direct current and of alternating-current apparatus, due obviously to the recent rapid development in the art as applied to alternating-current motors. Hence, while one of the bidders had apparently no trouble in showing a considerable difference of cost in favor of direct-current apparatus, another bidder, at the very latest stages of the settlement, brought to notice a type of alternating-current motor, which it was claimed would cost but little more than the direct-current apparatus. Further than this, it would appear to have been claimed that the overhead construction with alternating-current devices could be avoided on the Park Avenue viaduct and tunnel, and this, if true, would remove one of the strongest arguments against the use of the alternating current.

On the other hand, if we assume that a high-potential third rail could not be avoided, but that overhead construction would be necessary on the viaduct and tunnel, and taking into account the differences in the bids, there would seem to be a large difference in cost in favor of the direct-current system. If the figures were available and were before us, we could possibly make a more specific exhibit of the difference in cost referred to. The situation is, therefore, not a little complicated by the pros and cons in respect to cost, but it would seem that the very points thus alluded to have played their part in bringing about the decision in favor of the direct current. It can readily be understood that a great many features of objection in the minds of the railroad company would attend the use of the overhead construction of bare wire with the alternating-current system, including the liability of injury to trainmen as well as the tendency to corrosion of wires from the gases of freight steam locomotives. There are also obvious dangers and difficulties in lowering the four tracks of the Park Avenue tunnel under the existing enormous traffic, and a great many legal uncertainties crop up in connection with the construction of an overhead system on the Park Avenue viaduct. Admitting that the overhead construction could be avoided on the viaduct and in the tunnel, the difference in cost, if we understand the facts aright, would undoubtedly have been in-favor of the alternating-current apparatus, but viewed broadly and all things considered, the arguments for the direct-current system have prevailed, being supplemented by others of equal moment to which we shall now refer.

Amongst the points which we have elicited is one to the effect that the alternating-current locomotive would have a greater weight, thus adding from 7 to 10 per cent. to the train weight, with a consequent increased cost of transmission, installation and operation of the power plants, which would more than offset the economy due to the use of static transformers instead of rotary converters. Further than this, the alternating-current apparatus for both motor cars and locomotives would involve greater cost of maintenance.

The next point would appear to involve the greater depreciation in value of the alternating-current type of apparatus, and due to the curious fact that being now novel and more or less untried it would inevitably soon have to be discarded and scrapped to make room for improved types in the near future, whereas direct-current apparatus being standardized and universal in application, would prove a good asset with a high percentage of salvage whenever a change to alternating current might prove itself to be necessary. Over and above these leading considerations, others involved are the present imperfect development of alternating-current apparatus when viewed in regard to the complex and important traffic on the New York Central Railroad, which must be handled safely and successfully without any ifs or buts, the paralysis or temporary interruption of such a great national highway being attended with losses to the company and to the public beyond calculation. It is to be remembered, moreover, that the company is required to make a local change within a very short given period of time and without any chance of failure; and this being the case the conviction has been irresistible that direct-current apparatus is at once the safest and the only type to adopt to meet the stringent conditions imposed by the legal, financial, engineering and other broad considerations bearing upon the question.

It is not to be understood for a moment that the alternating aspects of the subject were not fully weighed, and from all we can learn in regard to this matter they were given the most prayerful consideration up to the very latest moment, but even allowing that the alternating-current system under the most favorable circumstances might cost a great deal less than the direct-current system, there remained the other reasons of policy and engineering technique which, so far as the commission and the railroad company were concerned, removed the last shadow of doubt as to the wisdom of adopting direct current within the proposed electrical zone, south of Croton and North White Plains. Going beyond this important and initial zone there would appear to be later on abundant opportunity for resort to the alternating current when its perfection would warrant its adoption for long-distance service. How close at hand this is no one can say. A great deal of the best invention and work of the time points in that direction, but meanwhile it must be felt that the New York Central Railroad Company is to be commended for the high prudence and wisdom which has been associated with its adoption of the most progressive policy seen in the main railroad field for a great many years. In fact, one might well call it the most momentous decision of the kind of the last half century.

Recent Electrochemical Developments.

MANUFACTURING MANURE FROM APATITE.

A patent issued to Mr. Wilhelm Palmaer, of Stockholm, Sweden, relates to a method for making bicalcic phosphate from apatite. In the bicalcic phosphate the phosphoric acid has the same manurial value as the phosphoric acid of superphosphate soluble in water or citrate solution. The process consists of several steps. The first step is the electrolysis of a solution of a suitable salt (chlorate of sodium or periphlorate of sodium), which yields at the anode an acid forming with lime a soluble salt and at the cathode a basic hydrate. The acid obtained at the anode is made to act on mineral phosphate in a separate vessel. To the acid solution of the mineral phosphate thus obtained the alkaline solution formed at the cathode is then added and precipitation of bicalcic phosphate results.

CURRENT NEWS AND NOTES.

WORK WITH RADIUM.—Prof. Roux, of the Pasteur Institute, reported last week some interesting experiments Dr. Danis made with radium. He hung a tube containing the metal above a cage containing mice for fifteen hours. Twenty days afterward the rodents began to lose their fur, which grew again, but of a different color, gray mice becoming white. When the period of exposure was extended the animals succumbed to paralysis, the younger mice being the most quickly affected.

CHICAGO MEETING A. I. E. E.—The coming meeting to be held January 12 is to be one of special interest to central station men, as an opportunity will be afforded for a free discussion of the papers presented at the New York meeting December 18. These will be abstracted briefly and Mr. Lamar Lyndon's paper presented at the previous meeting read at the same time. The committee has received assurance of the attendance of a number of central station men from out of the city.

NEW MULTIPLE VOLTAGE DISTRIBUTION SYSTEM.—A patent has been issued to Mr. George H. Gibson on a multiple voltage generator which allows a large number of voltages to be taken from a single machine. The generator has a double armature winding and the Dobrowolki principle is utilized of producing on a point of the winding of an external inductance an image of the neutral point of an armature winding, to which point a supply neutral conductor is connected. The machine has two commutators—one for each armature winding—and two sets of slip-rings for the neutral connection. The neutral or fifth wire of the distribution circuit is, by means of a special disposition described, made to act as a neutral for both commutator circuits. Assuming that the voltage at one commutator is 50, and at the other 200, voltages of 25, 50, 75, 125 and 200 are available on the distribution circuit.

ANNUAL DINNER OF THE BRITISH INSTITUTION OF ELECTRICAL ENGINEERS.—The British Institution of Electrical Engineers held its fifteenth annual dinner at the Hotel Cecil December 9, with a large number of distinguished guests present. Among these were Prof. E. Hospitalier, president of the Société Internationale des Electriciens; Sir W. H. White, Sir W. Ramsey, Lord Reay, Lord Monkswell (chairman of the London County Council), Lord Biddulph, Lord Claud Hamilton (chairman of the Great Eastern Railway), Hon. A. Brodrick, Sir Norman Lockyer, Prof. S. P. Thompson, Lieut.-Col. Crompton, Sir A. R. Binnie, Prof. W. E. Ayrton, Sir J. Wolfe Barry, Sir W. de W. Abney, Sir G. L. Molesworth, Sir J. F. Bridge, Major-Gen. W. T. Shone, Major-Gen. C. E. Webber, Sir H. Mance, Lieut.-Col. H. A. Yorke, Col. R. M. Ruck, Col. W. Pitt, Mr. R. B. Martin, M.P., Sir C. J. Owens and Mr. James Swinburne. About 500 were seated and one of the English journals ascribes the great success of the occasion to a new feature of the programme, which provided, after the formal ceremonies, a period of informal social intercourse. Lord Monkswell spoke on "The Institution of Electrical Engineers" and Mr. J. Swinburne. Sir C. J. Owens and Sir J. Wolfe Barry on "Railways and Telegraphs." Prof. S. P. Thompson proposed the toast, "Our Guests," compiling with it the names of Prof. Hospitalier, Lord Claud Hamilton and Sir William White. Prof. Hospitalier, on rising, received an enthusiastic welcome which, according to one of the accounts, "was well-nigh endless." He referred with pride to the fact that for 22 years he had been a member of the Institution. Sir William White, in replying, said he did not believe in a hard and fast separation between scientific societies and engineering societies. There was a distinction between pure and applied science, but a man who devoted himself to the application of science was equally as worthy of respect as the pure science man; and in connection with education matters engineers must not permit pure scientists to say what should be the training of the engineer. Sir William White, it may be added, is one of the "old guard" committed against the modern methods of technical education. After the dinner the company adjourned to a hall where members had an opportunity to meet the distinguished guests.

POWER STATION AT CAFFARO.—The numerous water powers found in the Italian Alps are now being used very extensively for developing electric power. One of the largest lighting and power plants is now being built in the Province of Brescia, on the Italio-Austrian boundary, at Caffaro. The station will be equipped with five generator units of 2,500 hp each, all furnished by the Oerlikon Company. The main line to Brescia will be 50 km. long and will carry 40,000 volts. Aside from the Bülach-Oerlikon transmission line, this is probably the only one in Europe transmitting so high a voltage. In connection with this power station, there will be a transformer sub-station of 3,250-hp capacity for operating an electro-chemical factory.

INSTRUMENT DIAL PLATE.—A prolific cause of trouble in indicating electrical instruments is the tendency of the scale to warp and hold the the pointer. To obviate this annoyance Mr. J. Franklin Stevens has devised and patented a method of constructing scales or dial plates which, though simple in detail, is stated to maintain a plate in perfect condition indefinitely, and to completely overcome all tendency of the cardboard to separate from its backing or to warp or blister when subjected to moisture. The method, briefly, consists in perforating the metal plate to which a scale card is secured, thus enabling the cement employed to sink in the perforations and thereby effect a closer union and contact with the metal The plate may be, say, 20 to 25 mils. in thickness, having about 400 perforations per square inch, each about 25 mils. in diameter. A slow-drying cement is used, and a moderate amount of heat is employed while the card and metal backing are subjected to pressure. After all scale divisions are on the card the face is coated with pure white lacquer or similar colorless water-proof substance.

LETTERS TO THE EDITORS.

Motor Drive in Railroad Shops.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with great interest Mr. R. Lozier's very able article in reply to my own, on the subject of machine tool drive, yet I must still adhere to the ideas advanced by me as far as railroad shops, or, in fact, any large shops are concerned, but agree with Mr. Lozier this far that if the shop is small, and the output varied, such an equipment as he describes may justify the increased cost of the multi-voltage system.

In a railroad shop, or in any large shop where there are a large number of tools installed, if the shops are properly laid out, the work will be adapted to the tool, namely, a tool that will do a certain class of work year in and year out. As an illustration, in a railroad shop, an axle lathe will turn axles, a wheel lathe will turn wheels, and so on, and the wheel lathe should not be called upon to do small work. Therefore, the speed at which these machines will run should never vary to any large degree. The maximum speed possible is quickly and easily obtained by the method outlined in my previous article, and a motor ordered for that rate of speed. Now, if there chance to be a few rare cases in which the speed must be varied, the cone pulleys can take care of the change readily, and far more economically than the multi-voltage system, of which the interest on the large initial outlay, goes on year after year, in addition to depreciation. And that the multi-voltage system is costly, no one who has figured on installing it can deny.

Mr. Lozier cites as an instance the finishing up of an armature spider, where the motor is speeded up and slowed down at short intervals. This is very well, but railroad shops do not do this class of work. Still, in a large shop, where this work is done, I see no reason why the work could not be arranged so that each tool could do certain work, and then the spider be passed on to the next tool, if there were many of them to do.

Again, in taking up my ideas on the grouping of tools, with a single motor to a group, at constant speed, Mr. Lozier admits the advantage of a motor without a commutator, but weighs against this the possible factor of wattless current.

Now the factor of wattless current only becomes apparent when the induction motor is underloaded, and it then becomes a mere question of judgment in determining the load factor of your group, and selecting a motor that will be so small as to have an efficient load. If a larger load does happen to come on at rare intervals, it is a well-known fact that the induction motor can take care of overloads with far greater ease than a direct-current motor, can, in fact, be blocked at full current without injury, which cannot be done in the case of the direct current, so this objection then becomes nil.

He also fails to state another factor in the case of the multi-voltage system, namely, the controller required. Now, as regards controllers, reversing the statement of the Irishman about whiskey, "some controllers are better than others, but there are none good," and when you throw this question into the balance, the advantage is altogether in favor of the induction motor, as any one who has had to maintain a large controller equipment can testify.

Again he speaks about the certain amount of direct current necessary for cranes in any case. I may say here, that on future installations projected by me that alternating current will be used throughout, for cranes as well as tools, as the alternating current crane has passed the experimental stage, and become a commercial success, and is as easily operated as a direct-current crane.

One word more and I have finished. Mr. Lozier and others have laid great stress on the fact of the operator being able in the multi-voltage system, to vary the speed of his work at will. Here I must differ from him radically, as I do not think that the operator should be allowed to vary from the instructions given him by his shop superintendent. Were this permitted every man would need to be of such high class and skill, that the cost of production would far outrun the economy gained, or else the amount of work and tools ruined would produce the same result.

In summing up, therefore, I may say that while Mr. Lozier's views are sound and well taken from his point of view I must still adhere to my own, as regards economy of installation, and operation, and I may here quote the saying of a high authority regarding an engineer. He says, "A successful engineer is the one who can make a dollar earn the most money." This saying is most true where large corporations are concerned, and doubly so in the case of small ones.

MONTREAL, CAN. C. H. HINES.

What is Not New in Peat Treatment.

To the Editors of Electrical World and Engineer:

SIRS:—On page 1014 of your December 19 issue I note your remarks in describing the would-be new telephonograph alleged to be just invented in England: "This was all done successfully years ago —let us have something really new." It is a pity you did not put the paragraph relative to the electrical preparation in England of peat, on page 1010, in the same category. The process described therein is identical in all essential respects with that described in the patents of Charon and Oligny issued something like two years ago in the United States. As I had a good deal to do with these patents and the experiments carried on under them at St. Isidore, Quebec, I am thoroughly familiar with the possibilities in this line, and it may as well be stated that, as regards electrical treatment of peat to carbonize it, there is absolutely "nothing in it." In fact, a very easy calculation will show that the mere cost of evaporating the water remaining in peat even after it is dried as thoroughly as possible by presses or centrifugal dryers costs more per ton than the price of coal. It is all very beautiful in theory to "expel all but a small remnant of the 80 per cent. of water" by a centrifugal machine, but anybody who is any way familiar with this class of machine knows that it can't be done. As for "moistening the mass with certain cheap chemicals," this is reminiscent of the "secret liquid" forming so prominent a feature of promoters' schemes, and it is practically safe to say that whether the liquid be cheap or otherwise does not change the character of the proposition.

It must be obvious to every one that the evaporation of water by electrical heat necessarily costs at least ten times as much as by direct heat from the fuel, for the simple reason that only one-tenth, at the maximum, of the heat of the coal is represented in the electric current produced therefrom. Hence it is perfectly obvious that the electrical process cannot compete with the direct process.

As for the alleged superiority of the electrical current in that "it converts but does not destroy any of the valuable elements of the peat, whereas coking by fire heat expels a large percentage of these elements in the form of gases, which being either wasted or burnt as fuel beneath retorts are lost from the composition of the ultimate product"—this is mere "springes to catch woodcocks." When peat is coked by direct heat in suitable retorts the gases expelled are principally water and incombustible gases, and they are utilized as far as possible to coke the peat by burning them (that is, the combustible portion) under the retorts, and are in nowise wasted. As for being valuable elements of the composition, that is nonsense.

Your citation gives the "high thermal value of 9,000 British units" as the result obtained by this alleged new process. As a matter of fact I consider this a very low thermal value, scarcely exceeding that of good hardwood. Ordinary lignite has shown as much. The Canadian briquetted peat already produced, as above alluded to, which I have seen burnt, has given a value of 12,437 B. T. U., as shown by tests of the Quebec Government Assay Laboratory, and but 2.87 per cent. of ash. The cost of producing such peat, not by the electrical, but by other processes tested, was estimated at between $1.50 to $2, and it is perfectly safe to say that this is the very lowest which can be reckoned on anywhere. The cost of producing it in the manner mentioned in your article would actually be found between $6 and $10 per ton instead of $1.21 as given.

Milwaukee, Wis. George W. Colles.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Alternator with Direct Excitation by Alternating Current.—Heyland.—A very long paper illustrated by diagrams, read before the Electrical Society, of Berlin. He describes in detail the principle of his new system of self-excitation and compounding of alternators which has already been noticed several times in the Digest. The first experiments with this type of alternator were made by Kolben & Co., and this firm has already placed a considerable number of machines of this type on the market. The machine is of the construction of an ordinary alternator with stationary armature and revolving field. The essential difference from the ordinary machine is that the exciting current is not supplied from an exciter, but the alternating current generated by the machine itself is, with the aid of a commutator, supplied to a peculiar system of parallel windings around the poles. The principle of the machine is discussed and diagrams are given which represent its behavior. The claims which he makes for this alternator are as follows: Compared with the ordinary alternator his new machine is distinguished by a better utilization of material (less weight of copper and iron per unit of power), by higher efficiency and by a more exact regulation. Since the armature reaction is removed, dimensions may be chosen for the machine which one would obtain with ordinary alternators with high armature reaction. With an ordinary alternator the maximum permitted voltage drop is generally given, and from this result the necessary field strength and the dimensions of the poles and iron cross-sections follow. His type of alternator may be built with a relatively weak field, so that all the dimensions are at once reduced, together with the iron losses, the copper losses and the copper on the poles. The machines have a high efficiency and the efficiency curve is good for all loads, since it increases rapidly for small loads and then remains nearly constant over a wide range of load. Another advantage is the absence of a direct-current exciter. If no exact compounding is required, but only regulation of voltage within the usual limits, the compounding transformer may be omitted altogether and the machine becomes very simple, requiring in operation in parallel no balancing wires or other accessories. The advantage due to the absence of the armature reaction is greatest in machines with few poles and running at a high speed, or in machines for low frequencies. After the paper had been read there was an extended discussion, a full report of which is given. It was brought out there that Heyland uses two transformers, one for compounding and the other for exciting.—*Elek. Zeit.*, December 17.

Reference.

Commutator.—Mason.—A communication giving instructions for amateurs how to make a commutator.—*Am. Mach.*, December 31.

Lights and Lighting.

Photometric Tests of Nernst Lamps.—Sheppard.—A communication referring to the fact that the candle-power of a Nernst lamp of American make varies very considerably with a small difference in voltage; thus a 1 per cent. variation makes a change of 6.4 per cent. in the candle-power. He considers this to be a characteristic difference with respect to Nernst lamps of German make. The data for the latter are given in Fig. 1, in which the full-line curve refers to the Nernst lamp of German make, while the dotted curve referring to the carbon incandescent lamp is given for comparison. An increase of voltage from 100 to 105 causes an increase of the candle-power by 1.5 per cent., and a drop of the voltage from 100 to 95 reduces the candle-power by 30 per cent. In England Nernst

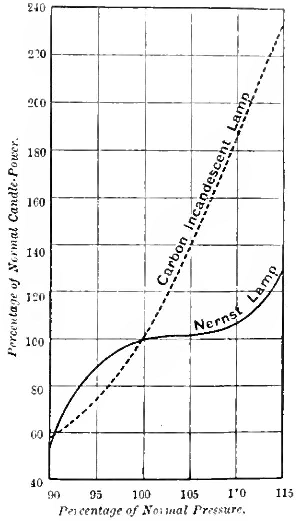


Fig. 1.—Curves of Photometric Tests.

lamps are required to be suitable not merely for the nominal pressure of the supply, but also for the maximum pressure likely to be met with. With the curves he considers that this is sound economy.—Lond. *Elec.*, December 18.

Power.

References.

California and Niagara Power Transmission.—Dunlap.—A comparison. In California widely separated electric systems have been unified into a single and very extended unit of large proportions and great mechanical difficulties had to be overcome. Niagara Falls power is in the midst of a thickly-settled section.—*Westgt. Elec.*, December 19.

Superheated Steam.—Reynolds.—An abstract of a paper read before the Rugby Engineering Society in which the author explains the principal objects of the use of superheated steam and the precautions which must be taken.—Lond. *Elec.*, December 18.

Indicator Diagrams.—Hubbard.—An illustrated article in which the author explains the indicator cards with reference to the internal working of the engine from which they are taken. The author gives cards showing the most common faults in the distribution of steam in the cylinder, such as too early or too late admission, too early or too late cut-off, too early or too late release and too early or too late compression. Directions for remedying all of these faults are given.—*Am. Elec.*, December.

Condensed Steam.—Parkinson.—An article on the utilization of condensed steam in central station economies. A simple filter for removing oil from the condensed steam, to render it suitable for boiler feeding, is described and illustrated.—Lond. *Elec. Rev.*, December 18.

Traction.

Alternating-Current Traction.—Eborall.—The first part of an illustrated paper read before the Manchester Section of the (British) Institute of Electrical Engineers. For urban and interurban tramways three-phase working is out of the question, and even if the single-phase motor should ultimately become an important factor in electric railway work, for this kind of roads. With regard to working costs, a certain economy would naturally result from the substitution of transformers for rotating converting machinery in substations, but this saving would not appreciably influence the total costs of operation, on account of the increased energy consumption in the secondary network. It is hardly likely that the all-round performance of any type of alternating-current equipment will ever equal that of the corresponding direct-current equipment, at any rate under the conditions usually prevalent in urban and interurban tramway work. However perfect the phase compensation of such motors may become, the losses in them and in the distributing system must be greater, other conditions being equal, while on the other hand the maintenance charges are not likely to be less. For overhead, underground and suburban electric railways, the situation seems a little more favorable to alternating-current working; but the commercial success of such lines turns very largely upon the question of rapid acceleration obtained at minimum cost with the help of a simple and flexible arrangement, and in this respect the direct-current equipment is superior to the alternating-current equipment, no matter what arrangements are made with regard to the starting and speed control of the motors. For branch lines and light railways and for high-speed railways where the distances are considerable and acceleration periods are relatively insignificant, the case is quite different. For such work the disadvantages of three-phase working are by no means serious. The author then discusses the principal features of three-phase motors and gives in a table a comparison between typical standard high-speed 500-volt railway motors of the three-phase and direct-current types, the former being arranged for 25 cycles. There is no great difference between the weight and dimensions of the two types of motor, what difference there is being in favor of the direct-current motor. The cost of the three-phase equipment is considerable in excess of that for direct current. Considered from the general engineering standpoint and from the point of view of cost of up-keep, the three-phase motor has the advantage. The speed control of the three-phase motor on tramways must be either a rheostatic or tandem-parallel control. With control by means of rotor resistances, a starting torque per motor equal to nearly three times the normal full-load torque is available for acceleration if necessary, provided the normal pressure is maintained at the motors; but it is accompanied by large losses in the rotor resistances. Still larger torques can be obtained for quicker acceleration if desired by increasing the pressure on the motors; but the result is even greater total losses. Generally speaking, the power consumption of well-designed three-phase motors during the starting period, when employing rotor resistance control, is of the order of 20 per cent. more than that required by the corresponding direct-current motors, starting under the same conditions, with the help of series-parallel control. This is the case for moderate accelerations, while for very rapid accelerations the difference in favor of the direct-current equipment is still more marked. The paper is to be concluded.—Lond. *Elec.*, December 18.

Single-Phase Traction with Speed Regulation.—Latour.—An article in which he says that the following three types of commutator motors may be considered as suitable for single-phase traction, all three allowing perfect operation near synchronism: First, the repulsion motor with a stator winding distributed in slots; second, the shunt motor without phase difference which starts as a repulsion motor; third, the series motor without phase difference. The second type, which may be wound for low or high voltages, is suitable for producing a uniform and nearly constant speed; i. e., for high-speed roads. The motor acts as generator and energy is thus given back, as soon as the speed of the motor is higher than the no-load speed. The excitation must not necessarily be single-phase, but this is the simplest arrangement. The first and third motor types mentioned above are alone suitable for traction with varying speed. The advantage of the repulsion motor is that it may be built directly for a high voltage, while the series motor is essentially a low-voltage motor. On the other hand, the series motor has that advantage over the repulsion motor that during starting the magnetizing current of the former is much smaller and may be reduced to zero when the motor has run up to speed. Whether a repulsion motor or a series motor is used, it is necessary to devise a suitable method for regulating the torque. If the voltage supplied to the motor is constant the torque depends only on the position of the brushes on the commutator, with relation to the terminal points of the stator. By a suitable regulation of the brush holder it is thus possible to obtain the positive or negative torque for a certain speed and the effect braking from full speed to stop without any loss of energy. Since the regulation of the brush holder may involve mechanical difficulties, it is preferable not to change the position of the brushes on the commutator, but the points where the current enters and leaves the stator. For this purpose the stator is connected with an apparatus, similar to a commutator, as shown in Fig. 2, and this

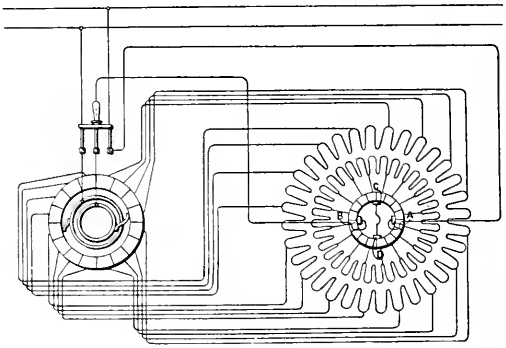


FIG. 2.—DIAGRAM OF CONNECTIONS.

apparatus is placed near the stand of the motorman. The author proposes to discuss the problem of starting without sparks at the commutator in a future article.—*Elek. Zeit.*, December 17.

Alternating-Current Traction.—In an editorial discussion Lincoln's recent paper is said to be a fair statement of the claims for the alternating-current system; on the fact of the showing made, it is thought the general opinion will be that the advantages of the alternating-current system are not sufficient to justify a change from the direct-current system. The main reason why the alternating system is cheaper in first cost is that the current is distributed at very high voltage; but the use of a high voltage is considered to be economy at the expense of safety.—*Eng. News*, December 17.

Reference.

Multiple-Unit Control.—An illustrated description, by Guarini, of the Siemens-Schuckert system in *Elec. Rev.*, December 19. A long illustrated paper, by Niethammer, gives a general review of the subject, with descriptions of the systems of Sprague, General Electric Company, Westinghouse Company and Siemens-Schuckert. In the discussion Adler described the pneumatic control system of Anvert.—*Zeit. f. Elek.*, December 6, 13.

Installations, Systems and Appliances.

Cut-Outs.—Garrard.—A communication referring to the recent failure of a British supply station. He does not believe that the insertion of a maximum cut-out in each generator circuit would prevent such a failure, since if a large current is produced and causes one or more of the maximum current cut-outs to open, the current is piled up in the other machines, whose maximum cut-outs would, therefore, open, one after the other, and the entire station would be shut down. He claims that the only automatic cut-out required in a generator circuit is a reverse-current cut-out; this should, however, not be set to operate at too low a reverse current. A safe value would be about 3 per cent. of the full-load current. The only form of proper reverse continuous-current cut-out can take is that of a polarized relay. This can be adjusted to operate at any exact value of reverse current, and will not operate under any other conditions. The actuating apparatus for knocking out the switch is a tripping coil, the circuit of which is made by the relay. The current for energizing the tripping coil can be taken from an external source, which is the better way, or it may be taken from the same bus-bars that the generators are feeding. It is easy to construct the trip coil with such a large factor of safety that it has sufficient power to open the switch, even if the bus-bar voltage is only ⅕ of the normal value. In an editorial note on this subject doubt is expressed whether central station engineers will share the author's views as to the superiority of the reverse-current cut-outs over other protective devices for direct-current dynamos. The reason of the antipathy of practical men to minimum and return-current cut-outs is that in practice it is found that they occasionally cut off the undamaged generators. In the case of a generating station of fairly large size, there is little danger in using maximum cut-outs between the dynamos and the bus-bars.—Lond. *Elec.*, December 18.

Durban.—The conclusion of the illustrated description of the traction and lighting system of Durban in South Africa. There are 17 miles of tramway track and a negative booster cable has been provided. To meet the large demand for motive power, some 6¼ miles of special motor mains have been laid in various places in town for a 500-volt direct-current supply with switch boxes, which are interconnected to the traction switch boxes, the rails being also used as the return. Where motor mains are laid in streets off the tram routes, a bare copper return has also been laid connected with the nearest rail. The motor mains are also made use of for the street arc lighting; the cables for the various circuits are taken from the nearest switch box up the traction pole, where they are connected to the bare overhead mains; there are about 6 miles of streets so lighted by 155 lamps, arranged in groups of five in series, with a resistance between the last lamp and the rail connection for the return circuit. For the lighting system alternating current with high-tension transmission is used; there are 14 transformer stations, containing transformers mostly of 30 kw.—Lond. *Elec. Rev.*, December 18.

Reconstructed and New Central Station.—An illustrated description of the plant of the Electric Light Company at Meriden, Conn. The old equipment consisted of six engines belted to arc machines and Eddy generators having capacities of 25 to 40 kw. These were replaced at seasons of light load by a 150-kw alternator and a 125 and a 225-kw direct-current generator. The prime-movers are all of the vertical compound type and can be controlled from the boiler room or from the engine room. Prior to the reconstruction the line losses averaged about 20 per cent. and the losses from the engine cylinder to the switchboard 30 per cent. By substituting enclosed for open-arc lamps, the line losses were reduced one-third, and by changing from direct-current series to alternating-current series, the total efficiency of the plant was raised to over 75 per cent. This system was installed for street arcs and the commercial arcs were transferred to a three-wire direct-current system so as to place them more under the control of the customer, and upon a meter rather than upon a contract basis. The old three-wire, 220-volt system was retained for the incandescent lamp service, but the losses between the station and the distributing centers were considerably reduced by the addition of more copper. The power service is almost entirely upon this system, and where this service assumes large proportions special feeders are run from the station in order to prevent fluctuations upon the lighting mains. The power factor of the arc light system averages from 70 to 75 per cent.—*Am. Elec.*, December.

Bradford.—The first part of a fully illustrated article on recent extensions of the Bradford central station, which was the first municipal lighting station in England, having started supply in 1899. A system for hiring out motors is in use, which has met with success, since at the end of 1902 some 641 motors were on hire out of a total of 913 motors, representing 4,398 hp connected. The latter figure has since grown to nearly 5,000. The new generating station contains 14 high-speed engines, with a total horse-power of 6,500; there are six 700-amp., 230-volt balancers on the lighting network; six 700-hp compound generators, giving either 750 amp. at 500 to 550 volts for traction or being run as shunt machines across the outers of the lighting network at 460 volts; and for 300-hp machines, which may be used the same way. In the evening, when the traction plant is closed down, a 100-kw motor-generator is used for transforming lighting current for traction service.—Lond. *Elec. Rev.*, December 18.

REFERENCE.

Charging for Electrical Energy.—CRAPPER.—A paper read before the Leeds Section of the (British) Institute of Electrical Engineers. He discusses the principles of the uniform meter rate and of two-rate meters. If a central station could operate at an approximately constant load for 24 hours per day, the service would be an ideal one and the uniform rate would be the ideal rate; but at present a uniform rate for all purposes and at all times is not only impracticable, but unjust. He advocates a differential rate in some form as the most workable system provided the initial rate is not too high.—Lond. *Elec.*, December 18.

WIRES, WIRING AND CONDUITS.

High-Tension Porcelain Insulators.—FRIESE.—An illustrated account of an experimental investigation. On high-tension lines, porcelain insulators behave like condensers, the wire corresponding to one plate, the earth to the other plate of the condenser and the porcelain mass to the dielectrics. The capacities of these condensers are to be considered to be connected in parallel among themselves and with the capacity of the transmission line against earth. The author has tested two different types of insulators, the results being given in tables and diagrams. The capacity of the insulators is small, although not negligible, since it increases the capacity of the line itself against earth by a few per cent. The capacity and dielectric constant were found to be independent of the voltage for both insulators. For one insulator the loss was found to be proportional to the square of the voltage, while for the other insulator type tested it was proportional to about the 226th power of the voltage.—*Elek. Zeit.*, December 17.

REFERENCES.

Losses in High-Tension Cables.—ROTH.—A communication referring to the investigation of Apt and Mauritius, recently abstracted in the Digest. He doubts whether the "loss figures," given by them for various insulating materials, are an exact indication of their quality, since the authors have not correctly taken into account the thickness of the insulating layer. He believes that their method of testing insulating materials gives correct results only when cables with equal cross-section and with equal thickness of insulation are compared.—*Elek. Zeit.*, December 17.

Cables of South Africa.—An illustrated article on the change which is now being made in Johannesburg from overhead electric wires to underground cables. The high-tension voltage is 3,000, while the low-tension distribution is by three-wire network with 400 volts across the outers. At present 15 miles of underground cables have been laid and this change is to go on steadily.—Lond. *Elec. Rev.*, December 11.

ELECTRO-PHYSICS AND MAGNETISM.

Stationary Electric Waves.—MOLLOY.—A paper read before the Dublin Section of the (British) Institution of Electrical Engineers. The experimental apparatus used by the author consisted of an induction coil giving from 20,000 to 30,000 volts, two Leyden jars, arranged so that the capacity of the circuit might be varied by placing them in series or parallel, and two coils, the self-induction of which could be varied within wide limits by means of sliding-contact pieces. The frequency of the oscillations was of the order 100,000 to 1,000,000 periods per second, and the number of oscillations in each single spark was 8 to 10. An analogy was drawn between an organ pipe and an electric radiator, in both of which the minimum changes of pressure occur at the open end and the maximum at the closed end. Though the principle of resonance will protect the secrecy of wireless telegraphy messages over a very large area near the receiving station, there always will be an area near the transmitting station over which resonance cannot afford complete protection. He showed this by bringing an untuned receiver into the neighborhood of the transmitter. As it approached the radiator, the receiver responded fully to waves emitted, and successfully tapped the message. The second part of the paper dealt with the higher harmonics, and for their exhibition a long vertical coil was used. A vacuum tube was placed in the field of this coil and the oscillator circuit was first tuned to the fundamental of the coil, the bottom of which was connected to earth; an effect as of a web of light, intense at the upper part, and gradually fading towards the bottom, took place when stationary electric waves were set up in the coil. Subsequently the oscillating circuit was tuned successively to the first, second and third harmonics of the fundamental proper to the coil, and the maxima and minima of the luminous discharge were evident. In these experiments the upper end of the coil was insulated, in which condition it follows the laws of a closed organ pipe, producing only odd partials; that is, n, $3n$, $5n$ vibrations per second. By connecting the upper end to earth it is possible to produce all the partials, n, $2n$, $3n$, etc.—Lond. *Elec.*, December 18.

Radium and Atomic Theories.—RAMSAY.—A short summary of our knowledge on radium. Concerning the transformation of radium into helium, he makes the following remarks: Just as there is a limit to the possible number of atoms in a compound of carbon and hydrogen, so there may be a limit to the atomic weight of an element. Those elements with high atomic weight, such as thorium, uranium and radium, are apparently decomposing into elements with low atomic weight; in doing so they give off heat and also possess the curious property of radioactivity. What these elements are is unknown, except in one case; one of the products of the decomposition of the emanation from radium is helium. Whether the process be reversed, no one knows. If gold, which has a high atomic weight, is changing, it is much more likely that it is being converted into silver and copper than is being formed from them. At this stage, however, speculation is futile. More experiments are required.—From Lond. *Mail* in *Scient. Am.*, January 2.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Formation of Lead Peroxide from Lead.—ROKOTNITZ.—A long article giving the results of laboratory tests on the electrolytic production of lead peroxide from lead with various electrolytes. With acid solutions the efficiency was better than with alkaline solutions. In pure sulphuric acid solution the output, however, is very small, but improves if such substances are added which first produces another lead compound from which peroxide can be formed more easily. He obtained the best results with an electrolyte containing 46.7 grammes of potassium sulphate and 30 grammes of potassium chlorate, in which case the ampere-hour efficiency of the peroxide formation was over 80 per cent.—*Centralblatt f. Accum.*, September 15, October 1, 15; November 1, 15.

Electrogalvanizing.—GRAEBRAN.—A description of some experiments made on plating zinc on iron, especially for plating the sides of vessels with zinc. He obtained the best results with a solution containing 6,000 grammes of water, 1,200 grammes of zinc sulphate and 60 grammes of sulphuric acid of 24° Baume. With a current density of 6 amp. per square decimeter and circulation of the solution the ampere-hour efficiency is nearly 100 per cent. An apparatus for plating the sides of a vessel with zinc is described which is essentially a nozzle through which the electrolyte is circulated, and which is pressed against the side of the vessel, the latter being, of course, the cathode. It is especially important that any soldered places should be plated with zinc as otherwise a galvanic action is set up.—*Elek. Zeit.*, November 12.

REFERENCES.

Electrolytic Formation of Lead Peroxide from Lead.—PETERS.—Continuations of his long serial giving the results of laboratory tests on the use of various electrolytes for the electrolytic formation of lead perxide from lead. No summary is yet given.—*Centralblatt. f. Accum.*, December 1, 15.

Electrodeposition of Copper.—COWPER-COLES.—A long article giving brief illustrated descriptions of various processes for plating iron and zinc with copper.—*Electrochem. and Met.*, November.

Electrolytic Drilling.—COWPER-COLES.—An illustrated description of an electrolytic drilling and slotting process. A nozzle is placed against the plate to be drilled. The electrolyte is circulated in the nozzle. The metal to be drilled is the anode and a solution of sulphuric acid is the electrolyte.—*Electrochem. and Met.*, October.

Galvanic Cells.—BERTHELOT.—A translation of some of his recent papers on the theory of galvanic cells; one refers to the "relation between the intensity of the voltaic current and the manifestation of the electrolytic output"; the second to "manifest electrolytic actions developed by batteries constituted by the reaction of two liquids, one containing an acid, the other an alkali"; the third to "new experiments on the limit of intensity of the current of a battery corresponding to the manifestation of an exterior electrolytic output apparent in a voltameter."—*Sc. Am. Sup.*, December 26.

Physico-Chemical Review.—The first number of a new journal with the title, *Physikalisch-Chemisches Centralblatt*, has just appeared, in which no original articles will be published, but abstracts given of all the original articles published in various countries in the field of physical chemistry. As far as possible the abstracts will be furnished by the authors themselves and will, therefore, be printed either in German or English or French. The editor is M. Rudolphi.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electric Thermostat.—DARWIN.—A (British) Physical Society paper, in which he describes an electric thermostat. The vessel, the temperature of which is to be maintained constant, is surrounded by oil contained in a bath. In the oil are placed two heating coils through which electric currents pass. By automatically controlling these currents, the temperature of the oil and consequently of the inner vessel, is kept very nearly constant. The control is effected by means of a Wheatstone bridge in the outer oil bath. This bridge has two opposite arms of copper and two of manganin, so that it is only balanced at some definite temperature. Its deviations from balance affect the position of a long horizontal boom attached to the suspended coil of a galvanometer. The position of the boom determines the greater or less descent of a "hit or miss" arm, which is periodically raised by a rotating cam, and can only fall to its lowest position when the galvanometer boom is to one side and allows it to pass. This position of the boom corresponds to a fall of temperature of the controlling bridge. Thus the position of the "hit or miss" arm at its lowest position depends on the temperature, and it is the variation of this position which regulates the amount of current passing through the heating coils. When the "hit or miss" arm is at its highest position, the galvanometer boom is absolutely free to move to its position of equilibrium. At every rotation of the cam the "hit or miss" arm is lowered, and if it passes the galvanometer boom a key is closed and a current passes through the "intermittent" heating coil. The current passing through the "permanent" heating coil is also automatically regulated. This apparatus is capable of keeping the temperature within 0.01° C. for a period of eight hours.—Lond. *Elec. Rev.*, December 18.

Electromagnetic Units.—E. H.—With reference to Kennelly's Institute paper and the recommendations made for the Saint Louis Electrical Congress, the writer expresses the opinion that sooner or later the c.g.s. system will become the international system of units. The metric system from which it is derived is incoherent, since the unit of density does not conform with the units of mass and volume. The fundamental unit of force varies on different points of the earth. What he says against the metric system is also to be said against the practical c.g.s. system. The absolute c.g.s. system is itself not free of fault, but represents, as Kennelly shows, the least imperfect and most coherent system. All units should get names. The nomenclature proposed by Kennelly is considered to be very simple. The editor opens the columns of his paper to a discussion of the subject.—*L'Ind. Elec.*, December 10.

REFERENCES.

Integrating Wattmeter.—An illustrated article on the construction of the Stanley wattmeter and the equipment of the Stanley Instrument Company's works.—*Elec. Rev.*, December 12.

Magnetic Vane Voltmeter or Ammeter.—BROCKSMITH.—An article, with working drawings, on the construction of a magnetic vane voltmeter or ammeter. The instrument is extremely simple, both in principle and construction, and has the advantage of being compact and neat in appearance, while being sufficiently accurate for all ordinary purposes. The article is replete with dimensioned detail drawings and all the information necessary for the building of the instrument.—*Am. Elec.*, December.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Simultaneous Telegraphy and Telephony.—PFITZNER.—An illustrated description of a system of connections which has been used for several years on several telephone double lines between Brussels

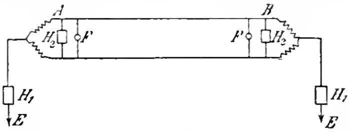


FIG. 3.—DIAGRAM OF GENERAL CONNECTIONS.

and Paris, and which enables one to telephone and simultaneously exchange telegrams between two pairs of Hughes apparatus. The general scheme of the connections is shown in Fig. 3, in which H_1 H_1 is the one pair and H_2 H_2 the other pair of Hughes apparatus; F F

are telephones and E is the earth. A modification of this scheme has also been used wih success by the German telephone department. The details of the connections are described and also given in form of diagrams.—*Elek. Zeit.*, December 17.

Magneto Switchboard for Small Exchanges.—O'BRIEN.—Telephone switchboards of the magneto type, in which the talking current for the sub-station instruments is furnished by local batteries located at each sub-station, have been almost entirely superseded in all the large and medium-sized exchanges in the country by the central energy common-battery type of switchboard. In a great number of small exchanges, however, where the expert attendance and supervision necessary for a common-battery board are not available, the simplicity and freedom from complicated circuits of the magneto board renders it especially suitable, and consequently this type of board is in use in small country exchanges to a very great extent. The author describes the wiring circuits, equipment and method of operation of a magneto switchboard having a capacity of 100 sub-station lines, which with the system in vogue in country exchanges is capable of serving as high as 400 to 500 sub-stations.—*Am. Elec.*, December.

Rapid-Type Printing Telegraph.—A note on an apparatus of Siemens and Halske based on the following principle: A disc, near the periphery of which the letters of the alphabet, figures, etc., are cut out, rotates at a speed of 2,000 r.p.m. between a moving strip of sensitive paper and a spark-gap. Every time the spark jumps the gap, that letter on the disc which happens to be at the time opposite the gap is photographed; 2,000 letters per minute may thus be recorded on the moving tape, which passes through a developing and fixing bath, out of which it emerges after about 9 seconds. To obtain good results, the spark, it is said, must occur with a punctuality by 1/400000f a second, and this has been attained by a suitable arrangement of condensers. The messages to be sent are first punched on tape, which is then rapidly run through a rotating sender by means of which corresponding current impulses in rapid succession are sent to the line.—Lond. *Elec.*, December 18.

Printing Telegraph Central Station.—GRADENWITZ.—An illustrated description of the type-printing telegraph service, recently added to the Berlin telephone service. The instrument used is a teletypewriter and the station is used at present to transmit exchange telegrams to a certain number of subscribers. It is, therefore, in the nature of our stock-ticker. The same system may, of course, be employed for transmitting telegrams from a central telegraph office to a certain number of newspaper offices.—*Sc. Am.*, December 26.

MISCELLANEOUS.

Welding Aluminum.—COWPER-COLES.—An illustrated description of various processes for welding aluminum and especially of his own machine for this purpose. The aluminum to be welded is first preheated and then the ends to be welded are pressed together so that a ring of metal is squeezed out, which is largely composed of aluminum oxide and acts as a supporting collar, the molten metal being retained within this collar. The weld is then instantaneously quenched by turning a handle, which allows water under pressure to be projected on the joint from a reservoir. The collar around the joint is afterwards filed off.—*Electrochem. and Met.*, November.

REFERENCE.

Siberia.—An article on electricity in Siberia. Six central stations are mentioned. The best equipped is at Tomsk, where "the maximum electrical output is 2,500 kw-hours per day." While there is nothing to learn from Siberian electrical engineering, yet their trade is worth having.—*Elec. Rev.*, December 12.

New Books.

THE DYNAMO. Its Theory, Design and Manufacture. By C. C. Hawkins, M.A., M.I.E.E., and F. Wallis, B.A., A.M.I.E.E. New York: The Macmillan Company. 413 illustrations.

The third edition of this book on the dynamo has been greatly enlarged, and its pages are replete with instruction. Through the general theory of the magnetic field and the production of e.m.f., the authors lead up to the dynamo in its modern form, and present their subject in a manner thoroughly up to date. It is gratifying to see how scrupulous the authors have been in mentioning the sources from which they have drawn, a custom which, in these days of literary piracy, deserves appreciation. The citation of the sources from which an author has drawn is not only a debt that he owes, but it is often extremely useful that the reader may be able to turn to the original pages for further information, and, therefore, the modern careless way of not stating the sources is greatly to be deprecated.

The eighteenth chapter treats of the theory of commutation, to which Mr. Hawkins has been a valuable contributor for many years. It is to be regretted that he does not give the theory of commutation at greater length. The chapters on the heating of dynamos and on armature reaction in alternators are excellent, the latest theoretical and experimental results having been considered. A passage from the author's preface shows the scope of the book, and we therefore cite it here: "At the same time the utmost economy in the materials and labor employed in the manufacture of a machine is imperatively called for in order to meet the increasing keenness of a world-wide competition; every pound of copper and of iron must be utilized to its fullest extent, and designs involving high-priced skilled labor must give way to simple types having easily-made interchangeable parts, with the consequent result that the machines for given outputs are smaller and more standardized. Thus in preparing a third edition it became necessary to rewrite most of the former chapters and to add several new ones."

The chapters on dynamo construction give a number of very fine cuts of modern dynamos of European and American makes, and the book as a whole will prove instructive and of interest to electrical and mechanical engineers.

Record Run of Electric Automobile.

Mr. Fred B. Whitney, clerk to the Committee on Naval Affairs of the House of Representatives, established the world's record at Washington, D. C., December 23, 1903, for an endurance run at the highest long-distance speed of an electric auto upon a single charge of storage battery. President A. L. Cline, of the local Automobile Association, acted as referee. The start was from the Dewey Hotel at 7.05 P.M. Tuesday night, December 22, in an electric Stanhope equipped with a 570-pound Porter battery and the run was made upon the streets of Washington. At 5.20 Wednesday morning the Stanhope collided with a heavy covered wagon, spilling considerable battery fluid, tearing off a tire, breaking spokes and springing axles, etc., and was hauled to a repair shop. A distance of 107.4 miles was

ELECTRIC AUTOMOBILE.

made in the actual time of 9 hours and 12 minutes, or about 12 miles per hour. The longest runs without shutting off current were 31, 23 and 21 miles. At 2 P.M. Wednesday after hasty temporary repairs had been completed the run was resumed and 13.8 miles were made in 1 hour and 30 minutes under the difficulties of a disordered machine. The Stanhope was run to its garage under its own power and showed a voltage of over 1.8 per cell and could have made more miles without accident. The total distance run was 121.2 miles in 10 hours and 32 minutes, or about 12 miles per hour. This establishes a world's record for long-distance run upon a single charge at the rate of 12 miles per hour and raises the long-distance rate one mile per hour. The world's record at 11 miles per hour was made at Cleveland, 1902, at 151 miles. The world's record at 10 miles per hour was made by Mr. F. C. Phillips, of Cleveland, at Chicago at 187 miles, using Porter battery.

New Types of Voltage Regulators for Generators.

The General Electric Company has recently placed on the market two new types of voltage regulators, designed for direct-current generators only (Fig. 1), and the other (Fig. 2), though primarily

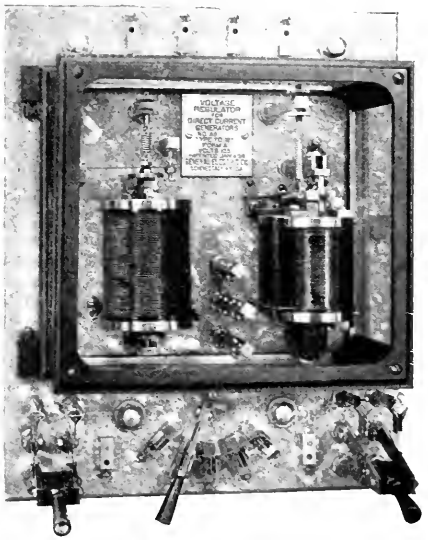


FIG. 1.—DIRECT-CURRENT REGULATOR.

designed for use with alternating-current generators, may, if provided with an exciter, be used on direct-current generators as well.

These instruments operate on the principle of rapidly opening and closing a shunt circuit across the field rheostats, the rheostats having considerable resistance turned in to give the regulator a good margin to work on. The first mentioned type is arranged to open and close

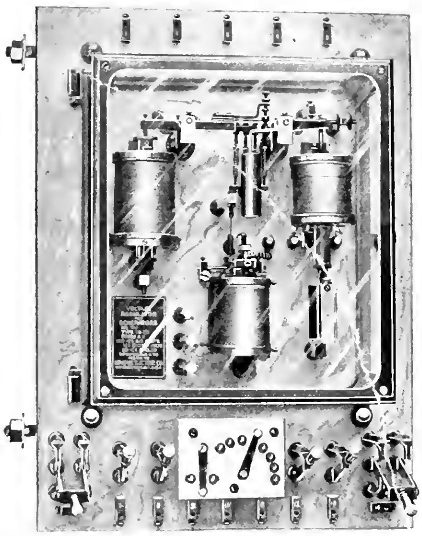


FIG. 2.—ALTERNATING-CURRENT REGULATOR.

a shunt circuit across the generator field rheostat, and the other across the exciter field rheostat.

The direct-current regulator consists of a main control magnet and relay. The relay is differentially wound, one of these windings being permanently connected to the circuit, while the other is opened and closed by the main contacts which are operated by the main control magnet. As the main contacts are opened and closed, they simultaneously open and close the relay contacts by means of the differential winding of the relay. These relay contacts open and close a shunt circuit across the generator field rheostat. To prevent injurious sparking at the relay contacts, condensers are connected in multiple across them. This regulator will maintain constant voltage on one shunt-wound generator, or will maintain constant volt-

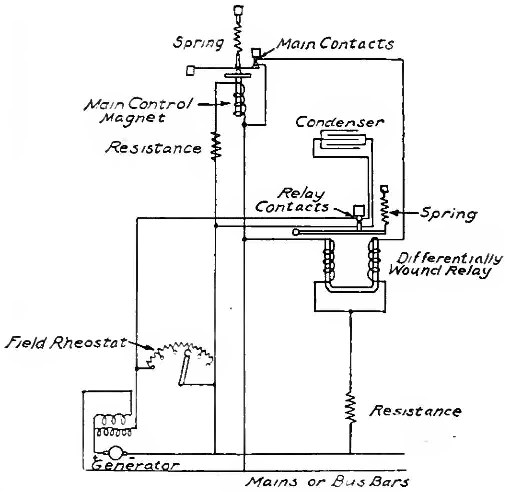


FIG. 3.—DIAGRAM OF CONNECTIONS.

age on several compound-wound generators operating in parallel, regulating, however, only one at a time. Several generators can be arranged to be controlled by one regulator, by means of the five-point

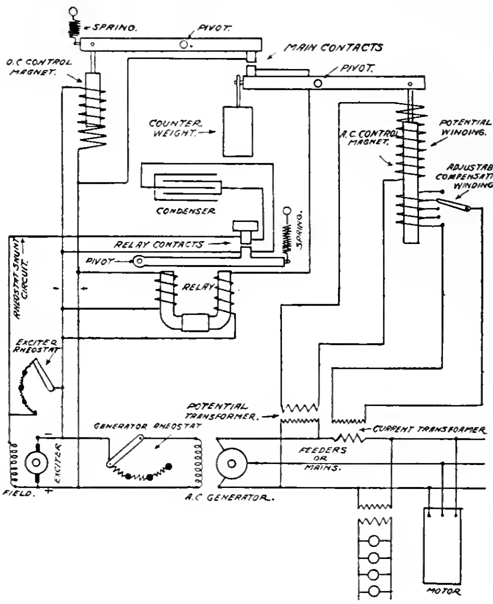
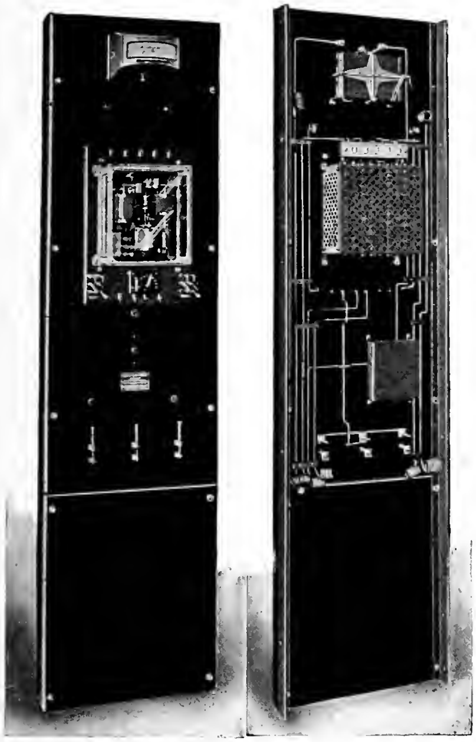


FIG. 4.—DIAGRAM OF CONNECTIONS.

rotary switch as shown in Fig. 1. The generator being regulated has a tendency to take the sudden fluctuations of load, but it is quickly equalized between the several generators by means of the compound winding of the machines. With shunt wound generators it will be necessary to have a regulator for each generator to be regulated.

These regulators are usually arranged to maintain constant voltage at the bus-bars, but may be connected to pressure wires brought back from the centre of distribution, thus maintaining constant voltage at the centre of distribution. The connections of this regulator are shown in Fig. 3.

The second type of regulator is designed to maintain a steady (but not a constant) exciter voltage, and consists of the same direct-current control magnet and relay as the direct-current type with the addition of an alternating-current control magnet having a potential and an adjustable compensating winding. These two windings work in opposition to one another. This magnet operates the lower main contact. The magnet core and lever are arranged by means of a counterweight to come to a balance at the correct voltage. Should the alternating voltage tend to vary for any cause, it would change the position of the lower main contact, which would cause the exciter voltage either to be raised or lowered, thus overcoming the disturbing factor. Without the use of the compensating winding, the regulator will maintain a constant bus-bar voltage, and by the use



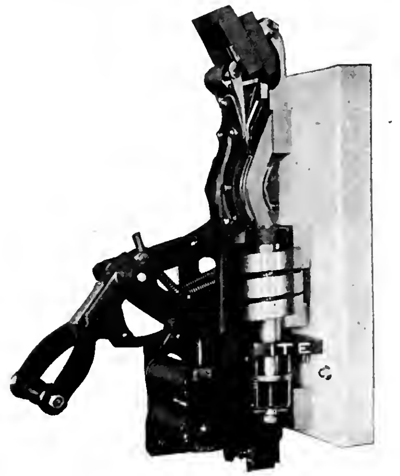
FIGS. 5 AND 6.—FRONT AND REAR VIEWS OF REGULATOR PANELS.

of the adjustable compensating winding and current transformer in the circuit to be regulated, the regulator will automatically compensate for line losses. The alternating voltage is automatically kept at its desired value by varying the exciter voltage. Once the regulator is adjusted to maintain constant voltage at the centre of distribution it will require no further adjustment, and the station voltage will be increased or decreased with the load to automatically maintain the desired voltage at the centre of distribution. This regulator is independent of temperature and frequency changes. Elementary connections are shown in Fig. 4.

These regulators are switchboard instruments in design and finish, and may be placed on the front of a switchboard panel or be placed at either end of a switchboard on rigid iron brackets made for that purpose, Figs. 5 and 6. The value of these regulators will be recognized in maintaining the desired potential on a system, regardless of variations of speed and load. It naturally results in reduced attendance at the switchboard, increased output of station and reduced lamp renewals due to perfect regulation. It is stated that there are now in service regulators of these types controlling upwards of 100,000 kw of generating apparatus.

Reverse Current Circuit Breakers for Protection of Generators in Parallel.

One of the latest types of I. T. E. automatic circuit-breakers, designed and manufactured by the Cutter Company, of Philadelphia, is the overload and reverse-current type, illustration of which is shown herewith. This circuit-breaker is especially serviceable for the protection of generators operated in parallel. In the electric railway power plant, or the lighting plant in a hotel, office building or department store, there is a time of day when the load comes on very rapidly, due to increased traffic or turning on of lights. At such a time the engineer has to start up an extra generator and throw it in parallel with the generators already carrying the load. The load, however, often increases so rapidly that the dynamos running are greatly overloaded before the extra machine can be cut into the circuit to carry its part of the load. If an engineer in his excitement, to get this generator into service, should attempt to throw it in parallel with the other generators before it is up to voltage, the ones carrying the load would also have to supply current to run this gen-



CIRCUIT-BREAKER.

erator as a motor until it was up to speed. This extra load at such a time would seriously overload the plant and possibly open the overload circuit-breakers on the generators.

To guard against such careless handling of generators, and also against open fields, etc., a reverse-current circuit-breaker is used, or rather a circuit-breaker combining the overload and reverse-current features. The reverse-current provision automatically opens the circuit-breaker on any specified reverse current, and the instrument can be provided with a calibrated scale so that it can be set to open when the reverse circuit exceeds a predetermined point. The tripping force is dependent upon the amount of reverse current and the greater the current the quicker the circuit-breaker is opened. The operation is practically independent of the voltage on the line and will open the circuit, even though the voltage fall to 25 per cent. of normal. The overload feature is the same as that used with other types of I. T. E. circuit-breakers and is positive and accurate in its calibration.

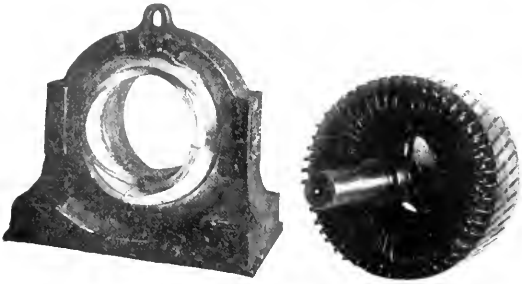
This type of circuit-breaker is also largely used for the protection of rotary converters operated in parallel. They are built plain reversal and overload and reversal in all capacities, single and double-pole, up to 12,000 amp., for use on circuits of any voltage up to 800 volts, direct current. Smaller types are used for the protection of electric automobile charging circuits and storage battery equipments of all kinds.

Freeport-Dixon Electric Railway.

The Arnold Electric Power Station Company, engineer and contractor, Chicago, Ill., has been retained by the Freeport-Dixon Electric Railway Company to prepare preliminary plans for its proposed line. The road will consist of about 35 miles of single track, and will connect the cities of Freeport and Dixon.

British Single-Phase Motor.

The Langdon-Davies Motor Company, Ltd., London, has for many years made a specialty of single-phase alternating-current motors, although they also make and supply direct-current, two-phase and multiphase motors. Their alternating-current motors, as regards the larger sizes, have a special construction of bed plate. This has the advantage of serving instead of slide rails, and further has the manufacturing advantage of reducing the size and weight of the pieces to be machined. As slide rails, it carries the weight in the plane of the motor axle and thus reduces the tendency to cant, especially with a



FIGS. 1 AND 2.—FIELD AND ARMATURE.

horizontal belt drive, and the protections on either side of the sliding part entirely avoid any sideways cant when tightening up the belt.

The fact that the above company are turning out over 2,000 hp of single-phase motors a year, and that in many cases factories have abandoned their gas and steam engines and replaced them by such motors to the extent of 200 or 300 hp, and are pleased with the result, forms a significant comment on the development effected. At Derby, which is a network having a single-phase supply, the consumption of energy for motive power for the year ending last March was 22 per cent. of the total units sold. This is a figure which will

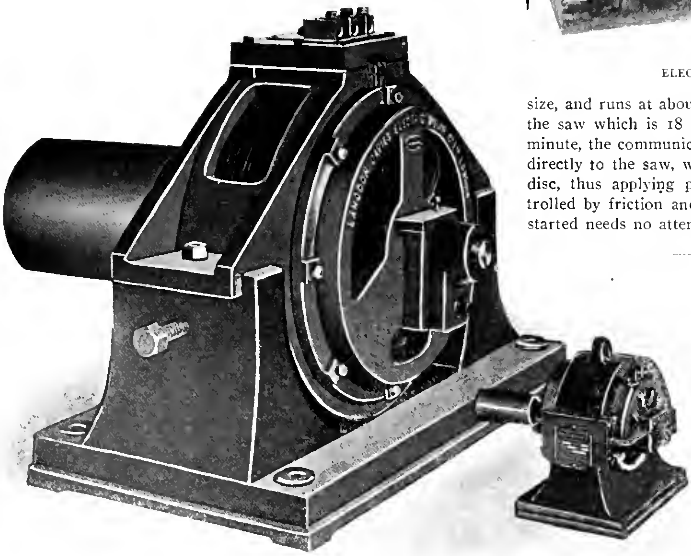


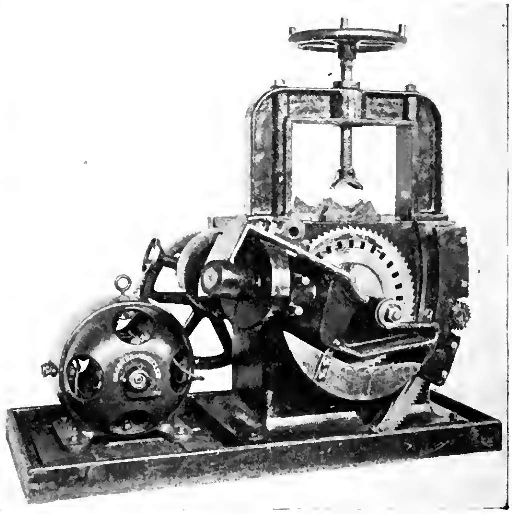
FIG. 3.—SINGLE-PHASE MOTORS.

be found to compare very well with any direct-current station of a similar size.

The repairs and renewals of the induction motors, especially those without slip rings, which can be adopted for nearly all purposes, are an almost nominal amount. The accompanying engravings show the windings of the rotor and stator of the smaller motors.

A Motor-Driven Cold Metal Saw.

A portable cold metal sawing outfit is illustrated herewith. It is a standard Higley saw, designed for cutting bar stock, to give lengths at a rapid rate, and is marketed by the J. R. Vandyck Company, of New York. The distance between the uprights of the clamp is 16 inches and the height under the arch of the clamp is 12 inches. The tool is capable of cutting round stock up to 7 inches in diameter, 12-inch I-beams, etc. The drive was arranged by substituting a sprocket for the belt pulley and connecting to the motor by a Renold silent chain. The supporting frame of the saw is swiveled about the sprocket shaft as an axis, and feeding is accomplished by swinging the saw up under the work, the feeding and returning being automatic. The motor is of the Crocker-Wheeler make, of 3-hp



ELECTRICALLY-DRIVEN METAL SAW.

size, and runs at about 725 h.p.m., when on 120 volts. At this speed the saw which is 18 inches in diameter makes about 4½ turns per minute, the communication being through a spur gear and bevel gear directly to the saw, where a sprocket engages in perforations in the disc, thus applying power very near the teeth. The feed is controlled by friction and is adjustable so that the machine when once started needs no attention until its job is finished.

Test in Wireless Telegraphy.

On the morning of Saturday, December 5, an interesting test in wireless telegraphy was made between Fort Wright, New London, and Fort Schuyler, New York, a distance of about 100 miles. The test was made by the De Forest Company on behalf of the Government. Three messages of about thirty words apiece were sent by General Greely, of the United States Signal Corps, from Fort Wright to Captain Reber at Fort Schuyler. The particular interest of thetest lies in the fact that certain conditions were imposed which made it very difficult to send a distance of 100 miles, namely, the height of the antennæ at the two stations was limited to 140 feet, and the power at the sending end to 3 kilowatts. The Government is erecting two stations in Alaska about 100 miles apart, and General Greely wished to satisfy himself that messages could be transmitted over this distance under the conditions stated. A number of army officers witnessed the test.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Improvement was the feature in the stock market throughout the week, but there was a sharp reaction at the close. Financial conditions are considered sound and healthy. Money is in good demand for legitimate purposes, and the supply resulting from the release of funds engaged in crop movement, with some $25,000,000 of foreign gold imported, gives promise of abundant ease in the future. Amalgamated Copper was heaviest among the active stocks, and lost 4¾ per cent. Its decline was a depressing influence upon other stocks on account of its recognized relation to the Standard party. The traction and electric securities all show advances on a fairly good business, the greatest relative activity being in General Electric, of which 12,460 shares were sold at prices ranging from 171½ to 180, the closing figure being 176, a net gain of 4½ points. Activity is also noted in Westinghouse common, 18,000 shares having changed hands, the extreme prices being 168 and 180, the former being also the closing quotation, ex-dividend, and representing a net gain of 2½ points. The preferred stock gained ½ point net, closing at 193½. In tractions B. R. T. closed with a net loss of 4⅛ points, the last price being 48¾. Metropolitan Street Railway closed at 121½, being a net gain of 1⅝ points. American Telephone & Telegraph closed with a gain of 2⅛ points, at 128⅛, and Western Union at 86½, a ¼ point better than the last previous record. Following are the closing quotations of January 5:

NEW YORK.

	Dec. 29	Jan. 5		Dec. 20	Jan. 5
American Tel. & Cable	80	80	General Electric	176	173
American Tel. & Tel	128⅛	125	Hudson River Tel	..	..
American Dist. Tel	24	24	Metropolitan St. Ry	125⅜	122¼
Brooklyn Rapid Transit	54	49⅛	N. E. Elec. Veh. Trns	..	..
Commercial Cable	..	..	N. Y. & N. J. Tel	..	..
Electric Boat	15	15	Marconi Tel	25	..
Electric Boat pfd	40	46	Western Union Tel	86⅛	86
Electric Lead Reduction	1	1	Westinghouse com	175½	168
Electric Vehicle	5¼	7⅝	Westinghouse pfd	190	185
Electric Vehicle pfd	9	11½			

BOSTON.

	Dec. 29	Jan. 5		Dec. 29	Jan. 5
American Tel. & Tel	128	126⅛	Western Tel. & Tel. pfd	78	78
Cumberland Telephone	*114⅛	*114⅛	Mexican Telephone	1½	1½
Edison Elec. Illum	232	231	New England Telephone	121	*122
General Electric	176	171	Mass. Elec. Ry	20	19½
Western Tel. & Tel	7⅛	8	Mass. Elec. Ry. pfd	75¾	75¼

PHILADELPHIA.

	Dec. 29	Jan. 5		Dec. 29	Jan. 5
American Railways	43½	43½	Phila. Traction	97¾	..
Elec. Storage Battery	54	56	Phila. Electric	6	5⅞
Elec. Storage Battery pfd	54	56	Phila. Rapid Trans	8⅝	8¼
Elec. Co. of America	8⅛	..			

CHICAGO.

	Dec. 29	Jan. 5		Dec. 29	Jan. 5
Central Union Tel	..	..	National Carbon pfd	92	92
Chicago Edison	..	..	Metropolitan Elev. com	17	17
Chicago City Ry	155	..	Union Traction	6½	6½
Chicago Tel. Co	..	..	Union Traction pfd	*29	28
National Carbon	20½	21			

*Asked

BELL TELEPHONE.—A Boston telephone official is quoted as follows: "I believe the result of President Fish's recent visit to the West will be an active campaign during the coming spring against the independents in the Middle West with a view of preventing their increasing their hold upon the city of Chicago. The battle will take place in the territory of the Central Union Company in the Middle West, where competition is the hottest and the field that General Sabin, of San Francisco, attempted to conquer. It will have to be done by funds furnished direct by the American Company, as the Central Union Company is already up to its bond limit and, notwithstanding its stock has been cut in two, the market value is far below 100. All the subsidiary companies with their reports sent to Gen. Thomas Sherwin, auditor, in December, will estimate the cost of next year's extensions and show the amount of money required. Based on the winter orders for poles and cables already placed, the extensions will exceed those of this year on all lines and at least $30,000,000 will be asked for, although the home office may cut this amount on account of the money stringency, to $25,000,000. With Bell stock selling at $126, it is quite probable that the new money will be raised by bond issues instead of selling at 7½ per cent. stock at par. Based upon the recent sale of Atchison bonds and the fact that all the Bell bonds previously issued have been distributed, the company ought to be able to market a block of $25,000,000 to net above 90, basing the rate fixed to be 4 per cent., a saving of say 3 per cent., or $750,000 annually."

GENERAL ELECTRIC.—On the subject of General Electric business in 1903-4, the *Wall Street Journal* says: "We understand that the General Electric will close the year with substantially the same net figures as for 1902. The gross business has been larger, but the expense of material, power and labor has been increased. The electric manufacturing companies are fairly well supplied with orders, but will doubtless enter the year with a reduced amount as compared with a year ago. The problem of high costs at the present time, with the prospects for a falling off in business at the end of the year, must be soon taken up, and it is expected that the orders now in hand can be so judiciously distributed over the year as to meet a reduced output for the whole of the year 1904 with some measure of economy in costs. This may involve a reduction in forces at Schenectady and Lynn and some readjustment of wages. A few departments of the company are still overcrowded, but in others there is a surplus of labor. The problem of 1904 is one of economic readjustments to irregular conditions."

BOSTON STOCK TICKERS.—The announcement is made that the Commercial-Financial Press Association has acquired the Boston *Financial News* and the New England stock quotation service, and through association with the New York News Bureau has become Boston correspondent for that association. By reason of the changes, on and after January 1 the service of the Boston *Financial News* will be conducted directly by the Commercial-Financial Press Association, the absolute control of which is in the hands of an interest closely allied with the New York News Bureau. The new management will install within the next two or three months an electric delivery service by means of the Burry bulletin printer, which has for some years been successfully operated in New York. The publication offices of the new association are at 35 Congress Street, and the business offices at 22 Congress Street. Charles B. Strecker is president and general manager of the company.

B. R. T. LEASE.—It was stated on Wall Street last week, in positive terms and from reliable authority, that the Brooklyn Rapid Transit system had been taken under lease by the Interborough Company on a 4 per cent. guarantee stock. The negotiations have not been closed, it is asserted, because of the insistence of the Rockefeller interests on a demand for an increase of the guarantee to 5 per cent. after a few years. The Interborough people object to an increase in less than ten years. The proposition to lease, however, has been absolutely agreed upon.

Commercial Intelligence.

THE WEEK IN TRADE.—Generally the earnings of the railroads remain good, and while the extreme high water mark may in some cases not be maintained on the majority of roads the reports are encouraging and the handsome surpluses over dividends paid, and the belief that it will be practical to reduce expenses in the future give reason to expect an indefinite continuance of the present rate of distribution, with some increases more than possible. Trade conditions in general are reported favorable, and there is a decidedly hopeful feeling as to new year's business. The extreme cold weather checked retail trade temporarily, but this is a mere seasonable incident, the future outlook being very satisfactory. No particular changes are noted in the iron and steel trade, while the other metals, including copper, remain practically unchanged from the last quotations.

DORTMUND ELECTRIC ROAD.—The commissioners of the Dortmund suburban district have decided to build an electric railroad at the district's expense. The General Electric Company (Allgemeine Elektrizitätsgesellschaft), of Berlin, whose bid of 1,640,000 marks ($390,320) has been accepted, will build the road and operate the same, under a concession, for a period of ten years. New electric roads are being built in many European cities by this company.

JOHN-MANVILLE COMPANY.—The British Johns-Manville Company, Limited, has been formed in London for the purpose of undertaking the selling agency for the specialties of the H. W. Johns-Manville Company, 100 William Street, New York. The capital of the company is $25,000. The directors will be Edward Bergtheil, of the London firm of Bergtheil & Young; H. J. Joseph, who will also be the manager of the company, and G. W. Becker, formerly of the New York offices.

HOBART ELECTRIC MANUFACTURING COMPANY.—An announcement has been received of the reorganization of the Hobart Electric Manufacturing Company, of Troy, Ohio, which went into effect on January 1. The purpose of this change is to materially increase the capacity of its factory. The capital stock of the company has been increased and contracts are now being entered into for a large and modern addition to its already well-equipped factory, which will enable it to treble its output. The secretary and treasurer, who held a controlling interest in the old company, will retain their holdings in the new organization and will be actively engaged in its management. Mr. C. C. Hobart, who has been so long identified with this company, retires from an active interest in the reorganized company. The Hobart Electric Manufacturing Company, although it has made little effort to force itself on the notice of the public, has, nevertheless, more than quadrupled its business within the last few years. A very large proportion of its output of dynamos and motors has been disposed of to concerns who are constant users of electrical machinery, and who, having found the Hobart apparatus to be thoroughly efficient and satisfactory, have favored it with continued patronage. In a quiet way the Hobart Electric Manufacturing Company has increased its business to such an extent that even with its constantly increasing facilities it has been unable to keep up with its orders. A number of contracts of from $10,000 to $25,000 each have been secured within the last year, so that the problem of selling has not caused much anxiety as compared with the problem of deliveries. Starting a number of years ago with the manufacture of a low-priced dynamo and motor, the Hobart Company has now come to be recognized as manufacturers of a standard machine. Especial attention has been paid by it to those parts of a machine which most frequently cause annoyance in operation. Aside from a standard line of dynamos and motors, this company also manufactures a dynamo designed especially for use with gas and gasoline engines. This machine adds to a standard machine a heavy fly-wheel and a third bearing to support it. It is a successful dynamo for overcoming the flicker in the lights caused by the irregular impulses of gas engines. A direct-connected electric coffee mill for use in groceries manufactured by this company has also met with popular favor.

A NEW TELEPHONE MANUFACTURING COMPANY.—The Dean Electric Company has been incorporated under the laws of the State of Ohio by Samuel B. Rawson, I. H. Griswold, T. M. Brush, A. E. Barker and W. W. Dean, to engage in the telephone manufacturing business at Elyria, Ohio, at which point a modern factory building will be erected on the main line of the Lake Shore Railroad. The names of several of the incorporators will be recognized as those of prime movers in the independent telephone field. Messrs. Rawson, Griswold and Brush are the founders and builders of a large number of exchanges in the States of New York and Ohio, among which are Albany, Schenectady, Cohoes, Niagara Falls, Elyria, Ohio, and numerous others. Mr. A. E. Barker has been connected with the engineering staff of the Kellogg Switchboard & Supply Company, of Chicago, having built the Detroit and New Orleans exchanges. He has also had charge of the sales end of the Kellogg Switchboard & Supply Company, with the title of sales manager. Mr. Dean has been connected with the telephone business for about 22 years and has been with the following companies: The Bell Telephone Company, of Missouri, at St. Louis; the Union Telefonica Company, Buenos Ayres, South America; the American Bell Telephone Company, of Boston; the Western Electric Company, of Chicago, and the Kellogg Switchboard & Supply Company, of the same city. The officers of the new company are as follows: Samuel B. Rawson, president; William W. Dean, vice-president and chief engineer; T. M. Brush, treasurer; A. E. Barker, secretary and general manager.

FIRE AT 131 LIBERTY STREET, NEW YORK.—Fire broke out about 3 A.M., January 5, at 131 Liberty Street, in which building a number of electrical concerns are located. The flames started on the sixth or top floor, in the printing plant of Boschen & Wefer The entire floor is completely gutted and the roof burned off. The amount of water which was used to quench the fire must have been enormous, as practically all the ceilings on the floors below leaked very badly when seen by a representative of the ELECTRCIAL WORLD AND ENGINEER. On the fourth floor J. P. Hall, the electrical engineer and contractor, has his offices. It was said that the damage done there would amount to about $1,500. The D. H. Darrin Company, manufacturers of elevators, etc., has its factory on the third floor. About $2,000 worth of damage is estimated to have been done. On the second floor the Automatic Switch Company has its plant. About $2,000 worth of damage is estimated to have occurred. The D. H. Darrin Company has its offices on the first floor. About $1,000 is expected to cover the damage. On the ground floor B. F. Sturtevant & Co.'s store and offices are located. It is believed that $1,000 will cover the damage done there. The fire is reputed to have started by the falling of a live coal out of a stove used by a plumber, who was making some repairs on the top floor. Most of the damage done is covered by insurance.

CHAMBLY POWER HOUSE.—In connection with our recent important and long article on electric light and power at Montreal, in the description of the Chambly power plant, it should have been stated that the McCormick water wheels referred to were built by the S. Morgan Smith Company, of York, Pa. One of our drawings showed two pairs of wheels on a line direct-connected to a generator, the wheels and draft boxes being placed in a concrete flume. This was the way the wheels were set when the plant was originally built. As remodeled, however, the plant has the water wheels and draft boxes on the inside of steel penstocks, the ends of which were shown in another of the cuts. At the time the dam at Chambly "went out" some months ago, the water wheels were placed in steel penstocks because it was feared that the concrete flumes might not stand much longer.

SOME HARRISBURG ENGINE ORDERS.—The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, has taken an order for a 150-hp Harisburg standard simple engine from the Ironclad Manufacturing Company, of Brooklyn, direct-connected to a 100-kw generator. The equipment will be used for both light and power. A 75-hp Harrisburg simple engine has been ordered for lighting Healy's Restaurant, New York. The generator will be a 50-kw one of Western Electric make. Among foreign orders received within the past few days is one for a 125-hp engine to be belted to a 75-kw General Electric generator for shipment to Chili for lighting use.

MEXICAN LIGHT AND POWER SCHEME.—Mexican advices state that Mr. James Kilton has secured a contract for furnishing electric light and power and the construction of a system of water works at Matehuela, a city of some 15,000 inhabitants, in the State of San Luis Potosi, Mexico. The plans include the building of four electric generating plants, which are to obtain power from water to be piped from large natural springs located on top of a mountain 1,000 ft. above the city and about 22 miles distant. The water of these springs is to be piped to the power stations and thence conveyed to Matchuela for the purpose of supplying the mains of the water works system.

EQUIPMENT FOR MEXICAN MINES.—The Penoles Mining Company, which operates extensive properties at Maprine, Mexico, placed recently contracts for considerable electrical equipment for driving hoists, pumps and compressors and lighting the mines. The contracts called for a 2,500-hp plant. The Allis-Chalmers Company, New York, secured the order for the engines, while the General Electric Company obtained the order for the generators—three-phase, alternating-current type.

LIGHT AND POWER STATION AT DRAMMEN, NORWAY.—A new light and power station has just been opened at Drammen, Norway. This station receives its power from Gravfos Falls over a 23½-mile transmission line. The entire electrical equipment, both for the station at the Falls and the one in the city, was furnished by the Oerlikon Company. The power station at the Falls has a capacity of 5,400 hp, and consists of six 900-hp units. The current is transmitted at a potential of 25,000 volts.

EQUIPMENT FOR LEHIGH CEMENT PLANT.—The Lehigh Portland Cement Company is to extend its plant at Ormrod, Pa. Considerable new equipment has already been contracted for. Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, took an order for a 340-hp tandem-compound Harrisburg standard engine, to be direct-connected to a 225-hp General Electric generator. Several motors are also to be installed.

BALL ENGINE ORDERS.—Dilworth, Porter & Co., Limited, Pittsburg, Pa., has recently placed a contract for three direct-connected units, the engines for which are to be furnished by the Ball Engine Company, Erie, Pa. The Sailors' and Soldiers' Home, of Grand Island, Neb., has contracted for a direct-connected unit. The Ball Engine Company, Erie, Pa., will build the engine.

THE DUNKIRK POWER & HEATING COMPANY, of Dunkirk, N. Y., has just completed the installation of the following units in addition to the previous plant: A 225-hp tubular boiler, under which is a Murphy automatic smokeless furnace; a 20 by 42 simple non-condensing Nordberg Corliss engine; a 250-kw. belted Western Electric, moderate speed, generator and switchboard appliances. Exhaust steam is used for steam heating through underground mains.

MEXICAN HYDRAULIC PLANT PROJECTED.—A hydraulic plant is about to be built on the River Tanoco at a place called Chorro Grande, in the State of Vera Cruz, Mexico. Filiberto Romero, of Vera Cruz, is primarily interested in the project. It is proposed to develop current for lighting and power use in the vicinity.

KEYSTONE ELECTRIC COMPANY has recently installed a 450-kw, 220-volt unit for the Erie Electric Light Company, of Erie, Pa. Mr. H. B. Coho is now vice-president and general manager of the Keystone Company, to which he is giving his personal attention.

General News.

THE TELEPHONE.

MEDORA, ILL.—The Medora Telephone Company, has been incorporated with a capital stock of $10,000. The incorporators are John Payne, Oliver Pirwin and William J. Bell.

BLOOMINGTON, ILL.—The Washington City Rural Telephone Company has purchased the Washington Telephone Exchange from Receiver Heald, of the Peoria and Eastern Telephone Company. Paul Goddard is president of the new company.

ALEXANDRIA, IND.—The Central Union Telephone Company will put in a new switchboard and change its system from magneto to the central energy system.

VINCENNES, IND.—The report of the first year for the Knox County Home Telephone Company shows a growth of 1300 connections with lines south, north, east and west. By Jan. 10 the Princeton line will be finished. The Sullivan connection has been in operation two months, and a long distance line will connect Indianapolis in the near future.

NOBLESVILLE, IND.—On Dec. 24, the entire interior of the Home Telephone Company exchange in this city was burned, the result of a cable coming in contact with the trolley wire of the Indianapolis-Northern Traction Company. Over 200 telephones were burned out. Many patrons who answered the false call were shocked and a number were burned.

CORYDON, IND.—The Cumberland Telephone Company is putting forth extraordinary efforts to enlarge its service in Southern Indiana. The company has agents out inducing farmers to build their own lines promising them connection and service under very favorable terms. It is claimed a large number of lines will be built by the farmers under the stimulus of the favorable conditions offered.

INDIANAPOLIS, IND.—The Central Union Telephone Company is arranging to divide the State into four districts, with a district superintendent in each division. The four district headquarters will be at Indanapolis, Logansport, Anderson and Terre Haute. A fifth division headquarters may be established at Ft. Wayne later on. The officials say the work of extending the service is being carried on so rapidly that it is no longer possible to handle it from one central point. Under the new plan the division superintendents will work under the general district superintendent in this city. R. A. Swan has been selected for Anderson, J. H. Sheppler for Terre Haute, and M. D. Atwater for the Indianapolis district.

BOONE, IA.—The headquarters of the Iowa Telephone Company are to be removed from Davenport to Des Moines.

COUNCIL BLUFFS, IA.—Mr. Thomas D. Metcalf and other local parties are endeavoring to revive interest in an independent telephone system, a movement for which was agitated something over a year ago, but failed to succeed because of the strong opposition by the Bell people.

PAXICO, KAN.—The Paxico Telephone Company has been incorporated with a capital stock of $2100.

REPUBLIC CITY, KAN.—The Republic City Telephone Company has been incorporated with a capital stock of $2500.

BELLVILLE, KAN.—The Bellville Independent Telephone Company has been incorporated with a capital stock of $35,000.

MARYSVILLE, KAN.—The Marysville Telephone Company plans to erect a new switchboard of from 300 to 400 drops capacity. The company will build quite a good many party lines during 1904. It has 234 telephones installed, the user of each paying $1 and $2 a year, according to service.

FRANKFORT, KY.—The Kirksville Telephone Company has been incorporated with a capital stock of $7500.

KENSINGTON, MD.—The Kensington Telephone Company is the name of a new concern organized here with B. A. Chapin as president.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company will expend $750,000 in improving its entire system.

BALTIMORE, MD.—The Hughes Telephone Mfg. Company has recently issued bonds to the extent of $50,000 for the purpose of developing the capacity of its plant.

PITTSFIELD, MASS.—The New York Central Railroad is installing a complete system of telephones in the yard in this city and at the Junction, which will connect the switch houses and terminals with the freight depot.

YPSILANTI, MICH.—The Washtenaw Home Telephone Company has been refused a franchise here.

LAKE CITY, MICH.—The Missaukee Telephone Company has been incorporated with a capital stock of $5000.

MENOMINEE, MICH.—The Central Telephone Exchange has just completed the installation of its new system. There are 700 telephones connected and the exchange cost $24,000.

WAYNE, MICH.—The People's Telephone Company at its annual meeting elected the following officers: President, Joseph Waltz; vice-president, John Chamberlain; secretary and treasurer, F. L. Edwards.

KALAMAZOO, MICH.—The Citizens' Telephone Company has perfected its re-organization, with F. P. Rowe, president; R. C. Packard, secretary and general manager; E. W. Bowman, treasurer. W. Wheeler, Chicago, is constructing engineer. The company is capitalized at $250,000, and will erect an extensive independent system in Kalamazoo with branch exchanges in a number of surrounding towns.

GRAND RAPIDS, MICH.—The new Strowger automatic telephone plant of the Citizens' Telephone Company is about completed. All that remains to be done is the completion of the work of cutting in and testing. The company expects to switch to the automatic system before Feb. 1, with about 4500 subscribers. The services of about 100 telephone girls will no longer be required, but the company will retain probably 40 employees in the long distance and information departments.

WASECA, MINN.—The Tri-State Telephone Company intends to build a line from here to Albert Lea.

REDWOOD FALLS, MINN.—The Redwood County Rural Telephone Company is constructing an extension to its line from here to Morton.

LA PLATA, MO.—The La Plata & Western Telephone Company has been incorporated with a capital stock of $1500. Directors: J. A. Dusley and others.

ST. CHARLES, MO.—The Kinloch Telephone Company is constructing a line from this city to Portage des Sioux and West Alton, this county. The line will be in operation by Jan. 15.

HANNIBAL, MO.—Articles of incorporation for the Hannibal and Ralls County Telephone Company have been filed. The incorporators are J. I. Davidson, Dr. W. L. Birney and I. H. Harper.

GALLATIN, MO.—The Crab Orchard Telephone Company, of Gallatin, has been incorporated; capital stock, $2008, all paid. Incorporators: W. E. Hathaway, Hiram Burns, W. P. Heysey, E. E. Duffy, E. H. Cravens, M. A. Shipley, John O. Heaston, W. T. Roper and others.

LIVINGSTON, MONT.—The Rocky Mountain Bell Telephone Company intends to construct telephone lines up the Yellowstone and Shield River valleys. The lines will be built from Livingston.

BASSETT, NEB.—At a special meeting of the stockholders of the Bassett and Springview Telephone Company the capital stock was increased to $25,000. This increase is to provide for new extensions which are projected in Rock, Brown, Holt and Loup Counties next spring.

ORD, NEB.—The Valley County Telephone Company has made a move to buy out the independent exchanges at Ord and North Loup and reorganize as a mutual company. The business men of both places are encouraging the movement as it will give valuable communications with both Custer and Garfield Counties and make a system which will embrace about 1000 telephones in the home county.

HILLSBOROUGH, N. J.—The Hillsborough & Montgomery Telephone Company, Hillsborough, Somerset County, has been incorporated; capital, $125,000. Incorporators: Peter A. Garretson, William C. Hendrickson, William M. Frankhouser, Louis E. Opie, A. J. Van Nuns, Belle Meade, David J. Smith and Jacob C. Gulick.

MANCHESTER, N. Y.—The Clifton Springs Telephone Company is extending its line north of Gypsum.

NORTH WOLCOTT, N. Y.—The North Wolcott Telephone Company is the name of a new company being formed here by N. J. Field, J. N. Robertson and others.

SHERMAN, N. Y.—The Independent Telephone Clearing Association has been incorporated with a capital stock of $5000. Directors: H. H. Corbett, W. H. Homewood and others.

CHARLOTTE, N. C.—It is reported that a deal is on foot for the purchase of the extensive interests of the South Carolina Long Distance Telephone Company by the Bell Company. This move is said to be a result of the failure of the American Contracting Company which has been financing the South Carolina Long Distance Company. It is understood that the Bell Company will make many improvements on the local system in the city of Columbia where the Long Distance Company has large holdings.

FARGO, N. D.—The Hunter Telephone Company has purchased the private wire from Blanchard to Amenia and will build one to Gradin.

SHELDON, N. D.—The Northwestern telephone line is to be extended from Englevale to Fort Ransom.

MT. VICTORY, OHIO.—The Mt. Victory Telephone Company has been incorporated with a capital stock of $25,000.

NELSONVILLE, OHIO.—The York Telephone Company has been incorporated with a capital of $1000. Directors: W. S. Follett, E. R. White and others.

OTTAWA, OHIO.—The village council has refused a franchise to the Central Union Telephone Company (Bell) which has been endeavoring to get into Ottawa.

MUSCOGEE, I. T.—The North American Telephone Company has completed the Denison-Wagoner division of its line and cut in on the local exchanges here. This company is covering Indian Territory and Oklahoma with its long-distance toll lines and already has connection with 157 exchanges in North Texas, Oklahoma and Indian Territory. The line is being built as rapidly as possible north to Joplin, Mo., where it will make direct communication with Kansas City and St. Louis.

TORONTO, ONT.—The Canadian Telegraph & Telephone Company is about to make application to the civic authorities of Toronto for permission to do business in this city. This company, which will have exchange connection with all the independent telephone companies of the United States and which also has the right to construct long distance lines from the Atlantic to the Pacific, intimates that it is prepared to give service at a rate much lower than that now charged in Toronto.

OTTAWA, ONT.—The city of Ottawa has received another independent telephone offer. This now comes from H. Waddington, president of the Stark Electrical System, of Toronto, a new corporation. The company proposes to give a combined service of telephone, electric light and power over one circuit. Arrangements have just been completed to install a plant in the town of Toronto Junction, Ont., and Ottawa is asked to await the result. The company claims that telephones will be given at 25 per cent of the present cost, and electric light at two-thirds the present cost. The company will make Ottawa an offer for an area within a radius of 15 miles at the following rates: Telephones $6 per annum and one cent for each out-going call, the maximum cost to be $15 per year for house and $36 for business telephones.

ELECTRIC LIGHT AND POWER.

OPELIKA, ALA.—The Alabama Electric Light & Power Company has been incorporated by C. G. Abercrombie and H. C. Davidson, both of Montgomery, to furnish electric lights and power for lighting Opelika and other towns and cities in this state and the state of Georgia. Capital, $50,000.

FLORENCE, COL.—It is stated that another power-house for supplying power to the mines of Cripple Creek and the traction company at Pueblo will be built by the Woods Investment Company on upper Beaver Creek in the vicinity of Pike's Peak.

DENVER, COL.—L. B. Curtis, of Denver, constructing engineer of the Routt County Electric Light & Power Company, writes that plans and specifications for the electric plant are being prepared and bids for construction will be received about April 1. The probable cost of plant will be $60,000.

LITTLETON, COL.—The Canon Power Company has been incorporated with a capital of $500,000 to utilize the waters of Bear Creek for generating electrical power to supply light to Morrison, Golden, Ft. Logan, Littleton, Englewood and parts of Denver. Incorporators: Albert B. Sanford, Arthur K. Smith and Geo. J. Bucher. The plant will be near Littleton.

WASHINGTON, D. C.—The Senate Committee on Pacific Islands and Porto Rico has made a favorable report on the bill to approve a special act of Legislature of Hawaii providing for the manufacture and distribution of electric light and power on the island of Oahu.

COLUMBUS, GA.—The Columbus Power Company has ordered machinery for developing additional water power which will bring the total up to 9000-hp. The new machinery will arrive in about four months time.

SHELBYVILLE, ILL.—The Shelbyville Water, Heat & Light Company has been incorporated with a capital of $50,000. Incorporators: C. S. Scovil, W. H. Beem, W. S. Middlesworth and others.

BLOOMINGTON, ILL.—The Consumers' Heat & Electric Company has purchased a 400-kw, 220-volt direct-connected General Electric generator, and a 600-hp Allis-Chalmers Corliss engine. This new equipment is now being installed in the company's new plant.

JEFFERSONVILLE, IND.—The United Gas & Electric Company has been granted a franchise in this city. The ordinance provides that the city shall pay $60 each a year for 110 or more arc lights for street lighting and settle an old bill of about $6500, on a basis of $46.50 for the lights that have been in service since Oct. 9, 1902.

SOUTH BEND, IND.—Contracts for the water power and electrical machinery for the power plant of the Oliver Chilled Plow Works are reported to have been awarded as follows: Westinghouse Electric & Mfg. Company, of Pittsburg, Pa., three 500-kw alternating current generators, switchboard, etc.; Dodge Mfg. Company, of Mishawaka, harness for 12 water wheels, and to the Jas. Leffel Company, of Springfield, Ohio, water wheels, turbines and governors.

RICHMOND, IND.—The local electric light rate war is not only arousing much interest here, but in other cities of the state. In some cities the local experience is held up as an indication of the troubles that municipal lighting is sure to bring. Mayor Zimmerman and other city officers are firm, however, in their declaration that the private company cannot "oust" the city from the business. The fight between the Light, Heat & Power Company and the municipal plant is sure to be the issue in the next campaign. Councilmen standing for re-election will be forced to stand for or against the sale of the municipal plant. On this issue an appeal has been made to the people. Mayor Zimmerman said: "If the city plant never does better than meet expenses it will have done a great good in bringing the price of electric lighting down to a reasonable basis. We would not have cheap electric lighting to-day but for the city plant, and we will have it no longer if the city is sold out to the private company."

GRAETTINGER, IA.—The citizens are planning to put in a $10,000 electric light plant.

CHARLESTOWN, KY.—A franchise for an electric light plant has been granted to Clarence R. Hay and work will be started at once. The town will take 20 arc lights at $48 per annum on a moonlight scale.

BELFAST, ME.—L. G. Vose, general manager Belfast Gas & Electric Company, writes that it is proposed to construct a complete water power plant at Hiramdale Falls.

IPSWICH, MASS.—Notes for $5000 for a lighting plant will be issued by the treasurer and selectmen.

DULUTH, MINN.—At the coming election a proposition to issue $50,000 water and light extension bonds will be voted on.

WINONA, MISS.—The Winona Water, Sewerage, Ice & Light Company, of Winona, has been incorporated with a capital of $250,000, with Claude R. Kelso, Robt. A. Allison and Arthur Blake, as incorporators.

COLUMBIA, MO.—The City Council has decided to purchase the water and light plant of the Colombia Water & Light Company.

RED LODGE, MONT.—It is reported that the Electric Light Company will install a new plant in the spring.

LITTLETON, N. H.—This town is establishing an electric light plant of its own. The equipment will include two 30-inch turbines which are being supplied by J. & W. Jolly, of Holyoke, Mass.

SODUS, N. Y.—This village is contemplating the erection of a $25,000 electric light plant. Mr. A. B. Williams can give information.

FRANKLIN, OHIO.—The Franklin Electric Light Company is installing a new engine, generator and boiler.

OAK HARBOR, OHIO.—The Oak Harbor Electric Company has been organized by C. H. Graves, Geo. Mylander, S. Mylander and E. B. Graves.

MECHANICSBURG, OHIO.—T. J. Long, of the Mechanicsburg Light & Power Company, writes that it is proposed to construct an electric light plant at a cost of about $8000.

BUCYRUS, OHIO.—The Bucyrus Electric Light Company is erecting a new lighting plant and the equipment has been received. It is expected the plant will be in operation in about 30 days.

TOLEDO, OHIO.—The board of public works has decided to install electrical power on the swing of the Cherry Street bridge and bids will be asked for on the motors and other necessary equipment.

CLEVELAND, OHIO.—Electric lighting companies throughout the State have joined hands in a movement to secure the repeal of the law passed by the last Ohio Legislature relieving the railway companies from maintaining arc lights at railroad crossings.

COLUMBUS, OHIO.—The Indianola Heating & Lighting Company has given a blanket mortgage for $1,000,000 to the Guarantee Title & Trust Company, of Cleveland. The company is erecting a large heating and lighting plant and the mortgage covers all the property.

TOLEDO, OHIO.—The Fisher Electric Company, of Toledo, has received a contract for installing an electric lighting plant at Capac, St. Clair County, Mich. The equipment will include a 150-hp horizontal automatic engine, a single phase, 60 cycle, 2300-volt, 75-kw lighting generator, together with necessary switchboard apparatus. The company commenced business about 14 months ago and has filled a number of contracts of this character.

GETTYSBURG, PA.—Adam Ertter is interested in the construction of an electric light plant.

COALPORT, PA.—The Coalport Light, Heat & Power Company, of Coalport, has been incorporated with a capital of $5000.

STEWARTSTOWN, PA.—The Deer Creek Water & Water Power Company, of Stewartstown, has been incorporated with a capital of $6000.

NORTHUMBERLAND, PA.—The Northumberland Electric Light, Heat & Power Company, of Northumberland, has been incorporated with a capital of $5000.

YANKTON, S. D.—Mr. Edmunds, proprietor of the electric light plant, has offered the City Council to sell his plant, exclusive of tools and office fixtures, for $15,000.

HENRIETTA, TEX.—The City Council has granted a franchise to the Brower Lighting Company to establish an electric light system through the town.

SAN ANTONIO, TEX.—The election to vote on the proposition to issue $200,000 of bonds for the construction of a municipal electric light and power plant was held on Dec. 19 and resulted in overwhelming defeat.

WAXAHACHIE, TEX.—The Waxahachie Gas & Electric Company has been organized here with a capital stock of $100,000 for the purpose of installing an electric light and power plant and a gas plant. The incorporators of the company are J. F. Strickland, Osce Goodwin, W. C. Ross and M. B. Templeton, all of Waxahachie, and R. C. Vickery, of Fort Worth.

SALT LAKE CITY, UTAH.—Some time ago a protest was made by citizens against the alleged inferior service rendered by the Utah Light & Power Company, which resulted in the appointment of a committee to investigate the matter. The committee has submitted its report which states, in substance, that while the service is far from what could be desired, on account of a lack of modern equipment for regulating the electrical current, it was no better than had been represented in the protest. The committee, however, announced that the electric light company had expended during the present year $520,000 in the improvement of its system and that of this amount $170,000 had been spent on the Salt Lake service. The report concludes with the statement that the Utah Light & Power Company is doing everything in its power to remedy the conditions at present prevailing. R. S. Campbell, manager of the lighting company, assured the committee that a large sum would be expended during the present year in improving the system.

COLUMBIA CITY, WASH.—The Town Council has granted a franchise to the Snoqualmie Falls Power Company to install an electric light and power station in Columbia.

WHEELING, W. VA.—The County Commissioners have decided to install an electric light plant at the County Infirmary at East Richmond.

COLEMAN, ALBERTA, CAN.—The International Coal & Coke Company has let contracts for the equipment to be installed in its coke works. The Westinghouse Elec & Mfg. Company will furnish the electrical equipment, and the Phœnix Iron Works, of Meadville, Pa., the engines.

CITY OF MEXICO, MEX.—The Mexican Government has granted a concession to Filiberto Romero for the establishment of an electric power plant on the River Tancoco, at a place called Chorro Grande, in the state of Vera Cruz.

MATEHUALA, MEX.—James Kilton has obtained the contract to supply this city with electric lights and power and to establish and operate a system of water works here. He has already begun the development of extensive plans which include the construction of four electric generating stations which are to obtain their initial power from water which is to be piped from large natural springs situated on the top of a mountain, situated at a height of 1000 feet above this city and 22 miles distant. The water of these springs will be piped to the power stations and thence conveyed to this city and used to supply the mains of the water works system. Engineers have examined and made favorable reports on the project and surveys are now being made preparatory to beginning construction work. It is proposed to not only supply the city with electric lights and power, but to also furnish power for operating the numerous mines which are situated in this district. A telephone system is being established here. W. H. Smith is interested.

OTTAWA, ONT.—A conference has taken place between the Ontario government and those interested in the development of the water power on Kettle Falls, at Fort Frances, Ont., Minneapolis men have already secured the rights on the United States side, and have also a preference on the rights on the Canadian side. The Ontario government insists on the condition that one-half of the power developed, which is about 5000 horse power, shall be used exclusively on the Canadian side. The conference closed without reaching any agreement.

THE ELECTRIC RAILWAY.

COLUMBUS, IND.—The citizens of Wayne Township have voted a 2 per cent subsidy tax for the Indiana Central Interurban Railway, which will extend from Columbus to Seymour. The tax will amount to $25,000.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company has let the contract for the equipment of a new power station in this city. It is said the machinery will cost $250,000, and that the buildings and power plant complete will cost $400,000. The road is almost completed to Marion.

RICHMOND, IND.—The Wayne County Commissioners have granted a franchise to the Columbus, Greensburg & Richmond Traction Company through the county and to cross the public highways. The company has its own right of way. The franchise provides for the building of the line within two years.

EVANSVILLE, IND.—The officials of the Evansville, Boonville & Rockport Interurban Railway Company have made arrangements with the Interurban Construction Company, of Indianapolis, to finance and construct the road. The engineers of the two companies are drawing plans and specifications, and when completed, contracts will be signed. Charles E. Maley, Claude Maley, Daniel Wertz and William Threlkeld, of Evansville, are the principal members of the company.

INDIANAPOLIS, IND.—The recent order of the Board of Public Works requiring the interurban cars entering this city to stop at street crossings wherever signaled and take on and let off city passengers has aroused a storm of objection by the interurban managers. They insist that it is an imposition on the interurban passengers to be crowded by city passengers, and that it is a great waste of time. President Henry, of the Indianapolis & Cincinnati Interurban line, suggested that the Board has full power under its contract with the City Street Car Company to compel the latter to give all the service that the demands of the city traffic require. Mr. Henry thinks there should be no necessity for using interurban cars in city service. The Board, however, renewed its order and threatens to punish the companies found guilty of refusing to take on city passengers.

LEWISTON, ME.—Fire, a few days ago, destroyed the car house and 35 cars of the Lewiston, Brunswick & Bath Street Railway, involving a loss of about $50,000.

AMHERST, MASS.—The Amherst & Sunderland Street Railway Company has petitioned the Railroad Commissioners for authority to issue bonds to the amount of $117,000 for the purpose of retiring outstanding bonds to the amount of $51,500 of funding so much of the company's floating indebtedness as may have been incurred for construction and equipment, and for the purchase of additional real and personal estate.

TRAVERSE CITY, MICH.—The Traverse City & Peninsula Railway Company has been organized at Traverse City, with a capital stock of $500,000, for the purpose of building an electric railway from Traverse City to Old Mission and the intervening summer resort and fruit growing country. The officers of the company are L. K. Gibbs, president; W. P. Crotser, of Traverse City, secretary; J. O. Crotser, of Kingsley, treasurer.

SPRINGFIELD, OHIO.—The Springfield & Washington C. H. Traction Company has been granted an extension of time to Jan. 1, 1905, in which to construct its line. The promoters claim they have succeeded in financing the project, and that work will be started within a few weeks.

MANSFIELD, OHIO.—The promoters of the Mansfield & Wooster Traction Company assert that arrangements have been completed for financing the project, and that work of construction will start in the spring. The headquarters of the company are in Shreve.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company has just placed contracts with the C. & G. Cooper Company, Mt. Vernon, Ohio, for a 1200-hp cross-compound condensing engine, and with the General Electric Company for a 1500-kw alternating-current generator, together with switchboards and equipment for two sub-stations.

FINDLAY, OHIO.—The Buckeye Traction Company has been organized by local people to build an electric railway between Toledo and Columbus by way of Fostoria, Carey, Upper Sandusky and Marion. A line from Fostoria to Marion would complete through connection, as roads are already in operation from Toledo to Fostoria, and from Marion to Columbus. The capital stock of the new company will be $1,000,000.

CHARDON, OHIO.—W. C. Warner, Monroe Warner and Andrew Warner, of Chardon, are the chief promoters of the proposed Cleveland, Chardon & Meadville Railroad Company, which has been incorporated to build an electric railway from Chardon to Meadville, Pa. The road will touch a number of towns that at present are isolated. A private right of way has been secured over a greater portion of the route.

SALEM, OHIO.—The Stark Electric Railway Company, which is completing its line into Salem, is negotiating for the purchase of the property of the Salem Electric Railway Company. The city system includes a power house and about 4 miles of road commanding the most desirable entrance to the town. The Salem people, it is said, ask $100,000 for the property, which is considered too high by the prospective purchasers.

COLUMBUS, OHIO.—Samuel W. Bennett, special counsel to the State Attorney-General, has rendered the opinion that stockholders of railroads, street railroads, electric light, gas, waterworks and other so-called quasi-public corporations are not exempt from double liability on their stock for the debts of these corporations by the recent constitutional amendment. It is claimed that the amendment applies only to private corporations. A number of such corporations have recently taken out charters in Ohio, under the impression that only a single liability could be enforced in the future under the amendment.

UNIONTOWN, PA.—The building of an electric railway from Fairchance to Point Marion, a distance of 13 miles, has been decided upon by a company including O. W. Kennedy, general manager of the H. C. Frick Coke Company, of Uniontown; John W. Byers, Lee B. and Owen H. Brownfield and others. A charter will be applied for, and the company will probably be capitalized at $250,000.

ERIE, PA.—At the second annual meeting of the stockholders of the Erie, Cambridge, Union & Corry Railway Company, the following officers were elected: F. A. Gibson, of Erie, president; John Doll, of Erie, secretary; F. L. Hoskins, of Edinboro, treasurer. Arrangements were made for active construction work to commence in the early spring. All contracts have been let for material and equipment. The capital of the company is $1,000,000. Axel H. Engstrom, of Philadelphia, is consulting engineer.

HARRISBURG, PA.—Application will be made at the State Department Dec. 31 for a charter for the West Penn Railway Company, which will be a merger of the electric lighting and power plants in the coke regions and the Pittsburg, McKeesport & Connellsville Electric Railway Company. The incorporators will be William S. Kuhn, Jacob V. Van Wagener, John I. Cockburn, Jesse H. Purdy and Jerome Hill, Jr. The capital stock will be merely nominal until the merger is completed, when it will be increased to more than $5,000,000. The West Penn Railway & Lighting Company has been in control of the electric lighting and power plants in Westmoreland and Fayette Counties. The lighting companies that will be included in the merger are located at Connellsville, Dawson, Irwin, Jeannette, Manor, Greensburg, Mt. Pleasant, Tars, New Haven, Uniontown, Fairchance and Masontown. In a number of cases the old stations have been abandoned, power now being supplied to the towns from the new power house, which is located a short distance above New Haven on the Youghiogheny River. Those interested in the company include: W. S. Kuhn, who is the general manager; J. S. Kuhn, E. C. Converse, M. K. Salsbury, W. S. Graham and J. B. Van Wagener. It is probable that W. S. Kuhn will be at the head of the new company. The organization will be completed by placing the lighting and power companies in one company and the railways in another, with the West Penn Railways Company as the holding concern.

WESTERLY, R. I.—The Westerly & Hopkinton Street Railway Company has purchased the control of the Pawtucket Valley Street Railway Company and has elected the following officers: William Hoxsey, president; Frank P. Sheldon, vice-president; J. O. Sweet, secretary and treasurer. The Westerly Gas & Electric Company (common stock is $50,000; preferred, $7500) is under contract of purchase, and will be acquired in a short time. In January the several properties are to be consolidated under the laws of Rhode Island as the Westerly Railway & Lighting Company. Capitalization, $200,000 common stock, $200,000 5 per cent cumulative preferred stock and $400,000 of 5 per cent thirty-year bonds. The management expects to extend the road from Westerly to Hopkinton in the spring.

JACKSON CITY, TENN.—The Johnson City Traction Company has completed its line to New Street, and is now running cars down Watauga Avenue. It now has about 2½ miles of track, and is expecting in the near future to extend the track to the Carnegie Hotel.

NASHVILLE, TENN.—The Silver Interurban Railway Company has just been incorporated here, with a capital stock of $250,000, which will later be increased to $1,500,000. The company will build an electric railway from Nashville to Lewisburg, and will probably extend the line to Huntsville, Ala.

BROWNSVILLE, TENN.—The Shelby County Traction Company will build an electric railway in the near future from Brownsville to Dyersburg, a distance of about 32 miles. The road will be used for both freight and passengers. This company also proposes to construct lines from Memphis to Colliersville and to Bolivar, Tenn. Judge T. J. Latham, of Memphis, is among those interested.

HOUSTON, TEX.—The City Council has passed the ordinance granting a franchise to the Houston & Galveston Interurban Railway Company. The line will be 48 miles in length, the shortest rail route between Houston and Galveston.

PORT ARTHUR, TEX.—The company which has been organized here through the efforts of John W. Gates for the construction and operation of an electric railway from this place to Taylor's Bayou will soon file its charter for record in the secretary of state's office at Austin. It is stated that Mr. Gates owns a controlling interest in the company. It is reported that the Beaumont & Sour Lake Construction Company will be awarded the contract for building the new line.

GALVESTON, TEX.—The Galveston City Railway Company will expend about $60,000 during the coming year for improvements. The original budget for the coming year embraced the proposed expenditure of $227,000 for extensions and improvements, but this sum has been cut down on account of the large amount that will be incurred in street paving due to the raising the grade of the city. Major R. B. Baer, president and general manager of the company, says that the company has expended the sum of $1,068,000 in rehabilitating the system and in improvements since the great storm which swept over the city three years ago.

FOND DU LAC, WIS.—The Fond du Lac & Eastern Railway Company seeks a franchise to build a line in this city and to sell power and light, and to build a power house.

WATERTOWN, WIS.—The Oconomowoc-Watertown Heat, Light & Power Company is seeking a franchise for an electric interurban line to run from Oconomowoc to Watertown, Lake Mills, Jefferson and probably Janesville.

TORONTO, ONT.—The Toronto Railway Company expects to have its new storage-battery plant in operation in three months. This battery is being installed solely to supply power to run the additional service given between 5 and 6.30 in the evening, and in the morning, if necessary. The company has had to increase its services in the morning and evening during the past year on account of the big increase in the suburban population of the city. Many people who removed to the Beaches to spend the summer are wintering there, and an increased number of those employed in the city are residing in East Toronto, Mimico, Eglinton and Toronto Junction.

NEW INDUSTRIAL COMPANIES.

THE MUTUAL STOCK & TELEGRAPH COMPANY, Buffalo, N. Y.; capital, $100,000. Directors: D. F. Harrington, William Walker and Peter S. Wering, Buffalo.

THE INTERMITTENT CURRENT CLEANING COMPANY, New York; capital, $100,000. Directors: G. G. Power, W. H. Donnally, and Frank Hendrick, New York.

THE VEHICLE SPECIALTY COMPANY, of Jersey City, has been incorporated; capital, $50,000. Incorporators: Le Roy S. Louis, William D. Johnston and Louis G. Morton.

THE VESUVIUS BATTERY COMPANY, New York, to manufacture electric batteries; capital, $10,000. Directors: S. G. Whiton, A. S. Apgar and L. H. Bigelow, New York.

BAKER & COMPANY, Newark, N. J., to refine ores, platinum and other materials; capital, $430,000. Incorporators: Cyrus O. Baker, Charles W. Baker, Henry R. Bond, Jr., and Edward A. Colby.

THE ELECTRIC UTILITIES COMPANY, of Mineola, Nassau County, N. Y., has been incorporated with a capital of $1,000,000. The directors are Andrew R. McLaren, Alfred H. Townely, George T. Van Valkenburgh, John D. Mason and Thomas J. Snee, of New York City.

THE DEAN ELECTRIC COMPANY has been incorporated under the laws of the State of Ohio and will erect a modern factory at Elyria, Ohio. The capital stock is $300,000. Incorporators: Samuel B. Rawson, I. H. Griswold, T. M. Brush, A. E. Barker and W. W. Dean.

THE KIRKLAND ELECTRIC COMPANY, of Kirkland, Oneida County, N. Y., has been incorporated; capital, $100,000. Directors: J. F. Wood, Clinton; G. L. Wood and H. B. Sweet, Utica. The directors have organized as follows: President, Henry W. Roberts, of Clinton; vice-president, George L. Wood, of Utica; secretary, James F. Wood, of Clinton; treasurer, Herbert Allen, of Clinton. Horace P. Sweet, of Utica, has been engaged as engineer.

OBITUARY.

CAPT. EDWARD B. IVES, Signal Corps, who had been on duty in the office of the Chief Signal Officer at the War Department for some time past, died in Washington on Dec. 29 from a complication of diseases. He was born in the District of Columbia, but was appointed to the Military Academy from New York in July, 1874.

MR. R. C. VILAS.—Royal Cooper Vilas, president of the Pyle National Electric Headlight Company, died last week in Chicago, aged 61 years. Mr. Vilas was born in Ogdensburg, N. Y. He was at one time General Freight Traffic Manager of the Erie Railroad in New York, and president of the New York Air Brake Company, of New York City.

H. T. RICHARDS.—It is with deep regret that we announce the death of Herbert T. Richards, secretary of the Safety Insulated Wire & Cable Company, which occurred on Dec. 26, last. Deceased was about 42 years of age, and was well known in electrical circles. His death was due to a surgical operation involving the kidneys, from the shock of which he did not rally.

PERSONAL.

MR. JOHN MATHER, of Wayne, Pa., has become general manager of the Merion & Radnor, Pa., Gas & Electric Company, as successor to Mr. W. E. Barrett.

MR. JOSEPH V. KUNZE, manager of the New York offices, 143 Liberty Street, of the Pelton Water Wheel Company, has returned from a trip to Mexico.

MR. MORRIS MEAD, well known for many years past as the city electrician of Pittsburgh, Pa., has retired and will hereafter enjoy his *otium cum dig.* with a pension.

MR. R. H. MANSON has been placed for the time being in charge of the sales department of the Kellogg Switchboard & Supply Company in place of Mr. A. E. Barker, resigned.

MR. ERICH BROCKHAUS, chief engineer of the Siemens-Halske Company, of Berlin, is on a visit to this country, like so many other prominent officers of the company before him.

MR. E. A. CHAPEL, formerly of the electrical department of the Chelsea, Mass., Gas Light Company, has been appointed superintendent of the Nantucket, Mass., Gas & Electric Company.

MR. THOMAS HANKEN has become president of the United Gas & Electric Company, of Dover, N. H., in place of Mr. H. L. Shepard. Mr. G. W. Welch has been elected treasurer.

MR. W. F. HOWE.—The ELECTRICAL WORLD & ENGINEER has a communication from this gentleman, but before using it would like to be furnished by him with some data of identification.

MR. C. E. REYNOLDS, superintendent of the mechanical department of the Rochester Gas & Electric Company, has resigned after 18 years' service to go to Boston. His associates gave him a diamond pin on leaving, as a mark of appreciation.

MR. JOHN F. SKIRROW, an able young man and one of the contributors to this journal, has been promoted to the position of assistant electrical engineer of the Postal Telegraph Cable Company. He was born in England in 1869 and has been with the Postal since 1890.

MR. ARTHUR J. HERSCHMANN, M. E., who has been associated with the Adams Express Company for five years past in New York City, has taken an office at 45 Broadway, and will make a specialty of heating, lighting and ventilating plants, their installation and supervision.

PROF GUIDO GRASSI, of the Turin, Italy, Museo Industrialo, will make a visit to this country next fall to be in attendance at the International Electrical Congress at St. Louis. Prof. Grassi conducts at the Turin Museo the course in electrical science developed by the late Professor Ferraris.

MR. EDWARD W. PARKER has issued for the U. S. Geological Survey a report on the production of gas, coke, tar and ammonia at gas works in 1902, in this country. The figures of 533 companies making gas from coal in 44 states and territories are included in this valuable document.

MR. P. G. GOSSLER, electrical engineer, etc., of the Montreal Light, Heat & Power Company, has resigned his important and responsible position there in order to become associated with the well-known engineering firm of J. G. White & Company, to which he will prove a valuable acquisition.

MR. W. G. ROSS, of Montreal, has resigned as second vice-president of the Montreal Light, Heat & Power Company, and has become managing director of the Montreal Street Railway. Mr. Rodolphe Forget, who resigned from the first vice-presidency of the power company to make way for Mr. McLea Walbank, was appointed to succeed Mr. Ross.

MR. J. T. OAKLEY, a well known leader in Democratic politics, has been appointed under the Tammany regime as Commissioner of the Department of Gas, Water and Electricity of Greater New York, succeeding Col. R. Munroe, who is also a member of the Democratic party, but conducted his department on very independent lines under Mayor Low.

MR. WILLIAM MACKENZIE, of Toronto, Can., who is president of the Saô Paulo Tramway, Light & Power Company, Limited, is now on a visit to New York. The company operates an extensive system in Saô Paulo, Brazil, which is about to be considerably extended. Mr. Mackenzie is at the Waldorf-Astoria and at the Saô Paulo offices, 29 Broadway.

M. CURIE has declined the red ribbon of the Legion of Honor and gives his reasons. "I don't like decorations," he says. "The institution is bad. Many people whom I esteem have them, but I don't want any. I am of the opinion that the hope of receiving decorations is not necessary as an incitement to acts of devotion or courage, as is commonly supposed."

MR. GEORGE W. EDGE, recently with Stanley & Patterson, has taken a position with the Trumbull Electric Mfg. Company, of Plainville, Conn., and will represent it through the middle west and eastern states. Mr. Edge will call on his old friends in his new capacity. Mr. Frank Trumbull has also accepted a position with the Trumbull Company and will travel in the states west of the Mississippi River and in the southern states.

MR. JOSPER F. KELLER, now manager of the New England Telephone & Telegraph Company will become second vice-president of that company this year. Francis A. Houston, now general counsel, will succeed Mr. Keller as general manager. Matt. B. Jones, of Powers, Hall & Jones, will succeed Mr. Houston as general counsel. Mr. Jones will hereafter give his whole attention to the New England Telephone & Telegraph Company.

MR. P. N. NUNN, chief engineer of the Telluride Company, Colorado, is referred to in the following dispatch from Salt Lake City of January 1: Announcement was made to-day that a new and unique school of electrical engineering would be founded during the current year by Mr. Nunn, of Telluride, Col. It is the intention of the founder to give a full course in mechanical and electrical engineering at Provo Canon, Utah, keeping the students actually employed and under pay during the period of their course.

PROF. S. P. THOMPSON, F. R. S., has just issued, in admirable pamphlet form, his admirable "note" on Gilbert, prepared for the three hundredth anniversary of the death of Dr. Gilbert, December 10, in connection with which event the British Institution of Electrical Engineers has just presented to the corporation of Colchester, where he was born and where he is buried, an interesting picture of Mr. A. Acland Hunt. The painting measures 6 by 4 feet and represents Gilbert expounding his magnetic discoveries and ideas to Queen Elizabeth.

MR. W. S. MONTGOMERY, who has for the past five years been connected with the Conover Condenser Manufacturing Company, of Jersey City, as secretary and sales manager, has severed his connection with that company to assume the management of the Payne Engineering Company of New York City, selling agent of the Payne Company, of Elmira, N. Y., builder of simple and compound automatic engines. On the same date, the Payne Engineering Company will remove to new offices in the Havemeyer Building, No. 26 Cortlandt St., New York.

MR. J. H. ROBINSON, of the U. S. Military Telegraph Corps, who made application as such for membership in the Society of the Army of the Cumberland has been advised by Gen. H. V. Boynton, president of the organization that the executive committee of that body is unanimously in favor of recognizing the claims of members of the Corps who served with the army, to be admitted to membership in the society. Every one must feel that this decision is right, and that the gallant telegraphers who went under fire just as freely as the rank and file are entitled justly to all the honors that can come to them.

MR. CHARLES JOHNS, JR.—A St. Thomas, Ont., newspaper says: "The first year's working of the Street Railway as a municipal service has resulted in a practical balancing of accounts which, in view of the fact that the system has been transformed into an up-to-date one, is considerably satisfactory. The total number of passengers carried was 359,190 and the total received for fares was $13,934.52, showing the average fare to have been 3.977 cents. The actual receipts were $14,603.35, only $136.43 less than the expenditure." It is interesting to learn that a student of the International Correspondence Schools, Scranton, Pa., Mr. Charles Johns, Jr., is manager of the St. Thomas Street Railway. He enrolled with the I. C. S. in June, 1899, at the age of 23, while employed as a machinist.

LEGAL.

MUNICIPAL PLANTS IN NORTH CAROLINA.—The Supreme Court of North Carolina has just handed down an opinion of importance to the effect that for a city to buy or establish a plant for light or water is a necessary expense and therefore does not require a vote of the people.

DUTY ON SUBMARINE CABLE.—Judge Henderson M. Somerville, of the Board of United States General Appraisers, administered a criticism to the Commercial Pacific Cable Company in overruling its claim for free entry for the cable from Hawaii to the United States, which was brought to Honolulu from England. The claim was made on the ground that the laying of the cable was a work of great public benefit. Such a claim, Judge Somerville said, might with propriety be made to Congress, but not to a judicial tribunal, which has no duty but to interpret the law as it finds it.

WATER POWER EMINENT DOMAIN.—A corporation authorized to develop and use the water power of a river and generate electric or other power, light, or heat, and utilize, transmit and distribute it for its own use or the use of other individuals or corporations, is held, in the case of Fallsburg Power & Manufacturing Company vs. Alexander, (61 Lawyers' Reports Annotated 129.) to be for a private use and not a public purpose, and therefore not entitled to exercise the right of eminent domain. Under statutory authority to exercise the right of eminent domain to secure land for a park, it is held, in the case of Laird vs. Pittsburg, (61 Lawyers' Reports Annotated 332,) that land needed for an addition to a free library building located in a public park may be taken.

GUTMANN RECORDING WATTMETER.—The order restraining the Electric Appliance Company, of Chicago, from selling or manufacturing the Gutmann recording wattmeter, which was granted on exparte application of the Westinghouse Electric & Mfg. Company, was continued on Dec. 29 by Judge Kohlsaat, of the United States Circuit Court, after a hearing. The action is based upon a suit brought in Philadelphia, in which the Sangamo Electric Company, of Springfield, Ill., the manufacturer of the Gutmann meter, intervened and became the defendants. In that action it was decided that the Gutmann meter was an infringement of the Tesla patents on the rotating magnetic field of the split phase type which belong to the Westinghouse Company. After an injunction was issued, it was discovered that the Sangamo Company was making a meter in which a slotted disc was substituted for the slotted cylinder before used. The Sangamo Company asked to have the injunction suspended as to this form, but this was refused. An application was made to have the Sangamo Company declared in contempt, but it was shown that at that time its factory was closed and no meters were being made. The contempt proceedings have not been decided. Later it was found that a large number of the disc meters had been sent to the Electric Appliance Company, of Chicago, which was selling them in the due course of business. The restraining order which has now been continued was then applied for.

EVANSVILLE WINS SUIT AGAINST THE CUMBERLAND.—Judge Anderson, of the United States Court, has dissolved the restraining order in the injunction suit brought by the Cumberland Telephone Company against the City of Evansville, Ind., to prevent the removal of its poles and wires from the streets. The court held that the city has a right to order the removal of poles, wires and other property of the company from the streets, and that the Cumberland has no right to operate in the city. It was shown that the Evansville Telephone Exchange was granted a franchise by the city in December, 1882. In July of the following year its business and property were purchased by the Cumberland Company and the latter company has carried on the business since that time. The telephone company alleged and declared that the right to the streets and alleys of the city, granted by the council in 1882 to the Evansville Telephone Exchange became the property of the Cumberland, together with all other property when the transfer was made. The answer of the city of Evansville was that it was outside the powers granted the original company to sell the property and business unless the franchise and ordinance under which it is operating specifically provides for such a sale and transfer. The court adopted this view and held that the Cumberland Company had no rights by the assignment of the Evansville Telephone Exchange and no rights under the ordinance of 1882 which it can ask the court to protect. The injunction was therefore dismissed for want of equity.

EXTRAORDINARY WASTE OF GAS.—The Kentucky Court of Appeals has reversed the judgment of the Meade Circuit Court in the case of the Calor Oil & Gas Company against W. C. McGehee, and affirmed it in the case of the Louisville Gas Company against the Kentucky Heating Company. The cases grew out of the efforts of the Louisville Gas Company to destroy the Meade County natural gas fields, from which the Kentucky Heating Company has for years been securing the gas which it furnishes to customers of Louisville. The Louisville Gas Company officers organized the Calor Oil & Gas Company, the stockholders being A. Hite Barrett, Rudolph Sneed and J. W. Speed. This company took over a number of leases of land made in the county. In this territory they erected what they called a lampblack factory. This factory was constructed with a stockade about it, inside of which no one was allowed to enter, and firearms were discharged to keep the neighbors away. When they began operations the Kentucky Heating Company had a gas pressure of sixty pounds, and in five months this was reduced to thirty pounds. The force of the lamp-black factory was two men, one for day and another for night. In five months the factory produced 300 pounds of lampblack, worth 4 cents a pound, and had consumed about 90,000,000 feet of the natural gas. The lampblack was never shipped away from the factory. On these facts the chancellor enjoined the operation of the lampblack factory, as violating the statutory laws against the wasting of natural gas. The retail price of natural gas for fuel in Louisville is 65 cents per thousand feet, making the value of the gas alleged to have been consumed in making $12 worth of lampblack $63,500.

Trade Notes.

PASS & SEYMOUR, Solvay, N. Y., have just placed on the market a new moulding receptacle. They are made in two styles to use with or without a shade holder. A postal card will bring samples and prices.

PITTSBURGH TRANSFORMER COMPANY, of Pittsburgh, Pa., issued a pretty Christmas folder with cuts of its large transformers and transformer tanks, giving an excellent idea of their solid and substantial construction.

"REASON WHY" is the title of a little folder, illustrated, sent out by the Pass & Seymour Company, Solvay, N. Y., giving reasons why its brass shell lamp sockets are held to be the best. The points are clearly and tersely made.

ROYAL ELECTRIC COMPANY, Peoria, Ill., has issued a neat calendar for 1904 showing one of its 100-kw 60 cycle Royal alternators of the inductor type, with exciter. A little information is given as to the features of the machine.

THE ORGAN POWER COMPANY, Hartford, Conn., has been developing some new devices for organ blowing with an alternating current motor and has issued a little brochure as to its Spencer organ blowing apparatus in general, water and electric.

JOSEPH T. RYERSON & SON, Milwaukee Avenue, Chicago, have just issued the sixth edition of Ryerson's Technical Library No. 4, describing the Continental boiler with Morison corrugated furnaces, and giving useful data and information regarding boiler design and construction.

"THE WHITE BULLETIN," copies of which have reached us, is a house journal issued by the White Sewing Machine Company, Cleveland, Ohio, in regard to its White steam automobiles which have made such a creditable record in the art. The little paper is quite up to the standard of the autos. and makes good reading.

YALE & TOWNE MFG. COMPANY has issued a neat little folder in regard to its chain blocks, this being the most recent printed matter given out by it in regard to the subject. It is called "Three Labor Savers" and deals with its triplex, duplex and differential blocks. Data are furnished as to each of these devices so economical of effort and expense. Copies can be obtained at 9-11-13 Murray Street, New York City.

KELLOGG.—The Kellogg Switchboard & Supply Company, of Chicago, has sent out a handsome new bulletin descriptive of its magneto or generator call telephones. This bulletin is the first of a series which will cover the entire product of the company in the telephone field. The arrangement of the matter and the descriptions and circuits have been carried out so as to constitute a popular text book for the small customer.

INCANDESCENT LAMP WALL CIRCULAR.—The General Electric Company has just issued from its lamp works at Harrison, N. J., a broad-sheet circular on heavy paper, devoted to its Edison lamps, on which is shown, full size, some 37 varieties with the data relative to each. This is a most striking and interesting circular and for the man who has the wall space a very nice thing to post up where it can be looked at every day with admiring eyes. It is very interesting to have thus brought to notice at one glance all the various makes and styles for different purposes, the lamps ranging from the largest to the smallest.

ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has, as already announced in these columns, taken up the manufacture in this country of the Nurnberg gas engine. It is a four-cycle double-acting machine, for all power purposes, and is built in units of from 130 to 6000-hp. It operates with natural, producer, coke oven, blast furnace or illuminating gas. It has been brought to a state of perfection in which it will answer with absolute reliability the most exacting demands of power generation, and in the hands of such a standard concern will doubtless find a very large application in this country.

ELECTRIC APPLIANCE FUSES.—The latest thing in fuses is illustrated and described on page 241 in Electric Appliance Company's catalogue No. 20. The cartridge fuse is made in any capacity from 3 amperes to 30 amperes, and is listed in 125 and 250 volts. The company is now prepared to fill orders in the same capacity for 500 volt fuses. This McBride enclosed fuse is a regular cartridge with the fuse enclosed, and from each end of the cartridge is a soft copper wire which adapts the fuse for any style fuse connection on any cut-out, switch, panel-board, switchboard; or, in other words, it can be used wherever a fuse is desired, with absolute assurance that it will blow without an arc. They require no special cut-out, but fit the old style Sawyer-Mann cut-outs, Edison blocks and any switch connection.

MOISTURE FOR CIGARS.—In the manufacture of cigars the condition of the atmosphere within the building is of vital importance. The air must be kept moist and at a constant warm temperature both in the winter and summer season. For maintaining an even, moist and warm temperature the fan system is peculiarly adaptable, because the quantity and quality of the air is under absolute control and may be varied at will. Fresh air is drawn from outside the building by means of a fan, is circulated through a moistening chamber and, in the winter season, between coils of steam pipes enclosed in a fire-proof steel plate jacket, and delivered under pressure to the work rooms, through distributing ducts. The speed of the fan regulates the quantity of the air, the amount of steam varies its temperature and it is evident that the amount of water sprayed through the moistening chamber varies its moisture. The fan is driven by a direct connected engine whose exhaust steam may be used in the heating pipes, or in the summer time when heating is unnecessary it may be by-passed and utilized for other purposes. It is readily seen that with this system the expense of operating is very low as no heat is wasted. The three factories of the American Cigar Company at Tampa, Fla., are provided with the fan system for heating, ventilating and moistening, and the results reflect credit upon the B. F. Sturtevant Company, of Boston, Mass., whose apparatus and system were used.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 29. 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

747,949. SIGNALING SYSTEM; William H. Dammond, Detroit, Mich. App. filed Nov. 5, 1902. Details.

747,967. TRAIN CONTROLLING AND SIGNALING SYSTEM; Fred P. Green, East Aurora, N. Y. App. filed Feb. 11, 1903. Mechanism by which the air brakes of a train can be operated from the train despatchers office, in case the train runs into a obstructed block.

747,968. ELECTRIC METER; Ludwig Gutmann, Peoria, Ill. App. filed Jan. 6, 1902. Improvements in the construction of a motor-meter in which the motor element has an armature consisting of a disk rotating in a conducting fluid through which current is conveyed to and from the armature, combined with a proper energizing field magnet.

748,053. BAR FOR COLLECTING ELECTRICITY FOR SECTIONAL CIRCUITS; Henry Dolter, Paris, France. App. filed Feb. 19, 1902. A contact shoe, parts of which are magnetic while other parts are non-magnetic, the collector being adapted to engage with studs in the roadbed and by the attraction of its magnetic parts close a circuit through the stud while by the non-attraction of other parrts, the circuit is opened before the contact is actually broken.

748,086. ELECTRIC FIRING GEAR FOR BREACH LOADING GUNS; John F. Meigs, Sigard A. S. Hammar and Leighton N. D. Mixsell, Bethlehem, Pa. App. filed Aug. 27, 1902. An apparatus whereby the contacts for firing the charge can be closed only when the other elements of the device are in proper position.

748,098. SYSTEM FOR CONTROLLING FLUID PRESSURE; Edward D. Priest, Schenectady, N. Y. App. filed May 21, 1903. The air pump on a train is cut out by the controller while the train is stationary, thus avoiding the annoyance to passengers of the operation of a pump, while the train is standing.

748,121. ELECTRIC ARC LAMP; Knut Tornberg, Medford, Mass. App. filed Nov. 1, 1902. The carbons arranged at right angles to each other are fed between two sets of grooved rollers which are driven by gearing.

748,123. ELECTRIC SWITCH; Isaac G. Waterman, Santa Barbara, Cal. App. filed Feb. 27, 1902. Details.

748,144. REGULATING DEVICE FOR ELECTRIC CIRCUITS; Malcolm H. Baker, East Liberty, Pa. App. filed June 26, 1902. A regulating reactance device having a regulating coil capable of relative inductive movement with respect to a magnetic core and an auxiliary coil, the two coils being arranged in series and being electrically opposed to each other.

748,145. METHOD OF REGULATING ELECTRIC CIRCUITS; Malcolm H. Baker, East Liberty, Pa. App. filed June 26, 1902. The method involved in the preceding apparatus patent.

748,146. CONSTANT POWER FACTOR REGULATING FOR ELECTRIC CIRCUITS; Malcolm H. Baker, East Liberty, Pa. App. filed June 28, 1902. A modification of the two preceding inventions.

748,147. METHOD OF REGULATING ELECTRIC CIRCUITS; Malcolm H. Baker, East Liberty, Pa. App. filed June 28, 1902. Same.

748,148. CUT-OUT FOR ARC LAMPS; Malcolm H. Baker, Pittsburg, Pa. App. filed Oct. 30, 1902. The points of a cut-out are held apart by a pin which rests upon a fusible material, the latter being melted when the carbon has burned away.

748,149. REGULATING DEVICE FOR ELECTRIC CIRCUITS; Malcolm H. Baker, New York, N. Y. App. filed Dec. 8, 1902. The circuit is controlled electrically by means of two coils, one of which is movable with relation to the other, both windings standing in inductive relation to a suitable core and one being connected with a special core forming a magnetic continuation of the first named core.

748,182. MAGNETIC POWER MECHANISM; Frederick Hachmann, St. Paul, Minn. App. filed May 8, 1903. Motion is obtained in a power apparatus by utilizing the difference in the forces required to move an armature laterally out of a field of force and axially or in a parallel direction therefrom.

748,185. ELECTRIC ARC LAMP FOR MULTIPLE OR PARALLEL CIRCUITS; Robert H. Henderson, Newark, N. J. App. filed March 30, 1903. A reactance device in series with the electrodes, having a floating core operating against a counterweight to keep the electrodes together when the lamp is not burning and to bring them together when the terminal arc voltage becomes too high in the normal operation of the lamp.

748,240. BEARING THERMOSTAT; George A. Wall, Providence, R. I. App. filed Oct. 28, 1902. The casing is attached to a shaft bearing and contains a circuit closer held open under tension by fusible material.

748,268. MAGNETIC CONTACT BOX FOR ELECTRIC TRAMWAYS; Alfredo Diatto, Turin, Italy. App. filed April 8, 1902. When the contact in the box is moved, a magnetic field is established and Foucault currents opposing the movements of the field are at the same time created with an object of preventing the formation of an arc between the various parts of the apparatus.

748,306. RECEIVER; Frank E. Peters, Fort Washington, Md. App. filed May 2, 1903. The particles of a coherer are constantly rotated between the poles of a magnet which at the same time serve as the terminals of the aerial circuit.

748,309. ELECTRIC HEATING PAD; William Richards, Los Angeles, Cal. App. filed July 2, 1902. A resistance wire interwoven with the threads of a blanket and connected with plugs for attachment to a circuit.

748,322. TROLLEY DEVICE; Ralph P. Tisch and Robert Kissinger, Hebron, Ohio. App. filed May 23, 1903. The wheel turns on cone bearings having threaded shanks by which they can be set up to compensate for the wear.

748,323. THERMOSTAT; Geo. A. Wall, Providence, R. I. App. filed Oct. 28, 1902. Details.

748,337. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; Charles Blakeley, Covington, Ky. App. filed June 18, 1903. Details.

748,338. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; Charles Blakeley, Covington, Ky. App. filed June 18, 1903. Details.

748,354. AUTOMATIC CONTROLLER FOR ELECTRIC PUMPS OR THE LIKE; Charles H. Durning, Swissvale, Pa. App. filed Jan. 26, 1903. The motor switch is controlled by a differentially wound magnet.

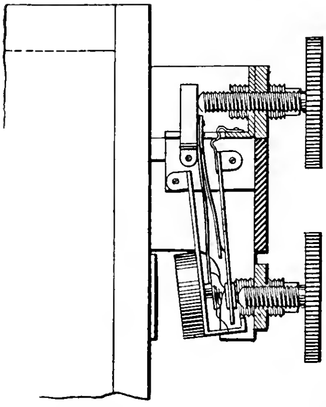
748,360. IGNITING DEVICE; William Gardner, Brooklyn, N. Y. App. filed Sept. 27, 1902. A box containing a battery, an induction coil and a metallic torch conveniently put up for cigar lighting purposes.

748,397. CIRCUIT CHANGING APPARATUS; William Meyer, Chicago, Ill. App. filed Oct. 10, 1901. Improvements in a telephone key-switch.

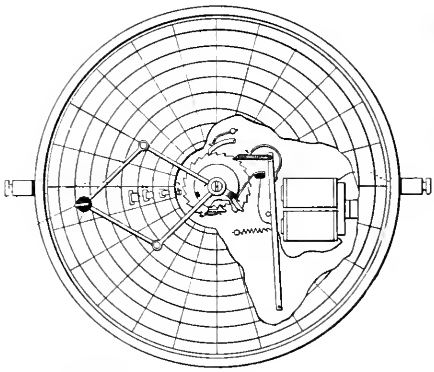
748,408. ELEVATOR SIGNALING APPARATUS; John McLean, New York, N. Y. App. filed Nov. 16, 1901. The indicators in the car are restored automatically as the car passes the landing to which they correspond.

748,409. ELEVATOR SIGNALING APPARATUS; John McLean, New York, N. Y. App. filed Dec. 8, 1902. The elevator attendant can send a return signal to the floor from which a call signal is sent, to indicate to an intending passenger which car will first arrive at the floor traveling in the direction in which the passenger intends to travel.

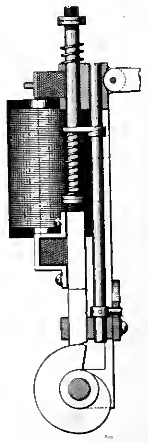
748,422. TROLLEY; Walter J. Rowley, Allegheny, Pa. App. filed May 7, 1903. Opening and closing levers to entrap the wire within the groove of the wheel.



748,442.—Vibrator for Induction Coils.



748,502.—Electric Signaling Apparatus.



748,534.—Electric Generator for Intermittent Currents.

748,441. TROLLEY; Thomas F. Varley, Lowellville, Ohio. App. filed Aug. 14, 1903. Pivoted guards to retain the wire are counterweighted to yield when they strike an obstruction.

748,442. VIBRATOR FOR INDUCTION COILS; Richard Varley, Providence, R. I. App. filed Nov. 6, 1903. In this vibrator the armature is put under motion by the attraction of the coil and then strikes a hammer blow against a circuit controlling lever to give a quick break of the circuit; on the return stroke of the armature, the circuit closing lever is pressed into intimate contact with the end of the contact screw.

748,445. INCANDESCENT LAMP SOCKET; Charles Wagner, Brooklyn, N. Y. App. filed May 2, 1902. A porcelain block having a lamp socket in one end and a axial metallic plug into which side openings lead for the attachment of wires to avoid external metallic parts.

748,450. BLOCK SIGNAL SYSTEM; Elmer E. Wolf and James B. Williams, Springfield, Ohio. App. filed June 20, 1902. Details.

748,451. RAILWAY CROSSING SIGNAL; Elmer E. Wolf and James B. Williams, Springfield, Ohio. App. filed June 20, 1902. In case a train reverses its direction just before it passes the crossing, the signal is rendered inoperative automatically.

748,488. CONTROLLING SYSTEM FOR CONVEYERS; Arthur C. Eastwood, Cleveland, Ohio. App. filed Oct. 16, 1903. Automatic devices for controlling the movements of cars that convey material to the top of blast furnaces.

748,501. ELECTRIC SIGNALING APPARATUS; Felix B. Herzog and Schuyler S. Wheeler, New York, N. Y. App. filed Jan. 25, 1886. The index of a transmitter is constructed to move either radially or in a circle over the face of a circular dial and the receiving index partakes of the same movements.

748,502. ELECTRIC SIGNALING APPARATUS; Felix B. Herzog and Schuyler S. Wheeler, New York, N. Y. App. filed Jan. 25, 1886. A modification of the preceding invention.

748,534. ELECTRIC GENERATOR FOR INTERMITTENT CURRENTS; Malcolm P. Ryder, White Plains, N. Y. App. filed March 11, 1903. An armature is lifted into a field by the slow movement of a cam and is suddenly released to impart a quick motion which generates sufficient current to supply a spark.

748,557. ELECTRICALLY CONTROLLED RAILWAY SWITCH; Frederick T. Kitt, Denver, Colo. App. filed March 4, 1903. Details.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JANUARY 16, 1904. No. 3.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
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NEW YORK, SATURDAY, JANUARY 16, 1904.

CONTENTS.

THE MODERN PRINTING OFFICE.

We imagine that a great many of our readers will have followed with interest the description that has run through three issues of this journal and now closes, on the electrical equipment of the Government Printing Office at Washington, D. C. The plant is not only striking on account of its size, but because of the extraordinary degree to which electric motors are utilized in driving the apparatus, no fewer than 600 power motors, many of large size, being in operation under that one roof. Another remarkable feature is the degree to which electric heating is used, many of its applications being highly original and directly illustrative of the economy and efficiency of electric heating under various special conditions. A third notable feature is the exclusive use of incandescent lighting. The spaces are so large we could well imagine excellent opportunities for the employment of arc lamps, but incandescents have apparently been found equal to every emergency.

THE DOWN-TRODDEN EMPLOYER.

The attention of the legal gentlemen who wrestle with tort cases is respectfully drawn to the extraordinary case just decided in England, in which the employer was held responsible for the death of a workman from lightning. We have long remembered with joy the suit for two dollars brought against a western railroad, said sum being the value of one rooster scared to death by a train, but the present litigation establishes a new record. The victim of this new outrage on the part of capital was working on a scaffold some twenty feet from the ground when a thunder shower came up, and the lightning leaped upon him and slew him, incidentally bagging a man on the ground floor of the same building. After hearing expert testimony and much argument from counsel, the learned judge decided that the accident arose out of the victim's employment in an elevated position, and gave judgment for the plaintiff in the sum of £300 and costs. Under these painful circumstances, what balm in Gilead is left for the well-intentioned contractor? Must he furnish a sort of portable cyclone cellar, into which the working force can be bolted by the foreman at the approach of Jove's batteries, or will it be sufficient to protect the neighborhood by temporary lightning rods? Would the liability insurance companies include this new risk gratis in their policies, and if not, what would they charge for the added protection? We have seen some queer cases decided in this country, but for sheer audacity this one must be placed upon a pinnacle of glory quite its own, and well guarded by lightning rods. Even the annals of claims against street railways could not furnish anything so spectacular. Employers in this country sometimes grumble at their hard lot, and feel that the workman holds the big end of the whip; but they should join in a pæan of thanksgiving that they live in a free and enlightened country, where they have nothing worse than walking delegates to contend with, and where horse sense is a common virtue of the judiciary.

THE WEATHER OF 1912.

The war of 1812 and the weather of 1912 have not a very close relationship, on the surface, to the copious showers of last summer and the mild days of November, but knowing enough we should find it all of a piece. Tennyson once remarked rhythmically that if he could comprehend the meaning of a flower snatched from the crannied wall, then had he mastered the philosophy of the universe. Thus, too, could we interpret the magnetic disturbances and auroral storms of recent date, there might readily be predicted, with accuracy, revolt and distress in Russia, war in Manchuria, good crops in Kansas, failure of hops in England, easy money in Wall Street, and a renewal of dividends on Steel common.

Abbe Moreux, director of the Bourges Observatory in France, is authority for the statement that we shall probably have rainy weather up to 1912, basing his forecast on the recent magnetic derangements that paralyzed the telegraph, caused the telephone to be tongue-tied, and even held up the trolley cars along Lake Leman. Such damp vaticinations must lighten the labors of other meteorologists, and determine the course of events. Maximum sun spots to whose outbreaks the terrestrial globe responds perforce, in these magnetic storms, are scheduled every 33 or 35 years, and as the next maximum is due in 1904-5, earthquakes, mine explosions, wet weather and consequent social and political results, of cosmic sweep, unfailingly impend, in the near future. Off-hand, this extra evaporation of the ocean is a good thing for the United States, whose inland central regions everlastingly cry aloud for more moisture; but the outlook in the British Isles, which had over a yard deep of rain last year, is less cheerful. Something more than a Chamberlain programme is needed to mitigate the conditions there. Moreux may be wrong, but the unvarying precision of Weather Bureau meteorological diagnoses argues strongly in his favor, and points to a large output of rubber coats and umbrellas during the next decade.

The Theory of Wireless Telegraphy.

In our last number we gave an abstract of a paper recently read by Prof. Blondel on the theory of wireless telegraphy for the advancement of science before the French Association. The theory which Prof. Blondel enunciates, in a most interesting manner, is entirely in accordance with that which we have consistently upheld in these columns, as will be found by reference to the issues for August, 1902, and other dates. That is to say, wireless telegraph waves are essentially semi-Hertzian waves attached to the conducting surface of the earth or sea. All that is known concerning the action and development of free Hertzian waves is immediately applicable to wireless waves, after allowing for the curvature of the conducting earth. In general, therefore, after passing to some distance from the sending antenna, the waves become virtually hemispherical, until their radius of emission reaches a length of fifty miles or so. After this radius has been reached, the hemisphere must reach the conducting strata of rarefied atmosphere, or strata of atmosphere having a degree of rarefaction that produces in vacuum tubes an electrical conductivity equal to, or even greater than, that of sea water. This would have the effect of checking further vertical expansion. Beyond this distance the wave would expand in two dimensions instead of three; or in a layer of non-conducting air, say fifty miles in thickness, with absorption in the conducting liquid ocean beneath, and also in the attenuated gaseous ocean above.

If the sea or land had perfect conductivity the waves would advance without absorption or penetration, the electric currents at the feet of the waves being confined to a mere infinitesimal skin upon the surface; just as very high-frequency alternating currents are confined to a thin skin of the copper conductors over which they travel. With imperfect conductivity, however, the waves sink more or less deeply below the surface of land or sea, as they advance, suffering absorption thereby, and producing real accompanying currents of the alternating type in the upper layers of land or water. There would be one alternation of current in the ground for each half wave through the air above. In the salt water of the ocean the current should penetrate less deeply than in the ordinary surface soil of the land. Fessenden has stated that this is a fact observed experimentally. Over deeply frozen ground of very feeble electric conductivity, there should be much reduced range of effective wireless telegraph transmission, unless good ground connection can be established at both the sending and receiving antennæ. The paper of Prof. Blondel gives the most complete and satisfactory mathematical development of the theory of wireless telegraphy that has yet come to our notice.

The Engineer and Academic Distinctions.

The engineering profession is by no means a bed of roses under the most favorable circumstances, but there seems in this country a singular lack of generosity toward the engineer on the part of those who would naturally be expected to appreciate his work. Members of the profession often grumble about the material recognition of their efforts, but this they do in common with most other professional men. In this land of freedom where every man holds himself to be a little better than his neighbor, it is perhaps natural that tangible assets should be the final criterion of true greatness, but there is still a more thoughtful side to American life and those there are who could and should recognize professional triumphs in all of the learned professions alike. We have been glancing over recently a list of the academic distinctions conferred this year by distinguished institutions of learning, and it is curious to note how completely the engineering professions were left out of the reckoning. Empty honors, one may perhaps say, but the recognition of scholars is certainly no less valuable than the appreciation of the ignorant, and in the long run other honors sometimes prove to be empty. And here academic honors are almost the only ones available for the acknowledgement of professional fame. Under the rule of effete monarchies where the Order of the Blue Buzzard and the Grand Cordon of the Green Turtle are considered distinctions to be coveted, and worthy emblems of national fame, their spectacular value, we admit, deserves acclamation. Besides, at a public function under the said effete monarchies, one finds some parti-colored breast plate necessary to avert the danger of being taken for a waiter. Here, where the advocate of true democracy should not mind being taken for a waiter, less flambuoyant honors serve the purpose.

But while the orders to which we have referred are often conferred abroad upon distinguished professional men, among them no small number of engineers, our American Universities are as chary of giving out honors to engineers as if each one carried a pension for life. One of the elements that makes against the growth of American science, pure and applied, is this very lack of everything like public distinction. One would think that the universities would be quick to appreciate the distinction of their sons in the engineering professions. Alas, the alma mater generally turns the other way or administers a glary stare and the cut direct. A returned missionary to Nova Zembla, a briefless attorney who by close study of ward politics has achieved notoriety, or a patron from whom a bequest may ere long be hoped—these receive the glad-hand degree. Of course, it may be held by finical apologists that one of the difficulties in the way of honoring the distinguished follower of applied science is the lack of a suitable degree to fit the case. For instance, we know few engineers of large experience who have not oftener given than received the degree of D.D., fewer still to whom an S.T.D. would be aught but a burden hard to live up to. A.M. has had no standing for many years by reason of its being given by some institutions to any graduate who has for three years kept out of jail and retained $5 to pay for the diploma. Ph.D. and D.Sc. are now held mainly as working degrees and seldom given *causa honoris*, although specially appropriate for scientific distinction. LL.D. and D.C.L. are used as honorary degrees and for purposes quite outside their original meaning. They are certainly as appropriate for distinguished engineers as for physicians, authors and politicians, and should not be begrudged when deserved. The pilots of industry certainly deserve far more recognition than has yet been accorded them in this country. Abroad they rank with the captain; here they are little more honored than the cook. But although a conference of the five most noted engineers in the country on a problem of international importance would not receive from the daily press a notice given to a fashionable divorce suit, the profession certainly deserves from its academic brethren more of fellowship and appreciation than it at present receives. Perhaps a few years may see a change for the better, for the time has come when, if ever, the forces of education and progress must work shoulder to shoulder for the common weal.

ELECTROSTRICTION.

Prof. More's article on electrostrition, which appears on page 127, opens up a very interesting question. According to the existing theory of electromagnetism due to the labors of Faraday, Maxwell and a host of others, any medium which is electrified stores electric energy to the extent of $K R^2/8\pi$ ergs per cubic centimeter, where K is the dielectric constant, and R the electric intensity, in abstatvolts per centimeter. Accompanying this storage of electric energy in space is a tension, or pull, along the direction of the electric flux, and a pressure, or shove in all directions at right angles to the flux. Similar conditions apply to magnetized space. The behavior of electrified bodies is apparently in complete conformity with the above propositions. In fact, the dictum that unlike charges attract, and like charges repel, may be regarded as a condensed statement of the proposition that a pull exists along electric flux paths, while a shove exists perpendicularly thereto.

The observable strength of the pull on an electrified pithball in an electric field, and the strength of the pull on a soft iron armature by an electromagnet, are consistent with the electric and magnetic tension and pressure equations. Moreover, when an electromagnetic wave is propagated in free space, the pressures and tensions in the plane of the wave form balance and disappear, according to theory, the shove of the magnetic flux just balancing the pull of the electric force, and vice versa. But in the direction normal to the wave front—that is, in the direction of advance of the wave—the electric shove and the magnetic shove coincide and aid each other instead of opposing and cancelling each other. Consequently, as was pointed out by Maxwell, the pressure, in dynes per square centimeter, in the direction of the wave's advance is numerically equal to the total voluminal electromagnetic energy of the wave front in ergs per cubic centimeter. This condition has been experimentally verified for arc light. A beam of light pushes where it strikes. Moreover, the power of a wave is equal to the product of this head pressure into the wave velocity, or the velocity of light.

But because in electrified ether there is a pull along the flux, and a shove perpendicularly thereto, it does not follow that the ether is deformed by these stresses. It may or may not be. There does not seem to be any evidence of distortion in electrified ether, nor any known means of making such distortion apparent, if it exists. Similarly, because in a dielectric substance, giving passage to electric flux, there are stresses in ether, it does not follow that there must be distortion in the solid, or mechanical strains. There might or might not be. If strains could be detected in an insulating solid such as glass, due to electric flux, these strains, if of a nature to correspond with the theoretical stresses of electric flux, would certainly corroborate the theory, but the absence of such strains would not necessarily refute the theory; because so little is known of the interconnecting mechanism between the ether and matter.

The strain in dielectrics due to the passage of electric flux through them is termed "electrostriction." Electrostriction has been claimed to have been observed by various physicists. Prof. More, however, in his article, takes the position that the effects which have been observed are spurious, and are due to other causes, such as the stresses between electric charges resident on opposite faces of a glass sheet, to which tin-foil coatings have been applied. He states that when care is taken to eliminate such independent and extraneous sources of stress, no electrostriction is detected by him, although his apparatus possesses abundant sensibility. It would be very interesting to have this experimental result confirmed by other observers. But whether the effect does or does not exist, is of no vital importance to the outstanding theory of electromagnetism.

THE METRIC SYSTEM IN 1903.

The tendency of the times to introduce labor-saving machines and by the exercise of intelligence, to save each other's labor is borne out in the sure progress that the International Metric System has made during the past year. This country made a great step in advance when it adopted a decimal currency in 1785. Prior to that time there existed time-honored but cumbersome pound, shilling and penny currency. There can be no doubt that a shilling, as a duodecimal thing, is theoretically superior to a dime, for it admits of division into sixpences, fourpences, threepences, twopences, pennies and halfpence; whereas the dime is only evenly divisible into five-cent pieces, two-cent parts and cents. Nevertheless, we do not know of anyone who considers that the old duodecimal system was superior to our dollar-and-cent system. Our dollar system is much simpler to learn, to think in, to compute and to reduce.

It was stated last year in evidence before the Congressional Committee on coinage, weights and measures by a specialist in national education, that one-twelfth of the average eight years of elementary school education in America, or about two-thirds of a year of study, could be saved if the metric system took the place of our multitudinous medley of customary weights and measures, and that the waste of money in teaching the present system to children, apart from the question of the value of the waste time to the children, was eighteen millions of dollars annually. This estimate seems a reasonable one. Manifestly, if the children could be put on the same level as the children of France, Germany and the other European countries in this respect, the assumed two-thirds of a year saved could be devoted to other things that cannot now be included in the elementary school curriculum. Our crude and unscientific system handicaps all our citizens, in education, in thinking, in application, and in computing. The very best system in the world should only be good enough for the American people to adopt.

Great Britain has made greater visible progress than the States toward the metric system during the past year, mainly owing to the official actions of her colonies. Most of these have either singly or jointly petitioned the British Government to adopt the metric system throughout the Empire. We learn that Lord Belhaven has given notice of introducing into the House of Lords early next session a bill for the compulsory adoption of the metric weights and measures throughout the United Kingdom, and that Lord Kelvin will second the motion. We wish the bill every success, and feel sure that any branch of the English-speaking people adopting the metric system will give the signal for all branches to follow forthwith.

Motor Automatic Switch Litigation.

The United States Circuit Court of Appeals, sitting at Chicago, Ill., rendered on January 5 a decision confirming a decision of Judge Kohlsaat of the Lower District Court, rendered March 26, 1903, sustaining the Blades automatic motor switch patent of January 7, 1900. The claim of this patent in suit was the combination in a shunt-wound motor of a magnet in the field circuit with a hand switch adapted to open and close the armature circuit, said switch being arranged to be held in its closed position by the said magnet in the field; and means for automatically retracting the switch to its initial position when the magnet is de-energized by the cessation of the current through the field circuit.

The court, in its opinion, held that there was patentable novelty in the application of an under-load retaining magnet to a manual starting box, in the location of such a magnet in the field circuit of a self-regulating shunt-wound motor, and in adjusting it to act in that location with the starting box located in the armature circuit; and the court could find nothing in the prior art to militate against the allowance of the claim in suit. One inventor, preceding Blades, addressed his attention to the dangers of the self-regulating shunt motor in the constant-potential circuit that comes from the cessation or material loss of current, but he missed the mark by directing his efforts to the wrong point—the main switch. As the court reads the Shepardson patent referred to, it contains no hint of the Blades structure. The parties to the suit were the Cutler-Hammer Manufacturing Company, appellees and owners of the Blades patent, and Edward W. Hammer and Edwin R. Harding, appellants.

The Institute Annual Dinner.

Preparations are being actively pushed for the annual dinner of the American Institute of Electrical Engineers on February 11, as already noted in these pages. The dinner will be held in the grand ball room of the Waldorf-Astoria, and it is expected to be a very large and interesting affair. It is intended to make the feature this year the celebration of the twenty-fifth anniversary of the successful introduction of incandescent lighting, and to this end the Edison Medal Association recently formed has joined hands with the Institute and intends to present to the Institute at that time the fund raised by it to found an Edison Medal, the first in the Institute's history. Tickets for the dinner will be $7 for members and $5 for ladies, without wine. It is also proposed to dispose of some seats in the boxes for those who might like to witness the proceedings and hear the speeches after the banquet; the price of these tickets to be a dollar each. Mr. Arthur Williams, of the New York Edison Company, and a member of the dinner committee, of which Mr. Calvin W. Rice is the chairman, has been put in charge of the decorations, which will be of an elaborate and sumptuous nature worthy the occasion. A very handsome menu is also being prepared which every guest will gladly preserve as a permanent souvenir. Mr. Rice has appointed Messrs. F. C. Bates and Calvert Townley as a committee on tickets, etc., and Messrs. C. W. Price, E. H. Mullin, Bancroft Gherardi, Jr., and W. J. Hammer as a committee on invitations, etc. The programme of speakers will be announced shortly.

The Edison Medal Association has also issued this week its formal circular, the details of which were given by us last week, as to the foundation of the Edison Medal to be awarded by the Institute each year to the student in electrical engineering whose thesis or recorded research shall be deemed most worthy of honor. This association, through its executive committee of thirty-one and its general committee of one hundred, is already actively at work and reports most gratifying results as to the collection of subscriptions to the fund, the contributors to which are Mr. Edison's associates and friends during the past twenty-five or thirty years of his work. It is remarkable how wide a range of development is included by this phrase, and how many men in different fields of occupation find their sympathies and approval enlisted by the purpose of the association. We are requested to state by the association that in case any who should contribute to the fund and desire to do so, have not received circulars and subscription blanks, they will communicate at once with Mr. R. T. E. Lozier, secretary, 220 Broadway, or Mr. Frank S. Hastings, treasurer, 80 Broadway. The chairman of the association is Mr. Samuel Insull, of Chicago, and Mr. Edison's pioneer associate, Mr. Charles Batchelor, is vice-chairman. It may be mentioned again that the date of the dinner, February 11, is Mr. Edison's birthday. He was born in 1847, and was, therefore, but thirty-two when the incandescent lighting art, in whose commercial development and perfection he was so strikingly prominent, may be said to have begun in 1879.

Destruction of A. I. E. E. Property by Fire.

The total destruction by fire on December 28th, 1903, of the printing house of McIlroy & Emmet, 108 Liberty Street, New York, means considerable loss of time and material to the American Institute of Electrical Engineers. The amount of the loss from a financial viewpoint cannot be even approximately estimated at this time, for the reason that the severe cold wave has caused the debris of the fire to be coated with ice, so that it is impossible now to extricate what may eventually be recovered. There is also a question as to what portion, if any, of the financial loss will fall on the Institute.

Secretary Pope estimates that on the evening of December 28 the following unfinished work was contained in the printing shop:

	Pages.
ELECTROTYPE PLATES:	
Vol. XX, Transactions, Sept. to Dec., 1902	306
Vol. XXI, Transactions, Jan. to June, 1903	601
Vol. XXII, Transactions, July to Dec., 1903	336
Total electrotype plates	1,243

	Pages.
TYPE: PAGE FORM:	
Vol. XXII, Transactions	414
Advance copies December papers	47
Pocket-Catalogue of Membership, Edition of August 1, 1903	87
Total	548

	Galleys.
GALLEYS:	
Mailing List	29
New Catalogue of Membership	36
Total	65

It is possible that some of these plates and galleys may be saved. The amount of salvage, however, cannot be determined until the insurance adjusters have finished their work; unfortunately, the adjusting is seriously hampered by the inclement weather.

The Institute office has on file authors' corrected copies of all the papers and discussions, also partially revised copy of the mailing list and catalogue of membership, so that nothing has been lost which cannot eventually be reproduced. The reproducing of the papers and discussions will, however, take considerable time.

Northwestern Electrical Association.

The annual meeting of the Northwestern Electrical Association at the Hotel Pfister, Milwaukee, Wis., on January 20, 21 and 22 promises to be as usual an interesting and successful affair. Mr. Thomas Mercein sends us the following programme:

Wednesday Morning Session—Convene 11.30.—Roll-call, reading of Minutes, president's address, secretary and treasurer's report. Afternoon Session.—Appointment of Nominating and Membership Committees, applications for membership, reports of all committees except Nominating, miscellaneous business. The following papers will be read: "Storage Batteries for Central Station Work," J. H. S. Waring; "Peculiarities of Magnets," Richard Varley; "Rectifiers," W. Scheidel. Evening.—Theatre party. Thursday, Morning Session.—The following papers will be read: "Double-Current Generators in their Connection with Double-Current Supply," W. L. Waters; "Central Station Heating," W. E. Schott; "Standard Practice in the Use of Alternating-Current Electrical Apparatus," J. J. Gibson. Afternoon Session.—Report of Nominating Committee and election of officers. The following papers will be read: "Steam Turbines" (illustrated), James Lyman; "Rectifiers," Prof. G. F. Burgess; illustrated lecture on Radium, Prof. R. A. Milliken. Evening.—Annual banquet. Friday Morning.—Unfinished business. Adjournment.

The Government Printing Office—The Electrical Equipment of the Largest Printing Office in the World—III.

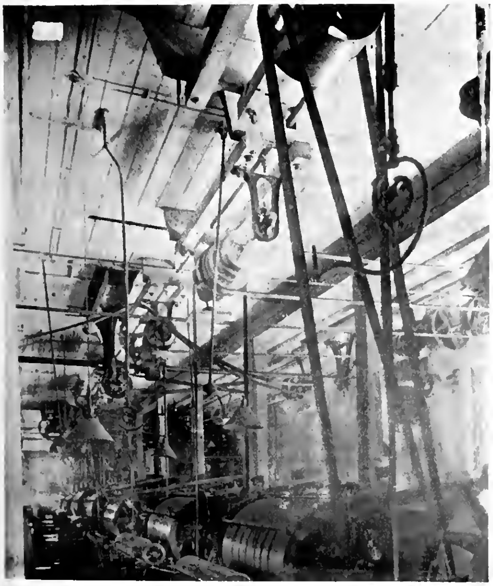
(Concluded.)

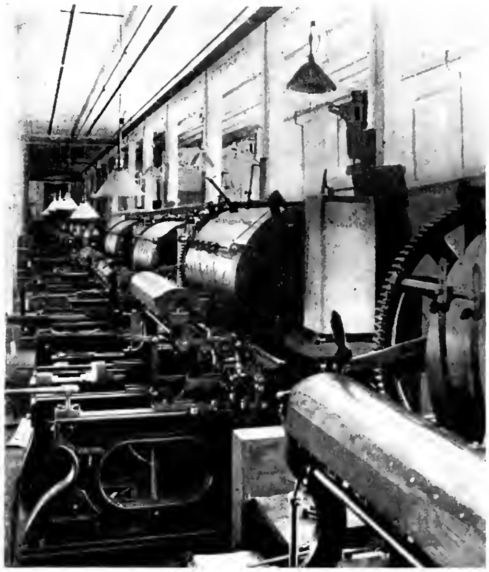
PRESS DRIVING.

THE two preceding sections of this article have dealt with the general details of the Government Printing Office at Washington, the power plant, the wiring distribution, the elevators, the electric heating equipment, and part of the electrotyping work. While none of these features has been gone into exhaustively, the text and illustrations required have filled some sixteen pages of this journal, and as this present section shows several more pages are required to note even briefly the leading points in regard to the motor equipment for press driving, and other parts of this most interesting and impressive installation. In fact, as remarked by Mr. Tapley, the chief electrician, who for two or three years past has been giving ceaseless attention to the problems connected with the plant, it would require a good week to give but a few minutes to each of the constituent items which make the largest printing office in the world such a remarkable example also of the successful application of electricity to the printing and graphic arts.

Before passing on to the description of the equipment, it may be noted that from the very necessities of the case Mr. Tapley has had to give more attention to press driving than any other question, and that his classic paper on the subject of the application of electric motors to running press machinery, presented before the electrical section of the Franklin Institute in 1899 still remains one of the best treatises available in regard to the economies and other advantages of the electric drive. Now five years later, its wealth of detail and experience renders it of continuing value, and it might well be quoted here in extenso if space permitted. Many of the arguments and ideas then advanced have, however, in the meantime, become embodied in current practice and find exemplars in the enlarged and new plant under review. One or two of our pictures are of the "before and after" class, Figs. 31 and 32, and in that connection as summing up the situation we may venture to quote from Mr. Tapley as follows: "The advantage to be gained from changing over from belted, steam driving to individual electric motor for printing press work is not alone in power saved, but better grade of work, less spoiled sheets, cleaner, healthier rooms for employees, less repairs to machinery, and most of all an increased product without a corresponding decrease in value of presses by running at too high speed." This, indeed, we might supplement by quoting with renewed emphasis his remark then also made: "There has never been a hitch in the motive power; not a motor has given out. In fact, such a freedom from interruption of power has never been known in the history of the Office as during the past three years, or since we adopted electric power." It will be remembered that in the opening portion of this article we dwelt upon the vital importance to the Government of uninterrupted operation, and cited a number of instances as to the publications, daily and of other periodicity, that must issue punctually from this wonderful bureau of intelligence and information.

The Government Printing Office was one of the first establishments to take up the direct application of motors to printing machinery, and a more thorough study of the subject has probably been made at this plant than at any other plant of the same character in the world. Before the purchase of the first motors a complete investigation was instituted by the Hon. Theodore Benedict, then Public Printer, and he detailed Mr. W. H. Tapley to carry on this work, Mr. Benedict, however, taking great personal interest in the securing of the requisite information. There only being a few establishments where motors had been applied direct to printing machinery, a comparatively small amount of data could be gathered by Mr. Tapley in his search, and therefore many of the methods of application were original. The first specifications issued by the Government Printing Office covered the furnishing of a lot of about sixty motors and four generators and a switchboard. The motors were wound for a pressure of 120 volts, this voltage being decided upon from the fact that a large part of the load was lighting, and it was not desired to have separate generators for operating the motors.





FIGS. 31 AND 32.—PRESSES WITHOUT AND WITH MOTOR EQUIPMENT.

In the original installation the motors in practically all cases were geared to the respective machines, this method of application being at that time considered the most advantageous. In the case of a number of ruling machines, some special speed reducers were employed and the motors of one-sixth horse-power capacity were coupled direct to the reducers. There were about thirty of these combinations installed at that time. In controlling the speeed of the motors applied to the various presses and other machines where variation in speed was desired, resistance in series with the armature was employed, in most cases the resistance being separate from the controller. The controller was placed in a position convenient to the operator. In a few instances it was found advisable to install a motor driving a group of machines such as in the electrotype foundry. At that time it was not deemed wise to attempt to apply motors to individual machines where they differed in character to such an extent, and especially as to the question of speed.

As a result of the benefits shown by the introduction of electric power, particularly from the point of increased output, motors were added from time to time until practically all shafting in the old buildings was eliminated. In some of the later installations direct connected type motors were used in driving certain types of presses, such as the Huber. In these cases the motor was mounted on the press shaft, the machine being bolted directly to the frame of the press. In some of the later installations, field weakening besides resistance in series with the armature, was introduced and found satisfactory. The question of reliability being an important factor in the operation of the Government Printing Office, instead of depending on fuses to protect the motors in case of excessive overloads from various causes, Mr. Tapley decided upon the wise plan of protecting each motor with a circuit breaker. This, of course, added considerably to the expense of the motor outfits, but has been found in practice to be an excellent investment.

The electrical propositions presented in connection with the new

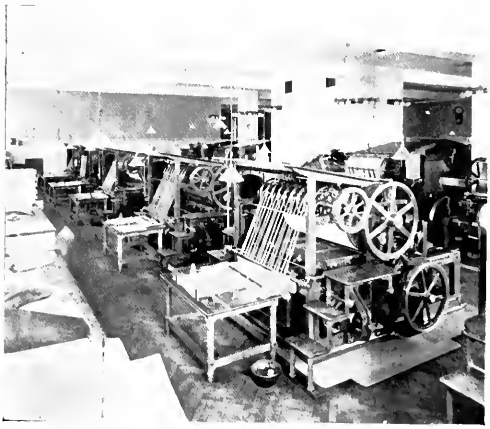


FIG. 33.—FIVE TWO-REVOLUTION PRESSES, MOTOR-DRIVEN.

Government Printing Office were most intricate, and all credit is due to Mr. Tapley in solving the various problems due chiefly to the tremendous proportion of current going into power apparatus. One of the most important was the continuance of the use of the existing voltage or the installation of 250 volt dynamos. After some weeks of careful examination into the various details connected with this problem, it was decided to adopt 125 volts for the new equipment station. The new Office is as stated above the most complete and unique plant of its character in this or foreign countries. The building alone contains over 600 motors in sizes from 1-6 to 100 horsepower and over 500 of the motors are of Crocker-Wheeler manufacture. In the new equipment many novel methods of application have been evolved, this being particularly so in the electrotype foundry, in which department every machine is individually driven as in the other departments. In the application of motors to presses, chain drivers have been largely employed, the motors (which are of the semi-enclosed type) being placed inside of the press. In the new building there is absolutely no shafting, which fact strikes one very forcibly when making an inspection of the plant. This will be touched upon again.

At the outset of this discussion of the power consumers, and the methods of driving the machinery it may be well to briefly collate a few of the more important features concerning the equipment for supplying power which were described in detail in part I of this article. The engine-generator plant comprises four units, each a direct-connected set, consisting of an Allis cross-compound Reynolds Corliss engine and a Crocker-Wheeler direct-current, 125-volt dynamo. In the order of their installation the sets are of the following sizes: one of 300 kw, one of 125 kw, and two of 600 kw each. At the generated pressure of 125 volts there is a total current capacity of 13,000 amperes, when the generators are run at their rated normal load, and with their ample ability to run at 25 per cent. over-load continuously for periods of four hours, it is possible, though beyond realms of the probable, to carry a load of 16,250 amperes for that length of time.

The power and lighting circuits, as has been described fully, are kept separate on the board and throughout the building, although the pressure is the same in both. This precludes the flickering of the electric lights with every fluctuation of the motor load, and possesses advantages in the way of safety and uninterrupted service for the illuminating, independently of the conditions existing in the power system. We may well look to the Government Printing Office for typical examples of the best methods for individually driving presses and other machines employed in the printing art.

The size alone is not the only feature in which the present plant differs from its predecessor. Many modifications have been introduced in the method of drive—a large number of belts have been eliminated, and while at an earlier time gearing was regarded as the only method for positive driving, and was in all cases employed where it was desirable to avoid slipping, to-day but few gears are seen, the greater per cent. of them being supplanted by chain connections. Perhaps the highest degree to which the perfecting has been carried is presented in the few cases where all forms of intermediate connection whether belt, gear or chain have been avoided by resorting to direct-connection with the motor spindle. There are cases, however, where such a scheme, commendable though it may be, is entirely out of the question. Oftentimes slipping is desirable, especially if it proves to be the means of saving the motor or machine from excessive shock in ordinary running, or even more serious injury in case of accident.

For such service there is nothing to replace the old-fashioned belt, nor, indeed, is there much to be said against it when the circumstances of the machine's construction, or situation allow for a reasonably long distance between pulley centers, for then the tension need not be excessive.

There are given herewith a few illustrations selected as fairly representative of the drives in use on the various classes of machinery. Each indicates somewhat the nature of the problem it involves, while the excellence of the solution speaks for itself. Features that will be recognized as common to almost all the equipments are the

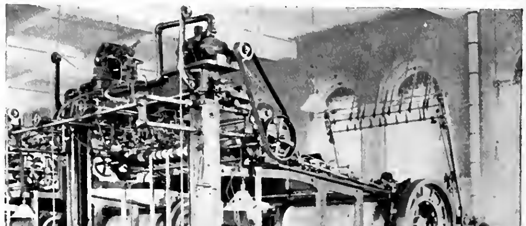


FIG. 34.—LARGE FLAT-BED TWO-REVOLUTION PRESS.

placing of the motor in a location where it occupies the least useful floor space, but remains accessible for examining or repairing. It will also be seen that the motor is incorporated in some way or other with the machine it drives, being invariably supported independently of the floor, walls or posts, and usually on a bracket elevated from the floor. Still another feature is the mounting of the controlling apparatus where it is handy, and at the same time protected from mechanical injury or from contact with dirt, chips, or in short, anything that would interrupt or interfere with its proper operation.

In Fig. 33 are illustrated five Potter 2-revolution presses, which are remarkable for their compactness and neat appearance. The same quality characterizes the driving element and the manner in which it has been embodied. It consists of a 5-horse-power Crocker-Wheeler motor located just under the bed, so that the sprocket, by which it drives through a Renold silent chain to the machine, is guarded by the steps and platform at the side of the press. The five presses shown, with a sixth, are all of this type in this room. Scarcely distinguishable, behind this row is an equal number of Hoe 2-revolution presses, each of which is driven by a 5-hp old-style bi-polar Crocker-Wheeler motor.

One of a line of machines of a larger size that deserves special mention is a flat-bed, 2-revolution Meihle press, shown in Fig. 34. This one is also chain-driven from a Crocker-Wheeler motor, in this case, of 7½-hp. The press has associated with it an automatic paper feeder, built by E. C. Fuller Company, of New York, which is geared-driven by a 1-hp bi-polar Crocker-Wheeler motor. Both of these motors are located in out-of-the-way positions, and practically add nothing to the space required by the machine proper.

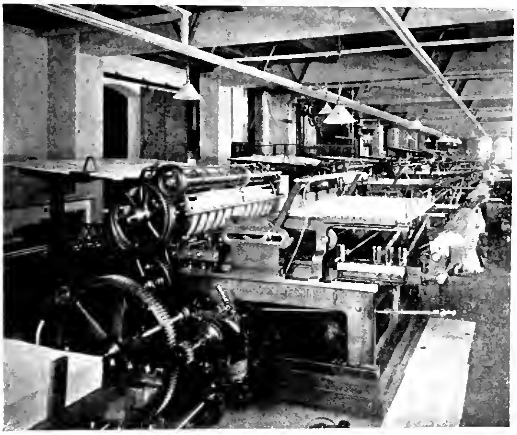


FIG. 35.—A LINE OF TWELVE MOTOR-DRIVEN PRESSES.

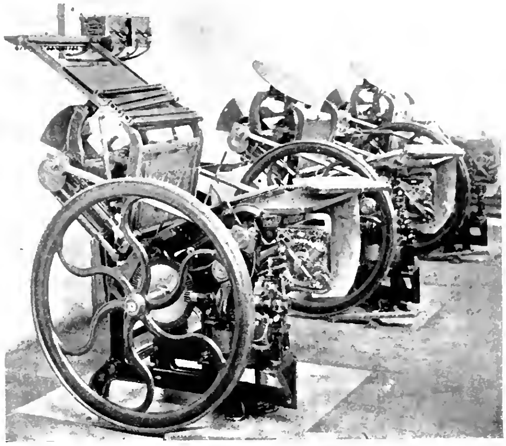


FIG. 36.—JOB PRESSES, SURVIVORS OF ORIGINAL PLANT.

In Fig. 35 a line of 12 presses are shown, the nearer ones being five of Whitlock make with 37 x 52-inch beds and direct-gear drive from 3-hp. Crocker-Wheeler bi-polar motors. Further on there are five Huber presses with 42 x 52-inch beds driven by 5-hp Crocker-Wheeler bi-polar motors, and two R. Hoe & Company presses driven by motors of the same size and style. These are a few of the pioneers which cling to the gear drive, a method which has its objection clearly indicated in the large-sized gear on the press. Now-a-days a slow-speed motor would be used to remove this objection, and it is not unlikely that this press, like the Meihle, would be chain-driven. A comparison between these two outfits is of interest as indicating the advance that has been made in this work even in five years' time.

Naturally there is considerable work executed in this plant on small job presses. Fig. 36 shows three typical outfits for such work. These are of Gordon make and are driven through bevel gearing by ½-hp Crocker-Wheeler bi-polar motors, mounted on the sides of the frames. These are also survivors of the original plant, but cannot yet be

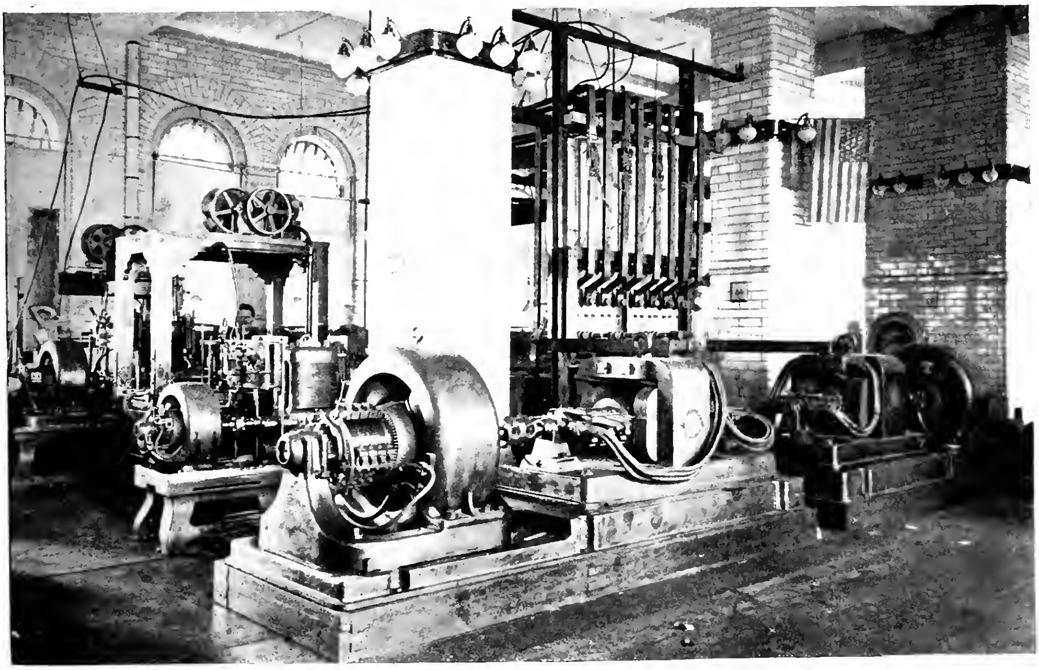


FIG. 38.—APPARATUS IN ELECTROTYPING DEPARTMENT.

classed as "back numbers." Much in their arrangement is quite worthy of more recent construction.

MISCELLANEOUS PRINTING OFFICE WORK.

So much for press drive. While it constitutes the more important side of the plant operations and constitutes the greatest per cent.

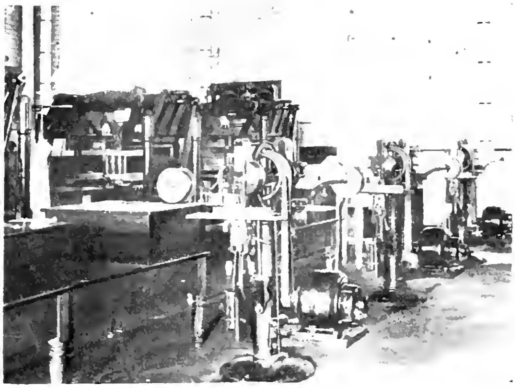


FIG. 37.—MOTOR-DRIVEN STITCHERS.

of the power load, it causes less perplexity in the matter of arranging satisfactorily than many of the smaller though indispensable machines, such for example, as the stitchers, shown in Fig. 37. These were built by R. H. Brown & Company, and are connected by the belt with ½-hp Crocker-Wheeler motors, mounted on brackets which are bolted to the supporting column of the machine near the base. The motor starter is mounted on the opposite side of the column, so that the outfit is entirely self-contained, and the floor about the base is easily kept free from litter.

One of the most interesting departments in the building, as noted last week, is that wherein are made the electrotypes for illustrations. As is well known, the process involves the use of current for depositing upon a wax impression of the original cut, a thin coating of copper which is then backed up with lead or white metal, and mounted on the block. All the apparatus necessary for this work is located in the section shown in Fig. 38, although all is not visible in the cut. Back of the columns are located the white glazed porcelain vats in which the wax impressions taken from the original half-tones, are immersed in a solution of copper sulphate, while current is passed through the solution, causing electrolytic deposition of free copper on the wax. Between the two piers may be seen the rear aspect of the substantial switchboard used in connection with the low voltage distribution to the electroplating baths. In the foreground are the two low-voltage generating sets which supply the current. These consist of Hanson & Van Winkle dynamos direct-connected to and mounted on the same base with 35-hp Crocker-Wheeler motors. On the left-hand side of the picture in the middle distance and the extreme rear are two so-called dipping machines. These are designed to do the same work; i. e., electrotyping, and to do it with greater rapidity, this being accomplished by causing the continual movement up and down of the plates while the deposition is taking place; hence the name "dipping machine." The principle of the action is that fresh, unexhausted copper solution is kept continually in contact with the surface, which causes the deposit to form faster. The device is an extremely useful one where rush work is undertaken, but is subject to the drawback that its work is of by no means as fine a grade as that obtained when using the slower process. The apparatus for causing the dipping is mounted on a platform over the tank and the motor-generator which serves that particular bath is located alongside. The nearer outfit is driven by a 7½-hp Crocker-Wheeler motor, and the other by a 10-hp.

After the formation of the electrotype plates it is necesary to trim them up before they are mounted on blocks. The machines for this work are shown in Fig. 39, the one on the left being a shaving machine for truing the back of the plate, or reducing it to a standard thickness; built by the Lovejoy Company, of New York. It is driven by a Crocker-Wheeler motor, mounted on a bracket secured to the legs at one end, right beside the controller and the terminal of the pipe conduit in which the wires are brought up through the floor to the motor and controller. The latter is placed under a protecting hood, as indicated, to exclude particles of metal and prevent the trouble due to short-circuits. The motor and controller are similarly mounted on the machine at the right, which is used for bevelling the edges of the plates, and was manufactured by the J. P. Felt Company, of New York. The controlling apparatus for each

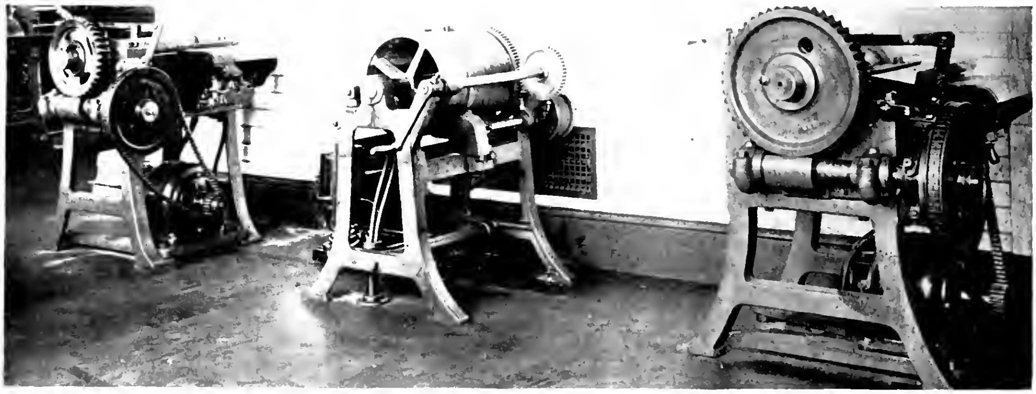


FIG. 41.—SHAVING AND BEVELING MACHINES ON CONGRESSIONAL RECORD AND SPEECHES.

FIG. 39.—ELECTROTYPE MOUNTING APPARATUS, MOTOR-DRIVEN.

machine consists of a starting box with a no-voltage release and a circuit-breaker for overloads, which also serves as a line switch.

Again the fact, so conspicuous in all the machinery, i. e., of supporting the motor in a contained manner somewhere upon the

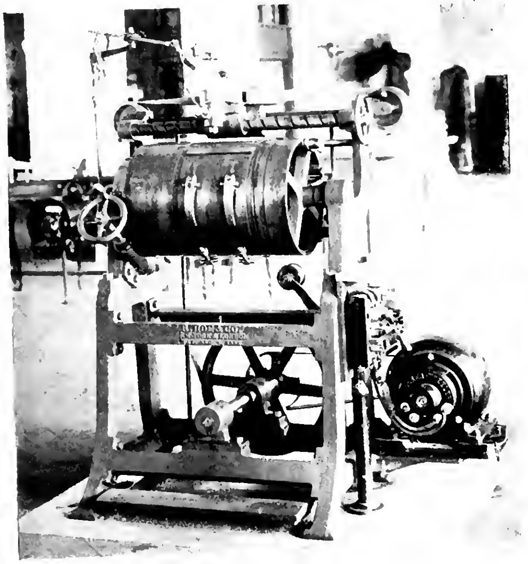


FIG. 40.—CARD-ROUTING MACHINE, MOTOR-DRIVEN.

machine is emphasized in Fig. 40, which illustrates a card routing machine built by R. Hoe & Company. This is for routing curved plates as used on cylindrical presses, the plates being fastened upon the surface of its drum. A 1-hp Crocker-Wheeler motor supplies the drive through a belt connection to a counter-shaft embodied in the lower part of the frame and in turn driving through a long belt which changes direction several times in order to impart motion to the spindle of the router on the adjustable tool head. In doing work on the machine the operator stands on the side shown in the cut, where with his left hand he may revolve the drum to extend the cut in one direction, while with his other hand he may travel the cutting head in a direction at right angles to the first. The same machine is shown at the right in Fig. 42, which brings out more clearly the course of the belt and the method of keeping it tight by means of an idler.

In Fig. 41, at the left, is shown a shaving machine, which is used on work for the "Congressional Record"; at the center, a bevelling machine and at the right a shaving machine, both of the latter being used in connection with the printing of speeches for the House and

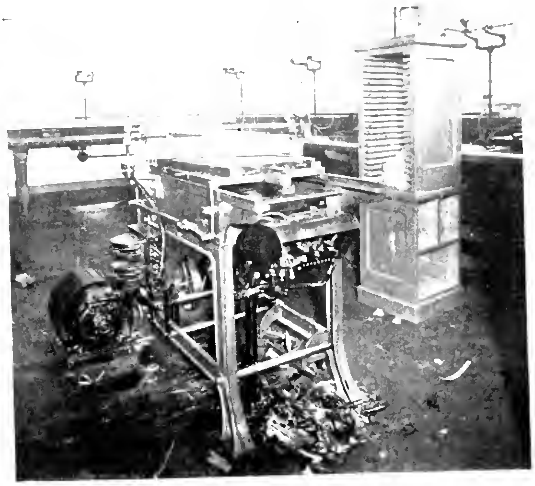


FIG. 43.—CASE SHAVER IN FOUNDRY.

Senate. The three were made by R. Hoe & Company, and are driven individually by 1-hp Crocker-Wheeler motor through Renold silent chains. A feature of these machines is the protection of the controlling apparatus, alluded to before, and clearly brought out in the picture.

Fig. 42 gives a general view of the electrotype finishing apparatus, showing routing, shaving and bevelling machines, saws, etc. Most of this apparatus is belt driven, in all cases by Crocker-Wheeler motors. Each one possesses merits of its own in the placing of the parts where they are out of the way and protected, yet at all times easily accessible. The advantage of avoiding overhead belts is

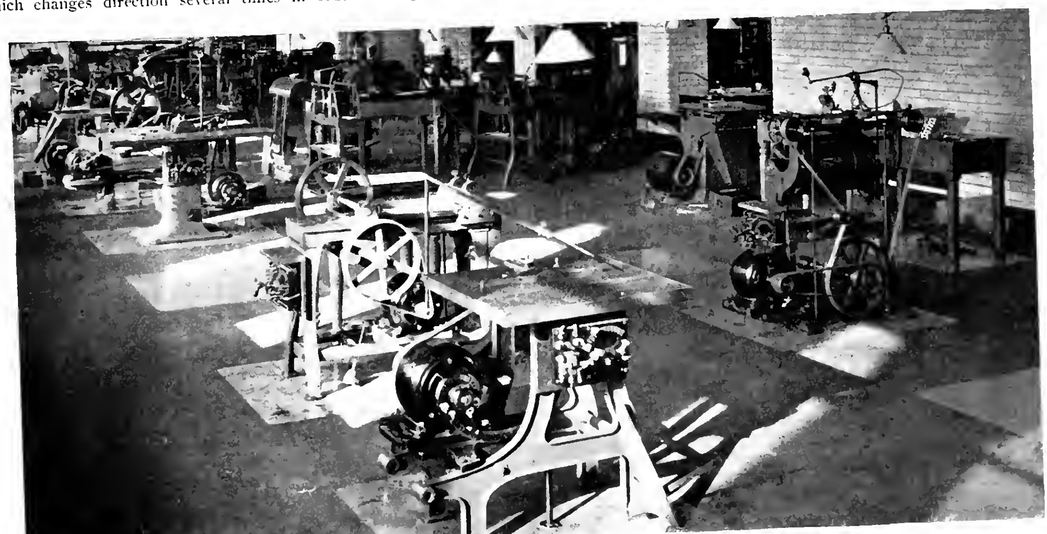


FIG. 42.—GENERAL VIEW OF ELECTROTYPE FINISHING APPARATUS.

strikingly indicated in this cut, where if they were to be group driven, their number and close spacing would make the problem an intricate one, particularly since it would be necessary to limit their positions to allow for straight belt lines. Figs. 31 and 32 illustrate this point most effectively, the first being a view taken in the old plant when the presses there shown were all belt driven from line shafting, and the second a line of presses as now set up in the new building. Even the photos show the effect of the increased lighting, and another benefit not indicated so clearly is the absence in the second case of dancing shadows cast by the moving belts across the work in the press to the annoyance and discomfort of the operators when attempting to scrutinize the type for faults.

It would, indeed, be difficult to enumerate all the motor drive in this branch of the office, but we may well supplement our cuts by Fig. 43, of a case shaver in the foundry, run by motor, and with a knife heated by electricity; Fig. 44, motor driven molding press in the foundry; and Fig. 45, showing the motor driven ruling machines in the bindery, the last appliances getting down to the use of electric power in very small modicums with motors of the fan class. The bindery includes, however, a great deal of heavy and ingenious machinery, all motor driven, upon which as much space might appropriately be expended as we have already given above to the press room equipment proper, the foundry, and other departments.

While this article has been in preparation, arrangements have been made for a further important addition to the printing press equipment in the shape of the new Hoe press to get out the larger edition now required of the "Congressional Record." According to the details which have been kindly furnished us by Mr. G. F. Read, of the R. Hoe & Company, of New York, the machine is for printing and folding the "Record," delivering the product in signatures of eight pages at the rate of 80,000 per hour, or sixteen pages at the rate of 40,000 per hour. It is constructed on the rotary principle, printing from curved stereotyped plates upon webs of paper supplied from two rolls, one at each end of the machine. After being printed the two webs are associated and led to a cutting and folding mechanism located midway in the length of the machine, from which the sheets are delivered upon moving aprons. The entire length of machine is 24 feet; height, 9 feet; width, 6 feet. The power required to drive the machine at speed is 30-hp, and a Crocker-Wheeler motor of standard type, making 825 r. p. m. is employed, placed below the folding and delivery mechanism upon the bed plate of machine. Another motor of 7½-hp, 875 r. p. m., is also used at times, when it is necessary to move the press slowly (about 6 per cent. of full speed), in order to "lead" the paper.

The means by which either motor may be used to drive is this:

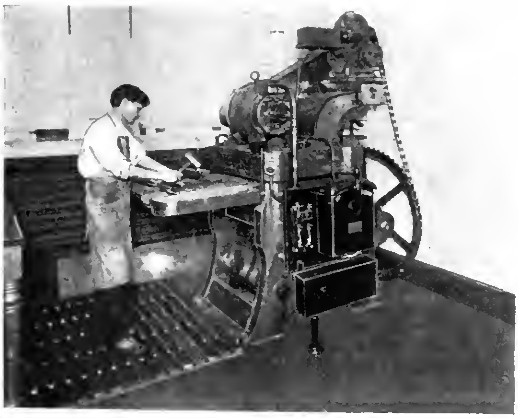


FIG. 44.—MOTOR-DRIVEN MOLDING PRESS IN FOUNDRY.

The armature of the large motor is coupled to a short shaft, on the opposite end of which is a rawhide gear pinion, in mesh with a large gear wheel on the outer end of the main driving shaft of the machine and which will run at 166⅔ r. p. m. Secured to the pinion shaft is a disc, carrying spring-seated pawls which are adapted to engage with the teeth of a ratchet wheel formed on the side of a gear wheel, mounted loosely upon the pinion shaft and driven through reduction gearing by the small motor.

With this arrangement, it will be understood that the machine may be moved at slow speed by the small motor only driving (through the reduction gearing and ratchet wheel) the pawls which are secured to the pinion shaft; and that when full speed is required the

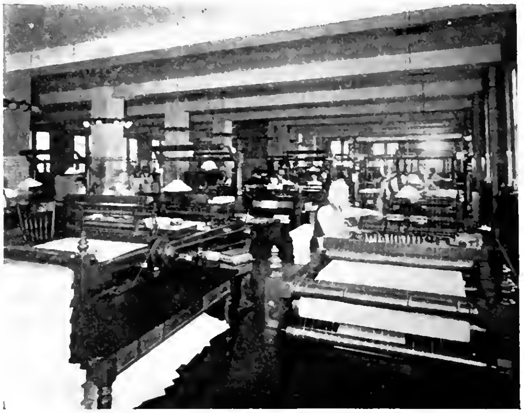


FIG. 45.—RULING MACHINES IN BINDERY.

large motor drives directly to the pinion shaft; the pawls at this time running away from the ratchet wheel and being thrown out of engagement with the teeth thereof by the centrifugal force. It is obvious that it is not necessary to continue running the small motor after the large motor has begun to drive. Located at various points about the machine are stations, each having a series of push buttons by which the full speed, slow speed or stoppage of the machine may be controlled.

Helium and Radium in London.

Somebody seems to have an object in stirring up old London in regard to radium. One recent story told of the tons of pitchblende refuse that had been thrown out by a chemical firm and used for road metal, and now comes another exciting suggestion of less solid, or perhaps a more liquid character. A cable dispatch from London of January 9th says gravely: "Will England in the near future develop a new industry? Is it possible that this old country has hidden away, deep down, mines of untold wealth of that invaluable element, radium? Such is the question many persons would like to have answered regarding London, where great quantities of radium are supposed to be buried beneath property which is too valuable to give over for the purpose of experiment. London's ancient city bath has come to the front this week because of the discovery that the old hot baths contain, in the waters they have been throwing up for centuries, no end of radium which has gone down the throats of invalid drinkers or has been disported in by bathers who must number millions. That excitement has been great over the discovery is shown by the columns which have been published in newspapers and letters discussing the wonderful find.

"It all came about in this way: The Hon. R. J. Strutt, son of Lord Rayleigh, while analyzing the waters of the bath, found, as he states in a letter which he sent to the Municipal Council of this city, that the waters contain radium in appreciable quantities. It was rather disconcerting, however, to have him state that he did not think the waters held enough to pay for extraction, though experiments promised interesting developments. As helium has been proved to be slowly evolved from radium, it is stated that helium, which is one of the deposits in the bath waters, owes its origin to radium which is buried somewhere under the bath. That it must exist there in plenty is believed widely, but how to get at it is one question, and another is, Could it ever be located? It may be miles beneath the earth's surface, but this discovery of radium has caused widespread interest in medical circles. Doctors have been surprised and sometimes puzzled by the cures wrought by the waters. One eminent local practitioner thinks that the presence of radium, even in infinitesimal quantities, in the springs may have wrought cures which seemed wonderful; but at present that can be a matter only for inquiry and investigation."

A Critical Review of Electrostriction.

By LOUIS T. MORE.

THE term electrostriction is applied to designate the mechanical strains that electrical forces produce in a non-conductor, such as glass or oil, which change in dimension or shape under their action. The phenomenon was first observed, or at least recorded, by Fontana in 1786. On charging a Leyden jar, which was filled with water, he noted an increase in the volume of the jar by means of the changed level of the water in a capillary tube inserted in it. The importance of this fact seems to have attracted little attention at the time, and no further observations are known until Govi, in 1864, confirmed Fontana's discovery in a more scientific manner, though he also wrongly attributed the action to the liquid in the condenser and not to the glass.

Two years later Duter corrected this mistake of Govi's and showed conclusively that the effect was due to a change in the volume of the glass and not to any change in the conducting fluid, which merely measured the strain. According to his results, the variations in the volume of the glass were proportional to the square of the difference of potential of the armatures and inversely as the thickness of the glass.

Shortly afterwards, Righi extended the experiments and increased their accuracy. For the first time, he employed glass tubes about a meter long, whose internal and external walls were coated with tin-foil. When the armatures of these condensers were charged, the tube lengthened proportionally to the square of the difference of their potentials and inversely as the thickness of the tube.

So the matter rested as an isolated fact, for, according to the theories of electricity then prevalent, the effect could be looked on only as an action of charged bodies at a distance, of the same inexplicable character as gravitation.

But when Faraday's conception of lines of stress in the electrified ether was better comprehended from the interpretation of Maxwell of the mathematical character of tubes of induction, it readily occurred to Maxwell and his supporters that electrostriction would serve for one of the fundamental proofs of their theory, as stresses in a medium might well be accompanied by strains in the matter involved in it, and it is from this time that the question has grown in importance and has been the subject of many experiments, hypotheses and controversies.

Maxwell's theory of displacement currents and of electrical stresses and strains in the luminiferous ether rests on four fundamental experiments, three of which were untried at the time the theory was formulated. These are:

1. A static charge displaced in space has all the electrical, electromagnetic and inductive actions of an electric current.

2. In a magnetic or electric field there are tensions along the lines of force and pressures at right angles to them.

3. Electromagnetic oscillations are transmitted with the speed of light.

4. The specific inductive capacity of a dielectric is equal to the square of its refractive index for light.

Of these four verifications, the second is the subject of this paper. Before considering it in detail, it is interesting to review how far they have stood the test of time and minute research.

1. We have for a proof of the first the famous experiment of Rowland with convection currents. An ebonite disc was charged and rotated at great speed near a magnetic needle, whose center was placed in the axis of rotation. The needle deflected to the right or left, according to the direction of rotation of the disc and in the same manner as a current of electricity flowing in the direction of rotation. Until very recently the experiment was regarded as conclusive. But Crémieu, who undertook the inverse problem, found no effect and questioned the results of Rowland's work. In the discussion which has ensued Crémieu seems to be the one in error.

The electromagnetic action of displacement currents was attempted by Röntgen in 1885. To produce this effect an ebonite disc was rotated from 120 to 150 times a second, on a vertical axis, between two parallel glass plates, A and B, whose internal faces were covered with tin-foil. The tin-foil on the upper glass plate, B, was grounded, and the sheet on the lower plate, A, was slit diametrically so as to form two insulated sectors. These two were charged with electricity of opposite signs by connecting them with the armatures of a charged condenser. The lines of force thus passed from the positively-charged sector of A upward to the grounded plate, B, through the movable ebonite disc and downward from B to the negative sector of A; consequently, the field was oppositely directed on the two sides of the medial slit in A. As soon as the ebonite disc was revolved, displacement currents were started, which were in contrary directions on the two sides of the slit. These currents were sufficient to deflect the lower needle of an astatic magnetic system suspended eccentrically to the plates; the lower needle being close to them and the upper one at a distance of 22 cm. Röntgen observed and measured these deflections, but the results are complicated by other causes, such as convection currents, thermoelectric effects, etc., and are not entirely satisfactory.

2. Stresses and strains in a magnetic field undoubtedly exist, as iron and other metals show unmistakable changes in length and cross-section when magnetized, which cannot be explained by any other cause.

Electrostriction or change in length of a dielectric in an electrostatic field was taken for granted by Maxwell from the results already described in this article. But recently, work of my own in this field makes it extremely doubtful if such an effect has ever been observed. It is, at least, certain that it is much more minute than was supposed.

3. It may be accepted that electromagnetic oscillations progress with the speed of light. It is even very generally admitted that light is but a manifestation of these oscillations.

4. Many investigators have endeavored to obtain the relation between the specific inductive capacity of a transparent dielectric and the square of its refractive index for light. In regard to liquids there is known to be a fairly close equivalence between the two, but the dielectric constant for solids is so complicated by extraneous effects that no sort of a relation has been found.

Before, then, Maxwell's theory can be established on these phenomena, they must be shown to be true beyond doubt, and this is far from being the case. Personally, I am not sure that electrostriction can be used as a criterion for this theory, as I can see no reason why there should not be stresses and strains in the ether in a field of force such as Faraday imagined, and that these stresses in the medium should necessarily produce a mechanical deformation in matter immersed in it. On the other hand, if a dielectric does expand, when charged, it would be a confirmation of the theory. The true and great importance of the question lies rather in the light it throws on the relation between matter and ether. This view is contrary to Maxwell's, as he evidently felt that electrostriction was a fundamental fact on which to base his theory, and the observations made up to his time warranted him in considering it as a striking confirmation. So also did Faraday, who, in paragraph 1297 of his "Experimental Researches," says: "The direct inductive force, which may be conceived to be exerted in lines between the two limiting and charged conducting surfaces, is accompanied by a lateral or transverse force equivalent to a dilatation or repulsion of these representative lines (1224); or the attractive force which exists amongst the particles of the dielectric in the direction of the induction is accompanied by a repulsion or a diverging force in the transverse direction." Maxwell is even more explicit. On page 165 of the first volume of his "Electricity and Magnetism," he writes: "The hypothesis that a state of stress of this kind exists in a fluid dielectric, such as air or turpentine, may at first sight appear at variance with the established principle that at any point in a fluid the pressures in all directions are equal. But in the deduction of this principle from a consideration of the mobility and equilibrium of the parts of the fluid it is taken for granted that no action such as that which we here suppose to take place along the lines of force exists in the fluid. The state of stress which we have been studying is perfectly consistent with the mobility and equilibrium of the fluid, for we have seen that, if any portion of the fluid is devoid of electric charge, it experiences no resultant force from the stresses on its surface, however intense these may be. It is only when a portion of the fluid becomes charged that its equilibrium is disturbed by the stresses on its surface, and we know that in this case it actually tends to move."

This stress along the lines of force as deduced by Maxwell is given by the formula, $p = \dfrac{K R^2}{8\pi}$, where p is the numerical value of the tension, K is the specific inductive capacity of the dielectric and R the electromotive intensity, or the strength of the field. Besides this tension there is a pressure of an equal amount in all directions at right angles to the direction of the lines of force. If these stresses in the ether are communicated to matter immersed in it, matter should lengthen along the lines of force and shorten at right angles to them.

The formula of Maxwell has been developed by later writers and perhaps the best attempt has been that of Dr. Sacerdote. To connect the actions of the ether and matter he introduces, in addition to the elasticity of the matter and its dielectric constant, the variation of the latter with pressure. If a long cylinder of the substance is charged by means of armatures adherent to its inner and outer faces, the expansion at right angles to the resulting lines of force is given as $\frac{\delta l}{l} = (a + k_1) \frac{K V^2}{8\pi d^2}$, where l is the length of the tube, d the thickness, K the dielectric constant, V the difference of potential which is equal to $R d$, a the inverse of Young's modulus, and k_1 the specific change of the dielectric constant with pressure, that is

$$k_1 = \frac{d k}{d p} \frac{1}{K}.$$

He makes a number of assumptions principally as regards k_1, and also in that he assumes no heat to be evolved by the charges and no mechanical deformation of the cylinder to be caused by the electrical attraction. The last two will be shown later to be of a size sufficient to account for all observed effects. And as for k_1, it has never been determined with any accuracy. "Indeed (I quote from my last paper), even its sign is a matter of dispute, some obtaining a positive value and others a negative one. It is introduced into the equation on the ground that the relation is a reciprocal one. If the dielectric constant of a substance increases with a tractile force applied perpendicularly to the lines of force, it is assumed, when a dielectric is charged, that the field of force should produce a tractile force, accompanied by a corresponding elongation. But it should be remembered that this coefficient is not yet determined, and even if it were the reciprocal relation may not exist. In a general way, the dielectric constant *is* greater, the denser the substance; it may well be that if a gas, or a solid to a less degree, were compressed, and the molecules thus become closer together, the dielectric constant might increase. It does not at all follow that the increase is accompanied by a repulsion of the molecules at right angles to the field, unless we make the assumption that an electrical charge produces in some manner a mechanical strain. If the dielectric constant is shown by experiment to increase with a tractile force, not because the molecules of matter are incidentally brought closer together, but because of the stress itself, then the reciprocal relation that a charge causes a strain perpendicularly to the field will hold, or vice versa. But until one or the other is indisputably proven, to introduce either one into the equation to prove the other is tacitly assuming the whole question of the mechanical relations between ether and matter."

The experimental work in recent years is due principally to Quincke, Cantone, Shearer, Wüllner and Wien, and myself. The work of Quincke is thorough, but deficient in accuracy. He experimented with small glass tubes, about a meter long, clamped horizontally, which were usually silvered on the inside and immersed in a conducting fluid for the other armature; the elongations were magnified by Oertling's mechanical lever and read with a telescope and scale. He also used glass thermometers filled with acidulated water and silvered on the outside, whose volume changes was measured by the rise or fall of the liquid in a capillary tube sealed to the bulb.

His results are that solids like glass expand in length perpendicularly to the lines of force; that this expansion is proportional to the square of the potential difference and inversely as the square of the thickness. For flint glass the expansion, reduced to unit dimensions, is $\frac{\delta l}{l} \times \frac{d^2}{V^2} = 2 \times 10^{-13}$, and for crown glass, 4×10^{-13}. But his results contain many discrepancies due mostly to heating, to irregularities in the shape of the tubes and thermometers and from the sagging which must certainly occur when fine glass fibres are stretched horizontally between two end supports. Heating was shown by the fact that the dielectric never returned to its original length when the electricity was discharged, and gradually increased in length while uncharged. He himself gives prominence to the fact that if a bent glass tube or one not uniformly thick be used, there is a large amount of distorsion due to the non-uniformity of the field. This irregularity must also occur when thermometers are employed, as it is naturally impossible to blow a bulb perfectly spherical, and also uniform in thickness. Quincke states "that thermometer No. 34 had a bulb of somewhat irregular shape and wall thickness, so that the inner portions of the bulb on electrification would be especially affected. It is, therefore, not comparable with the others, and is included only because it shows the greatest change of volume which I have been able to observe in glass." This thermometer showed an expansion of 68.36, where No. 9 of the same glass, of practically the same thickness, and at the same difference of potential, gave only 5.277. This great difference due to what he calls a "somewhat irregular shape and wall thickness," makes one wonder whether the expansion of No. 9 might not largely result from the same causes.

Prof. Cantone, alone and in collaboration with Sozzani, has published many experiments, beginning in 1888. He used cylindrical condensers and measured their changes in length by means of the shift in interference bands of light, reflected between two parallel mirrors, one of which was fastened to the end of the tube. The tubes were about 70 cm. long, 7 mm. in diameter and ranged from 0.045 to 0.2 cm. in wall thickness. The armatures were adherent to the glass and the greatest elongation was 2.6 bands, while most were less than one band. The elongations reduced to unit dimensions, average $\frac{\delta l}{l} \times \frac{d^2}{V^2} = 6 \times 10^{-13}$. This result is calculated from the deflections observed when the tubes were charged; the return, when the tubes were discharged, sometimes equalled the above, and was sometimes less than half. The time of charging also affected the amount of the elongation very much; but no law could be formulated, and no reasons are given for the time of charging determined on to give the correct value.

In spite of the carefulness which Cantone's experiments show, there are evidences that the values given are, at least, partly due to causes other than the one he ascribes them to.

In the first place, the amount of the elongation increases with the time of charging and to an unknown extent.

Secondly, they are partly due to heating of the tube. Cantone attributes the erratic return of the tubes to the heat evolved, and this varies between a complete return and a value of one-half. If so, surely part of the elongation in *charging* must be due to the same cause.

Thirdly, the armatures touch the glass, and this attraction will elongate the tube, using Poisson's ratio, approximately one-third the observed amount.

Fourthly, tubes of the dimensions given are flexible, rarely straight, and do not have a uniform wall thickness. All of these defects tend to strain the tube when it is charged, as the field is not uniform. The amount of this strain is large, and even with unusually accurate tubes it is difficult to avoid an apparent elongation greater than the supposedly true effect.

Unless these causes of a possible elongation are eliminated, the elongation observed is subject to criticism.

Very soon after these experiments were published and before I was acquainted with them, I published in 1900 my first paper, in which I came to the conclusion that glass did *not* elongate when it was charged, and the effects observed by others were due to extraneous causes. Dr. Sacerdote criticised the paper, pointing out Cantone's results which in his opinion were the only trustworthy ones, and wrongly interpreting a statement of mine, maintained that my apparatus was not sensitive enough to observe such small values. In a subsequent paper I corrected Sacerdote's error and proved that my apparatus could and did detect much smaller quantities. But not content with this I have gone over the work again, using apparatus of the same nature, but considerably more sensitive.

While the question was in this state, Dr. Shearer made a series of experiments on glass and rubber tubes, measuring their changes by interference methods similar to Cantone's. Although he observed elongations, he accounted for them by heating and slight distortions due to an unsymmetrical field, confirming my own results in full.

My own apparatus consisted of three coaxial tubes, 65 cm. long, the middle one, of glass, was the experimental tube, about 4 cm. in diameter and 2 mm. thick; the other two, of heavy seamless brass tubing, formed the armatures or were connected electrically to tin-foil armatures pasted on the experimental glass tube. The three were fastened vertically in a massive iron base. Great care was used to have them rigid and accurate in alignment.

The magnifying arrangement was an optical one. It consisted of a little three-legged brass table, bearing a vertical mirror. The legs were made of needles which had an effective distance between the points of 3 mm. One of them rested on the top edge of the experimental tube and the other two on the inner brass one, so that any relative change of length of the tubes tipped the table and mirror. A lens with a focal length of a metre brought the image of a fine horizontal glass thread, after reflection in the mirror, to a sharp focus at a metre's distance in front of the tube. Then the vertical movement of this image when the mirror tilted was observed by a cathetometer microscope, one division of whose micrometer screw head was equal to 0.002 mm. As a result, a change of length of 6×10^{-6} mm. in the experimental tube could be observed.

The observations recorded by others have been for glass charged by armatures adherent to it, but this arrangement is certainly faulty as the electrical attraction of these must compress the glass between them mechanically and so expand it perpendicularly to this direction or in the direction measured. The correct disposition is to separate the armatures from the solid dielectric and to fill the intervening spaces with a non-conducting liquid of as nearly the same dielectric constant as possible. If this precaution is taken the attraction of the armatures cannot affect the glass, and by having a liquid of nearly the same dielectric constant as the glass, the drop in potential between the armatures is nearly constant. With my arrangement I could employ both methods. The results, as given in my last paper, may best be summarized separately for the cases of adherent and non-adherent armatures.

ADHERENT ARMATURES.

1. When a tube is first charged it apparently increases in length about 15 divisions of the micrometer, or 90×10^{-6} mm. for a potential difference of 33,000 volts. If the tube is charged more slowly, for about a minute, the elongation is more than double, and a less time in charging diminishes the effect to a very small displacement.

2. With an increasing potential the elongation increases, but not uniformly, and a return to lower potentials shows a value much less than the original deflection for that potential.

As the armatures are adherent, we must make a correction for their mechanical attraction. According to Poisson's theory for the expansion of a solid perpendicularly to a compressing force,

$$\delta l = \frac{1}{E} \frac{K V^2}{8 \pi d^2} \acute{o} l.$$

where E = Young's modulus,
K = the dielectric constant,
V = the potential difference,
$\acute{o}$ = Poisson's ratio,
l = the length of the tube,
d = the thickness of the tube.

Substituting the proper values for these constants, the increase in length, for $V = 33{,}000$ volts, is 3 divisions of the micrometer. That is at least one-fifth the elongation when a tube is first charged and one-half for subsequent charges.

Again, a correction is to be made for heating. This effect was quite apparent, as after the glass had been once charged it never came back to its original length; it then when discharged began to elongate slowly for a long time. For example, a tube when the image was perfectly steady, was charged and then discharged, in five minutes the image showed an increase in length of 92 divisions.

A simple calculation shows that a rise in temperature of 0.017° C. will expand such a tube the entire 15 divisions of the micrometer, or the average initial increase of the tube for a potential of 33,000 volts. It is almost impossible to measure the heating of the glass itself, but I did measure the increase of temperature of a layer of oil which filled the spaces between the experimental tube and the two brass ones, placed there to prevent leakage. One end of a thermopile, made of a single iron-platinum couple, was immersed in the oil and touched the surface of the glass, while the other was kept in melting ice. When the galvanometer, which was included in the circuit, was steady the tube was charged and discharged ten times. The galvanometer indicated a rise in temperature of the surface of the tube of from 0.4° to 0.9°. This is greater than is required to expand the glass the observed amount, and will, in connection with the mechanical pressure of the electrodes, account for all the observed phenomena—both of elongation with the charge and slow increase after the discharge.

NON-ADHERENT ARMATURES.

For experimenting with non-adherent armatures, the tin foil was removed from the experimental tube and the inner brass tube grounded while the outer one was charged by a static generator to a potential of from 33,000 to 45,000 volts. In order that these charges should not leak away from the charged tube, a glass cap was fitted over the top and bottom of it. The spaces between the three tubes were then filled with pure lard oil, which had been carefully filtered. Although the dielectric constant of this oil is somewhat less than that of glass, it was the only fluid which would maintain so high a potential for long without excessive leakage. With this arrangement, using potentials which ended always by shattering the glass, *no deflection occurred.* The heating, as the leakage along the surface of the glass was practically stopped, was very much diminished and still more retarded. So much so that the tube could be charged, observed and discharged before the rise in temperature was sufficient to deflect the image to any extent. While one charge and discharge with adherent electrodes heated the glass in five minutes sufficiently to expand it 92 divisions, ten charges and discharges produced now in four minutes a deflection of only 42 divisions. That no elongation by the strain of an electrical charge occurred could not be due to any lack of sensitiveness or accuracy of the apparatus, as it was capable of recording changes much less than those recorded by others.

The experiments are to me conclusive either that glass is not affected at all by strains in the ether or else it is a vanishingly small quantity. And further, I have shown that the observations of others may be fully accounted for by extraneous causes which they did not eliminate. This effect must, if I am found correct, be withdrawn as a proof of Faraday's and Maxwell's theory.

One of the most convincing proofs that dielectrics do not elongate is the fact that as our apparatus and methods are refined the elongation constantly diminished until they are now practically vanishing quantities.

Since my paper went to press Wüllner and Wien have published in *Drude's Annalen der Physik* a very elaborate and exhaustive series of experiments on electrostriction. They unfortunately used Quincke's method of thermometers. For this purpose the glass is blown into a large spherical or cylindrical bulb with a capillary tube sealed to it. The expansion of the volume of the glass produces an increase in the content of the bulb and a consequent lowering of the fluid in the capillary. Their results naturally confirm those of Quincke, which have been pronounced unsatisfactory both by Sacerdote and Shearer, as well as by myself. The principal sources of error of this method are the unavoidable change of shape and volume of a bulb, which is not and cannot be a perfect sphere or cylinder when it is subjected to the forces of an electrical charge, the heating of the bulb which cannot be measured and the inaccuracies in reading the meniscus of a capillary water column which is charged or near a charge.

Their work, while it is remarkable for its thoroughness and the care which its authors took to avoid and discuss errors, cannot influence the question much one way or the other, as they unfortunately adopted a defective method.

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Measurement of Current by Copper Voltameter.

By J. L. Dickson.

LET us assume that it is desired to measure the current of one 110-volt incandescent lamp and that we have no ammeter with which to accomplish the result, but that near at hand is a copper voltameter suited for the purpose.

In the diagram let G represent a tangent galvanometer; C a com-

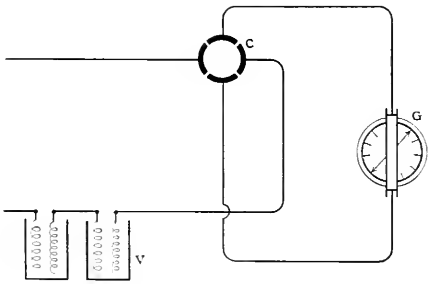


DIAGRAM OF CONNECTIONS.

mutator, which is used to reverse the current; V a copper voltameter consisting of two cells connected in series. The voltameter contains two copper wire coils, one the gain coil, the other the loss coil; the gain coils are shown in the diagram as being the smaller ones.

The gain coils should be weighed very accurately and placed inside the loss coils; then both coils should be placed in jars containing $CuSO_4$ (copper sulphate); this solution being made by dissolving one part (by weight) of crystals of copper sulphate in five parts (by weight) of water, and adding 1 per cent. of strong H_2SO_4 (sulphuric acid), this excess of acid serving to dissolve such impurities as may exist in the copper sulphate.

Now, let the apparatus be connected in series as shown in the diagram, the exact time taken and the current turned on. Allow the current to flow about 45 minutes, reversing its direction through the galvanometer, G, every five minutes by means of the commutator, C. Then remove the gain coils and dry them by dipping in distilled water, roll them on filter paper until only a thin film of water remains, then insert them in strong alcohol; dry on filter paper and weigh as soon as dry.

Suppose the following readings were obtained during a certain test:

Before run coil weighed.	After run coil weighed.	Time in min.
65.47 grams	65.87 grams.	45

From the above data the strength of the current in amperes can be calculated.

Let w_1 = the original weight of gain coil,
w_2 = the weight after current has passed,
t = time in seconds during which the current flows,
I = strength of current in amperes,
.000329 = the electrochemical equivalent for copper.

$$\text{Then } I = \frac{w_2 - w_1}{.000329\, t}, \text{ or}$$

$$I = \frac{65.87 - 65.47}{.000329 \times 45 \times 60}, \text{ or}$$

$$I = .45 \text{ ampere.}$$

This is the amount of current taken by one incandescent lamp at 110 volts. To determine H and the galvanometer constant, let us again assume that the average angle deflection of the galvanometer, G, was noted to be 60° when the current was flowing. From this the "reduction factor" of the galvanometer can be computed as follows:

The current equals the tangent of the angle of deflection multiplied by the constant, or algebraically it is:

$$I = K \tan D \quad (K \text{ being the constant}).$$

Substituting the values assumed, we have $.45 = K \times 1.73$, or

$$K = \frac{.45}{1.73}, \text{ or } K = .2601.$$

Therefore, "reduction factor" is .2601.

The general equation of the tangent galvanometer is:

$$H \tan \phi = \frac{2\pi\, n\, I}{r},$$

where H = horizontal intensity,
$\tan \phi$ = tangent angle of deflection,
n = number of turns on galvanometer,
I = current in absolute units,
r = radius of galvanometer.

$$\text{Let } n = 20 \text{ and } r = 14.85, \text{ then } 1.73\, H = \frac{2 \times 3.14 \times 20 \times .45}{14.85 \times 10},$$

or $H = .22$. This gives the horizontal intensity at a certain assumed point.

Rather Dear Lighting.

The annual report issued by the managers of the municipal lighting plant of Taunton, Mass., shows a cost per arc of $120.77 per year. The number of street lights operated was 247, and the number of hours burning was 2,987. The attempt is made as follows to put forth a better showing by Mr. Abner Coleman, the manager: "In figuring the cost of the street light, to the city, under the rule of the Board of Gas and Electric Light Commissioners, the cost is $120.77 per light per year. The cost is obtained by taking for one side of the account the total cost of interest, the amount charged off for depreciation, and the total cost of maintenance, from which is deducted the total income from light and power sold, less any increase of material on hand at the end of the year. Now, in figuring the total cost of interest, it includes that of the interest on the $175,000 bonds issued for the new station, and as this part of the equipment has earned but very little, it does not seem hardly fair to add to it the cost of street lights this year, so that deducting the amount of $6,125 from the total would show a cost of $96 per light. Of the total amount of the increased cost of coal, about $4,500 of the amount was a direct addition to the cost of the street lights, and added about $18.22 to the cost of each light for the year."

The Grounded Neutral.

By R. S. Hale.

Whether the grounded neutral is an advantage, as now seems to be the general opinion, or whether it is a disadvantage as some people would still try to make us believe, it is a condition and not a theory that confronts us in the Edison three-wire direct-current systems in the great cities of the country. The neutrals of these systems are so thoroughly grounded that it would probably be impossible to insulate them even if it should be attempted. Since they are grounded the electrical condition is different from the small insulated two-wire or three-wire systems with ground detectors on the switch board that formed the earliest type of electrical distribution, and why should we not take advantage of this difference? There are four ways in which the wiring on a three-wire system with grounded neutral can be done more cheaply and as safely or more safely than at present and these are as follows:

First, the use of single-pole switches instead of double-pole; second, the use of single-pole cut-outs instead of double-pole; third, the consolidation of the neutrals when there are several circuits side by side; and fourth, the use of a cheaper insulation or no insulation on the neutral.

First, in regard to the switches, let us consider the electrical condition of the circuits when in use and when disconnected. We need consider only the plus side since the conditions on the negative side will be practically the same.

When the circuit is connected the plus side is at 110 volts at all points (neglecting drop), the neutral is at zero potential at all points (again neglecting drop) and is solidly connected to the ground in the street. Inside the house the neutral is, according to present practice, insulated, but when the circuit is in use the neutral inside the house is connected to the ground through the switch, and outside neutral.

When the circuit is not in use, the neutral inside the house is (if a double-pole switch is used) disconnected from everything, and there is a possibility that it might be crossed with some high potential circuit, in which case this cross would not be discovered until some one touched either the neutral or positive inside the house, or until the circuit was again put in use. This obviously is a more dangerous condition of affairs than if the neutral inside the house were connected to ground at all times. The argument is easily recognized as the usual one in favor of a grounded neutral, and while a cross with high-tension wires is less probable inside the house than out, yet it is a possibility and should be guarded against if there is no accompanying disadvantage in the means used for protection.

That there is no disadvantage in having the neutral inside the house connected to ground at all times, is easily seen when we remember that the water pipes and gas pipes inside the house are solidly connected to ground at all times and hence also to the neutral wire in the street; and that if the neutral inside the house were connected to ground at all times it would be in exactly the same electrical condition as these same bare pipes.

The advantage of breaking the circuit at both poles, as with a double-pole, instead of at a single-pole switch, might seem to be in favor of the double-pole switch, but a single-pole switch with a break distance equivalent to a double-pole switch is much cheaper than the latter, and takes up much less room and is much less liable to get out of order. In case the neutral should be accidentally grounded inside the house, the positive side of the double-pole switch is the only side that breaks the current, while a single-pole switch of break distance equivalent to the double-pole would always be fully effective.

Next in regard to the cut-outs. If a double-pole cut-out is installed, both sides are effective in case of a short circuit between the two wires of the circuit. It is only the positive cut-out, however, that is effective in case of a short-circuit between the positive wire and the ground, which gives a worse short-circuit than between the two wires. Hence, if the cut-out on the positive side is sufficient for the worst case, why go to the expense of a cut-out that will be no more effective and will operate only in a few of the less dangerous cases? If, however, it is felt that the second cut-out is desirable, why not put it in series with the first cut-out, but put both on the positive leg where both will always be effective? It should be noted that if there should be an accidental ground on the neutral inside the house, the neutral cut-out is of no use whatsoever.

Third, in regard to consolidation of neutrals, frequently two circuits will be run side by side, as for instance the circuit for the public lights in the hall of a building and the circuits for the tenants. At present separate neutrals are run for each of these. Two No. 14 wires, however, cost much more than a single No. 10, which is rated at the same carrying capacity as the two smaller wires, and would operate much better, since there would be less drop in the neutral in case of unbalancing of either circuit, and would be better in practically every way.

There is, of course, one case in which the single-pole switch or single-pole cut-out, etc., might cause trouble, but it is a case which never occurs in house wiring, and should never occur in any wiring. The case referred to is when it is attempted to save copper by using a neutral smaller than the others. In such case opening the single-pole switch or blowing the single cut-out might throw a current on the neutral greater than its carrying capacity. Even in this case the cut-out on the neutral is a questionable advantage, since if one side of the circuit should be so overloaded as to blow the neutral fuse only, then nearly the whole pressure between the outers, say 150 or 200, or even 220 volts might be thrown on one side of the house wiring, and would be fully as dangerous a condition as if there had been no neutral fuse.

Fourth, in regard to the use of a cheaper insulation or bare wire for the neutral, in the old-fashioned systems of insulated circuits there was as much reason for insulating the return as the outgoing wire. In the modern system, however, with grounded neutral, the electrical pressure on the neutral can never be over a few volts, hence a much cheaper insulation gives an equal factor of safety for all purpose. In fact, when we remember that the gas pipes and water pipes and steam pipe system is in exactly the same electrical condition as the neutral, since they are solidly connected to the neutral outside the house, there would seem to be but little argument for insulating the neutral so carefully inside the house.

The insurance rules were made up at the time when the insulated systems were the rule, and their requirements for double-pole switches, double-pole cut-outs, separate neutrals for all circuits and for complete insulation on the neutral inside the house are a relic of the old days. The requirements for double-pole switches and double-pole cut-outs perhaps had a basis also in the added safety of an extra break on the switch, and an extra fuse to protect in case of some short circuits; but as has been shown above, the same safety can be secured more efficiently and cheaper by putting the extra break distance and the second fuse on the positive wire. That the insurance rule is merely a relic of the old days and is not based on any sound insurance or electrical reason is shown by the other insurance rule that does permit a single-pole switch on circuits carrying a small number of lights, with, however, no rule as to whether this switch shall be placed on the neutral or on the wire that has the current at the full main pressure. If such single-pole switch is placed on the main wire, the situation is just as recommended above, and the only reason for not extending it to larger circuits would seem to be the question of an efficient single-pole switch, which can be easily taken care of at a less expense than the present double-pole switch. If, however, the single-pole switch on these small circuits be placed on the neutral, as in allowed by the present rules and as is frequently done, then we have a very dangerous condition of affairs, since when the switch is open the ordinary tests, as for instance, screwing in a lamp, would indicate no current on the circuit, while grounding any part of it, either main wire or neutral, would give at least a spark and in some cases a short-circuit.

It is suggested, therefore, that with a view to greater safety and a very considerable saving in expense, that the insurance rules should require that in all connections to any three-wire system with grounded neutral, the neutral wire should be a solid connection at all points with no cut-outs or switches whatsoever, from the neutral wire in the street up to the lamp or current consuming device.

In order to make the switches and cut-outs equally efficient with the present installation in all cases (they would be much more efficient in most cases) it might be required than when the neutral is thus made solid, then on 110-volt systems only the switches and cut-outs now allowed for 250-volt systems be allowed, and that on 250-volt systems only the switches and cut-outs now allowed for 500 volts be permitted.

The rules should also be changed so that whenever a neutral wire is installed under such conditions that the maximum difference in pressure between it and ground does not exceed, say, 10 volts (this would be due only to drop) then only such insulation be required as is now required on bell wiring and similar systems with a corresponding maximum potential.

These changes will, as has been shown, give at least equal safety to the present rules, and in some cases be much safer. They will reduce by a considerable percentage the cost of wiring, which is still the greatest obstacle to the introduction of electric light. Therefore why cannot the electric companies and insurance companies arrange to take advantage of the situation as it actually exists, rather than cling to obsolete rules based on conditions that are obsolete for all the great electric installations?

In regard to this matter, I may say that I recently installed an isolated plant, and for this installation I obtained as a special case from the insurance office that had jurisdiction permission to use grounded neutral, single-pole switches, single pole cut-outs and to consolidate the neutral in several places, thereby saving in all several hundred dollars. The question of using a bare neutral was also spoken of, but in this case of factory work the difference in cost between bare wire and the ordinary wire permitted for all the work was so slight that I did not press the point. If rubber-covered wire had been required for the main wires, I think that I could have obtained permission to use a much cheaper grade of wire for the neutral. This installation has given no trouble in any way that I have heard of.

Blockmann Radio-Telegraph System.

By A. Frederick Collins.

It is surprising yet none the less true that nearly every improvement in wireless telegraphy may be traced back to the original researches of Heinrich Hertz, on the action of electromagnetic waves in air. This is again strikingly illustrated in a new system of radiotelegraphy recently patented by Georg Friedrich Rudolph Blockmann, of Kiel, Germany.

In this recent addition to the art of wireless transmission Blockmann has made use of a fundamental principle discovered by Hertz, namely, the refraction of electric waves through an insulating medium; but before examining into the practical and commercial possibilities of the German inventor's apparatus a review of his lamented compatriot's remarkable discoveries in electric radiation will be useful by way of introduction.

Hertz, in 1888, published in *Wiedemann's Annalen* 36[1] a paper "On Electric Radiation," in which he described a series of experimental results in the production and propagation of free electric waves. The apparatus he devised was similar to that used by him for producing longer waves, except that its dimensions were greatly reduced, and the oscillator in consequence radiated much shorter waves than in his preceding experiments.

The oscillator consisted of two brass rods, each 13 cm. in length, placed in a line, the abutting ends, forming the spark-gap, being fitted with brass spheres 4 cm.; this radiator was provided with its initial energy from the terminals of a small induction coil, giving a maximum spark of 4.5 cm.; three storage battery cells supplied current to the primary winding or inductor and for the experiments in this case the spheres of the spark-gap were brought to within 3 mm. of each other. The detector was a copper wire 1 mm. in thickness bent in a circular form, but having a diameter of only 7.5 cm.

One of the terminals of this resonator ended in a brass sphere 5 mm. in diameter, whilst the opposite terminal was provided with a screw adjustment, so that a spark-gap of micrometer dimensions could be obtained. Now with this apparatus Hertz was enabled to produce the electric ray, which may, without considerable error, be considered the path of the wave. It was by means of these distinct rays of electric force that this distinguished savant reproduced all the elementary experiments heretofore regarded as belonging strictly to the realm of optics.

The account he has given of the amalgamation of the electromagnetic theory and the physical demonstration thereof is exceeded in interest only by the beautiful manner in which he showed the consolidation of electric forces and those of the optics of light, and to these reasons may be attributed the scientific popularity into which wireless telegraphy instantly sprung on its introduction in 1897.

With the apparatus described above, Hertz first proved that the electric forces emitted were identical with light emanations and radiant heat by demonstrating the rectilinear propagation of the ray. This was accomplished by interposing a sheet of zinc at right angles to a line joining the parabolic mirrors when an electric shadow as complete as that presented by light was evident. Again he found that insulators such as wood, rosin, pitch, etc., do not in the least interfere with the passage of long electric waves through them, but that all of the metals (conductors) would intercept them. The test proved that electric waves like light have a rectilinear motion in a homogeneous medium.

The polarization and reflection of Hertz's electrically emitted ether wave does not concern the system of Blockmann, but it may be stated merely in order to progress logically to phenomena which do have a bearing on it. By interposing a screen or grid, made by stringing parallel wires over a wooden frame, Hertz was enabled to observe all the optical manifestations attendant upon the polarization of light by microscopically lined crystals.

That the waves could be reflected was long known to Hertz, and in the admirable apparatus he devised the data he obtained in his previous experiments were made use of and parabolic mirrors were provided, first to emit the incident rays and second to make these rays converge and concentrate them on the arms of the resonator. Based on this principle, Marconi designed his earliest wireless apparatus, but in the Blockmann system the reflection of the waves plays no principal rôle, although the fact that the waves may be reflected is taken advantage of in a secondary manner, which will be indicated presently.

The refraction of light as the bending of the luminous ray when passing from one medium into another is called, is familiar to everyone, but to attempt the experimental demonstration of refracting an electric wave, say a meter in length, would have surely astounded the mind of a lesser genius than Hertz. In order to find out, as he puts it, whether any refraction of the ray, from his oscillator, took place in passing from air into another insulating medium, he had a large prism made of hard pitch.

The base of this prism had two equal sides each of which measured 1.2 meters and having a reflecting angle of nearly 30°. The height of this great prism was 1.5 meters and it weighed 1,200 pounds. Its refracting edge was placed vertically, so that when an electric wave approached the side of the prism its lower end would strike the surface of the pitch first and enter it; then, since the velocity of electromagnetic waves is less in denser insulating mediums than in air, the lower end of the wave is retarded until finally the whole wave has entered the prism when the change of wave front has changed the direction of the ray in the pitch.

The wave now progresses in a straight line through the homogeneous mass until its upper end emerges first, and, acquiring the accelerated speed of light waves in air, namely, 186,500 miles per second, the wave by the time the lower end has left the prism has been bent out of the line of propagation and the ray is refracted from the perpendicular. This is precisely what Hertz anticipated, and this is exactly what actually occurred. The waves were refracted, the ray was bent out of its normal line of propagation and to the mind of Hertz and to the satisfaction of every living physicist all doubt as to the identity of light, radiant heat and electromagnetic wave motion was removed.

Now, the certain new and useful improvements in wireless telegraphic transmitting and receiving apparatii, as invented by Georg F. R. Blockmann[2] is the practical outcome of the foregoing experiments of Hertz in refracting electric waves. Likewise, it is an example of how every niche in the art of wireless transmission is rapidly being filled in. The advantages of the heliograph in signalling is well known and to those who have had occasion to use it its objectionable features are even better known. Blockmann has nicely filled in the gap between the visible light signals of the heliograph and the invisible signals of the wireless telegraph.

Like the former and unlike the latter signals may be transmitted in any direction, but unlike the former and like the latter its rays may be sent forth in cloudy weather and at night equally as well as in the bright sunlight of day.

His invention, as indicated in a recent patent specification, consists of a transmitting and receiving apparatus, each of which are contained in a metallic box. The vertical sectional elevations, *I* and *II*, Fig. 1, and the side elevations (Fig. 2) gives an excellent idea of the principles underlying his system. The transmitter, *I*, comprises a metallic chamber for the purpose of intercepting and pre-

[1] Reproduced in Hertz' "Electric Waves," translated by D. E. Jones.

[2] U. S. Letters Patent 736,483.

venting the passage of electric rays into the interior chamber, except through the lens, *h*, which may be constructed of any suitable electric wave refracting material, such as rosin, wax, pitch, etc.

The casing or chamber is made large enough to not only include all the instruments, but may be virtually a station so that an operator may conveniently work the apparatus from the inside. However this may be, the source of e.m.f., as a battery or generator, *d*, a Morse key, *e*, for breaking up the circuit into the Continental code, the induction coil, *g*, with its attendant interrupter, *f*, and an oscillator or radiator, *c*, is contained therein. The latter is subsequently enclosed in a metal casing placed back of a tubular metal cone, having fastened in its larger diameter the lens of insulating material, *h*.

The chamber is pivotally mounted on a suitable support, *a*, so that it may be turned in any direction in azimuth; the lens, *h*, with its tube and oscillator, is also supported by pivots and may be moved through an arc of 30° vertically; by the compound movements of the lens and chamber it is possible to turn the lens in any direction, both in azimuth and altitude.

Blockmann points out that the same effect may be obtained by the suspension of the chamber from gimbels, as in the searchlight or in the manner of mounting turret guns. In his patent drawings the inventor shows the receiving chamber, *II*, also made of metal mounted above the transmitter, *I*, as indicated in Fig. 2, and arranged to follow the compound movements of the transmitter by means of the levers, t_1 *t*, and the connecting rod, *u*. It is obvious, however, that the sending and receiving chamber may be operated independently of each other.

The general arrangement of the transmitter and receiver are similar. In the focus of the two, *l*, of the receiving chamber is placed the ray detector, *m*, in the form of the usual coherer and the other appliances for receiving a message; these comprise the regulation tapper—not shown—the relay, *n*, in series with the coherer, a local cell, *o*, and a second local circuit, including the tapper, Morse register, *r*, and battery, *p*, for operating them. This apparatus may, of course, be replaced by the American type of receptor using instead an auto-coherer and a pair of head telephones. One of the strongest features of the new system is its applicability to firing mines by electricity, when the key of the transmitter may be made to close and remain so for a predetermined period of time. A correspondent from Berlin has communicated to the writer the interesting news that the German Government is now testing the merits of the system for specialized classes of work.

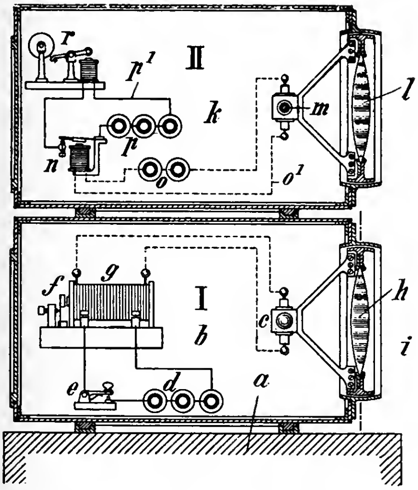


FIG. 1.—RADIOTELEGRAPH SYSTEM.

To facilitate the directing of the lenses, small finding telescopes—called finders—are rigidly mounted on the levers in front of graduated and arcuated bars, *v*, and the flexibility of the system makes it especially commendable for serving a greater variety of purposes and in a more exact manner than is possible with the ordinary wireless telegraph.

The range of Blockmann's apparatus is not nearly so great as with the grounded oscillator and resonator systems, and, therefore, excludes a large amount of uncertainty due to atmospheric changes to which the older systems are subject, and having no high masts to render its position conspicuous and as an arbitrary method for obtaining selectivity it is certainly a success.

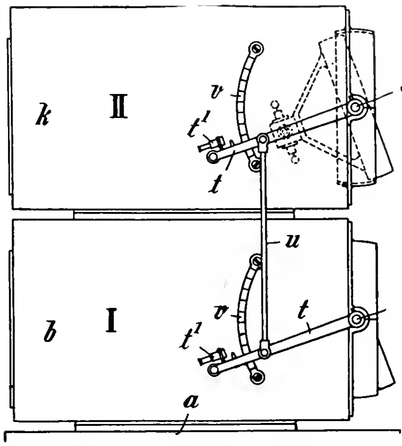


FIG. 2.—RADIOTELEGRAPH SYSTEM.

Blockmann does not limit his invention to the simple convex lens nor to any specific material for their construction, but broadly states that all methods known to optics for the intensification, enlargement and concentration of luminous rays such as compound lenses, etc., is embraced in the scope of his present apparatus for electric ray telegraphy, all of which is an interesting practical application of Hertz's fundamental observations.

Electric Traction in Italy.

Mr. Richard Guenther, the United States Consul-General at Frankfort, Germany, makes notes of the following: "The Frankfort *Journal of Commerce* states that electric propulsion by means of accumulators on the Italian Meridional route has not proved a success. The management of the road has, therefore, been authorized to discontinue this electric system on certain lines and to replace it by steam.

"The electric system, however, by trolleys over the 90-odd miles of the standard-gauge railroad along Lake Como has met all requirements. Some days ago a meeting of interested parties took place at the instance of the Chambers of Commerce of Milan, Lecco and Chiavenna, which resolved to request the government to immediately establish the trolley system upon the lines of Lecco to Milan. The results with the electric system with a third rail over the 45 miles of the standard-gauge Milan-Varese-Porto Ceresio Railroad have been entirely satisfactory. The traffic on this line, which connects Milan with Lake Lugano, has increased surprisingly on account of the cheaper rates, number of trains and quicker time. The management of the road is perfectly satisfied with the financial result.

"The Mediterranean Railroad contemplates the extension of the electric system with a third rail over the lines Verese-Laveno-Gallarat-Sesto Calende-Arona, so that then Milan will be directly connected with the upper Italian lakes by four electric standard railroads."

Distance No Object.

At a meeting of a scientific society at Strasburg, Germany, on January 9, according to press dispatch, Prof. Braun, inventor of the system of wireless telegraphy named after him, stated that recent discoveries and improvements made the question of distance in etherography of no importance.

Methods of Signaling and Operating in Telephone Exchanges.—IV.

By Kempster B. Miller and Charles S. Winston.

IV. TOLL CONNECTIONS.

Methods of handling toll connections are much more diversified than those by which connections of a purely local nature or those between two subscribers in the same exchange are brought about. The problem is different and more complex, as the requirements are more exacting and difficult of fulfilment, and many factors enter which need not be taken into consideration in handling local connections. As a result the service of an increased number of operators is involved in making a toll connection and a more or less complex system of accounting must be put into effect.

In toll work the call is nearly always for a party in a distant city or town whose name and address, together with his telephone number (if he has one) must be taken, as must also in most cases, the same data concerning the party calling. This necessitates a written ticket being made out that serves not only as a memorandum to the toll operator in bringing about the connection but also as a basis of the toll charge. As the time of the conversation and the predetermined rate between the points concerned determine the amount of the charge for any conversation, the measuring of the time elapsed from the moment when the parties are actuallly brought together, until they release the toll line, is naturally important, and adequate means must be provided for its accomplishment.

An entirely different class of work on the part of the operators is required which necessitates special operators trained in this particular line. The system should be so devised that these toll operators may co-operate with the local or subscriber's operators without in any way making the work of these latter operators special or out of the ordinary. A poor toll system will do much to hamper the work of the local operators, thus reducing their efficiency and increasing the cost of operation; but of even greater importance a poor toll system will cause a direct loss of revenue by the delays during and between conversations. The greatest investment of money in a toll line system is in the lines themselves, and the earning power of toll lines depends (after the rates are fixed) on the proportion of the time they are kept busy, and this, provided the traffic is good, depends largely on the speed in making up the circuits and getting the parties together.

It is evident that there are three general classes of connections through a toll board; "Local to Toll," where a local subscriber calls through the multiple board for a toll connection; "Toll to Local," where a call is received over a toll line for connection with a local subscriber; and "Toll to Toll" or "through" connections where a call is received over one toll line for connection with another.

KELLOGG TOLL SYSTEM A, USING RECORDING OPERATOR.

The Kellogg Switchboard and Supply Company has two standard methods of handling calls between toll and local subscribers. Wherever the toll board is of considerable size, or, generally, wherever the toll lines are multipled throughout the several sections of the toll board, it is customary to provide, in addition to the regular toll line positions, one or more positions known as recording operator's positions and, at the local multiple switchboard, one or more positions known as incoming toll trunk positions. The recording operator is concerned only with local to toll calls, while toll trunk operators, or toll switching operators as they are often called, have a hand in making all connections between toll and local subscribers. At night, or whenever the toll business is light, it is customary for the recording operator to handle all business at the toll board, and on this account it is the usual thing to place within the reach of the recording operator's position a multiple of all toll lines and a multiple of the toll trunk lines.

Each toll operator's position is equipped with a sufficient number of two kinds of cord circuits: toll to local, used for making all connections in either direction between a local subscriber and a toll line; and toll to toll, used in connecting two toll lines.

Each toll to local cord circuit includes a repeating coil and has on its local side a supervisory lamp adapted to be placed under the control of the subscriber, this side being adapted to common battery work. The toll side is adapted to magneto signaling, and has bridged across it a clearing out drop.

The toll to toll cord circuits have no repeating coils, and in addition to the usual listening and ringing keys a clearing-out drop is bridged across as in the ordinary magneto cord circuit.

Between the recording operator's position and the subscriber's operator's positions on the local multiple board extend a number of "recording toll trunks," each of these terminating in a jack and a lamp on the recording operator's position, and on the multiple board in jacks multipled through all the sections in the same manner as regular subscriber's lines. By these recording toll trunks the calling subscriber is originally put in communication with the recording toll operator.

The recording operator has a number of listening cords to enable her to receive instructions over the recording toll trunks; and in addition to these she has for night work a number of toll to local and toll to toll cords, for performing the ordinary duties of a toll operator.

When a local subscriber desires a toll connection, he will signal his operator at the local multiple board in the ordinary way, and in response to her question will state that he desires a "long distance" or toll connection.

Upon receiving a call for a toll line the subscriber's operator will then test the multiple jacks of the recording toll trunk circuits until she finds one which is not in use; and will then insert the calling plug associated with the answeing plug, which is already in the answering jack of the calling subscriber, into this trunk jack. This act will light the lamp associated with the recording toll trunk at the recording operator's position on the toll board. The calling supervisory lamp at the multiple board will not light, and thus the recording operator will be given entire charge of the connection. The recording operator will plug into the recording trunk jack with one of her listening plugs and, speaking directly to the calling subscriber,

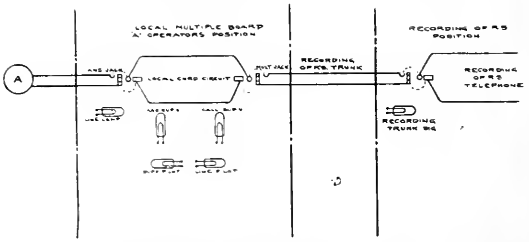


FIG. 6.—SHOWING CONNECTION BETWEEN RECORDING OPERATOR AND CALLING SUBSCRIBER IN KELLOGG SYSTEM "A."

find out whatever information is needed for making the connection. The connection thus established between the calling subscriber and the recording operator is shown in Fig. 6.

With the information thus obtained from the calling subscriber the recording operator will make out a ticket noting the numbers and necessary information to identify the calling and the called subscribers. She will then tell the calling subscriber to hang up his receiver and wait until called, and she herself will withdraw the listening plug from the recording toll trunk jack. When the calling subscriber hangs up his receiver, the answering supervisory lamp at the multiple switchboard will light, and when the recording operator withdraws the listening plug, the calling supervisory lamp also will light, and the operator at the local board will remove the connection.

The connection so far established is thus entirely destroyed, it having been made merely for the purpose of conveying the order directly from the calling subscriber to the recording toll operator. The final connection between this subscriber and the toll subscriber will, as will be seen, be made through an entirely different channel.

It will be noticed that the work on the part of the subscriber's operator was in this case regular, and that the action of her supervisory signals conveyed the same meaning to her as in the case of any purely local connection.

The method described, of selecting the trunk to the recording operator merits attention. It is one of the few cases where it is found better to have the operator at the originating or outgoing end of a trunk test for a free trunk rather than have the operator at the distant or incoming end designate the trunk by order wire. There is good reason for this apparent departure. In toll work, in order to avoid mistakes, and to relieve the "A" operator of special work, it is best to have the calling subscriber give his order directly to the operator at the toll board. There is, therefore, no need of order wires. Moreover, it would confuse the recording operator while making out a ticket for one connection, to be interrupted by receiving order wire instructions from subscriber's operators. Under the arrangement spoken of, the recording operator may make out the tickets of each waiting subscriber in turn, accuracy in this respect being of paramount importance, warranting some sacrifice of the calling subscriber's time.

After the recording operator has made out the ticket she will pass it to one of the toll line operators, who will test a multiple jack of the desired toll line with the toll plug of one of her toll to local cord circuits, or find out by other means whether the toll line is busy. In case it is not busy, she will insert this plug into the jack and ring up the distant subscriber, or the operator or operators at distant exchanges, necessary to make up the connection. The connection may be ordered up, as is frequently the case, by telegraph over separate lines, or over the telephone lines duplexed.

As soon as the connection has been made up at the toll board and the called-for party has been secured, the toll operator will speak over an order wire to the toll switching operator at the local multiple

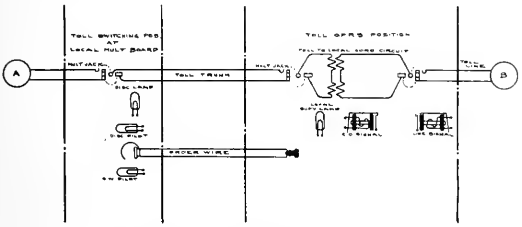


FIG. 7.—SHOWING CONNECTION BETWEEN TOLL AND LOCAL SUBSCRIBER IN KELLOGG SYSTEM "A."

board and give her the number of the subscriber who previously called for toll, and tell her to put up a trunk connection. In the building up of this, the final connection between the calling local subscriber and the toll subscriber, reference is made to Fig. 7.

The trunk lines, leading from the toll board to the toll trunk operator's position on the multiple board, end in plugs at the latter position and in jacks at the toll board, these jacks being multipled through the toll sections. The toll trunk operator will designate the trunk line which is to be used, and, *without testing*, insert the plug of this trunk into the multiple jack of the subscriber designated. At the same time the toll operator will also, without testing, insert the local plug, which is associated with the toll plug already in the toll line jack, into the multiple jack of the toll trunk line. If the local subscriber's line is in use, the supervisory lamp in the local side of the toll to local cord circuit at the toll board will not light, but if the line is not in use, this lamp will light. Thus the supervisory lamp acts as a ringing signal for the toll operator, enabling her to ring the local subscriber who made the call, the instant he hangs up his receiver, in case he was using his telephone on another connection while waiting to be called by the toll operator.

If the toll switching operator at the multiple board was obliged to test before plugging into the multiple jack, the operation would not be as rapid and the toll operator would be very much delayed, as it would be necessary for her to keep reminding the toll switching operator to keep on testing until she found that the line was not in use. As soon as the toll operator receives the signal, as described, she will throw the ringing key and ring the bell of the local subscriber.

After the incoming toll trunk operator has inserted the trunk plug into the multiple jack, the toll operator has entire charge of the connection. At the end of conversation the toll subscriber will, by turning his hand generator, throw the clearing out drop at the toll board, or this may be done by a distant toll operator; and the local subscriber, by hanging up his receiver, will light the supervisory lamp in the local side of the toll cord circuit. The toll operator will then take down the connection.

The act on the part of the toll operator of withdrawing the local plug from the toll trunk jack will light the clearing-out lamp associated with the toll trunk plug in the multiple jack at the local switchboard. The toll trunk operator will then take down the connection, and the calling subscriber's line will be free for another connection.

At the toll switching operator's postion at the multiple board it is customary to locate an order wire pilot lamp which lights whenever an incoming order wire call is received at that position, if a switching key at that position has been thrown. If there are in the exchange two or more toll trunk positions or toll trunk and incoming trunk positions, arrangement may be made so that incoming calls may be switched from one position to another in the same way that incoming calls are switched from one incoming trunk position to another.

The establishing of the final toll connection over a different portion of the multiple board than that at which the local subscriber's call originated, *i. e.*, through the multiple jack at the toll trunk position, rather than through the answering jack of the calling line, has an advantage not yet mentioned, in that it largely removes the possibility of fraud on the part of the calling subscriber. Owing to changes which may have been made at the intermediate distributing board, in the relation of the answering jack to the multiple jacks of any line; and owing to the existence of party lines where several subscribers are served by the same line, the operator who answers a call cannot tell whether a calling subscriber gives the proper number or not. The recording operator who receives this information directly from the calling subscriber has even less chance of knowing this. Under the arrangement described, where the original connection is taken down and the calling subscriber afterwards called through the multiple jack of the toll trunking position, any subscriber who attempted to get the toll connection charged to someone else would not get his connection at all, because the toll trunking operator would plug into the wrong multiple jack.

Calls from a toll line for a local connection ("toll to local") are handled in practically the same manner described above after the preliminary connection between the calling subscriber and the recording operator has been taken down and the ticket passed to the toll operator. In the toll to local connection the recording operator and the subscriber's operator play no part. The ticket is made out by the toll line operator who orders up the connection with the subscriber called for at the toll trunking position as before. Fig. 7 is therefore illustrative of a toll to local connection also.

KELLOGG TOLL SYSTEM B, USING NO RECORDING OPERATOR.

In small exchanges where the toll business does not justify having multiple toll boards, circuits known as two-way toll trunk circuits are provided. Each of these circuits ends at the multiple board in a plug and a lamp, and at the toll board in a cut-off jack and a lamp.

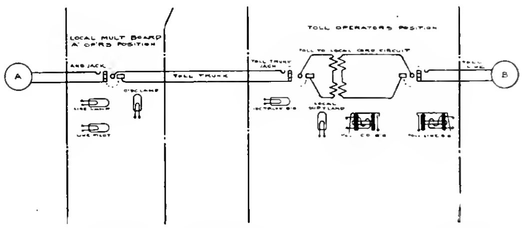


FIG. 8.—SHOWING CONNECTION BETWEEN LOCAL AND TOLL SUBSCRIBER IN KELLOGG SYSTEM "B."

The number of these circuits provided depends, of course, upon the amount of business which they will have to handle, but it is customary in many cases to provide two circuits at the right of every other operator's position. In this case each toll operator acts as a recording operator, and after receiving a call from the multiple board for a toll connection, puts up the connection herself, without the help of another operator. In describing this system reference is made to Fig. 8.

In this system the method of operation when a local subscriber calls for a toll connection, is as follows: The local subscriber signals his operator in the ordinary way and the operator inserts the answering plug of one of her cord circuits into the answering jack and finds out that connection with a toll line is desired. She then withdraws the answering plug from the answering jack and in its place inserts the plug of a two-way trunk line. This act will light the lamp associated with the toll board end of this trunk line. The toll operator will then insert the local side of one of her toll to local cord circuits into the jack of this trunk line and find out from the local subscriber the number of the toll line with which he desires to be connected. She will then insert the toll side of the cord circuit into the jack of this toll line and ring. She will find out by listening in at short intervals when the toll subscriber answers.

At the end of conversation the toll subscriber, or the distant toll operator, will throw down the clearing-out drop, and the local subscriber, by hanging up his receiver, will light the supervisory lamp in the local side of the toll to local cord circuit. When used for a local to toll connection this supervisory lamp does not light until conversation is finished. When the toll operator withdraws the local plug from the two-way trunk jack, the clearing-out lamp associated with the local board end of this trunk will light, and the subscriber's operator will take down the connection at the local board.

In the case of a call from a toll subscriber for a local subscriber, the toll subscriber will throw down the line drop at the toll board and the toll operator will plug in with the toll plug of a pair of toll to local cords, throw the listening key and find out that connection is desired with a local subscriber. She will then speak over an order wire to one of the operators at the multiple board, who has within her reach one or more of the plugs of the two-way toll trunk lines. The operator at the multiple board will designate the trunk line which is to be used and, without testing, insert the plug of this trunk into the multiple jack of the desired line and at the same time the toll operator will insert the local plug into the jack of this same trunk. The supervisory lamp in the local side of the cord circuit at the toll board will light, if the local subscriber's line is not busy, and the toll operator will ring. Thus the supervisory lamp in a toll to local cord circuit serves as a ringing signal in the same manner as described in connection with the toll system when recording operators are employed. When the local subscriber answers in response to the ringing of the operator, this lamp will be extinguished. At the end of conversation the toll operator will receive the disconnect signal from both the local subscriber and the toll subscriber, and will remove the toll and local plugs from the toll and trunk jacks, respectively. The act of removing the local plug from the latter will light the clearing-out lamp at the multiple board and the local operator will take down the connection.

In case the toll and local operators misundertand each other, and the toll operator plugs into a trunk line jack, other than the one assigned, the supervisory lamp in the local side of the cord circuit in use will not light, and the clearing-out lamp associated with the trunk plug which the local operator has inserted at the multiple jack, will light. In this way these lamps serve as guards against inaccurate connections.

In this system many of the refinements of the more complete Kellogg System A are lacking, but in many towns where the toll business is comparatively small, and the matter of first cost considerable, it has been found expedient to adopt it. In small exchanges the work does not warrant the expense of a toll trunk operator, and it is seen in this latter system, the work of the toll trunk operator is distributed among the subscriber's operators, while the work of the recording operator is distributed among the toll operators. Thus the principle of having the subscriber's operator do no work of a special nature, is sacrificed to expediency. The feature of preventing fraud on the part of a calling local subscriber is also sacrificed, but in small exchanges this feature is not as important as in large ones.

Recent Electrochemical Developments.

MERCURY CATHODE PROCESS FOR THE ELECTROLYSIS OF SODIUM CHLORIDE.

In a patent granted on January 5 to Mr. J. J. Rink, of Elsinore, Denmark, an apparatus for the electrolysis of sodium chloride is described in which a horizontal layer of mercury is continually moved through a series of cells in which the mercury is alternately alloyed with sodium and again decomposed. The first, third, etc., cells are, therefore, electrolytic cells in which by cathodic reaction sodium amalgam is produced, while the second, fourth, etc., cells serve for liberating the sodium from the amalgam and forming sodium hydroxide. The main new feature of the arrangement appears to be that the inventor makes the area of surface of mercury twice as great in the cells in which the mercury gives off its sodium, than in the electrolytic cells in which it is charged with the sodium. The electrolytic cells are made narrow in the direction of the movement of the mercury in order to keep the degree of amalgamation of the mercury low, while the large surface exposed to the lye in the other chambers enables the mercury to give off the sodium fully to the solution, so that pure mercury is introduced into the next electrolytic cell.

ELECTROLYTIC PRODUCTION OF HYDROXIDES AND OXIDES.

A patent granted to Mr. F. F. Hunt, of New Brighton, N. Y., describes the following method of electrolytically producing hydroxides or oxides of metals: Both electrodes of the electrolytic cell are made of the metal, the hydroxide or oxide of which is to be produced. If, for instance, tin hydroxide is wanted, both electrodes are of tin and a solution of sodium chloride is used as electrolyte. The current produces tin chloride at the anode and sodium hydroxide and hydrogen at the cathode; the tin chloride and sodium hydroxide then react with each other, with a resulting formation of sodium chloride and tin hydroxide. During the process water is lost, but the sodium chloride is continually regenerated, while tin hydroxide is produced. After a while polarization at the cathode would set in and would diminish the economy of the process. The inventor, therefore, reverses at suitable intervals (for instance, every minute) the direction of the current through the cell, thus making each electrode alternately anode and cathode. This appears to be the chief feature of his method. If the electrodes are made of a metal which does not form a hydroxide, like silver, the oxide instead of the hydroxide is formed.

STORAGE BATTERY INVENTION.

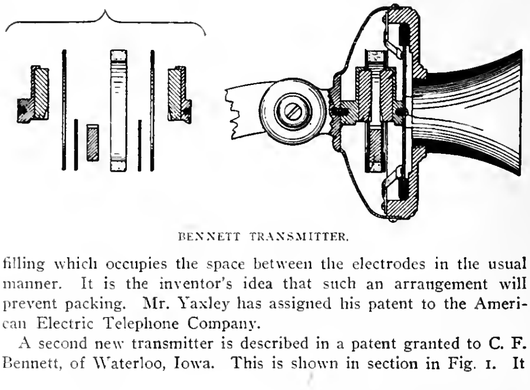
A patent granted to Mr. F. A. Feldkamp, of Newark, N. J., refers to a method of formation of accumulator plates by the following chemical process: Against a sheet of lead there are placed one or more pieces of suitable porous material, such as linen, cotton, cheese-cloth or other loosely-woven fabric in sufficient layers to obtain the desired thickness. For fastening these layers of porous material to the lead conductor, a method of sewing is used covered by a previous patent of the inventor. Upon the porous material is then sprinkled zinc dust or granular zinc and the plate is then suspended in a solution of lead acetate or lead nitrate with the result that lead separates from the solution and becomes thoroughly imbedded in the porous material in the form of spongy lead. The porous material or fabric may first be treated to render it acid proof.

New Telephone Patents.

NEW GRANULAR TRANSMITTER.

Since the scientific investigation of the so-called microphonic distance of various conducting substances some years ago, by which investigation it was proved conclusively that a maximum microphonic effect existed in a carbon contact, almost all transmitters have been designed using carbon electrodes. Here and there we find a departure from the general rule, some metal being used for one or both of the electrodes.

Last week's patent issue describes such a transmitter, in this case but one electrode—the stationary one—being of metal. This transmitter is the invention of E. E. Yaxley, of Chicago. The front electrode is a mass of carbon granules securely cemented to the diaphragm; while the rear one is of brass, cup-shaped, the bottom being corrugated. Over the mouth of this cup there is secured a perforated brass plate through which may freely pass the granular carbon



BENNETT TRANSMITTER.

filling which occupies the space between the electrodes in the usual manner. It is the inventor's idea that such an arrangement will prevent packing. Mr. Yaxley has assigned his patent to the American Electric Telephone Company.

A second new transmitter is described in a patent granted to C. F. Bennett, of Waterloo, Iowa. This is shown in section in Fig. 1. It will be at once noted that the movable electrodes comprise the upper portion of the walls of the button. The lower portion of the button is a carbon block with its upper surface practically horizontal. This forms a base upon which is mounted mica sectors and rings, which form a packing through which the semi-circular electrodes may freely vibrate to compress the carbon granules. A serrated upper surface to the stationary carbon block assists in agitating the granules.

PARTY LINE SYSTEM.

N. E. Norstrom, of Chicago, has patented a party line system embracing both subscribers' and central office mechanisms for selective and lock-out working. Unfortunately, the method of selection depends upon step-by-step switches, these being located at the subscribers' stations. This introduces such complication at the subscribers' stations that the system appears a retrograde step from the best modern systems.

Telephone Transmitters.—V.

By Arthur V. Abbott, C. E.

ERICSSON Transmitter.—The Ericsson Telephone Co. presents a transmitter which is somewhat unique in design and differs decidedly from most of those of American manufacture. In Fig. 35 a combined transmitter and receiver is shown, and also a model of the transmitter by itself. In Fig. 36 the transmitter of the combined model is shown dissected. In Fig. 37 the individual transmitter is opened, while in Fig. 38 it is completely dissected. In many respects the Ericsson transmitter resembles that manufactured by the Stromberg-Carlson Company.

The transmitter consists of a case of two parts ½ in. thick and 2¼ in. in diameter, made of pressed brass. The front half carries the diaphragm, as is shown in Fig. 37. This is of iron 2⅛ in. in

FIG. 35.—ERICSSON COMBINED TRANSMITTER AND RECEIVER.

diameter and .012 in. thick. The front electrode consists of a piece of brass in which a number of corrugations are punched, as is shown in Figs. 37 and 38. This front electrode may or may not be gold-plated, and is secured to the front of the diaphragm by means of a screw and carried to one side of the case and then attached underneath one of the springs, which check diaphragm vibrations. The capsule containing the carbon is curious. It consists in the first

FIG. 36.—ERICSSON INSTRUMENT DISSECTED.

place of a pressed brass cup, as shown in Fig. 38. This is lined with a celluloid washer, upon which a spider-shaped copper spring is placed. On top of the copper spring a carbon electrode is secured

FIG. 37.—ERICSSON TRANSMITTER PARTS.

and then around this electrode a felt ring 5/16 in. thick and 1¼ in. in diameter is placed. In the center of the electrode a little bit of felt is placed, as shown in Fig. 36. The interior of the felt ring is filled with 12 grains of coarse granular carbon. The carbon electrode is 7/16 in. in diameter, and contains three circular grooves. The diaphragm is protected by means of two heavy layers of oil silk and is cushioned by two rings of blotting paper.

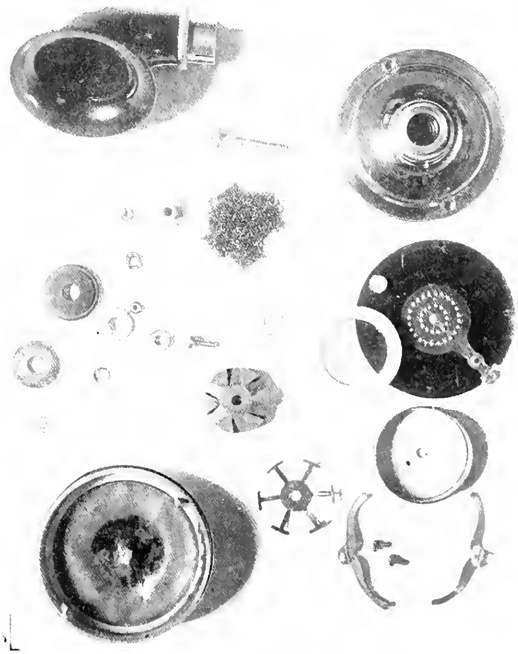


FIG. 38.—ERICSSON TRANSMITTER DISSECTED.

The Manhattan Transmitter.—The transmitter manufactured by the Manhattan Telephone Company is shown at *D*, Fig. 21. In Fig. 39 the rear cover is removed and in Fig. 40 the instrument is dissected. There is a light brass face plate fashioned in the usual manner, which contains a rough aluminum diaphragm 2⅜ in. in

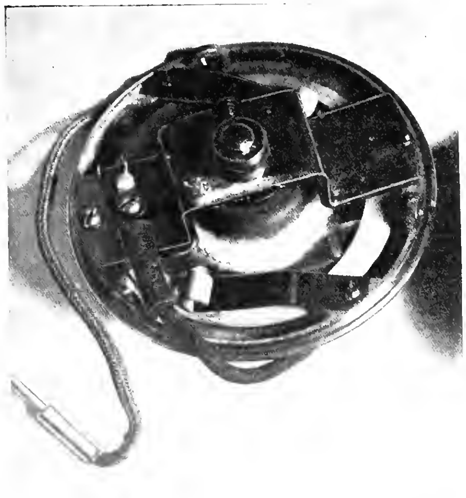


FIG. 39.—MANHATTAN TRANSMITTER WITH REAR COVER REMOVED.

diameter and .021 in. thick. On this diaphragm a heavy piece of flannel is cemented, and in the center of the flannel is placed a carbon electrode ½ in. in diameter. The rear electrode is designed to combine both the functions of an electrode and of a capsule for retaining the granular carbon. It consists of a round carbon block, having a deep cavity and a sharp edge, as shown in Fig. 40. This carbon block is ⅛ in. more in diameter than the front electrode and

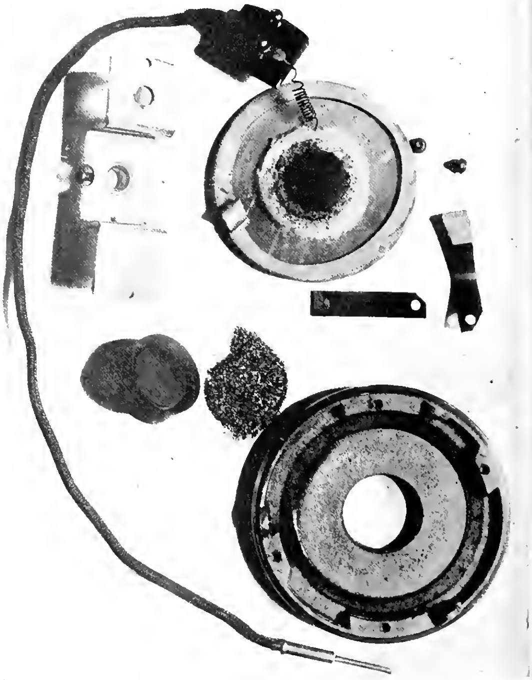


FIG. 40.—MANHATTAN TRANSMITTER DISSECTED.

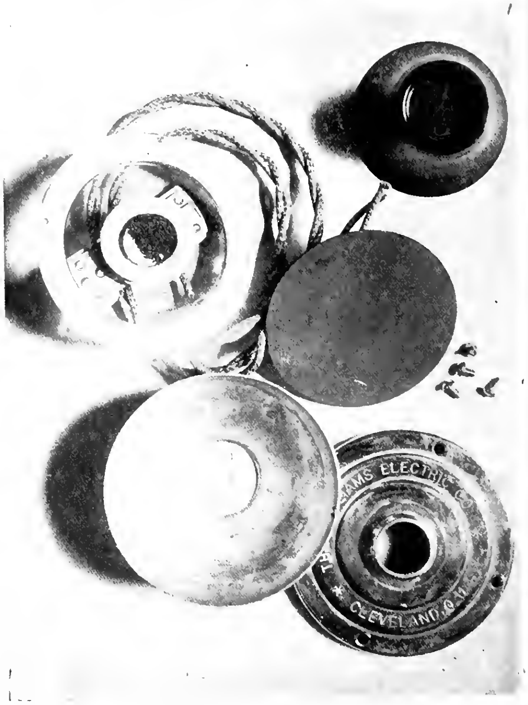


FIG. 41.—WILLIAMS TRANSMITTER DISSECTED.

is filled with 8 grains of granular carbon; then the diaphragm is placed over it so that the flannel covers the sharp edge of the cup.

The bridge, ⅞ in. wide and 1/16 in. thick, is then placed over a stud to which the carbon cup is attached and the whole placed upon the face plate, the bridge being secured by two screws.

This design relies upon the elasticity of the felt to seal the circumference of the carbon cup and to retain the granular carbon in position. A general construction of the instrument prior to the removal of the bridge may be readily seen from Fig. 39.

The Williams Transmitter.—This instrument is shown in Fig. 21 at *G* and in Figs. 41 and 42 dissected. The general shape of this transmitter is similar to all of the solid backs which use a hemispherical cap, but in this case both the front and rear of the instrument are of brass .03 in. in thickness. The diaphragm is of carbon

FIG. 42.—WILLIAMS TRANSMITTER DISSECTED.

2½ in. in diameter and .038 of an in. thick. It is placed directly upon the front half of the case without any cushion. The front of the carbon is covered with a heavy layer of varnish, presumably to make the carbon moisture-proof. The bridge consists of two parts, as shown in Fig. 42, a circular ring stamped out of brass, and a cross bar which is attached thereto by means of four insulated screws and rubber washers. This cross piece carries a spring, as is shown in Fig. 42, .018 of an in. thick and 2 in. long. The rear electrode consists of a disc of brass 1⅛ in. in diameter and .022 in. thick. This plate is dished in the center and provided with a small spool-shaped projection having a sharp point. This projection engages with the spring on the bridge, and the point centers in an adjusting screw that runs through the middle of the bridge plate. On the face of this electrode a ring of felt 1⅛ in. in diameter over all, ⅛ in. thick, with a ¾-in. hole, is cemented. This is filled with 8 grains of granular carbon and pressed directly upon the rear of the carbon diaphragm. It is evidently the office of the spring upon the bridge to keep the rear electrode and its ring of felt pressed tightly against the carbon diaphragm, while the adjusting screw is supposed to secure the necessary solidity by impinging upon the sharp tip which projects from the rear of the brass plate.

To the Front.

It is stated that the Japanese Government has ordered back to Japan twelve of the fifteen Japanese engineers who are at the Westinghouse Electric Company's plant at East Pittsburg, on account of the threatened war.

Meeting of the Chicago Electrical Association.

The evening of January 8 a large number of visitors and members of the Chicago Electrical Association listened to a very interesting lecture by Mr. C. G. Y. King, mechanical engineer of the Chicago Edison Company, on the erection of the 5,000-kw turbo-generators in the Fisk Street Station. A large number of lantern slides served to illustrate the successive steps taken in the work of preparing the foundations for and the erection of the units proper. This also afforded those present an opportunity to study the design and actual construction of a turbo-generator. The plan and cross-section of the power house was also shown and the lay-out of the same likened by Mr. King to a comb, the turbine room or row of turbines corresponding to the back of a comb and the batteries of the boilers to the teeth of the comb arranged at right angles to the turbine room.

The subject of an affiliation of the Chicago Electrical Association with the Western Society of Engineers was brought to the attention of the members by a resolution which was passed requesting the secretary to bring the matter to the attention of each member to permit of action being taken at the next meeting. Under such an arrangement the association would retain its integrity, being known as the Electrical Section of the Western Society of Engineers, and furthermore would enjoy all of the privileges which the members of the latter have. The election of officers resulted as follows: President, W. B. Hale; vice-president, F. M. Holbrook; secretary, De Witt C. Tanner; treasurer, H. G. Dimick; auditor, Hayward Cochrane; directors, Albert Scheible, Harold Almert and W. G. Carlton.

Electrical Equipment of a Modern Newspaper Office.

The invasion of the printing office by electricity has been well exemplified in our extended article on the Government Printing Office at Washington. The *New York Times* now gives some details of the electrical equipment for its superb new home on Broadway and Forty-second Street, showing that private enterprise is in no respect falling behind the standard set by a department with virtually unlimited national resources behind it. First of all it is interesting to note that the journal will not put in its own steam plant, as first intended, but will take service from the New York Edison Company. In so doing it gives publicly a number of pertinent reasons for its decision.

The following is the remarkable list of the uses and applications of electricity in the building, requiring, it is said, about 400,000 kw-hours per annum, or, say, 1,000 kw-hours daily:

One hundred and eleven motors—4 Hoe octuple presses; 1 press, job; 1 press, electric proof; 8 Kohler safety devices for controlling press movements; 2 autoplates, turning out eight stereo plates per minute; 38 linotypes; 3 pumps, house; 3 pumps, sewage; 1 pump, air compression for pneumatic tubes; 1 pump, air vacuum for cleaning carpets and offices; 1 pump, ink; 1 paper conveyor, for carrying printed papers from presses to delivery room; 7 elevators, passenger and lift; 4 Leonard system of control for elevators; 1 gallery lift; 8 trolley hoists for paper rolls; 8 fans for metal pots and for ventilating press room; 6 gymnasium; 1 machine shop lathe; 1 machine shop lathe; 1 stereo molding machine; 1 stereo tail cutter, round; 1 stereo shaver, round; 1 stereo router; 1 stereo shaver, flat; 1 stereo trimmer, flat; 1 stereo saw; 1 stereo jig and drill machine; 3 refrigeration.

Light—4,000 incandescent, 15 arc, Cooper Hewitt lamps, search, signs, bulletin service, elevator flash, cigar lighters, carriage call.

Heat—Stereo matrix; restaurant, including plate warmers, coffee urns, tea kettles, egg boilers, griddles, self-dumping oyster cooker for stews, toasters; stereo pastepot; soldering irons; hair curler for ladies' toilet; heating pads; heating tailors' irons.

Dental—Mallet, gold annealer, sterilizer, dental engine, mouth lamp, porcelain baking furnace, reflector for working on dark days, X-ray apparatus, cautery.

Miscellaneous—Time clock connection, fire alarm connection, telegraph connection, telephone connection, messenger call connection, office call connection.

The plaza north of *The Times* Building extends for a distance of 1,000 feet to Forty-sixth Street. The suggestion has been made for the erection of an immense electric flash sign above the sixteenth floor which shall give carriage calls for the seventeen theatres in that vicinity to carriages waiting in this large area. For instance, the number 623M would be a call from the Metropolitan Opera House; 542E would summon a carriage to the Empire; 427B would mean the Belasco Theatre, and 818N would give notive from the New Amsterdam. In this way carriages for all theatres would have an ample space, the plaza would become the real centre of midnight activity, and would reduce the inconvenience now caused by blocks and delays such as occur on opera nights.

CURRENT NEWS AND NOTES.

TELEPHONE FIGHT AHEAD.—It is reported that the Central Union Telephone Company, whose headquarters have just been moved from Chicago to Indianapolis, is to be used to fight the independent telephone companies in the Middle West, and if possible, prevent them from getting into Chicago. This promises to be an expensive campaign.

INDIANA ENGINEERING SOCIETY.—The fifth annual convention of the Indiana Engineering Society will be held in Indianapolis on January 14, 15 and 16. Papers will be read on the following named subjects: "Railway Construction," "Central Power and Heating Plants," "Surveys for Electric Railways," "Interurban Railways in Small Cities," "Statistical Paper on Interurban Roads." C. C. Brown is secretary of the society.

AUTOMOBILE SHOW.—The annual automobile show in New York City will begin on January 16 at Madison Square Garden and last one week. More than 185 firms have been accommodated in the distribution of space, and thirty or forty have had to go unprovided. The exhibition is held under the auspices of the Automobile Club of America, the National Association of Automobile Manufacturers and the Madison Square Garden Company, with Frank W. Sanger as manager.

THIRD RAIL IN PENNSYLVANIA.—It is said in a special dispatch from Wilkesbarre, Pa.: "Estimates are being made of the cost of equipping the Delaware & Hudson Railroad between this city and Carbondale with the third-rail system, to be used exclusively for passenger service. This is to compete with the Westinghouse Company's new cannon-ball third-rail system between this city and Scranton, and to relieve the congestion of freight and coal traffic which now crowd the road. The plan is to build a third-rail track alongside the present tracks, the roadbed being wide enough, and to use the present tracks for freight and coal." Why "cannon-ball"?

NEW YORK-PHILADELPHIA TROLLEY.—It is stated that by the Trenton Terminal Railway Company effecting an agreement with Joseph H. Mayer for the use of the land needed to join the tracks of the Camden and Trenton & Trenton and Trenton & New Brunswick trolley lines, the way was opened last week for continuous traction route between New York and Philadelphia. It will take but three weeks, after the weather moderates, after which time cars can run through New York to Philadelphia. This $1,500 purchase is all that has kept through service back for six months, it is said.

MUNICIPAL TELEPHONY.—In an interesting editorial note the New York *Tribune* says: "Municipal telephony is one of the enterprises into which the city of Glasgow went two or three years ago. How far it is judicious for local governments to perform functions ordinarily exercised by business corporations is a question about which there is a wide difference of opinion. Perhaps no universal rule can be laid down for all countries. In some of her other undertakings Glasgow has apparently been successful. In this one she has been peculiarly unfortunate. The cost of her plant exceeded the original estimates by about 50 per cent., and experts declared in advance that the low rate she offered to patrons would involve a loss. The municipal authorities keep a stiff upper lip in the present dilemma, but they doubtless feel that their course was ill advised."

NATIONAL ELECTRIC LIGHT ASSOCIATION.—One of the most interesting and valuable portions of the volume of *Transactions* which the National Electric Light Association is about to issue is the report with cuts in colors on Decorative and Sign Lighting. If for nothing else the members are likely to prize this volume on receiving it. Mr. Arthur Williams, the reporter on the subject, has been appointed to take up the matter again this year in a second report, and proposes to handle the subject in a somewhat different manner, adding to illustrations the ideas and opinions of central station men on advertising signs, and selecting instances in which decorative lighting of that character has been productive of increased trade and revenue to the users. He is now collecting such data, and all of our readers interested in the subject should communicate with him at the offices of the New York Edison Company.

ELECTRICITY IN INDIA.—A letter from United States Consul William Thostee, of Bombay, India, dated December 8, 1903, says: "As you are probably aware, Bombay is not lighted nor fanned by electric power. The cars are still horse trams, and what little electric lighting there is is in a private capacity. The tram lines, however, are to be turned into electric lines, and the contract has been let to the Brush Electrical Company, in England, who are expected to have things going by this time next year. The Bombay Electric Company, Meadows Street, Bombay, is the largest firm dealing in electric supplies and sundries. The Bombay Telephone Company, Limited, is the only telephone company in the city. The new Taj Mahal Hotel, which is just opened here, is to be fitted with electric fans and lights. It will have its own private installation and power house until the Brush Company get their installation in, and then will take its power from them."

ELECTRICITY IN SURGERY.—A special cable dispatch of January 9 to the New York *Sun* says: "The story of a curious surgical operation at the St. Antoine Hospital has been communicated to the Surgical Society. The patient swallowed a packing nail, which was shown by an X-ray photograph to have lodged, head downward, at the level of the seventh rib. A bronchoscope, which consists of a tube, the inner surface of which is highly polished to serve as a reflector, with an electric lamp arranged so as to throw a strong light on the tube, was passed into the bronchial tube and then withdrawn. This process was repeated for six days with larger and larger tubes, and then an eight millimeter tube was inserted to a depth of nearly fifteen inches. A magnet had been specially made to put into the tube, but it was too short to fit and the coughing of the patient forced a suspension of the operation. A second X-ray photograph showed that the nail had now slipped to the level of the eighth rib. The doctors, therefore, performed the operation of temporary tracheotomy. A ten millimeter tube was introduced to a depth of fourteen inches, and the operator then saw the nail. The magnet was introduced and the nail adhered to it. The whole operation lasted only five minutes and saved the patient's life."

GRADE CROSSINGS.—In his message to the Legislature of New York State, Governor Odell says: "The approval of an item in the last appropriation bill for the change of grade crossings in the city of Schenectady brings up an important question for consideration by the Legislature. As is well known, heretofore almost all of these improvements, so far as the State has been concerned, have been restricted to the rural communities. The State has declined to aid in the construction of roadways within the boundaries of the cities. But it is the State's duty to protect the lives of its citizens, whether in the cities or rural communities. Under existing laws the State contributes 25 per cent., the locality 25 per cent. and the railroads 50 per cent. for removing crossings at grade. There have been, however, no appropriations for any single piece of work such as that approved by me for the removal of crossings at grade in the city of Schenectady. If the policy of the State is to continue along this line it would be well to define some maximum limit to which it should go, and the whole work thereafter should be under the control of the Railroad Commission, appropriations being made in accordance with their recommendations. It would be well also to prohibit by statute any future grade crossings in the State in the construction of railroads so that this expense may be guarded against in the future. It will certainly grow to alarming proportions otherwise, unless the localities, have their interests in this direction sufficiently protected." The trolley car traffic at this point is very large.

RADIUM IN UTAH.—It is claimed that two discoveries of ore that contains radium have been made in Utah and Idaho by Capt. James Lawrence, a geologist and mining expert. Lawrence says that the strike is a most important one, and will have the effect of reducing the present price. The ore has been tested by a New York assayer, and is said to have a large amount of the precious radium in it.

A WEIRD WIRE WALL.—At Washington on January 5 Representative Dixon introduced a resolution directing the Secretary of Commerce and Labor to inquire into the cost and feasibility of constructing a wire fence along the Canadian boundary between Lake of the Woods and Point Roberts. The purpose of the wire fence, as disclosed in the preamble of the resolution, is to keep out Chinese laborers who steal across the line and to prevent violation of the law with respect to smuggling. Mr. Dixon wants the fence equipped with telegraph, telephone or other electric apparatus to convey warning to inspectors and others charged with the execution of the exclusion and tariff laws.

RADIUM AND MINE SLAG.—A cable dispatch from London of January 5 says: "Prof. Ellershausen, a German, has invented a method of extracting zinc white from refuse slag. He and Prof. Sir William Ramsay successfully experimented at the Hafaa mine in North Wales to-day, showing that a ton of zinc white can be extracted from fifteen tons of slag by a far simpler and cheaper process than is now used in a roundabout production from spelter. Great Britain imports about 200,000 tons of zinc white annually from the United States, Germany and Belgium because its manufacture from spelter is unprofitable. It is now apparent that millions of tons of mine refuse that has hitherto been regarded as useless can be turned to account. Prof. Ramsay said, after the experiments, that he could not see why a new era of prosperity should not dawn in Wales. It is noteworthy that in the course of the process cadmium is extracted, which is serviceable in procuring radium."

THE WEATHER BUREAU.—"Only 17 per cent. of our weather forecasts throughout the year were inaccurate," said Prof. Willis Moore, chief of the Weather Bureau, in addressing the House Committee on Agriculture on January 9 on the annual appropriation bill. The members of the committee looked out and saw the sun shining brightly and then turned and read the professor's daily weather map, which said "partly cloudy," remembered his prediction of a rise in temperature when a cold wave came instead, smiled and said nothing. Prof. Moore added that until experience has led to new discoveries in meteorological science there would always be a certain percentage of inaccurate forecasts. He asked for an increase in the appropriations for the bureau to provide for the establishment of eight additional stations as follows: At Providence, R. I.; Hartford, Conn.; Honolulu, Sitka, Alaska; Roswell, N. M.; Durango, Colo.; Madison, Wis., and one in north central Illinois. He also asked for $50,000 for increase of buildings. The total amount desired for the Weather Bureau is $1,500,000.

FARM TELEPHONES are a familiar feature out West, but a correspondent of the New York *Evening Post* says about them in Connecticut: "The coming report of the telephone company, which, outside of the single town of Greenwich, practically monopolizes the Connecticut field, will show that the corporation has about 25,000 stations in the State, of which about 5,000 have been installed during the past year. Of the new stations about one-quarter, or some 1,250, are of a distinctively farm character—that is, established in farm houses or in outlying parts of farm towns. Nine of the forty-five exchanges of the corporation are now either in farm towns or are in towns where the farm business of the company is very large and where the wires reach over an extensive farm region. The company is pushing steadily and increasingly its rural extensions and making closer connections with the few independent farm telephone groups. Sometimes the company leases its instruments to the farmers, sometimes the farmers construct the lines and keep them in repair, and sometimes the company; but in practically all cases the farmers are connected either by toll line or regular service with the nearest exchange, and through it with the general system of the State. According to a high official of the company, about 6,000 stations in the State are now of a "farm" character; and the farmer, when once he takes the telephone at the regular rate of $18 a year, rarely drops it."

Letter to the Editors.

The Choice of Wattmeters.

To the Editors of Electrical World and Engineer:

Sirs:—It has been with much interest that I have read the article by Mr. MacGahan in the Electrical World and Engineer of November 21, 1903, under the heading of "The Choice of Wattmeters." Being deeply interested in the subject of electrical measuring instruments itself, and particularly in recording or integrating wattmeters, I beg to ask your indulgence in presenting a somewhat different view from that held by Mr. MacGahan.

There is no room for a difference of opinion relative to the primary requirement of a recording wattmeter—accuracy; not simply initial accuracy, for that is a comparatively easy requirement to fulfill, but continued accuracy after a long period of service. It is to this end that the meter manufacturer is striving and the rapid strides during the past few months in this direction are the result. Referring more specifically to the article under discussion, in connection with which I differ from Mr. MacGahan is the following:

"When it is stated that a wattmeter is accurate within 2 per cent. it is meant that all these cases (referring to variations of operating conditions) each of a magnitude such as would be found in actual operation and all acting in unison produce a resultant error not exceeding 2 per cent." For the sake of argument, we will ignore the fact that there must invariably be errors due to observation standards used in making tests, etc., which in themselves cannot be depended on under ordinary conditions within one-half of the above limits, and discuss only the errors inherent in the meters themselves.

A 10 per cent. change in voltage or frequency is not uncommon in actual central station practice, and it is well understood that a meter that will not vary more than 1 per cent. in accuracy under the above conditions has well nigh reached the acme of perfection. A combination of these two variations, provided they are concurrent, and such I understand is the way Mr. MacGahan has considered them, will produce the error of 2 per cent. Combined with these may also be errors due to the other causes mentioned. I do not wish in any sense to imply that these variations are always cumulative, for as a matter of fact they frequently act differentially and thus the combined error may be well within the limit cited. The point I wish to make is that conditions exist in service under which any meter may be in error in excess of 2 per cent. as a result of an accumulation of error influences. I would instantly test any meter which I found in service under such a guarantee and the results would, I think, leave no doubt as to the truth of the claim.

There is, of course, now, and always has been, a great difference of opinion relative to sealing of wattmeters by the manufacturer, but I must differ from Mr. MacGahan in his statement that "The only excuse for a manufacturer supplying unsealed wattmeters is in cases where their moving element is so heavy that the jewel bearings would not stand the rough handling due to shipment, etc."

The desirability of an unsealed meter from the central station's standpoint is completely ignored. Granted that a manufacturer cannot make time guarantees on unsealed meters, the main benefit accruing from the ability of the purchaser to make his own adjustments, repairs, etc., should not be lost sight of. In a large majority of cases the only repairs or recalibration necessary can be accomplished on a meter at the point of installation with the expenditure of a minimum amount of time and labor; but if the meter is sealed by the manufacturer there is nothing to do but remove and return often involving delay and dissatisfaction, not to mention the temporary loss of the meter itself.

I note further this statement: "It should be understood, of course, that the manufacturer's seal does not prevent the purchaser from repairing his own wattmeter if he so desires." Does not this itself refute what has been said earlier in the article regarding "dispute with customer" * * * "Seal and guarantee—by disinterested party" * * * "only excuse for a manufacturer supplying unsealed wattmeters, etc.?"

It has been my experience that whenever the manufacturer's seal is broken there his responsibility ends, and this being the case the effect of a manufacturer's seal actually prevents purchasers making their own repairs when otherwise they much prefer to do so. Is not the real reason for a manufacturer's sealing his meter explained by the conclusion that the mechanism is so delicate and difficult to adjust at the hands of the ordinary central station man that it can be entrusted only to the care of experts, or in other words to the manufacturer himself? Is it not a fact that the example of sealing was not by a meter which its makers claimed to be too delicate and too complicated for proper care by the average meter man, and is not the same tendency rather towards unsealed wattmeters with all makers simply because a delicate sealed meter is too unpopular to be universally introduced?

Passing now to the determining factor of a meter's life, I find that Mr. MacGahan has eliminated from consideration all friction causes except that due to the disc rotating on the jewel bearing. I admit that the friction due to the recording mechanism and top bearing is very small and difficult to measure, but I maintain that this friction is a very considerable portion of the total friction in the meter, and as it is constantly increasing due to age and use, therefore, is not negligible.

The ratio of torque to weight is not nor can it be a true measure of a meter's value. For example, by doubling the thickness of the disc the torque is doubled, likewise the weight, but is the total friction of the meter also increased twofold? Not by any means. The friction due to the top bearing is but slightly if any increased. So here, then, is a distinct advantage of increasing the torque even at the expense of increasing the weight in an equal degree. If it is possible to get an accurate measure of the friction torque, then the meter showing the highest ratio of full load torque to friction torque must in the natural order of things have the most enduring accuracy.

Furthermore, high torque in a meter has its greatest value in overcoming, not initial friction, but increase of friction. Here the weight of the moving element has no effect except upon the pivot and jewel friction, and if the highest grade only of eastern sapphires are used for the bearing, practically no jewel trouble is experienced, with any meter of the induction type at present on the American market. What else, therefore, remains to cause an increased friction, except the top bearing and recording mechanism which are obviously independent of the weight of the moving element?

I do not wish in the least to imply that the lightest moving element possible with a given torque is undesirable, nor that high torque should be attained solely by a heavy moving element; but I do maintain that ratio of torque to weight is not a reliable indication of the life of a meter. Tests which I have made, however, show that the highest torque induction meter on the market to-day has a greater ratio of torque to weight than any other jewel bearing meter.

SCHENECTADY, N. Y. W. F. HOWE.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Measuring the Slip of Induction Motors.—BIANCHI.—An illustrated description of several methods for measuring the slip of induction motors. What he considers to be the simplest and most exact method which can be used when the induction motor has an armature connected to slip rings in connection with an outside rheostat, is to bring a magnet needle swinging between two arresting pins, $h\,h$ (Fig. 1) near the connecting wire between motor and rheostat,

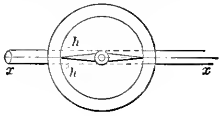


FIG. 1.

so that the axle of the needle is in the direction of the wire. If the frequency of the current in the wire is n (from which, of course, the slip of the motor can be easily determined, since n is the frequency corresponding to the slip), the magnet needle makes $60\,n$ periodic movements per minute, which may be counted. If the motor has a squirrel-cage armature this method can, of course, not be used. In this case he applies the arrangement shown in Fig. 2.

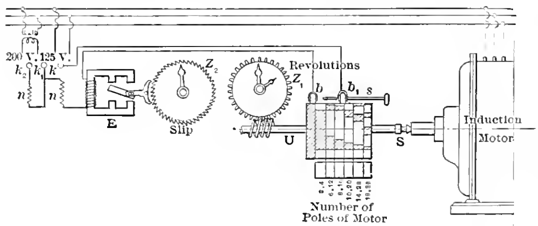


FIG. 2.

Connected to the shaft of the induction motor is the rod S, geared at its end to a disc, Z_1, by which the revolutions are counted. The same rod carries the commutator, U, consisting of a series of contact discs and two brushes, b and b_1. C_2 is the dial which counts the number of impulses sent from the commutator, U, to the electromagnet, E. There are three terminals, k, k_1 and k_2; k and k_1 are used for voltages between 70 and 125, while k and k_2 are used between 125 and 200 volts. In the case of a high-voltage motor a small auxiliary transformer is made use of. The commutator, U, serves for sending periodic currents to the electromagnet. U consists of seven contact discs, the first of which has an uninterrupted metallic surface on which the brush, b, slides. The other contact discs have different numbers of insulating pieces inserted on their surface, and the brush, b_1, is connected to that contact disc which corresponds to the number of poles of the motor. The electromagnet, E, has four free poles, between which a permanent magnet oscillates as armature and transmits these oscillations to Z_2. If the terminals, k and k_1 are connected with the network, while S is not yet set into the motor shaft, then there will be no oscillations of the armature of the magnet, E, although there may be a connection between b and b_1. The reason is that the frequency of the exciting current is too high and the inertia of the armature of the magnet is too great. If, however, S is set into the motor axle, then the frequency of the current supplied to E corresponds to the frequency of the rotor current, which is, of course, the frequency of the slip. To such a slow frequency the armature of the magnet, E, can follow. From the reading obtained on Z_1 and Z_2 the slip can be easily determined.—*Elek. Zeit.*, December 24.

POWER.

Electric Power with Greatly Varying Load.—LIOUVILLE.—A mathematical article discussing the case where power is supplied to a number of intermittently working machines, so that the power required from the generator is constantly varying. If for the generator an armature be used capable of carrying continually the maximum intensity of current, one would arrive at too large dimensions. On the other hand, it is incorrect to base the dimensions on the mean current, since this gives in general too small dimensions. The armature is to be considered as the seat of an irregularly pulsating current, the heat effect of which is proportional to the mean square of the instantaneous values of the current. He gives some mathematical calculations which show that if n equal motors are to be supplied with current, the heat effect is n times the square of the effective current, $+\ n$ times $n - 1$ times the square of the mean current. For instance, in the case of three motors, each taking 50 amp. for 20 seconds, 10 amp. for 10 seconds, and no current for 30 seconds, the heat effect corresponds to an effective current of 67.5 amp.; while if simply the mean intensity had been taken, a current of only 55 amp. would have been found, thus involving an appreciable error. —*L'Ind. Elec.*, November 25.

TRACTION.

Alternating-Current Traction.—EBORALL.—The conclusion of his illustrated paper. He discusses at length the tandem-parallel control, which, if compared with the rheostatic control, offers considerable advantages from the point of view of rapid acceleration and economy. Quite apart from the considerably diminished losses in the rheostats, an appreciable amount of energy can be returned to the lines during retardation. However, both the efficiency and power factor when running in tandem are considerably worse than the corresponding values when the motors are working in parallel, and at light loads this disadvantage is rather great. These disadvantages are inherent in the method and independent of the manner in which it is carried out; they become very serious at usual frequencies, so that it is quite doubtful whether tandem-parallel control is commercially practicable at frequencies much above 25. The commercial application of tandem-parallel control in any form to multiple-unit trains would be difficult, if not impossible. It is, of course, perfectly possible with rheostatic control of the motors. He then discusses the various motors which have been recently proposed for single-phase traction: Series motors (Lamme, Finzi); repulsion-induction motors (E. Arnold, Deri, Schuler); repulsion-series motors (Latour, Eichberg-Winter). The scheme of the latter is very clearly and briefly indicated in Fig. 3, *a* and *b*. He thinks that both arrangements are quite similar, and that the only difference

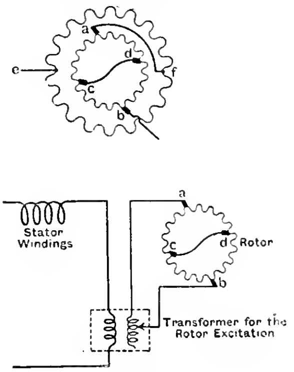


FIG. 3.

between them, apart from constructional details, is that in the Winter-Eichberg motor the rotor is indirectly in series with the stator, as indicated in Fig. 3, *b*. The use of the current transformer for supplying the brushes, *a b*, allows the stator to be worked at the full line pressure, no step-down transformer being, therefore, required on the car. At the same time the entire switching and the speed control is performed on the low-pressure side, i. e., in the secondary circuit of the current transformer. Naturally, the arrangement lends itself well to multiple-unit trains, the control being characterized by the absence of rheostatic losses and by the permanent connection of the various motors in parallel.

Single-Phase and Three-Phase Traction.—NIETHAMMER.—A reply to Szasz, who had recently compared the Eichberg-Winter single-phase motor with the three-phase motor, with relation to their suitability for traction purposes, and had reached conclusions somewhat in favor of the latter, as recently noticed in the Digest. The present author says that he has never denied that the commutator single-phase motor lacks entirely bad properties, since it is 10 or 20 per cent., or even more heavier and larger than a direct-current motor, and, therefore, also somewhat heavier than a three-phase induction motor. Moreover, the commutator motor at rest has as large or larger iron losses than when running, being thus similar to the three-phase induction motor, and dissimilar to the direct-current motor. With repeated startings the commutator single-phase motor will heat more than the direct-current motor. The present author believes, however, that Szasz's comparison between the single-phase and a three-phase motor is unfair, since there are important differences in details of the construction of both motors—for instance, with regard to the air-gap. He finally points out that the compensated single-phase commutator motor has the undeniable advantage that it needs one less conductor than the three-phase motor; that economical starting is possible without losses in resistances; that it changes speed like the direct-current series motor, in accordance with the load; and that it allows an economical regulation of speed. A disadvantage, however, is that single-phase conductors, generators and transformers are 10 to 30 per cent. more expensive than polyphase apparatus, and this disadvantage cannot be completely overcome by generating polyphase currents and supplying the currents of the different phases to different sections of the road.—*Zeit. f. Elek.* (Vienna), November 29.

SZASZ.—A reply to Niethammer's criticism. He does not think that the difference of the details of construction renders his comparison unfair, since he has compared the representative types of the two motors in their completeness without taking into account differences in detail. Concerning the possibility of maintaining a schedule of three-phase traction, he says that the tandem connection of the motors enables one to maintain any schedule which has been designed for an average speed between full and half speed corresponding to the parallel or the tandem connection of the motors respectively.—*Zeit. f. Elek.* (Vienna), December 20.

Electrical Heating of Third Rails for Sleet Removal.—A description of a method of removing the sleet from the third rail by heating it up by electrical means. Calculations are submitted as to the amount of power required, and it is estimated that 20 kw will raise the temperature of 1,000 ft. of a rail of the size used in New York, within a reasonable time, from 8 to 10° F., and that one-tenth of this power only will then be required to maintain the rail at this temperature. It is proposed to use transformers every 500 ft., and as these are used only two or three days during the year they can be cheaply built and can be manufactured for about $5 per kilowatt. Their operation will not interfere with the use of the rail for train service, as the rail need not be sectionalized. With the alternating current, the outside of the rail will heat up first and this is a desirable feature.—*St. R'y Jour.*, December 12.

Mountain Railway.—WILSON.—A fully-illustrated description of the Chamonix Railway in Switzerland, which has a length of 12 miles and several steep grades, the heaviest being 9 per cent. and 8 per cent. over 2,300 and 1,500 yards, respectively, while inclines of 2 per cent. are frequent. Two water power stations supply the energy, each being equipped with four 350-hp turbines, the generating voltage being 550 volts. A third rail is used, placed on one side or the other of the line, according to necessity, and with its crown 9 in. above the top of the running rails. It is fixed with iron bolts to insulating blocks of paraffined beech, which, in turn, are bolted to oak distance pieces fixed on the ends of the sleepers. The maximum leakage to earth is stated to be less than one ampere per thousand yards. The fact that this decreases with the fall of rain or snow is explained by the assumption that any dust which has accumulated on the surface of the insulating blocks and caused leakage, is washed away by the action of the rain. To allow of the passage of cars at grade crossings and switches, a gap is left in the contact rail, the interval being bridged by a copper bond laid underground in a wooden trough, run up solid with asphalt. At all such interruptions the rails are so disposed that at no time are the collector shoes on the cars entirely out of contact with the third rail. In the stations and wherever the public may have access to the lines, the third rail is protected by a guard plank. All cars are equipped with motors, each truck having two axles, each of which is driven independently by an electric motor. Each truck is provided with four collector shoes, two on each side. The shoes are supported on a system of hinge joints and are pressed downwards by springs, so that they follow any inequality in the height of the rail and always make good contact. Each car has a controller and all the controllers on the train are worked simultaneously by compressed air.—*Cassier's Mag.*, January.

REFERENCES.

Single-Phase Motor.—EICHBERG.—A communication in which he and Winter protest against Latour's priority claim recently noticed in the Digest. Their common work has been carried on absolutely independently of Latour and only shows similarity with the latter's motors in one point, namely, in respect to the excitation through the armature. This method of exciting is contained in their German patent application of November 15, 1901, while Latour claims that it is shown in his French application of December 12, 1901. This method of exciting becomes especially valuable in connection with their system of speed regulation, "for only in connection with this system is it possible to run within a wide range of speed with a power factor of 0.95 to 1.0."—Lond. *Elec.*, December 25.

Heatingof Railway Motors.—GONZENBACH.—Some comments on an article of Dodd and Canfield on ventilation of railway motors. The writers consider that for high-speed interurban service the artificial ventilation of motors is highly desirable. It is scoffed at in some quarters, but the writer compares the ventilation of motors with the ventilation of transformers and concludes that the usual practice of blowing air through transformers should be used with direct-current motors or else some other methods of cooling motors should be employed.—*St. R'y Jour.*, December 12.

Efficiency of Transmission Systems.—An article giving the results of some tests on the efficiency of one of the distribution systems in the Middle West. The line is 100 miles in length and power is distributed at 26,000 volts from one station. The maximum distance to which power is transmitted is about 60 miles. The apparatus losses were 11.9 per cent. and the transmission losses were 5.1 per cent.—*St. R'y Jour.*, December 19.

Installations, Systems and Appliances.

Central Station Statistics of Germany.—Extended annual statistical tables giving information up to April 1, 1903; 939 stations are noticed, while no information was available concerning 32 stations, so that in reality the number of central stations in Germany is 971. Insulated plants are not included. There are now 50 plants which have a capacity above 2,000 kw. The highest capacity, namely, 26,523 kw, is that of the Moabit station of Berlin. The total capacity of these 50 stations, which are situated in 37 cities, is 271,479 kw. The total number of plants is 939 (against 870 in 1902), to which there are connected 5,050,584 (against 4,200,203 in 1902) incandescent lamps of 50 watts, 93,415 (against 84,891 in 1902) arc lamps of 10 amp., and motors of an aggregate capacity of 218,953 hp (against 192,059 hp in 1902). There are a number of stations which supply current, not to a single town, but to a number of towns. For instance, the Bruehl station supplies 66 towns, at a distance of 9 to 12 miles, with current for light and power. The whole industrial district of upper Silesia is supplied from a single plant, while the water power plant at the Rhine falls supplies 46 towns. These stations have a very favorable influence on the industrial development of a district. Some larger tramway companies intend to enlarge their tramway stations into stations for supplying light and power over greater districts. In the industrial districts near the Rhine, there are a number of smaller stations which supply current for power in houses and smaller shops. For instance, the station of Anrath, near Crefeld, supplies current to motors, each of not more than a quarter or a half horse-power, used for silk manufacture in houses. The statistical tables cover 28 pages. The following figures are taken from the summary of the 939 stations. There are 766 stations with 257,-243 kw, using direct current; 45 stations with 30,550 kw, using single or two-phase alternating current; 59 stations with 83,283 kw, using three-phase current; two stations of 970 kw with monocyclic systems, while 67 stations use a mixed system. Of the latter, 55 stations with 102,470 kw, use a combined three-phase and direct-current system, while 12 stations with 8,041 kw, use a combined single-phase and direct-current system. The 939 stations are situated in 906 cities; 552 stations with 316,235 kw use steam power, 98 stations with 24,-851 kw use water power, 61 stations with 6,378 kw have gas engines. In one station with 220 kw wind power is utilized; 196 stations with 41,861 kw use both hydraulic and steam power. Of the 939 stations, 339 have a total capacity up to 100 kw, 422 stations a total capacity between 101 and 500 kw, 90 between 501 and 1,000, 39 between 1,001 and 2,000, 30 between 2,001 and 5,000 kw, and 19 more than 5,000 kw. There are in use 203,758 electricity meters.—*Elek. Zeit.*, December 24.

Isolated Station.—A fully-illustrated description of the power, light and heat plant for a large establishment in Berlin. It was necessary to crowd a plant of 2,400 hp into a large shop building, wedged in on all sides between shops and private residences. The plant has been placed in the basement and under the roof, the area built upon being 70,000 sq. ft. The demand for power, light and heat varies very much, there being a total power demand of 1,020 hp for normal conditions with a maximum of 2,345 hp. These 230-hp and two 500 to 700-hp engines are in use, while a storage battery of 7,200 amp.-hours, which can be discharged at 2,052 amp., has been put down. A central injection-condensing plant was adopted for the whole engine outfit. There are installed 460 arc lamps, 13,000 incandescent lamps and 56 large Nernst lamps, while for the elevators, ventilators, refrigerating machinery, etc., 32 electric motors with an average total power consumption of 120 kw are installed. The equipment of the boiler and engine rooms is fully illustrated in diagrams. The article is to be concluded.—Lond. *Eng'ing*, December 18.

REFERENCE.

Switches.—Woodfin.—An article illustrated by diagrams and tables giving details of the design and manufacture of a double-pole switch.—Lond. *Elec. Rev.*, December 25.

Electro-Physics and Magnetism.

Radiation.—Sanford.—A long paper on an undescribed form of radiation. When the terminals of the secondary winding of an induction coil are connected to the plates of an air condenser, the condenser plate connected to the cathode gives off a peculiar form of radiation into the condenser field whenever the current is interrupted in the primary coil. If a spark is allowed to pass between the discharging knobs of the secondary, the radiation is given off from both condenser plates; but when no discharge occurs it is given off only from the cathode plate. This radiation appears to be of the same nature as the ultra-violet radiation from a luminous body, and may be reflected, refracted and polarized like ordinary light. When it falls upon bodies placed in the condenser field, these bodies become sources of a secondary radiation very similar in its properties to the primary radiation by which it is produced. This secondary radiation may, in the case of metals at least, be given off both from the side of the body upon which the primary radiation from the cathode falls and from the side facing the anode. It may even be given off into an insulated hollow conductor placed in the condenser field. In addition to this secondary radiation, the metals may reflect the original primary radiation. The experiments made by the author are described at length. To explain them he says that had the experiments been carried on in the field of a condenser from which the air had been exhausted, the ordinary cathode radiation would have passed across from the cathode plate to the anode. Since this cathode radiation is believed to consist of negatively-charged electrons driven off from the cathode, it seems probably that the same electrons will be sent off when the space between the condenser plates is filled with air. In the latter case they are stopped by colliding with air molecules, while in the former case they are stopped only by the anode or the walls of the containing vessel. These electrons when striking against the walls of the tube or against metal plate contained in the tube, give rise to the Röntgen radiation, and it seems probable that their collisions with the gas molecules in the condenser give rise to the radiation described by the author.—*Phys. Rev.*, December.

Secondary Radioactivity in the Electrolysis of Thorium Solutions.—Pegram.—It is well known that the surface of bodies in the air near thorium compounds becomes charged with a temporary radioactivity under the influence of the thorium emanation, and that its activity is much increased if the surface is negatively electrified. The present author investigated what results would be obtained by electrolysis of solutions containing salts of thorium. With platinum electrodes he found that the anode became more or less radioactive, and that this radioactivity was only temporary. From solutions of "chemically-pure" thorium nitrate he obtained a thin adherent anode deposit which was found to be highly radioactive, and when analyzed turned out to be lead peroxide. This proves, of course, the impurity of the thorium nitrate used. If is added a small amount of some salt such as lead nitrate or copper nitrate, to a solution of pure thorium nitrate, a metallic cathodic or oxide anodic deposit may be obtained which is found to be radioactive. From solutions of the purest thorium nitrate obtainable no visible deposit is obtained on the anode, yet it is radioactive, the activity in this case decaying rapidly, becoming nil in about half in one hour. To explain the phenomena two hypotheses may be made. First, that the molecules or the atoms of the lead peroxide have been so disturbed by being closely associated with the radioactive thorium that they now exhibit the properties of radioactive matter; or, second, the radioactivity is a property of some kind of matter derived from the thorium which in some way becomes closely attached to the lead peroxide. The second view of secondary radioactivity is strongly supported by most of the work relating to the question. In adopting it, there is still the question of how the radioactive matter comes to be so closely connected to the lead peroxide as to be precipitated with it; that is, whether the connection is an atomic, molecular, or simply a mechanical one.—*Phys. Rev.*, December.

REFERENCE.

Induction, Inductance and the Induction Coil.—An illustrated didactic article treating on these three subjects.—*Am. Elec.*, December.

Electro-Chemistry and Batteries.

Edison Storage Battery.—Janel.—An abstract of a paper read before the International Society of Electricians in Paris, giving some information on the manufacture of the active material. The active iron material, consisting of a mixture of iron and protoxide of iron, is obtained by passing a current of hydrogen over pulverized sesquioxide of iron at a certain temperature, given as 480° C. The reduced iron is then very slowly cooled in a current of hydrogen and washed in water; it thus loses its property of igniting, or at least of oxidizing, when exposed to air. The mixture is a bad conductor and conductivity was formerly imparted to it by the addition of graphite. It is stated that the use of graphite has now been abandoned for the active iron material, and a different process of manufacture is employed. The iron is not raised to quite so high a temperature, and, therefore, probably contains less protoxide; it is then mixed with ammoniated copper and oxide of mercury, and, the iron reducing the compounds, there is finally obtained a mixture containing 64 per cent. of iron, 30 per cent. of copper and 6 per cent. of mercury. Each particle of this mixture is said to be made up of a grain of iron covered by a porous envelope of copper amalgam, in a very finely divided state, together with a small quantity of oxide of iron. In the latest type of cell, the number of plates with an active nickel mass is twice as great as that of the plates with an active iron mass.—Lond. *Elec.*, December 25.

REFERENCES.

Color Photography and Electrolysis.—RIEDER.—An article in which he suggests that the fact that very beautiful colors can be obtained by anodic deposits might be utilized for a solution of the problem of photography in colors. He has made some preliminary experiments in this direction. He first produces a picture on a sensitive plate, the methods used by him being described in detail, and then brings the plate as anode into a bath for producing colors on the plate. He really thus gets a picture with several fine colors, but the colors do not agree with those in nature.—*Zeit. f. Elektrochemie*, November 19.

Anti-Friction Metal.—RIEDER.—An illustrated description of a method of making an anti-friction metal consisting of graphite grains embedded in copper. A layer of graphite grains is placed at the bottom of a mould and the copper is deposited electrolytically so as to fill the spaces between the grains. After these are filled, another layer of graphite grains is placed upon the first one and electrolysis is continued, etc. The best graphite grains for this purpose have the size and irregular forms of carborundum No. 30. If such a copper surface in which graphite grains are embedded rubs against another metallic surface, then the wear and tear causes some graphite to come between the two rubbing surfaces, so that the friction is diminished and the wear and tear is counteracted. It is possible to render the copper deposit more or less porous by varying the current density. He believes this material might be suitable for dynamo brushes.—*Elek. Anz.*, December 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Meters for Four-Wire, Three-Phase Systems.—STERN.—An illustrated article in which the author first refers to the fact that if the design of a three-phase meter is based on the most general equations of a three-phase system, it becomes very complicated. It is much easier to design meters for the practical conditions under which a four-wire, three-phase system is generally operated. The secondary network is mostly arranged in such a way that between the three mean conductors and the neutral wire there is a voltage suitable for lighting, say 110 volts, so that between any two main conductors the voltage is 190. The lamps, which are non-inductive, are connected between the neutral wire and a main wire, while the motors are connected to the main wires. In many cases another tariff is used for charging for light than for power, so that the problem of measuring the power is to be subdivided into two problems, the one relating to the determination of the power consumed by the motors, and the other to measuring the non-inductive load between any of the three

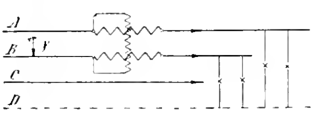


FIG. 4.

main conductors and the neutral wire. For measuring the power of the motors a three-phase motor for equally loaded phases may be used, especially if the neutral wire is not connected to the neutral point of the motor. For measuring the non-inductive load of the lamps, three cases must be distinguished, namely, whether, besides the neutral wire, one or two or three of the main conductors are brought into the building. If only one is in the building, an ordinary single-phase motor may be used. If two main conductors are brought into the building, the arrangement of Fig. 4 may be used in which the two currents, *A* and *B*, are combined to act in opposition, while this combination is made to act together with the voltage between *A* and *B*. This arrangement, which corresponds to an ordinary three-wire meter arrangement, measures the non-inductive load between *B* and *D* and between *A* and *D*. It is, however, supposed that there is no consumption of power between the conductors *A* and *B*. If all three main conductors are brought into the building, a modification of this arrangement may be used as illustrated in Fig. 5.

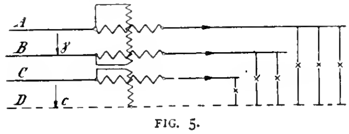


FIG. 5.

In this case a single-phase measuring system is added for measuring the power *Cc*. It is again supposed that no current is consumed between *A* and *B* or *A* and *C*, or *B* and *C*. Both measuring systems, shown in the last illustration, may be easily combined in a single instrument.—*Elek. Zeit.*, November 26.

Influence of the Waveform on the Application of the Two-Wattmeter Method.—BLOCH.—A mathematical article. The two-wattmeter method has the advantages that the power is obtained by means of only two readings; that it is not necessary to get at the neutral point of the system; and that the power factor may be found by a very simple formula from the ratio of the two wattmeter readings. The latter formula does not give, however, the exact power factor, if the e.m.f. and current have wave forms different from a sine wave; the formula gives nearly always larger values of the power factor than if the latter were determined from measurements of current, voltage and power. With loaded induction motors the difference may be up to 5 per cent., according to the wave form. This has the following effect: Modern three-phase motors are generally designed so that when operated as generators with direct-current excitation, they give approximately sinusoidal curves, and they operate as motors with the highest power factor if a sinusoidal e.m.f. is impressed upon them. If such a motor for which the manufacturer has guaranteed a power factor of 0.9, is connected to a network the voltage of which has a wave form differing greatly from the sine form, the power factor will be less than 0.9. By means of measurements with the two-wattmeter method it is possible to ascertain whether the power factor of a three-phase motor is unfavorably influenced by higher harmonics. If this is the case, the above-mentioned formula gives nearly always higher values for the power factor than if determined from power, current and e.m.f. The arithmetical mean between both values is approximately equal to—although somewhat smaller than—the value of the power factor which the motor would have for the most favorable wave form.—*Elek. Zeit.*, December 3.

Galvanometer.—WHITE.—A description of a convenient galvanometer for elementary work which is claimed to be at least as accurate as the Weston milliameter, can be read as quickly and easily, and has the same resistance for a given sensibility. It has the disadvantage that its indifference to outside magnetic disturbances, although great, is not complete. He points out that a reflecting galvanometer has distinct advantages over the old-fashioned tangent galvanometer. The reflecting galvanometer, with smaller deflection and greater radius of the scale, does not require so careful centering of the needle, and hence a small instrument is in this respect as good as a very expensive galvanometer with a pointer. The short needle is more quick-acting. The shortness of the needle and the smaller deflection give a small deplacement of the poles of the needle. The diameter of coil necessary to make the instrument obey the tangent law is thus much reduced. He uses a movable magnet system of two needles, with poles oppositely directed, and adds, of course, a control magnet. For the magnet system the Weiss form has been selected, in which there are two vertical needles, each end of the combination having two unlike poles belonging to different magnets, but acting like two poles of a horizontal magnet, whose length is equal to the distance between the two needles. The needles used are 1.2 mm. thick and 43 mm. long, placed 8 mm. apart. The weight is about a gram. The system is assembled in two or three minutes by laying the needles parallel on two strips of mica and fastening them with sealing wax. The damper is a horizontal wire 4 cm. long, turning in a shallow layer of clear kerosene. For the suspension a small spring is used which weakens the effect of shocks, together with a bundle of eight silk fibres instead of one. In order to make the galvanometer direct reading, the scale is bent to a curve such that distances measured along it are proportional to the tangent of half the angle subtended. The scale is read by the double-mirror system. A small stationary mirror either below and behind or above and in front of the swinging one gives an image of a line somewhere on the scale. There are two coils of the Helmholtz type, each 4 cm. in diameter. Fig. 6 shows the magnetic system with suspending spring and fibres, hemispherical mirror, and damping wire, full size. The upper piece of mica is behind the mirror. The dotted circles show the size of the coils, and the small dotted square shows the position of the stationary mirror.—*Phys. Rev.*, December.

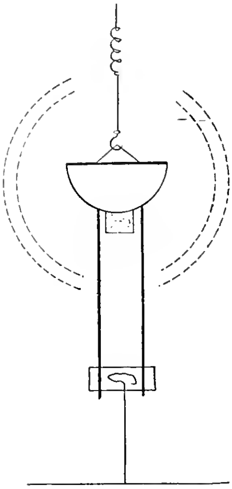


FIG. 6.

REFERENCES.

Machine Testing.—ABBY.—In a continuation of his illustrated serial he deals with commercial tests of rotary converters.—*Elec. Rev.*, December 12.

Three-Voltmeter Method of Measuring Alternating-Current Power.—NIES.—An illustrated article giving the essence of a lecture delivered before the Chicago Electrical Association on the split-phase method for the measurement of power in alternating-current circuits.—*Am. Elec.*, December.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCE.

Wireless Telegraphy.—A communication by Arco on the part of the German Gesellschaft für Drahtlose Telegraphie, in which he claims that several of their patents are infringed by De Forest.—Lond. *Elec.*, December 18.

MISCELLANEOUS.

Electric Welding.—An illustrated article in which it is said that the method of electric welding by means of the direct-current arc is comparatively very expensive, since only a small part of the arc is utilized for welding. This method is suitable only if electric power is cheap or for special purposes in which the welding cannot be done as well as by other methods. On the other hand, welding by utilizing Joulean heat is cheaper and in this case alternating current is preferable. Some apparatus of a German firm are described, in which the welding apparatus is provided at the top, while the base contains a transformer, the secondary low-voltage winding of which is made up of large dimensions, so that the loss in it is very small. Such apparatus are made for tube welding, chain welding and other purposes. The larger the cross-section of the surfaces to be welded, the longer is the time of welding and the smaller the current consumption per unit of cross-section. The watt-seconds per unit of cross-section increase with increasing cross-section. It is believed that in workshops in which much welding is to be done the cost of operation together with interest and amortization represents a saving compared with non-electric welding.—*Elek. Anz.*, December 20.

Aluminum.—WILSON.—A note on a lecture on the manufacture and uses of aluminum. The magnetic permeability and the specific resistance of iron can be increased by the presence of a small quantity of aluminum. A mixture of aluminum with ammonium nitrate forms an explosive, the reaction being as follows: The aluminum combines with oxygen to form alumina, and nitrogen and steam are produced in the presence of intense heat, thereby causing enormous expansive forces. The gases formed are harmless.—Lond. *Elec.*, December 25.

REFERENCE.

Lodge.—An account, with portrait, of the life and work of Sir Oliver Lodge.—*Sc. Am.*, December 26.

The Lorimer Automatic Telephone System.

MACHINERY displaces operators in an automatic telephone exchange. On one plan, it is possible to provide an automatic machine at the exchange for each subscriber which no one else can use. At such an exchange, each separate automatic machine must obviously stand idle during most of the time. Automatic exchanges constructed on this principle must contain a large amount of machinery, unless the mechanism for each connected telephone is very small. In the Lorimer automatic system the idea of separate apparatus at the exchange for each connected telephone is discarded, and the machinery there is devoted to the common use of all the telephone subscribers. This is the most distinct feature of the Lorimer system. A result of this feature is that only enough automatic apparatus is required at each exchange to connect the number of telephones that will probably be required in conversation at any one time. As only ten to twenty per cent of all the telephones connected to an exchange are ever in use at once, the automatic apparatus in a Lorimer exchange, like the number of connecting cords in a manual exchange, is limited by the probable demands for service. This construction with only enough automatic apparatus at an exchange to connect the telephones that are to be

FIG. 1.—TELEPHONE.

engaged in conversation at any one time is fundamental in the Lorimer system. This system consists in brief of a telephone and automatic transmitting device at the station of each subscriber; of automatic connecting apparatus at the exchange which is devoted to the common use of all the subscribers; of two wires between each telephone and the exchange; and of a common return wire to which all telephones and the exchange are joined. Electrical energy for all automatic movements at telephones and at the exchange is supplied by a dynamo or storage battery at the latter, and this is the only source of current in the system. For the extremely interesting data and arguments herewith, we are indebted to the manufacturer's expert staff.

Another distinct feature of the Lorimer system is the fact that the amount of automatic apparatus at an exchange, and the cost of this apparatus, increases in direct proportion to its capacity. Thus, the apparatus for an automatic exchange of 5,000 subscribers costs only ten times as much as the apparatus for an exchange of 500 subscribers. As regularly manufactured the automatic apparatus is in sections, each of which is suitable for 100 subscribers. These sections are all exact duplicates of each other, and an exchange started with one or more sections may add new sections up to any capacity as the number of subscribers increases. This addition of new sections requires no change as to those already in use, no matter how far the addition is carried.

In operation this automatic system is prompt, accurate, secret, continuous, and free from interruption. Connection between any two telephones on the system is completed within eight seconds after a call is made at either of them. The telephone connected to a calling line is certain to be the number called, because the automatic operation of the exchange is guided entirely by the number for which the indicator on the calling telephone is set.

As each call is received and the connections are made entirely by automatic machinery that is common to all of the subscribers, it is impossible for any one at the exchange to find out who is calling or being called at any time. Much less can any one at an exchange hear any conversation between two connected telephones. As each telephone has its own separate metallic line, no one at a third telephone can hear what is said between two that are connected.

No attention by any attendant is required when a call and connection are made, so that the automatic exchange is in a position to give continuous service day and night, no matter how small the exchange may be. Having been connected by the automatic exchange, the two telephones remain connected until the receiver at one of them is hung upon its hook. No third telephone of the system can either break the connection between two that are engaged in conversation, or secure any connection with their lines.

Any subscriber may call and be connected with any other on the automatic system without the intervention of further human agency. To do this the sliding pointers on a plate having four rows of figures, each from 0 to 9, inclusive, are set over the figures that go to make up the number of the telephone called, beginning at the left hand side. Thus, in the cut, the pointers are set to call the number 5,276. The next move is to press a lever that projects at the right-hand side of the telephone box down to its lowest position.

This lever immediately begins to rise, and as soon as it reaches the original position the receiver should be placed to the ear and the ringing button, located near the lower edge of the indicator plate, should be pressed. If the called telephone was busy so that connection with it could not be had, the receiver of the calling telephone will yield no sound when the button on its indicator plate is pressed. If the calling and called telephones have been connected by the automatic exchange, a distinct vibration may be heard at the receiver of the calling telephone when its ringing button is pressed. This vibration indicates that the bell on the called telephone is ringing.

The person holding the receiver of the calling telephone thus knows when the bell of the called telephone rings, because he hears it. To make these movements at the calling telephone requires less time than is consumed by communication with the central operator in a manual system. Either of two connected telephones may be immediately disconnected and left ready for a new call by hanging its receiver on the hook.

If in any case all of the automatic apparatus in the section to which a calling telephone is connected at the exchange is momentarily in use, the lever at the side of the telephone box will not rise until a division of the automatic apparatus is released. As soon as this happens the connection is completed between the calling and called telephones without any further effort on the part of the person calling. In other words, a call when once made is stored by the automatic exchange until the connections can be completed.

Besides an ordinary receiver, transmitter and call bell, the telephone of each subscriber on the Lorimer system includes what is termed a signal transmitter. This transmitter is a device for automatically making and breaking the signaling circuit, and includes a circle of contact pins set in insulating material, an arm that moves over these pins, a spiral spring that actuates this arm, a pawl that holds it, and an electromagnet that disengages this pawl when current from the exchange enters its windings.

The indicator plate and its four sliding brushes already mentioned, are in constant electrical connection with the common return wire that runs between the exchange and every telephone of the system. When either sliding brush is set over any one of the ten figures near its slot, a certain one of the contact pins in the circle is put into electrical connection with that brush and consequently with the common return wire. Between the forty pins that correspond to the forty figures on the indicator plate there are interposed dead pins, so that the contact arm in passing over them rests alternately on a dead pin and then on a pin corresponding to one of the figures on the indicator plate.

Besides the dead pins and those that correspond to the forty figures on the indicator plate, the circle contains what are known as the normal pin, the preliminary pin, and the talking pin. The normal pin is the one on which the revolving contact arm rests when the telephone is not in use, and this pin is connected to the No. 2 wire of the telephone through its call bells and a switch. At each telephone the No. 1 wire is connected to the arm that revolves over the circle of pins through a switch which is operated by the receiver hook.

The No. 2 wire is connected to this last named switch through the receiver, transmitter and the ringing key, so that when the receiver is on its hook the Nos. 1 and 2 wires of the telephone are connected through the revolving arm, the normal pin and the call bells, provided the level at the right side of the telephone is in its normal or highest position. Unless the revolving contact arm is on either the normal pin or the talking pin, the receiver hook remains locked in its lowest position even though the receiver is removed. Unless the receiver hook is in its lowest position the lever at the right of the telephone cannot be moved to make a call.

An automatic exchange for any number of telephones in the Lorimer system is made up of duplicate sections with capacity for 100 telephones each.

Each section is mounted on a steel frame, occupies a floor space of about 1½ by 10 ft., and is 4 ft. high. In large exchanges the sections are placed front to back with sufficient room left between them for a passageway. The space occupied by each section is about 1½ by 8 ft. and is 4 ft. high, and weighs approximately 1,000 lbs. The construction of the frames and sections is made up entirely of metal and insulating materials, and no wood is used in any part. Each section

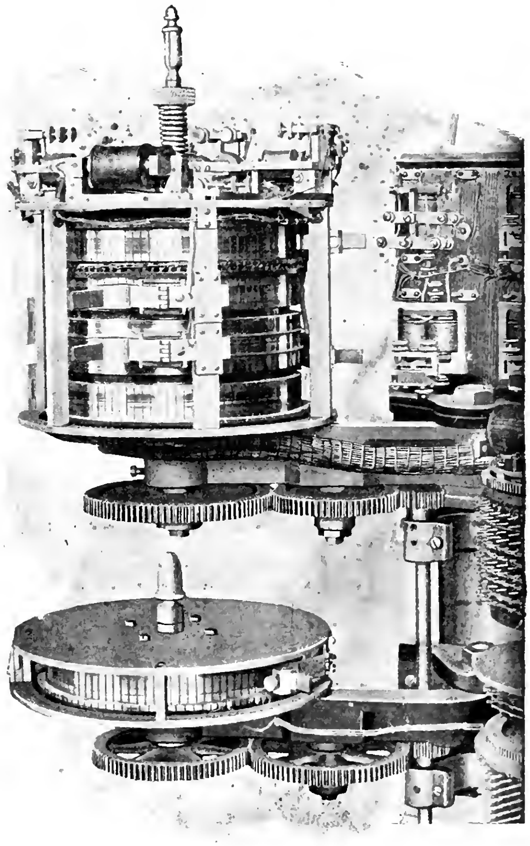


FIG. 2.—DECIMAL INDICATOR.

includes one horizontal and six or more vertical shafts, according to the percentage of the connected telephones that is assumed to be required at any one time. If the section provides for conversation between any ten of its connected telephones at the same time, then it will carry six vertical shafts. The vertical shafts are all geared to the single horizontal shaft, and revolve constantly with it when the exchange is in operation. The speed of these shafts is 50 r.p.m. All of the sections in an exchange are driven from a common source of power, and where there are only two sections the power may be derived from an electric motor mounted on their common frame.

Not more than 1/8 hp is required to operate the shafting and other parts of each section.

Each vertical shaft of a section is adapted to drive a row of automatic circular switches or circuit changing devices by means of electrically operated clutches, that start and stop the switches as required. The left-hand row on the front of a section contains four of these circuit changing devices, and is called a sectional division. Each of the other vertical rows of apparatus in a section contains five circular switches, and is called a percentage division. The office of the sectional division is to respond to the call of any telephone in its section, by starting a chain of automatic movements by which one of the idle percentage divisions connects the calling and the called telephone. In other words, the sectional division responds to the call of any one of the entire 100 telephones in its section, and transfers this call to any one of the five percentage divisions, all of which can connect ten telephones in pairs at any one time. Thus, by reason of this action of the sectional division, only five percentage divisions are necessary to do the work that would require fifty percentage divisions if one of these divisions was provided for each pair of connected telephones. Only seven percentage divisions are provided ordinarily on each section, because experience shows that not more than ten per cent of all the telephones connected to a system are commonly in use at the same time. And in consideration of the fact that the clearing out apparatus is instantaneous seven divisions will have a larger capacity than the ten per cent of cords and plugs usually provided in manual practice.

FIG. 3.—CYLINDER SWITCH.

Each percentage division of a section corresponds to one of the connecting cards at a manual exchange, with this difference: The cord can connect two telephones only when it is put into position by an operator, while the percentage division, actuated through the sectional division, takes a position automatically that connects the calling and called telephones. Just as in a manual exchange it is only necessary to have enough connecting cords for the percentage of all the telephones that will be in use at any one time, so in a Lorimer automatic exchange it is only necessary to have a corresponding percentage of the so-called percentage divisions. Were it not for the application of this percentage principle, fifty of the so-called percentage divisions would be required for each 100 subscribers, since one of these divisions connects two telephones, but the actual requirement is only five percentage divisions for each 100 subscribers. It also provides for the application of the placing of the telephones of an exchange on sections of different capacity as determined by their use. Thus the business telephones can be connected to sections having ten or more percentage divisions and the residence ones to sections having 3 or 4 percentage divisions. By this arrangement a large saving is made in the initial cost. In the same way those who are known to abuse the use of the telephone by long continued conversations may be assigned to a section having an automatic conversation limit apparatus which will disconnect them after the lapse of a certain time.

Of the four circuit changing devices that go to make up a sectional division, three consist of commutators and contact rings mounted in metal clamps, and one is a commutator or circular switch whose segments or contact parts consist of strips of German silver set radially in a hollow cylinder of insulating compound. Within this hollow cylinder a revolving brush makes contact with the ends of the German silver strips. Each percentage division contains five of these cylindrical switches with German silver contact strips, as just mentioned. As these switches make up the great bulk of all the apparatus at the automatic exchange, the simple and substantial character of their construction is important. In their main parts all these cylindrical switches are duplicates ,and each includes a hollow cylinder of insulating compound with 528 strips of German silver mounted symmetrically and radially therein, so that their ends project at both the inner and outer surfaces of the cylinder. Each cylinder of insulating material is 6¾ inches in outside and 4¼ inches in inside diameter, and is 3 inches long between metal end discs. These German silver contact strips are punched from sheet metal, and each strip is 1 15/16 inches long, 3-16 inch wide at its interior, and ⅛ inch wide at its exterior end. Between the interior ends of radially opposite strips the diameter of the cylinder is 3⅝ inches, and the diameter over their exterior ends is 7½ inches. The 528 strips are arranged in twelve circles of 44 strips each, the sides of the strips being in the planes of these circles.

Within each circular switch is an aluminum spider that carries a number of brushes mounted radially in a clamp of insulating material, and each brush consists of two strips of German silver so placed that they make hard wiping contacts with both sides of each strip in a certain row of the cylinder, when the spider is revolved. Each of these brush spiders takes its motion from one of the vertical shafts whenever it is mechanically connected thereto by the operation of an electric clutch. The shafting of each section and the brushes on the decimal indicator are normally in motion, but the other automatic apparatus moves only in response to a call, and then comes to rest. The contact surfaces thus wear only in proportion to the number of calls. The contacts between these German silver brushes and strips are included in the talking circuit between two connected telephones, and form the greater part of the wearing surfaces in the entire exchange. The cylinders of insulating compound are quickly and cheaply made by casting them in a metal mould that holds the

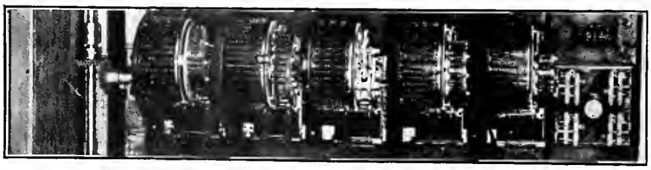


FIG. 4.—PERCENTAGE DIVISION.

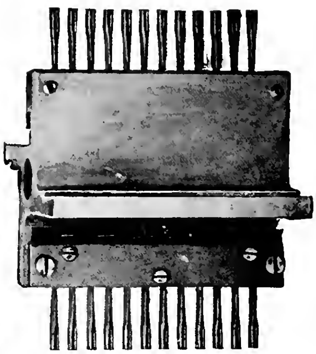


FIG. 5.—BRUSH FOR CYLINDER SWITCH.

German silver strips in their proper positions until the compound hardens.

The wearing qualities of these cylindrical switches is illustrated by the one shown in the cut, whose spider was placed within the cylinder and then revolved by a lathe to an amount corresponding with 23,000,000 calls. This switch remains in good serviceable condition.

The Nos. 1 and 2 wires from the 100 telephones of a section are all connected to cylindrical switches in each of the percentage divisions, each contact being made by soldering a wire to the outer end of one of the radial strips of German silver. Wires used to make these connections are cotton, silk and paraffine insulated, and those entering each cylinder switch are carried through a distributing ring of hard fibre at its lower side. Beneath this ring the wires are brought into a cable, and then pass to numbered holes in a strip of fibre on the back of the steel frame of the section. All of the strips are arranged in regular order, and as the holes in them are numbered the connection of wires from the telephones to those that terminate in the strips is a very simple matter. As all of the wires that run to the several switches of each section are in plain sight and arranged in regular order, tests for breaks or other troubles are easily made. In the connection of a new section at an exchange it is only necessary to bring the two wires from each of its 100 telephones to the terminals of wires in the fibre strips, and to join the new section to the others by a cable of forty wires that also come to the fibre strips.

In each sectional division, the piece of apparatus which receives the first impulse from a calling telephone, and sets in motion the chain of automatic operations that completes the desired connection, is called the "decimal indicator." This indicator includes three commutators of 100 segments each, one commutator of ten segments, and two battery contact rings. These commutators and rings are held in a stationary position about a central revolving shaft, and a concentric frame carrying brushes is driven by this shaft through a friction clutch. One of the 100 segment commutators on a decimal indicator is called the "line ring," and the No. 1 wire from each telephone of the section is connected to one of its segments. A storage battery at each exchange supplies current for the automatic apparatus there and at the connected telephones, also for conversation. The system is thus operated entirely with central energy. A battery of 30 volts is ordinarily employed, and the poles of the battery are connected respectively to the two contact rings of the decimal indicator. One terminal of the storage battery is also connected to the common return wire that joins the exchange with every telephone on the system.

When the lever at the right-hand side of a telephone is pulled to its lowest position, the automatic operations that connect the calling and called telephones begin. This movement of the lever at a telephone connects its No. 1 wire to the common return wire. As the brush frame of the decimal indicator is normally revolving at the rate of 15 r.p.m., each segment of its line ring comes under the brush that travels on that ring once every four seconds. When the brush on the line ring reaches a segment whose connected wire, the No. 1 wire of a telephone, is joined to the common return wire at that telephone, the poles of the storage battery are united through these wires and the winding of an electromagnet. The action of this electromagnet releases the clutch through which the brush frame of the decimal indicator is driven, and this frame comes momentarily to rest with its brush on the segment of the line ring to which the No. 1 wire of the calling telephone is connected. In this position of the brush frame certain circuits are closed by the brushes that rest on segments of the other commutator rings of the decimal indicator, and currents in these circuits actuate magnets that bring one of the idle percentage divisions of the section into operation. The position or segment on which the brushes of the decimal indicator are brought to rest gives an indication on a percentage division of the line calling, and connects that calling line to apparatus on the percentage division through which the called line may be found. At the same time the winding of the magnet of the signal transmitter at the calling telephone is closed on the battery through its No. 2 wire and the common return, and the stop that holds the lever of this telephone in its lowest position is thereby released. When the lever at the side of a telephone is drawn to its lowest position, a spring is compressed which tends constantly to restore the lever to its highest position. Such return of the lever is impeded by a stop, which may be released by the action of the magnet last named and controlled by the exchange apparatus. The momentary closing of the battery circuit through the No. 2 wire, the common return wire, and the winding of this magnet at the calling telephone allows the lever to rise one step, and it is then engaged again by its stop. Movement of the telephone lever to its lowest position forces the revolving arm of the signal transmitter from the normal pin to the preliminary pin in the circle of pins already mentioned, and thereby makes the connection between the No. 1 wire and the common return. When the

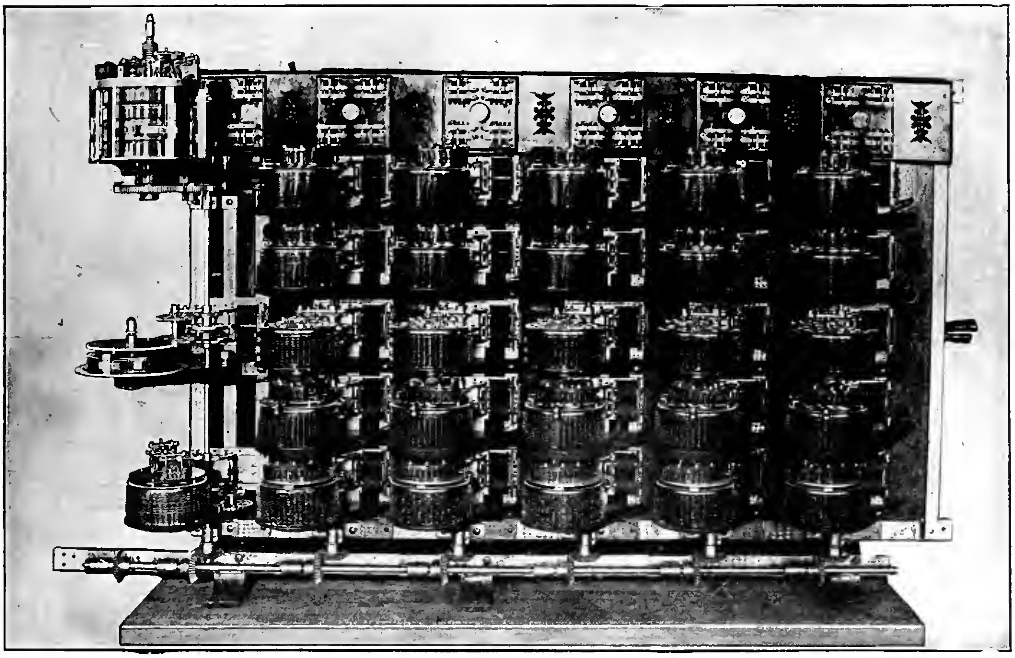


FIG. 6.—FRONT OF SECTION.

telephone lever rises one step from its lowest position it moves the contact arm away from the preliminary pin, and thus breaks the connection between the No. 1 wire and the common return. The moment current ceases in these wires the clutch on the decimal indicator is released, and the brush frame begins to revolve. The decimal indicator is thus ready to receive another call and start a new series of automatic operations for the connection of a different pair of telephones, as soon as the lever and contact arm of the telephone that last called have made their first automatic movement.

The series of automatic movements, put into operation when the decimal indicator stops its revolution in response to a call, are continued by parts of the sectional division and by a percentage division after the brushes of the indicator resume their motion. By these automatic movements, the winding of the magnet at the calling telephone is intermittently excited ,and the lever at the side of the telephone gradually rises step by step, and causes the contact arm to revolve over the circle of pins that correspond to the figures on the indicator plate. This contact arm, after leaving the preliminary pin, passes first over the quadrant of pins that correspond to the thousands figures, and then in succession over the quadrants that correspond to the hundreds, tens and units figures, respectively, of all the telephone numbers in the system. Whenever the revolving arm makes contact with a pin that is connected with the common return wire through one of the pointers that has been set over a figure on the indicator plate, the No. 1 wire is united to the common return at that telephone. In the circuit thus formed a current flows that causes the percentage division that has taken up the call to complete a contact there that corresponds to one figure in the number of the called telephone. When the lever at the calling telephone has risen to within one step of its normal or highest position, the revolving arm has passed over the four quadrants of pins that correspond to the four numeral places on the indicator plate, and the percentage division engaged in the call has completed connections at the exchange that correspond to the number of the called telephone. The result of these movements is that the Nos. 1 and 2 wires of the calling telephone are connected to one winding of a repeating coil at the exchange, and the Nos. 1 and 2 wires of the calling telephone are connected to the other winding of this same coil. At this point in its revolution the contact arm reaches the talking pin, and the No. 1 wire is thereby connected to the common return, so that the automatic apparatus at the exchange prevents interruption of the connections between the calling and the called telephone.

The lever at the calling telephone having risen to within one step of its normal or highest position, comes to rest, and the call may now be completed by taking the receiver from its hook and pressing the button on the indicator plate. Pressure of this button starts an alternating current through the No. 2 wire, the common return, and the call bells of the called telephone, and this current, passing through one winding of the repeating coil at the exchange, induces current in the other coil that flows through the Nos. 1 and 2 wires of the calling telephone. This induced current causes the sound that may be heard in the receiver of the calling telephone when the button there is pressed, after the automatic connections have been made. When conversation has been finished, the receiver should be returned to its hook, and the lever at the telephone that made the call will then rise one step to its normal position, while the contact arm of the signal transmitter moves from the talking pin to the normal pin. At the same time the percentage division through which connections were made at the exchange resumes its normal condition, and is then ready to take up another call from the decimal indicator.

The Lorimer automatic system has some advantages that especially concern the engineer and investor, while others appeal directly to telephone users. Perhaps the greatest advantage claimed from the standpoint of an operating company is the entire saving of the wages of telephone operators. This saving is not cut down by the wages of skilled engineers to keep the automatic apparatus in order, for one attendant is able to keep an automatic exchange for 2,000 telephones in working condition. Neither do repairs and depreciation of the automatic exchange represent a large offset to the saving from operators' wages, because of the simple and duplicate character of the cylinder switches which make up the great bulk of the automatic apparatus. Second only to the saving in the wages of operators is the advantage of a possible increase in an exchange from the smallest to the greatest capacity without discarding or changing any of the older sections as new sections are added. Furthermore, an increase of exchange capacity in this system increases the first cost only in direct proportion to the capacity. In other words, the automatic exchange, be it large or small, costs so much per section with a capacity for 100 telephones. In a manual exchange, as is well known, the cost per connected telephone goes up more nearly as the square

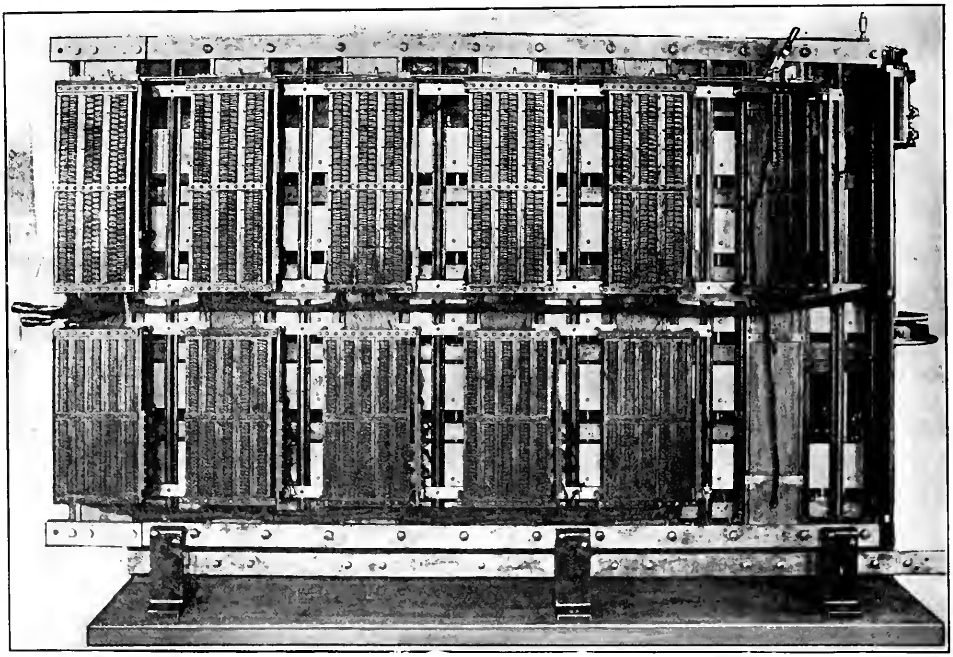


Fig. 7.—Back of Section.

of the number than in direct proportion to it. As each automatic section has all internal connections completed before it goes from the factory, and only connections to its numbered terminals are made at an exchange, the cost of installation is much below that for a manual board of equal capacity. In this automatic system there is no reason to install a large exchange at the start and then wait for the business to grow, but the capacity may be increased from time to time as wanted, by the addition of sections for 100 telephones each. Besides the foregoing, the automatic exchange has the very obvious advantage that its service cannot be interrupted by strikes or labor troubles with operators.

To telephone users this automatic system offers advantages in prompt, continuous, secret service, that do not exist in manual exchanges. In a manual exchange the service may or may not be prompt, in the automatic exchange it must be prompt. In a manual exchange, the cost of night operators may prevent continuous service; in the automatic exchange there is no corresponding cost. In a manual exchange the service cannot be secret, in this automatic exchange it cannot be other than secret.

While the circuit of a telephone in use may be interrupted at any time in a manual exchange, such a circuit can only be interrupted by hanging up its receiver if the telephone is connected to the automatic exchange.

With a manual exchange reasonable rates must rise with the number of connected telephones, but with an automatic exchange the investment increases directly as the capacity, and reasonable rates should remain constant.

The Lorimer brothers have devoted nearly a decade to the invention of the automatic telephone here described, and their ideas have been carried out by skilled mechanics in a well equipped factory.

As the perfected system stands to-day, ready for the market, it represents a cash outlay of several hundred thousand dollars. The Lorimer system is covered by patent applications in the United States and many foreign countries. These patents, save that for Canada, are owned and the system is manufactured by the American Machine Telephone Company, Limited, of Piqua, Ohio.

Mr. N. D. Neill is president and general manager of this company, Mr. C. J. Kintner is vice-president and Mr. G. W. Lorimer is secretary, treasurer and electrical engineer. Rights covering the manufacture and sale of the Lorimer apparatus in Ontario and Quebec have been acquired by the Canadian Machine Telephone Company, Limited, of Toronto, Canada. This company has fitted up a factory for the manufacture of the automatic apparatus, has the construction of several exchanges under way, and one in operation in Toronto.

The Voltaphone.

The Stanley Electric Manufacturing Company has placed on the market a new type of instrument, named the "Voltaphone," which combines the functions of voltmeter, telephone and clock. In keeping track of the drop of potential at distributing centers, the usual practice has been to send out men with portable instruments to the various sections where energy is distributed, and have them telephone voltage readings to the station attendant during the periods of changing loads at these points, the station man making record of these reports, and adjusting his apparatus as best he could to meet these requirements. The voltaphone performs the same service that an attendant would if he were stationed with his voltmeter and telephone at the same point, and were in communication with the station operator.

The voltmeter side of the instrument is connected to the service in the usual way, and the telephone connections are made the same as in regular telephone work, usually requiring but a few minutes to install the voltaphone for operation, provided a telephone line between the distributing center and the generating station is available. The telephone wire should be continuous between the voltaphone and generating station during the hours that voltage readings are to be taken; that is to say, it should not be necessary for the generating station to ask the telephone operator for connection with the instrument whenever readings are desired. It does not interfere with the use of the line for other service, and if several voltaphones are to be used on the same telephone line, they can be arranged with a system of polarized relays, and any sub-station can be called up as desired, or the instruments can be made so that they may be set to announce at specified times, thus enabling the attendant to learn, as often as is deemed necessary, the exact condition at the centers of distribution. The clockwork of the instrument should be wound as often as necessary, probably every day, the mechanism giving 75 to 100 readings with one winding.

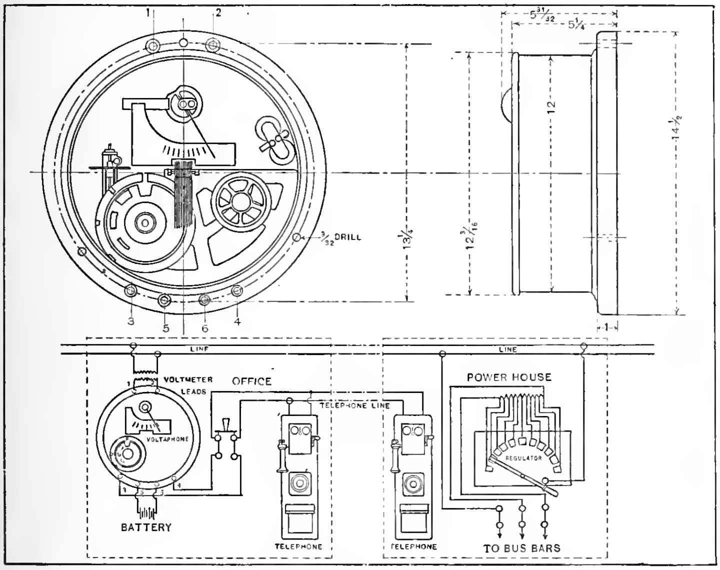


FIG. 1.—DIAGRAM OF VOLTAPHONE CONNECTIONS.

FIG. 2.—VOLTAPHONE.

The instrument is made to suit the conditions under which it is to be installed. The voltmeter is made for the desired voltage, and the telephone relay is wound to work in harmony with instruments in use, and is also made to respond to signal or to announce at certain predetermined periods. It is furnished with either a gramophone disc, which gives the readings in words, or with a signaling disc, which gives the readings in dots and dashes, easily understood, and capable of being distinguished when, from line troubles, the spoken words might be unintelligible.

The signals are those commonly known in telegraphic practice as dots and dashes. For example: One dot, or short sound, signifies that the voltage is 1 per cent. high; two dots, 2 per cent. high; three dots, 3 per cent. high; four dots, 4 per cent. high; while one dash, or long sound, indicates that the voltage is 1 per cent. low; two dashes, 2 per cent. low; three dashes, 3 per cent. low; four dashes, 4 per cent. low. One continuous sound indicates that the voltage is normal. The instrument also indicates if the voltage is above or below this range.

In operating the voltaphone, the station attendant rings up on his telephone in the usual way, and this sets in operation the instrument, which immediately gives him the voltage at its end of the line and repeats the reading, requiring about one-half minute for the two readings. If the voltage changes after the first signal, the second indicates it, making it feasible to change the voltage after getting the first signal, and to note the result of such change in the second signal.

The details of construction have been carefully worked out, and, considering the service performed, the mechanism is very simple, only such parts being used as are found to be reliable in the well-known instruments that are combined to form the voltaphone. The intention has been to furnish a practical instrument at a reasonable cost, which can be used on any telephone or telegraph line, to convey to the power house reliable information of conditions at a distant point.

Single-Phase Condenser Motor.

We illustrate herewith the latest type of General Electric single-phase motor for general power purposes, from 1 up to 15 hp. and especially designed for operation on lighting circuits. By the use of condensers and a starting resistance in the armature circuit, the result is a starting current which does not exceed that of full load, and a high power factor at all loads, thus eliminating the lagging currents common to other motors of the induction type, especially at light loads.

This type of single-phase motors differs from other types in which condensers have been employed, in that the condensers are not connected in shunt with the motor, but are energized by a tertiary motor circuit in which current is induced. In consequence, the motors

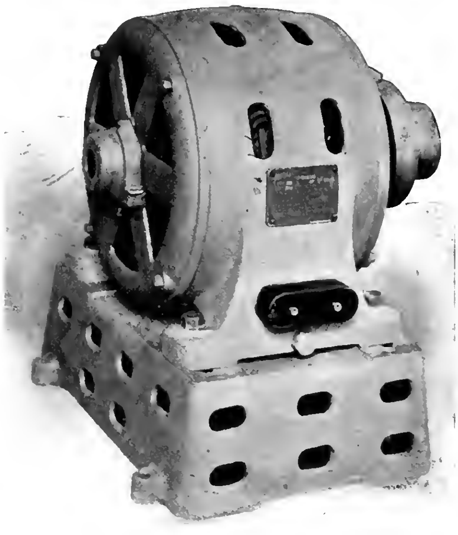


Fig. 1.—Single-Phase Condenser Motor.

do not require the sine wave of e.m.f. necessary when the shunt method of connection is employed, but may be operated with equal satisfaction on any e.m.f. wave form. Neither compensators nor any other auxiliary devices are used with the motors, the form of field winding being such that the condensers can be connected directly to the motor. The condensers are sealed in air-tight tin cases, impervious to moisture, and located in the sub-bases.

Low starting current is obtained by means of a coil-wound armature in which is placed a resistance. This resistance is in series with the armature winding at the time of starting, and is automatically cut out before normal speed is attained, by a centrifugal switch contained in the armature. With this method of starting, the motors are entirely automatic, and should the circuit be interrupted and again completed, the motors will start without the slightest attention.

To obtain full-load starting torque, a clutch pulley composed of two parts is employed. One part is a split ring which is attached to the shaft and revolves with it; the other part consists of the pulley face and an outer shell. This shell being free upon the shaft, remains stationary until the armature has attained a considerable speed, when the ring expands, gripping the shell and causing it to revolve with diminishing slip as the speed of the armature is increased, until they both revolve at the same speed. A pulley of different diameter may be used by simply removing the outer shell and substituting one having a pulley of the desired diameter. The standard pulleys should be used wherever possible, as they are properly proportioned for the various motors.

It is sometimes desirable or even necessary to suspend the motor from the wall or ceiling and these motors are constructed to readily

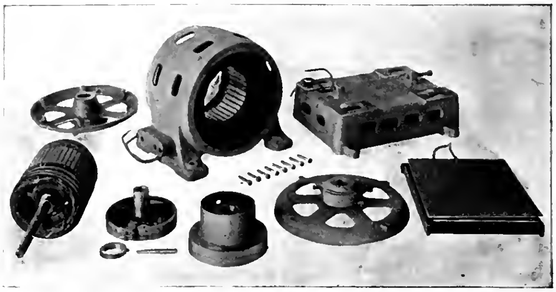


Fig. 2.—Elements of Motor.

meet these requirements. They may be prepared for wall or ceiling operation by simply loosening the end shields and turning them 90 or 180°, respectively. The importance of this feature in connection with an installation in mills or factories where space is limited will be quickly recognized. The motors lend themselves very readily also to direct connection to centrifugal pumps, generators, etc., the connection being accomplished by means of a clutch coupling. They can also be geared or belted to very slow-speed pumps and other machines.

The standard windings are as follows: All sizes up to and including 3 hp are wound for 110 volts, and the larger sizes for 220 volts; the standard frequency is 60 cycles. The motors will operate satisfactorily over a range of voltage or frequency 10 per cent. either above or below normal. It should be remembered, however, that a low voltage and high frequency or the reverse have an accumulative effect, and the variation referred to should cover the sum of the variations.

Most induction motors give rise to lagging current, which increases the current taken by the motors and causes the apparent power input to exceed the real power input. The ratio of the real to the apparent watts is called the power factor. The idle current is not in phase with the e.m.f., and, therefore, represents no loss of energy except that absorbed in heating the conductors, but it may have a detrimental effect upon the regulation of the system, or assume such proportions as to seriously diminish the useful output of the station. With the present type of single-phase motor, however, the question of power factor has been given special attention and idle currents have been reduced to a minimum, and in the larger sizes they have been entirely eliminated. In the sizes smaller than 7½ hp, the currents are lagging and the power factors range from 50 to 90 per cent. from no load to full load, respectively. In the larger sizes, however, the power factors range from 70 to 100 per cent., and the current at fractional loads is leading, which tends to improve the power factor of the circuits from which inductive loads are operated. The efficiencies, moreover, of single-phase motors are much higher than those of other single-phase motors.

The speed of an alternating-current motor varies with the frequency and is not materially affected by variations of voltage. It cannot, therefore, exceed normal if the frequency remains constant. The temperature rise of the motors will not exceed 40° C. under continuous operation at full load. This moderate increase allows liberal margin for overload without excessive heating. The motors can be operated from the same transformers as arc or incandescent lamps, or they can be supplied with separate transformers. In either case 1 kw capacity of transformer is allowed per horse-power of motors installed.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stocks recovered from the depression caused by the passing of the dividend on United States Steel common and the unfavorable financial statement of the corporation, and at the close the market was steady. There were no features of particular interest. Money eased off materially and as soon as the January payments had been concluded call loans fell to between 3 and 4 per cent., while time money was offered freely. It has been remarked that the suspension of the Steel Corporation dividend had more effect on the general list of stocks than upon Steel itself and the other industrials. The manipulative support in Amalgamated Copper and Brooklyn Rapid Transit was kept up, those stocks being rather strong features. The sales of Brooklyn Rapid Transit were 151,750, the closing price being 53¾, a net gain of 2 points. Metropolitan Street Railway was quiet, closing at 122, this being a gain of ½ point. General Electric was inactive throughout the week, the sales amounting to only 2,910 shares. This stock closed at 174, thereby losing 2 points net. Westinghouse common gained 4 points and preferred 1 point, the closing figures being 172½ and 192, respectively. Western Union made a gain of 1½ points, closing at 88, and American Telephone & Telegraph ⅛ point, the closing price being 126. Following are the closing quotations of January 12:

NEW YORK.

	Jan. 5	Jan. 12		Jan. 5	Jan. 12
American Tel. & Cable	80	85½	General Electric	173	173
American Tel. & Tel.	125	124	Hudson River Tel.	..	..
American Dist. Tel.	24	25	Metropolitan St. Ry.	122¼	120½
Brooklyn Rapid Transit	49⅛	49⅛	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	176¼	N. Y. & N. J. Tel.	..	..
Electric Boat.	15	17	Marconi Tel.	..	..
Electric Boat pfd.	46	45	Western Union Tel.	86	87½
Electric Lead Reduction	1	1	Westinghouse com.	168	165
Electric Vehicle	7⅝	9¾	Westinghouse pfd.	185	185
Electric Vehicle pfd.	11½	13			

BOSTON.

	Jan. 5	Jan. 12		Jan. 5	Jan.
American Tel. & Tel	126½	125	Western Tel. & Tel. pfd.	78	79
Cumberland Telephone	*114½	*110¾	Mexican Telephone	1½	1¾
Edison Elec. Illum.	231	233	New England Telephone	*122	120
General Electric	171	173	Mass. Elec. Ry.	19½	21
Western Tel. & Tel.	8		Mass. Elec. Ry. pfd.	75¼	75¾

PHILADELPHIA.

	Jan. 5	Jan. 12		Jan. 5	Jan. 12
American Railways	43½	*44	Phila. Traction	97¾	97⅝
Elec. Storage Battery	56	56	Phila. Electric	5⅞	6⅜
Elec. Storage Battery pfd.	56	56	Phila. Rapid Trans.	8¼	8¾
Elec. Co. of America	..	8⅜			

CHICAGO.

	Jan. 5	Jan. 12		Jan. 5	Jan. 12
Central Union Tel.	..	..	National Carbon pfd.	92	92
Chicago Edison	..	148½	Metropolitan Elev. com.	17	17
Chicago City Ry.	..	162	Union Traction	6½	6
Chicago Tel. Co.	.	125	Union Traction pfd.	28	30½
National Carbon	21	24			

*Asked

WIRELESS TELEGRAPH CONSOLIDATION.—At the annual meeting of the International Wireless Telegraph Company at Trenton, N. J., on Jan. 6, a resolution to consolidate with the American De Forest Wireless Telegraph Company was adopted without a dissenting vote. The Greater New York Security Company will finance the consolidation. The International stockholders, it is said, will receive $7,500,000 of stock in the new concern and have an interest in about seventy patents. Vice-president and general manager Gehring reported that instruments of the American De Forest Company had been ordered by the Belgian, Swedish and Japanese Governments and that the London *Times* had two sets ordered in anticipation of war in the Far East. The following directors were elected: Dr. G. G. Gehring, H. Shoemaker, M. Van Boskirk, William J. Hopper and John Mayhew. The consolidation was effected by the issuance of shares of the De Forest for shares of the International Wireless on a share-for-share basis. The International was organized originally as the American Wireless Telephone and Telegraph Company, with a capital of $5,000,000. It obtained control of five subsidiary companies—the Northeastern, Atlantic, Northwestern, Pacific and Continental—each organized on a five-million-dollar basis, and was subsequently reorganized as the Consolidated Wireless Telegraph and Telephone Company, with a capital stock of $25,000,000, through exchange share for share of the stocks of the controlled companies. This was later reduced to $7,500,000. Throughout these changes the stock had been offered to the public, and when the Consolidated was formed further stock offerings were made. Then came, a year later, the organization of the International Wireless Telegraph Company, with a like capitalization, which is now superseded by the acquisition of the latter by the American De Forest. The shares of the International and De Forest have a par value of $10. The actual value time must prove.

MICHIGAN TELEPHONE SALVAGE.—Last week the bondholders' committee of the Michigan Telephone Company, which recently acquired at foreclosure sale the properties of the corporation, were in session at the office of N. W. Harris & Company, New York City, working out a plan of readjustment of the various interests involved in the company's affairs. The property was bid in by the bondholders' committee at $4,100,000, and had been valued at something like $10,000,000 by minority stockholders' representatives, who subsequently made an ineffectual effort to have the sale annulled. The majority of the stock of the Michigan Telephone Company is owned by the Western Telephone Company, 51 per cent of whose stock is owned by the Bell. There is also a floating debt of $2,400,000 for money advanced by the Western Telephone Company besides accrued interest. No statement of the plans under consideration was given out by the bankers, who are managers of the bondholders' syndicate. Allen W. Forbes, of N. W. Harris & Company, said that negotiations had not progressed far enough to admit of such a statement, and that all accounts of an alleged plan of reorganization were unauthorized. The outline of the plan alluded to came as a Detroit dispatch to a Wall Street news agency. It stated that the bondholders will receive an equivalent of par and interest for their holdings, and will have an option of taking new preferred stock to the extent of from $1,000,000 to $1,500,000, the issue being made for the purpose of providing working capital. With the new preferred stock the company would have a total issue of $6,500,000.

MASSACHUSETTS STREET RAILWAYS.—The Massachusetts Railroad Commissioners report as follows on the street railways of the State:

	1903.	1902.	1901.	1900.
Pass. car.	....	465,472,382	433,526,935	395,027,198
Car mls. run	....	100,280,687	93,005,225	81,750,768
Gross	$27,027,651	$24,918,684	$23,179,304	$21,387,641
Op. ex.	17,519,367	15,912,852	14,565,141	13,159,947
Net	$9,508,284	$9,005,309	$8,614,163	$8,227,694
Charges	5,905,368	5,215,980	5,616,458	5,190,192
Balance	$3,602,916	$3,388,851	$3,398,183	$3,037,502
Dividends	3,586,248	3,138,711	3,417,117	2,409,874
Surplus	$16,668	$250,140	Df. $198,340	$627,628

CHICAGO ELEVATED TRAFFIC.—Chicago's elevated electric railroads broke all previous monthly records in December, except in the instance of the South Side Elevated Company, whose figures for November were not equalled. For the full year this road's gain was 10,714 passengers per day, or 13.65 per cent over 1902. The Metropolitan showing was not so large. For the year the gain was 6,543 passengers a day, or 6.19 per cent. The Northwestern increased its traffic 4,652 passengers per day during December, and the daily average for the year was 4,324 passengers in excess of the average showing for 1902.

KEYSTONE TELEPHONE.—The Keystone Telephone Company, the first organization to actively compete with the Bell Company in Philadelphia in recent years, has completed a full calendar year of operations, 1903. The net earnings reported by the company for the calendar year ended December 31, 1903, (December partly estimated) are $230,418, which is twice the amount required to pay a 5 per cent dividend on the $2,500,000 preferred stock. No further steps have been taken about a bond offering.

CONTINENTAL CONSOLIDATION.—A cable dispatch from Paris of Jan. 9 says: "As a result of recent negotiations it is announced that the Mediterranean Thomson-Houston Company and the German Société Génerale d'Electricité have been amalgamated. The new company will have a capital of $1,200,000. There has been no conclusion of the negotiations for the amalgamation of the French Thomson-Houston Company into the combination, but no hitch has occurred, so far as is known."

EMPIRE CITY SUBWAY.—The Empire City Subway Company, Limited, of New York City, filed with the Secretary of State on January 13 a certificate of an increase of capital from $2,750,000 to $3,500,000. The certificate is signed by William T. Bouchelle, John H. Cahill, Joseph P. Davis, and John W. Lieb, Jr.

MERCANTILE ELECTRIC COMPANY ELECTION.—At a meeting of the Board of Directors of the Mercantile Electric Company last week, William H. McIntyre was elected a vice-president and Alvin W. Krech was elected a director.

TWIN CITY RAPID TRANSIT.—The Twin City Rapid Transit Company has completed plans for an extension of its system and will expend $1,500,000 on the project. The first extension will be a line from Minneapolis to Excelsior, on Lake Minnetonka, one of the great pleasure resorts. The line will ultimately be extended to Anoka and Shakopee and will take in several towns. Power will be derived from dams at Elk River, which have already been acquired and upon which work has begun. This and a new line between St. Paul have been agreed upon. There are two direct lines now between the Twin Cities, but the accommodations are inadequate at times during the summer season, and will so continue until a new line is built or more power houses are erected.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade at the opening of the year, while not particularly active, shows a predominance of satisfactory features. The cold and stormy weather, which generally prevailed in the first week, had a considerable retarding effect on business and a disorganizing influence on transportation. Wholesale business is seasonably quiet at leading Eastern and Central Western markets, but a noteworthy feature is the spring demand and shipments already begun at the Southwest. Collections show a slight improvement and money is easing up, supplies of that commodity being better than heretofore. The outlook for the spring, while conservative, is favorable. The war talk has been a stimulus to many markets, especially those for cereals and provisions, but securities and cotton have been depressed by the same influences. Iron and steel, in the cruder forms, were steadier and though quiet in the East there was a better demand in the West for finished forms. As an indication of the future expansion of agriculture it is notable that Western and Southern plow manufacturers are buying more freely and interests catering to Southern trade have begun to run overtime to fill orders. The industrial situation on the whole looks somewhat better, employees showing a disposition to accept modified wages, and a number of iron and steel mills and furnaces are resuming on a readjusted basis of cost. Railway earnings for December last indicate a 7 per cent. increase over those of 1902, and the final returns for the entire year are fully as good as those foreshadowed in earlier weeks. The business failures for the week ending January 7, as reported by *Bradstreet's*, numbered 262, against 209 the week previous, and 336 the corresponding week last year. The same source of information notes the fact that the week's failures sum up the smallest total reported at this period for three years past. Complete failure returns for the year show a reduced number of casualties, though a larger volume of liabilities than in the previous year, the latter based upon an increased number of financial suspensions of concerns "on paper capital" and a few failures of large manufacturing concerns. Trade on the Pacific Coast is good in all lines except lumber, and with the Orient it is expanding largely. Copper developed considerable strength and there was considerable buying by consumers here and abroad. Prices have advanced, the closing quotations being 12⅜ to 12⅝c. for Lake, 12¼ to 12½c. for electrolytic, 12 to 12¼c. for cathodes, and 12 to 12⅛c. for casting stock.

TELEPHONES IN POST OFFICES.—A special dispatch from Cleveland, Ohio, of January 12 says: "The order of Postmaster-General Payne, which bars from the Post Office of the United States all independent telephones has raised a row. The order prescribes that only the instruments of the companies that have long-distance connections with Washington shall be used. In the Middle and Western States the independent companies have a very extensive service and their charge of discrimination is being taken up by Congressmen. Cleveland, as the headquarters of many of the largest of the Companies, has started the fight against the order, and it is aided by the National Independent Telephone Association and the Ohio State Telephone Association. A personal appeal has been made to President Roosevelt, who has promised to make an investigation. Senator Hanna has been appealed to by capitalists interested in the independent companies, many of whom are his warmest friends. Congressmen, too, have been interested, and the question is certain to be entangled with politics. The president of the Cuyahoga Company, the independent telephone exchange system of Cleveland, has declined to remove his telephones, saying that he will make a fight and trust to the courts for his money."

ELECTRIC PUMPING EQUIPMENTS FOR PITTSBURG.—The Westinghouse Electric & Manufacturing Company has placed a contract with the International Steam Pump Company for seven Deane single power well heads and artesian pump barrels which are to be used for pumping water from driven wells at their plant at East Pittsburg. The well heads are to be furnished with motor bases and double reduction gears for direct connections to Westinghouse motors of 5-hp capacity, each operating at 700 r.p.m. The heads will operate at 30 r.p.m. and the pumps will deliver water against a maximum water pressure of 125 pounds. One of the reasons for installing this system is the great prevalence of typhoid fever in the Pittsburg district. The town of East Pittsburg is provided with water works, but the supply is taken from a neighboring river open to contamination. However, in all the district it is found that by drilling down through a few strata of rock a water supply of absolute purity can be secured, and it has been proposed that ultimately the whole city of Pittsburg shall be supplied with water by this method.

SHANGHAI TROLLEY CONTRACT.—A cable dispatch from London of January 13 says: "The Shanghai correspondent of the *Times*, in a dispatch, illustrates the decadence of British commercial prestige in China by citing the action of two British electric companies with reference to a tramway contract in Shanghai. These companies have abandoned their contract, alleging the impossibility of raising the necessary capital, owing to the uncertainty of the political outlook. Their action, the correspondent says, emphasizes the crisicism recently directed against the methods of British financiers in the Far East."

OTTO GAS ENGINE WORKS.—The stockholders of the Otto Gas Engine Works have decided to increase the capital of the corporation from $600,000 to $2,500,000 and build a large, new plant just as soon as the management can find a suitable site for the purpose. Large gas engines, producer gas plants, launches and marine engines, gasoline hoists, compressors and other adaptations of the gas engine will be built promptly at the new plant. A suitable site must contain not less than thirty acres, located on a good water front, with good railroad facilities.

THE AUTOMOBILE TRADE CLUB was organized at a meeting held at the Hotel Navarre, New York City, on Jan. 11, with officers as follows: President, A. D. P. Smith, of Smith & Mabley; vice-president, E. T. Birdsall, of the Standard Automobile Company; secretary, E. B. Gallaher, of the New York Garage Company; treasurer, John E. Plummer. The headquarters of the organization will be at the Hotel Navarre, where a suite of rooms has been engaged.

TELPHERAGE MACHINERY TO COAL JAPANESE WARSHIPS.—The United Telpherage Company, 20-22 Broad Street, New York, has secured a contract by cable from the Japanese Government for telpherage machinery to be used for coaling warships. The company expects to close two further contracts with the same government within the next few days. The machinery will be manufactured at the company's plant at Westfield, N. J.

THIRD RAIL ON LEHIGH VALLEY.—It is stated on excellent authority that the Lehigh Valley Railroad Company is planning the purchase of the Binghamton & Southern Railroad for the purpose of running it as a third-rail electric railway between Dushore, Pa., and Binghamton. It is also said that the Lehigh Company will equip its branch from Harvey's Lake to Wilkesbarre with the third-rail system.

TRUMBULL SPECIALTIES FOR CHILI.—The Trumbull Electric Company, of Plainville, N. Y., through its New York representative, J. D. Watson, has lately secured a substantial contract for its electrical specialties—rosettes and switches, principally—from J. K. Robinson, of Iquique, Chili, who looks after the Westinghouse interests throughout Chili, Peru, Bolivia and Ecuador.

LIGHTING ENGINES FOR NEW FEDERAL SUGAR PLANT.—The Federal Sugar Company has just let a contract for the lighting engines to be installed in its new plant at Yonkers, N. Y. The American Engine Company, of Bound Brook, N. J., secured the contract, which calls for three engines of 120-hp capacity each, to be direct-connected to 75-kw dynamos.

MEXICAN HYDRAULIC PROJECT.—A hydraulic plant is to be constructed on the Jamapa river near Cordoba, Mexico, for general power purposes in that vicinity. Theodore Vanden Peereboom, an ex-officer of the Belgian Army, also Francisco Louvrier and Renato Jonat—both engineers in Mexico city—are primarily interested in the scheme.

ST. LOUIS FAIR.—The Intramural Railway at the World's Fair is completed. The formal driving of the last spike, and the passage of the first electric train over the road will soon be appropriately celebrated. The boilers, which will form part of the battery for power and light used in the operation of the road, have been installed.

MEXICAN POWER & LIGHTING PROJECT.—An extensive electrically operated flour milling plant is to be built at Texcoco, Mexico, by Jose de la Horga. A waterfall will be utilized for supplying the necessary power and for lighting the town. The hydraulic plant will be located about four miles from Tecoco.

BIG TELEPHONE SYSTEMS.—New York City is no longer alone in having over 100,000 telephone subscribers. The Chicago Telephone Company gained 1617 in December, 22,124 in the year, and began January with 101,187.

EQUIPMENT FOR LONDON PRINTING PLANTS.—Kohler Brothers, of Chicago, Ill., have recently taken some fair-sized orders for the electrical equipment of printing presses in London.

General News.

THE TELEPHONE.

ATKINSON, ILL.—The capital stock of the Henry County Telephone Company has been increased from $2500 to $15,000.

FAIRFIELD, ILL.—The Egyptian Telephone & Improvement Company has been incorporated; capital, $2500; to operate telephone, electric light and heating systems. Incorporators: C. M. Brock, Luke Whitson, John H. Morlan.

SLOAN, IA.—The Lawton Telephone Company has been organized here. J. A. Smith is president; A. Boline, vice-president; Dr. C. M. Wray, secretary.

DUBUQUE, IA.—The Iowa Telephone Company will erect a modern telephone exchange building and rebuild the local exchange at a cost of $140,000.

LAKE MILLS, IA.—The Silver Lake & Briston Telephone Company, of Worth County, has filed articles of incorporation with $5000 capital. O. T. Groe, of Lake Mills, is president.

TOPEKA, KAN.—The Carbondale Telephone Company, of Carbondale, has been incorporated. Capital, $2000.

FRANKFORT, KY.—The Tichenor & Hall Telephone Company, of Nelson County, has been incorporated with a capital of $50.

IONIA, MICH.—The Allen Mutual Telephone Company has been incorporated with a capital of $4500.

ESCANABA, MICH.—The Finch Telephone Exchange, of Escanaba, will extend its line to Cedar River this year.

AUSTIN, MINN.—The Tri-State Telephone Company will build a line from Austin to Dexter.

NEW YORK, N. Y.—The Independent Telephone Clearing Association, of New York, capitalized at $5000, has been incorporated. Directors: F. M. Randall, W. H. Homewood and H. H. Corbett.

NEW YORK, N. Y.—Fire on the eighth floor of the main telephone exchange at 81 Willoughby Street, Brooklyn, a few days ago, caused damage to the extent of about $5000. The 150 operators filed out of the office in good order, without any mishaps. The fire drill is practiced in this office. The fire was quenched by the use of sand by the male employees, and communication was soon established.

WINSTON-SALEM, N. C.—It is officially announced that the Bell Telephone Company has secured full control of the field at Winston-Salem, absorbing the Interstate Company. The plant of the Interstate Company at Goldsboro, N. C., is also absorbed by the Bell Company. It is further announced that the Bell Company will extend its lines through the eastern part of the state, making many new connections. The Bell Company has absorbed the entire Interstate Company's system in North Carolina except the exchange at Durham, N. C.

CHARLOTTE, N. C.—The Capital City Telephone Company has been organized in Raleigh. W. T. Gentry, of the Bell Telephone Company, of Atlanta, was elected president; L. A. Carr, of the Interstate Company, of Durham, vice-president; D. I. Carson, George Watts, Hunt Chipley, Julian S. Carr are directors. The Bell Company has taken control of the Interstate Company at all places save Durham. It also controls the Home Telephone Company, of Raleigh. Raleigh and Charlotte will have the only independent exchanges. The new Capitol City Company has been chartered for the purpose of consolidating the various telephone companies in this state.

ELYRIA, OHIO.—The Elyria Telephone Company has increased its capitalization from $50,000 to $100,000 and is preparing to make extensive improvements.

JEFFERSON, OHIO.—The Rock Creek Local Telephone Company was organized here by the adoption of a constitution and election of officers. W. W. Weiss is president.

LIMA, OHIO.—Leading stockholders of the Lima Telephone & Telegraph Company have agreed to purchase the interests of the Federal Telephone Company in the company.

MINERAL RIDGE, OHIO.—The Central District & Printing Telegraph Company (Bell) is putting up new cable and practically rebuilding its exchange at Mineral Ridge.

CLEVELAND, OHIO.—The entire issue of the preferred stock of the United States Telephone Company has been pooled and option on it given to Claude Ashbrook, of Cincinnati, which expires April 1.

NORWOOD, OHIO.—The Norwood Citizens' Telephone Company, capital stock $10,000, has been incorporated by P. H. Shorthall, F. Fangman, C. M. Jones, J. J. Cushing and others. They will build a local exchange.

TOLEDO, OHIO.—The council has appointed a committee to examine the books of the Toledo Home Telephone Company in order to determine the justice of the company's claim that its present rates are too small to be profitable.

LORAIN, OHIO.—Mayor King has vetoed the ordinance passed by the council granting a franchise to the Ohio Telephone & Telegraph Company which is said to be controlled by the Bell Company. The mayor claimed the independent service was satisfactory and sufficient.

TOLEDO, OHIO.—The Empire Electric Company, capital $20,000, has been incorporated by C. E. Sumner, Charles Hartman, W. M. Godfrey, Robert Tucker, F. F. Graves and others. The Company is engaged in installing a telephone plant at San Diego and other cities on the Pacific Coast.

BRILLIANT, OHIO.—The Ohio Valley Telegraph & Telephone Company has been incorporated with $20,000 capital stock by J. G. Gilchrist, Robert Carpenter, C. J. Waddle, J. L. Cox and others. It will build a system connecting Steubenville, New Alexandria and other towns with the extensive coal fields in that district.

TOLEDO, OHIO.—The United States Telephone Company is preparing to string several new long distance lines between Cleveland and Toledo and is building a line west from Toledo to South Bend, Ind., which will give connection with the new Chicago company, thus affording through service from Buffalo to Chicago and all intermediate points.

CLEVELAND, OHIO.—President Dickson, of the Cuyahoga Telephone Company proposes to make radical changes in the charges made for certain classes of service and to do this, careful estimates are being made as to the cost of many items that enter into the charges made for telephone service. Mr. Dickson thinks that a charge of $10 is too much for placing an extra name in the telephone directory and he also considers $10 too much of an extra charge of a desk extension telephone. On the other hand he sees no reason why the company should change the location of a telephone free of charge. Mr. Dickson denies that present contracts are to be abrogated.

RIPLEY, OKLA.—The Ripley Automatic Telephone Company has been incorporated with a capital stock of $15,000. Directors: J. W. Butcher and others.

READING, PA.—The Consolidated Telephone Company is extending its lines to Eastern Berks.

KUTZTOWN, PA.—The Consolidated Telephone Company will extend its lines from here to Lenhartsville.

PITTSBURG, PA.—The Montour Telephone Company has been incorporated with a capital stock of $10,000. Directors: W. B. Woford and others.

BEAVER, PA.—A charter has been recorded here incorporating the Beaver Valley Telephone Company with the following directors: John M. Buchanan, Agnew Hice and Robert W. Darragh, of Beaver; John H. Miller, James G. Mitchell and Henry M. Camp, of Rochester; John Reeves, Dr. J. S. Louthan and Frank F. Brierly, of Beaver Falls; F. G. Barker, F. W. Walker, J. F. Mitchell and R. D. Hunter, of New Brighton; Edward J. Bischoffberger, of Freedom, and Paulus E. Koehler, of Monaca. The line will connect the following towns: Eastvale, Beaver Falls, Patterson Heights, College Hill, Homewood, Ellwood City, Rock Point, Bridgewater, Beaver, Vanport, Industry, Smiths Ferry Georgetown, Hookstown, Rochester, Monaca, Freedom, Baden, Economy and Ambridge.

HURON, S. D.—A franchise for another telephone company has been asked by Messrs. Goecke, of Sioux Falls, and Wisard, of Howard. Metallic circuits with underground wires in the business portion of the city are proposed.

CENTREVILLE, TENN.—A new telephone company is being organized here, to be known as the Citizens' Telephone Company.

SOMERSET, TEX.—The Somerset & San Antonio Telephone Company has been chartered with a capital stock of $3000. The incorporators are W. Caruthers, J. W. Briggs, J. B. McLaughlin, August L. Ernest, W. R. Caruthers and J. N. Dixon.

SAN ANTONIO, TEX.—A switchboard of 2299 capacity, of Stromberg-Carlson make, is in service here by the San Antonio Telephone Company, which has 2200 subscribers. Superintendent A. L. Beze informs us that "by increasing the capacity of the switchboard and doing some outside construction, the number of telephones could be nearly doubled in one year. San Antonio, with a population of 60,000, covers an area of 36 square miles which would make a plant to properly cover the entire city a little expensive, but would prove a paying investment."

WINCHESTER, VA.—The Southern Bell Telephone Company has applied for a franchise in Winchester and a strong fight is expected before the matter is settled.

RICHMOND, VA.—The Laurel Fork Telephone Company, of Carroll County, Va., has been chartered with a capital stock of $5000 by G. W. Alderman, president, and others.

HAMPTON ROADS, VA.—The War Department has forbidden the Hampton Roads Railway & Electric Company from entering the reservation of Old Point, Va., the time having elapsed in which the privilege held good. The company is at present in the hands of a receiver.

WASHBURN, WIS.—The Bayfield County Telephone Company is extending its lines to Bayfield and Houghton.

ABBOTSFORD, WIS.—The Abbotsford Electric Light & Telephone Company has been incorporated with a capital stock of $25,000. Directors: E. C. Schilling, J. Young and others.

LA CROSSE, WIS.—The La Crosse Interurban Telephone Company has been incorporated with a capital stock of $50,000. Directors: W. T. Burford, C. H. Schweizer and others. This is a consolidation of the La Crosse & Southeastern and La Crosse County Telephone Companies.

CRIVITZ, WIS.—The Wisconsin Telephone Company has offered the Wausaukee Independent Telephone Company $5600 for its 50-mile toll line which connects the towns of Wausaukee, Pound, Beaver, Coleman and Marinette. It is said the Wisconsin Company will parallel the lines in the case of a refusal to sell.

TEPEACA, MEX.—Strong inducements are being offered by the jefe politico of this place to any responsible company that will undertake the establishment of a system of telephones in this district.

CHARLOTTETOWN, P. E. I.—The Telephone Company of Prince Edward Island, Ltd., was incorporated in 1885, and covers the most thickly settled piece of country in Canada. It is remarkable for the immense proportion of long distance toll offices and line to local exchange subscribers. Ninety toll offices, all long-distance lines, are grounded, and the McClure system is used in the two largest exchanges. The company contemplates entirely remodelling its system and bringing it up to date. This has already commenced, and it is thought a larger volume of business will result. There is no telephone communication with the mainland. Some of the improvements projected by this company are: new line poles and metallic circuit to Summerside (45 miles); 10 miles new long-distance line; long-distance toll offices equipment: and a new distributing rack, pole line, and increased cable capacity in Charlottetown.

Electric Light and Power.

GADSDEN, ALA.—The new power plant of the Alabama Steel & Wire Company, at the steel plant, has been completed and the electric cars are now being operated by power generated at the new plant. The old plant, formerly used for the car line and lights combined will now be used for the city electric light power.

ATLANTA, GA.—Under the new contract entered into in April this city now has 821 arc lamps at $75 each, or a total of $61,575; 446 series lamps at $33.75 each, or a total of $15,052.50 per year, making a grand total of 1267 at a total cost per year of $76,627.50, or a saving of $7.50 per arc lamp over the price paid the previous year.

BOISE, IDA.—A company which has in view the utilization of the power of Shoshone, Auger and Twin Falls on the Snake River will be organized in the near future under the laws of Maine. The plant will have a capacity of 100,000 horse power and the purpose is to distribute the electrical energy in Idaho, Nevada and Utah. A fall of 430 feet can be obtained from the three falls within a distance of ten miles. The company has already completed a tunnel at Shoshone with a capacity of 20,000 horse power. Dr. A. C. Conrad, I. B. Perrine and F. C. Rutan have been quietly working on the project here. If the present plans are carried out the cost of the plant will be in the neighborhood of $750,000.

JACKSON, KY.—The local lighting plant has been closed. A number of the largest creditors have applied for a receiver for the company. Lewis Enrich, the manager of the company, recently tried to sell his holdings to the Jackson Development Company, but was unsuccessful.

JACKSON, MICH.—There is some talk of constructing a municipal electric light plant.

NEGAUNEE, MICH.—The Council has voted to expend $15,000 for improving the electric light plant.

SCHOOLCRAFT, MICH.—Schoolcraft's municipal lighting plant, built at a cost of $16,000, was started for the first time on city lighting on Christmas day. The plant, which is run by a 125-hp steam engine, furnishes twenty-seven arc lights for the streets and has a capacity of 1500 incandescent lamps for commercial lighting.

WAVERLY, MINN.—Bids will be received Jan. 16 by the Village Council for $8000 electric light plant and water works bonds. Edw. J. Giblin is Village Recorder.

COLUMBIA, MO.—The Mayor writes that the plant of the Columbia Water & Light Company is being appraised with a view to selling the same to the city.

ST. CHARLES, MO.—The directors of the St. Charles Light & Fuel Company have decided to increase the capital stock of the company from $20,000 to $30,000.

WARRENSBURG, MO.—The City Council has authorized the City Attorney to draft an ordinance submitting the question of public ownership of an electric light plant to a vote of the citizens.

PALMYRA, MO.—The Palmyra Light & Water Company, owned by B. F. Hobert, has been sold to W. E. McCully, of Macon, Mo., State Railroad Commissioner. At a recent election the city voted down a proposition to buy the plant for $25,000, and it is presumed these are about the figures paid by Mr. McCully.

JOPLIN, MO.—W. G. Sergeant, of this city, has concluded the deal for the transfer of the water rights of Spring River at Baxter Springs, Kan. The syndicate represented by Mr. Sergeant, composed of Joplin capitalists, paid $2250 for the Baxter water rights, including the dam, mill wheels and all rights on Spring River owned by the town. The syndicate has also purchased the Boston mills, and is now dealing for the water rights at Lowell. The scheme is of vast proportion. Spring River is to be dammed and the entire Joplin mining district is to be furnished with electric power, and other industries will also receive their power from the same source. The power house is to be built at Lowell, just over the border in Kansas, and the work of developing the system will begin in the spring.

IRVINGTON, N. J.—The Town Council has authorized the Fire and Water Committee to secure estimates on the probable cost of an electric light plant.

PLAINFIELD, N. J.—The Public Service Corporation has leased the Union, Somerset and Middlesex Lighting Company, which includes the Plainfield Gas & Electric Light Company and plants at Bound Brook, Somerville, New Brunswick, Rahway and Metuchen. These companies were recently consolidated, the capital being $1,500,000, with the power to issue bonds to the amount of $2,750,000.

ALBANY, N. Y.—Saml. C. Wooster and Walter E. Ward, of this city, are reported interested in the construction of an electric light plant in the west end.

AKRON, N. Y.—The citizens have voted to issue $10,000 bonds for an electric light plant.

CLIFTON SPRINGS, N. Y.—This village is considering the construction of an electric light plant.

NEW YORK, N. Y.—The Triumph Light Company, of Brooklyn, capital $50,000, has been incorporated. The directors are J. H. Roth, H. F. Ashury and John Hoffmann, of Brooklyn.

PORT HENRY, N. Y.—D. F. Payne, of Wadhams Mills, N. Y., is reported to be negotiating with Port Henry people for the installing of electric lights, power to be transmitted from Wadham's Mills.

BOONVILLE, N. Y.—In October, 1901, the people of this village voted in favor of a proposition to raise $45,000 for the erection of a plant to furnish electricity for lighting. The plant was started in operation on Christmas day. The plant is located on the Black River about four and a half miles north of Boonville. The dam across the river is 300 feet long and 22 feet high.

QUEENSBURY, N. Y.—To develop the power resources of the fall of Upper Hudson and to distribute electric power as far west as Utica and Syracuse and as far south as Hudson, the Hudson River Electric Power Company, of Queensbury, with a capital of $1,000,000 has been incorporated here. Directors: E. J. West, Bryce E. Morrow and L. W. Guernsey, all of Glens Falls.

CHEROKEE, N. C.—Bids will be received Jan. 21 by W. A. Jones, Commissioner of Indian Affairs, Department of Interior, Washington, D. C., for furnishing material and constructing an electric light system at the Cherokee school.

ATTICA, OHIO.—The citizens have voted to issue $6250 bonds for an electric light plant.

CADIZ, OHIO.—The Cadiz Electric Light & Power Company has increased its capital from $10,000 to $20,000. Wm. T. Wood is president.

COURTLAND, OHIO.—The question of installing an electric lighting plant is being discussed by local people and the council will be asked to issue $6000 in bonds for the purpose.

XENIA, OHIO.—The Peoples' Gas & Electric Light Company has been fined for contempt of court. The company has been having a controversy over the use of non-insulated wires and recently refused to furnish the city with light, although under contract to do so. A mandatory order to furnish lights issued by the circuit court was ignored, and this resulted in contempt proceedings.

CLEVELAND, OHIO.—The Cleveland Board of Public Service has decided not to accept the schedule of prices proposed in the recent ordinance to compel the Cleveland Electric Illuminating Company to reduce its rates, but it has been decided that a committee of three arbitrators should be appointed to settle on an equitable rate to be charged for electricity. The city will appoint one man, the electric light company another, and the two thus chosen shall select a third.

WILKESBARRE, PA.—The Ashley Electric Light Company has petitioned Council for a franchise to furnish Wilkesbarre with light.

LEBANON, PA.—The Edison Electric Illuminating Company is improving the street lighting system of the city at a cost of $33,000. The old arc lamps are being replaced with new and larger ones.

HOLLIDAYSBURG, PA.—The following officers of the Hollidaysburg Electric Light & Power Company have been elected: President, James W. Gromiller; vice-president, W. H. Markland; secretary and treasurer, John W. Cliber; superintendent, W. A. Frank.

HARRISBURG, PA.—The following-named companies have filed incorporation papers recently: The Fair Chance Electric Company, Pittsburg; capital, $5000; Dunbar Electric Company, of Uniontown; capital, $5000; West Fayette Electric Company, of Uniontown; capital, $5000; North Huntingdon Electric Company, of Greensburg; capital $5000; Hempfield Electric Company, of Greensburg; capital $5000; Bullskin Electric Company, of Uniontown; capital $5000; The East Huntingdon Electric Company, of Greensburg; capital $5000; Pittsburg Heat & Power Company, Pittsburg; capital $5000.

NEWTOWN, PA.—The Newtown Electric Street Railway Company has secured the contract for lighting the streets at the following rates: Ten arc lights of 2000-cp each and 30 incandescent lamps of 32-cp, none of the arc lamps to be placed more than 1500 ft. distant from State or Penn Streets, at $1827 per year for 3 years, or $1740 per year for 5 years; the lamps to burn from dusk to dawn every night; each additional incandescent lamp to cost $28; each additional arc lamp to cost $78, but if less than five are added at one time the price to be $90; the incandescent lamps not to be used longer than 600 hours before being replaced, and if they fall below 75 per cent. of their specified candle power to be replaced before the 600 hours have elapsed.

MILLER, S. D.—The City Council has granted to Stephen Pauly a 20-year franchise for the construction and operation of an electric light plant.

FRANKLIN, TENN.—The Council has granted a franchise to Nashville capitalists, represented here by John S. Denton, giving them the privilege of constructing an electric light plant. The company proposes to construct an ice and cold storage plant in connection with the same.

DETROIT, TEX.—The Detroit Electric Light & Power Company has been incorporated with a capital stock of $10,000. The incorporators are W. E. Whitner, W. T. Davis and J. R. Dillahunty, all of Detroit.

AUSTIN, TEX.—An explosion in the city power house recently resulted in the death of one man and wrecked $30,000 worth of machinery, besides damaging other machinery and the power house very badly. The cause of the accident was the breaking of the governor on the fly wheel.

WAXAHACHIE, TEX.—The Waxahachie Gas & Electric Company has been organized here with a capital of $100,000, to install an electric light and power plant and a gas plant. Incorporators: J. F. Strickland and M. B. Templeton, of Waxahachie; R. C. Vickery, of Ft. Worth, and others.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company has recently increased its electrical supply by establishing a power plant on the Bear River at Garland, Utah. The plant has a capacity of 5000 horse power and is now ready for operation.

CULPEPER, VA.—The Virginia Construction Company, of Richmond, has just completed a new electric light plant at Culpeper for the city and the system has been satisfactorily tested.

FT. MYER, VA.—Bids are wanted Jan. 22 for constructing an electric lighting system at Signal Corps Post, Ft. Myer. Archibald W. Butt, Q. M., U. S. A., can give further information.

NORTH YAKIMA, WASH.—The sale of the Yakima Water, Light & Power Company to Robt. E. Strahorn, of Spokane, is confirmed.

ABBOTTSFORD, WIS.—The Abbottsford Electric Light & Telephone Company has been incorporated with a capital of $25,000.

MILWAUKEE, WIS.—Mayor Rose in his annual message recommends the early construction of the municipal electric light plant.

ENID, OKLA. TER.—The Enid Gas Light, Heat & Power Company, of Enid, has been incorporated with a capital of $150,000 by Lawrence A. Martin and Avery A. Humphrey, both of Guthrie.

The Electric Railway.

MONTGOMERY, ALA.—Negotiations are pending for the consolidation of the Montgomery Traction Company and the Montgomery Street Railway.

AUGUSTA, GA.—A charter has been granted to the Georgia Traction Company to construct an interurban line from Athens to Carnsville, a distance of 33 miles. The capital of the company is $500,000.

ATLANTA, GA.—The electric cars of Atlanta are now under the control of a "train dispatcher" who, by means of a new telephone system just put in, directs the movements of the cars of the Georgia Railway & Electric Company. There are thirty telephones located at various parts of the city.

CHICAGO, ILL.—The proposed plan of reorganization of the Calumet Electric Street Railway by the certificate-holders of the National Bank of Illinois has been definitely abandoned.

CANTON, ILL.—At the recent meeting of the stockholders of the Illinois Central Railway Company, officers were elected as follows: U. G. Orendorff, of Canton, president; W. O. Dean, of Evanston, first vice-president; R. F. Henkle, of Canton, second vice-president; James A. Lawrence, of Chicago, third vice-president; W. D. Plattenburg, of Canton, secretary; E. A. Heald, of Canton, treasurer. Attorney F. A. Dolph was empowered to make the necessary legal arrangements with the Cleveland Trust Company, after which, at the call of the president, another meeting will be held, at which the purchasing and construction committees will be appointed.

DANVILLE, IND.—The right of way between this city and Cartersburg has been purchased by the Indianapolis & Danville Traction Company, and the road will be built connecting with the main line at Plainfield.

COLUMBUS, IND.—The Indiana Central Electric Railway Company has applied for a fifty-year franchise to enter Columbus. The company proposes to build an electric railway from Columbus to West Baden by way of Seymour.

COVINGTON, IND.—The Fountain-Warren Traction Company, promoted two years ago to build a road from Covington to Danville, has made arrangements to begin construction work immediately. The contract has been let to a New York Construction Company.

CHEROKEE, IA.—The Cherokee Electric Lighting Company is considering plans for the construction of an electric railway between Cherokee and the State Hospital for the Insane, which is located about a mile distant from the city. Seventy-five thousand dollars worth of bonds will be floated to cover the expenses of construction and equipment. The power will be furnished by the present power plant of the company.

MADISONVILLE, KY.—The Madisonville Traction Company will build a 12-mile extension from Madisonville to Nortonville. J. M. Huffaker is president of the company.

OWINGSVILLE, KY.—Henry L. Martin, representing Cleveland and Cincinnati people, has right of way and franchises for an electric road from Hillsboro to Salt Lake, Ky.

LEXINGTON, KY.—A suit for the appointment of a receiver and sale of the property of the Blue Grass Consolidated Traction Company has been filed in the Circuit Court at Lexington by B. F. McDonald and twenty-eight other lien holders.

SUMMIT, LA.—Dr. H. K. Butler and several other prominent citizens have acquired the charter for an electric railway from Summit to Magnolia, and will shortly put forth efforts to secure the necessary capital to build and equip the line.

AUGUSTA, ME.—The Railway & Electric Equipment Company, capital $1,000,000, has been organized to sell cars and locomotives for steam and electric railways. Elwood C. Jackson, of Philadelphia; Charles C. Rolston, Chicago, and Frank J. Lewis, Cleveland, are among the incorporators.

PITTSFIELD, MASS.—A petition will be made to the Massachusetts Legislature for an act to incorporate the Berkshire Northern Street Railway Company, the object of which is to operate electric railway lines in North Adams, Williamstown and Cheshire, as a part of a system which is planned to connect the Berkshires with Troy, N. Y. Attorney P. J. Ashe and C. Q. Richmond, of North Adams, Mass., are interested.

DOWAGIAC, MICH.—The City Council has granted to J. G. McMichael a franchise for the electric railway to run from Benton Harbor through this city

MINNEAPOLIS, MINN.—The Minnesota Power & Trolley Company is seeking permission to use the old right of way from Hopkins to Excelsior for an electric railway. Power will be developed at Elk River, from the Mississippi River.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company's new power station at the foot of Felix Street is now in operation. The main railway equipment consists of a 1000-kw generator, direct-connected to a 1000-hp Corliss engine. The main equipment of the lighting department consists of a 1500-kw generator, direct-connected to a steam turbine of 1500-hp. As a reserve the company has installed one 425-kw. and one 250-kw generator which can be used either for lighting or power purposes. Besides this, the company will keep in reserve the entire plant that is now used to furnish power for the street railway system. This is the old plant and will be allowed to remain, but the lighting machinery will be taken out.

HASTINGS, NEB.—The Nebraska Central Electric Railway Company is arranging to extend its lines to Omaha.

NEW YORK, N. Y.—The Aldermen have voted unanimously in favor of the franchise for the extension of the Manhattan Elevated system to Westchester, which had previously been approved by the Rapid Transit Commissioners. The extension is nearly completed, and the company has announced that it will open the line early in the spring.

GLOVERSVILLE, N. Y.—The Fonda, Johnstown & Gloversville Railroad Company has purchased the property of the Adirondack Lakes Traction Company, consisting of the trolley line leading from Gloversville to Mountain Lake, and all the accoutrements, hotels and pavilions at the lake. The road will be run independently of the Fonda, Johnstown and Gloversville system, and John Shanahann has been elected president, Lyman K. Brown, vice-president, and E. H. Stechel, secretary. The road will be placed in first-class condition and many improvements are planned at Mountain Lake. The road, which was built in 1901, suffered a severe blow July 4, 1902, when a collision resulted in fourteen deaths. It opens up a delightful country, and under the new management promises to become a well-known Summer resort.

CLEVELAND, OHIO.—The Cleveland, Painesville & Ashtabula Railway has been formally transferred to the company of that name. Heretofore the road has been operated by the Electric Construction Company, of Cleveland, by which it was built.

TOLEDO, OHIO.—The Lake Erie Traction Company, of Toledo, has been incorporated with $100,000 capital stock by S. P. Douglass, W. H. Drake, W. W. Drake, Geo. M. Bailey and C. B. Metcalf, of Findlay. The company proposes to build an electric railway from Toledo to Columbus.

WEST LEIPSIC, OHIO.—The Toledo, Columbus & Cincinnati Electric Railway Company has applied for a franchise in the village. It is stated that practically all the required right of way has been obtained and that contracts for the construction of the road will be placed in the near future. Ellis Bartholomew, of Toledo, is president of the company.

CORTLAND, OHIO.—C. G. Phillips, promoter of the Kenilworth-Warren line, which, it is claimed, has been financed and will be built by the people interested in the Cleveland & Sharon Traction Company, is now projecting a line from Kenilworth to Jefferson. These lines would give both Warren and Jefferson direct connection with Cleveland. Preliminary engineering work for the Kenilworth-Warren line is now in progress.

MECHANICSBURG, PA.—The directors of the Star Trolley Company have decided to order at once all necessary supplies for the early completion of the line.

WILKESBARRE, PA.—The Wilkesbarre & Wyoming Valley Traction Company has signed a contract for new equipment for the South Wilkesbarre power house.

WARREN, PA.—It has been decided to extend the Warren-Jamestown Electric Railway from Frewsburg southward, instead of following the route previously planned.

DONORA, PA.—The Douglass & Donora Street Railway Company, capital $18,000, has been chartered to build a 3-mile line connecting these two Allegheny County points.

NANTICOKE, PA.—Councils have killed the ordinance granting the Nanticoke & Hanover Street Railway Company a franchise, and passed on two readings the ordinance granting a franchise to the People's Street Railway Company, covering practically the same territory.

ALTOONA, PA.—Philadelphia capitalists are interested in a project to build an electric trolley line from Altoona to Bedford, Pa. Power for operating the road will be furnished by the Bedford Water Power & Electric Company, in which City Engineer Harvey Linton, of Altoona, is interested, owning all the water rights.

WILKESBARRE, PA.—At a meeting of the directors of the Hazleton, Weatherly & Mauch Chunk Traction Company, R. F. Loper & Company, of Philadelphia, were awarded the entire issue of $1,000,000 in bonds. The firm will act as fiscal agent of the company, and is to finance and build the line from Hazleton to Mauch Chunk. This road is an important link, connecting the electric railway system from Scranton to Philadelphia.

COLUMBIA, S. C.—The Columbia Electric Street Railway, Light & Power Company, will, it is reported, make extensive improvements. E. B. Clark is general manager.

KNOXVILLE, TENN.—The Knoxville Traction Company has been granted a franchise to build extensive additions to the present lines in the city.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway will issue 30-year 5 per cent bonds to improve the system and build additions to the lines now in operation.

FREDERICKSBURG, TEX.—A company with a capital stock of $300,000 is being organized to undertake the construction of an electric railway from Fredericksburg to Waring, a distance of 25 miles. Among those interested is Alfred Vander Stucken.

GREAT BRIDGE, VA.—An electric railway from Money Point to Great Bridge is being worked up. The line will be six miles long. A connection with Norfolk will likely be made. It is said that the Buell interests are backing the scheme.

TORONTO, ONT.—A company of Toronto, Ont., capitalists has a proposition before the city council of St. Catherines, Ont., to construct an electric railway from St. Catherines to Niagara-on-the-Lake, thence along the river road to Queenstown, thence to St. Catherines, making a belt of 28 miles in length, and embracing the richest fruit lands in the district. The town of Niagara will aid the enterprise to the extent of $15,000, and loans from Grantham and St. Catherines aggregating $45,000 will be asked. The road is capitalized at $250,000.

MONTREAL, QUE.—There is every probability of the proposed electric road between Montreal and Ottawa going through. The finances, which have heretofore been a stumbling block to the enterprise, are said to have been satisfactorily arranged. One water power has already been secured and others along the proposed route will also shortly be obtained. The company has a capital of $500,000, and has been granted a subsidy of $128,000 by the Dominion parliament. The road must be commenced within six months and be completed in three years. The head office will be in Montreal, and the board of provisional directors include Edgar McMullen, of Boston, Mass., the president of the company and J. Douglas Wells, of New York, first vice-president.

New Industrial Companies.

THE RAMBLER AUTOMOBILE COMPANY, of Hatboro, Pa, has been incorporated; capital, $5000.

THE PENNSYLVANIA CARBON GRAPHITE COMPANY, of Scranton, Pa., has been incorporated; capital, $15,000.

THE RUSSELL ELECTRIC COMPANY, of New York, has been incorporated; capital, $10,000. Directors: G. W. Russell, Jr., Minnie G. Reddon, and J. H. Taylor, of New York.

THE PORTABLE ELECTRIC SAFETY LIGHT COMPANY, has been incorporated at Jersey City. It will manufacture and deal in electrical machinery and appliances of every kind.

THE PORTABLE ELECTRIC LIGHT COMPANY, of Jersey City, N. J., has been incorporated; capital, $250,000. Incorporators: Duncan L. McLaren, Henry H. Graff and Joseph Du Vivier.

THE ATLANTIC EQUIPMENT COMPANY, of Schenectady, N. Y., has been incorporated to repair and deal in engines; capital, $25,000. Directors: Leigh Best, C. B. Denny and C. E. Patterson, New York.

THE OWNERS' AUTOMOBILE COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $2000, full paid. The shareholders are Horace A. Davis, William C. Woods and George L. Moselle.

THE COMMERCIAL AUTOMOBILE COMPANY, of New York, has been incorporated: capital, $2000. Directors: O. J. Hershmann, New York; Frederick Werner, Brooklyn, and Anderson Price, Rutherford, N. J.

THE CROSELMIRE & ACKOR COMPANY, Newark, N. J., has been incorporated to crush and treat mineral ores; capital, $100,000. Incorporators: Frederick A. Croselmire, William F. Ackor, and Cecil H. MacMahon.

THE GATE CITY MOTOR CAR COMPANY, of Keokuk, Ia., with a capital stock of $10,000, has been incorporated by Jesse E. Baker and Latham H. Ayer, Jr. These with E. Ross Baker, constitute the first board of directors.

THE MACHINERY & ELECTRICAL COMPANY has been incorporated in Los Angeles, Cal., with a capital stock of $250,000. The directors are Hugh T. Duff, W. B. Woodhill, W. F. Gibbs, C. F. Baker and F. C. Armstrong.

THE POWER CITY ELECTRIC & AUTO. STATION, of Rochester, N. Y., has been incorporated to deal in electrical supplies; capital, $6000. Incorporators: E. M. Van Alstyne, A. W. Van Alstyne, G. R. Van Alstyne, all of Rochester, N. Y.

THE WORTHINGTON AUTOMOBILE COMPANY, of New York City, has been incorporated; capital, $200,000. Directors: G. G. Worthington, of Shawnee, Pa.; W. J. P. Moore, of New Britain, Conn., and H. R. Lounsbury, Jr., of New York City.

THE H. R. ASHBROOK COMPANY, of Toledo, O., capital $10,000, has been incorporated by H. R. Ashbrook, E. M. Taylor, U. G. Ashbrook, J. A. Yoder and others, of Toledo. The company will succeed to the business of H. R. Ashbrook who has been engaged in the handling of telephone securities.

Legal.

WATER POWER CONTRACT.—In a case brought up to the Court of Civil Appeals of Texas between the Gonzales Water Power Company and the Citizens Electric Light & Power Company at the same place, a judgment in favor of the plaintiff water power company was reversed. It was held that, under the plaintiff's contract, to continuously furnish defendant the use of a water wheel for power, plaintiff, failing to keep it in good repair and condition as stipulated, thereby preventing operation, is liable for defendant's additional expense of obtaining other power.

TO PAY FOR TAPPING.—The Texas Supreme Court has rendered a decision affirming the judgment of the lower court awarding the Uvalde National Bank of Uvalde, Tex., $1200 damages against the Western Union Telegraph Company for a loss sustained through wire tapping. The money was obtained from the bank by Rief and Fisher, two noted wire tappers, who are now serving sentences in the Missouri penitentiary for a similar practice, committed in that state. Rief played the rôle of a cattle buyer. The Supreme Court holds that the Western Union was guilty of undue negligence in the transmission of the message over its line.

BLADES STARTING BOX PATENT UPHELD.—The Blades patent, No. 418,678, dated Jan. 7, 1890, covering the automatic underload release starting box, has been upheld in a decision by the United States Court of Appeals at Chicago. The patent was held valid in 1897 by Judge Baker of the Circuit Court of Indiana, and since then suit has been brought in another district. Suit was started in 1898 against Harding & Hammer, selling agents for the Chicago Rheostat Company, which was afterwards acquired by the General Incandescent Arc Light Company. A similar suit is now pending at New York City against these companies.

UPHOLDS EIGHT-HOUR LAW.—The constitutionality of the Kansas eight-hour law has been affirmed by the United States Supreme Court. Justice Harlan said, in handing down the opinion of the court, that if the statute is mischievous, the responsibility rests with the legislators and not the courts. The Kansas law was enacted in 1891 and provided that eight hours should constitute a day's work for workmen employed by the state or by any municipality in the state. It also prohibits contractors from requiring laborers engaged on work for the state to perform more than eight hours labor in a day. Both fine and imprisonment are provided for violation of the law. The case decided was that of W. W. Atkins vs. the State of Kansas. Atkins had a contract with the corporation of Kansas City, Kan., for paving and he was charged with requiring a workman to labor ten hours a day. He was prosecuted in the state courts where the decisions were uniformly against him. Atkins appealed from the decision of the state supreme court to the federal supreme court, alleging that the statute is in violation of the first section of the fourteenth amendment to the constitution, in that it denied him the protection of the law and deprived him of his property without due process.

BOARDING STREET CARS.—In the trial of a personal injury action brought in the United States Circuit Court by Henry D. Corliss against the Nassau Electric Railroad Company of Brooklyn, the controversy was whether the car, which it was alleged the plaintiff was attempting to board, was moving or at rest. It was held by the Circuit Court of Appeals, when the case came before it on an appeal from a judgment in favor of the plaintiff, that evidence of a custom of cars to stop at the point where the accident occurred was admissible. The court said, in part, by Judge Coxe: "The plaintiff's right to recover depended solely upon his ability to establish the proposition that the car was at rest when he attempted to board it. The fact that the place was a designated stopping point for all the defendant's cars, and that they all stopped there, was strongly corroborative of the plaintiff's testimony that the car was not moving. Assume, for the purpose of illustration, that the accident had occurred on a steam road—at Tarrytown, for instance, on the Hudson River Railroad. Can there be a doubt that, in answer to defendant's testimony that the train ran through the station at Tarrytown without stopping, the plaintiff would be permitted to show that Tarrytown was one of the scheduled stations for that train, and that it always stopped there? We think not. The plaintiff was not attempting to prove negligence in stopping or not stopping the car, but simply the existence of a rule and custom which required that the car should stop at that point, and that, in accordance with this rule and custom, all the cars of that line did stop."

Educational.

COLUMBIA UNIVERSITY, N. Y.—Prof. G. F. Sever forwards us the following list of investigations now under progress at the university: Determination of hysteresis losses of a condenser; a comparison of methods of induction motor calculation; selenium photometer; tests on direct current elevator equipments; tests on alternating current elevator equipments; development of a new method for the compounding of alternating current systems; design of and shop tests on a unipolar generator; investigation on arc lamp electrodes; test of a variable speed motor; determination of the ratio of the resistances of the feeder and the return systems of trolley lines; electrolysis in relation to sub-surface systems; comparative costs of central station and isolated plant supply; design of a direct reading instrument for the determination of the strength of magnetic fields; development of methods for the determination of magnetic properties of iron and steel; development of a method for overcoming the inductance in high tension alternating current systems of distribution.

Obituary.

MR. T. H. DELANO.—Mr Thomas H. Delano, founder and editor of the trade paper *Tobacco*, of this city, died last week at his residence, in Greenwich, Conn. Mr. Delano was at one time a publisher in the electrical field, where he was then well known. For many years he was the treasurer of the New York Press Club.

MR. L. ELLIOTT, president and controlling owner of the Antigo Electric Light, Power & Heating Company, of Antigo, Wis., died suddenly the night of Jan. 2. Mr. Elliott, in addition to his active interest in the electric light company, was also the manager of the Antigo Telephone Company and treasurer of the Columbia Manufacturing Company.

MR. H. RUDDICK.—Mr. Hamilton Ruddick, a mechanical and electrical, consulting and constructing engineer, died in his apartment in Brooklyn, last week. He was born at St. John, N. B., in 1826. He came to this country as a young man, and has held many positions throughout the East, being one of the first inspectors of hulls appointed by the United States Government to the port of Buffalo.

MR. F. H. CLARK.—Frank Hodges Clark, once private secretary to Gen. Benjamin F. Butler, died at Chicago last week. During twenty-one years he was a paymaster in the United States Navy. Since 1890 Mr. Clark had been an official of the General Electric Company and of the Westinghouse Electric Company at Washington, D. C., and recently was appointed receiver for the Helios-Upton Storage Battery Company. He was widely known and greatly liked in the electrical field.

GEN. C. H. BARNEY.—Gen. C. H. Barney died at his home in Hackensack, N. J., on Jan. 10, of spinal meningitis. He was sixty years of age. He served as Adjutant General of Rhode Island for five years. In Gov. Van Zant's time he was a Commissioner from New Jersey to the New Orleans Exposition. He served through the civil war as Lieutenant in a Northern regiment, and for several years was Superintendent of the New York and New Jersey Telephone Company. He leaves a wife and three adult children. He early recognized the great value of the telephone, superintended the building of the first long distance line between Providence and Boston and afterward took part in the construction and extension of the system in the metropolitan district, now known as the New York & New Jersey Telephone Company. He was associated at various times with the Inter-state Telephone Company of Providence, the Sawyer-Man Electric Company and the New York Telephone Company, was a member of the National Telephone Association and the National Electric Light Associations, and was well known to electrical engineers and managers all over the country. He was at the Columbian Exposition and also at the Atlanta Exposition, as manager of the Electric Launch service on the water-ways, which proved a very popular feature.

PERSONAL.

MR. THOMAS J. JOHNSTON and Mr. George C. Dean, of the patent law firm of Johnston & Dean, are now located in offices at 11 Pine Street, New York City.

MR. W. F. RICHARDSON, formerly assistant manager of the John A. Roebling's Sons Company's branch, at Cleveland, Ohio, has been transferred to the San Francisco headquarters.

PROF. F. B. CROCKER, of the electrical engineering department of Columbia University, New York City, has sailed with Dr. M. I. Pupin for a short winter trip in Mediterranean waters, proposing to be back by the end of February.

MR. ROBERT W. BLACKWELL, head of the firm bearing his name, is again in this country from London, and will be at the Albemarle Hotel, New York City, for a couple of weeks. He arrived by the *Celtic* at the beginning of this week.

MR. EDWARD N. LAKE, formerly with the Western Electric Company and more recently upon the engineering staff of the Chicago Edison Company, has assumed the management of the switchboard department of the J. Lang Electric Company, of Chicago.

MR. E. A. CAROLAN, manager of the London office of the General Electric Company and a director of the British Thomson-Houston Company, Limited, has returned to New York from a trip to the Pacific Coast and Mexico and will leave next week for Europe.

MR. IRVING H. REYNOLDS, who was formerly with the Allis-Chalmers Company and for many years was identified with the design and construction of their engines, has accepted a position with the William Tod Company, of Youngstown, Ohio, as consulting engineer.

MR. W. W. BORMAN, of Robert W. Blackwell & Company, Ltd., London, is now visiting this country. It will be remembered that Mr. Borman carried on the New York house for some time. He has been busy renewing old friendships and acquaintances, and is glad to be over here again.

MR. D. D. TATE, the chief electrician of the Barney & Smith Car Company, Dayton, Ohio, has been in the east lately, and has been busy putting into commission on the Erie Railroad a splendid new parlor car, whose general equipment, inclusive of the lighting, is about the finest known.

HON. CHANDOS S. STANHOPE, president of the Mexico Electric Tramways, Limited, which concern operates some 120 miles of electric traction system in Mexico City, has arrived in New York from a visit to Europe. While here he can be found at the Hotel Albermarle.

MR. FRANCIS J. GREENE, of Detroit, is endeavoring to introduce a system of wireless telegraphy for train signals and has organized the American Engineering Company to handle the business, with a capital stock of $2,500,000. It prints on a tape its signal and opens and closes signal lighting circuits. Wireless apparatus is delicate stuff for such vital purposes.

MR. WILLIAM SCHWANHAUSSER, chief engineer of the International Steam Pump Company, has returned from a two months' trip to Europe, where he went for the purpose of visiting several of the large engineering works in England and on the Continent. Some large contracts are expected to be received shortly as a result of Mr. Schwanhausser's visit abroad.

MR. A. B. SANDERS, who has for a number of years past been connected with the engineers' department of the American Telephone & Telegraph Company, of New York City, and later with the Electric Storage Battery Company, of Philadelphia, has connected himself with John B. Watson, Drexel Bldg., Philadelphia, taking charge of Mr. Watson's electrical department.

MR. HENRY EDMUNDS, of London, who has been visiting this country and has spent several weeks here and in New England with his family, has returned home. He gave attention to several electrical and other matters while here, and left very well pleased with results in general. He has a large circle of friends in this country, dating back to the earliest days of electric lighting.

MR. GEORGE W. DAVENPORT, a well-known "old timer" in the light and power field, and who, since his early Thomson-Houston days, has been deeply interested in the direction and management of electrical properties, has become third vice-president of the Niagara Falls Power Company, that office having been recently created. Mr. Davenport is a valuable acquisition to the staff of that important enterprise.

PROF. A. G. BELL.—A cable dispatch from Genoa of Jan. 7 says: Professor Alexander Graham Bell, of the Smithsonian Institution, at Washington, and Mrs. Bell left here to-day on the North German Lloyd steamship *Prinzessin Irene*, with the body of James Smithson, founder of the institution, who died in Genoa in 1829. The city of Genoa will maintain the monument erected to the memory of James Smithson.

MR. JAMES C. STEWART, of the American contracting firm of James Stewart & Company of St. Louis, Pittsburg and London, is now on a visit to this side. He had supervision of the construction of the Trafford Park, Manchester, plant of the British Westinghouse Company, and has since had charge of the building of the various large power plants for which the company has secured throughout Great Britain.

MR. G. COLLINS.—George Collins, author of "A Strange Railroad Wreck," bearing the imprint of The Broadway Publishing Company, is, says the *New York Times*, an almost helpless cripple. He is employed in a telegraph office in Pittsburg. He is said to be a fine linguist, an expert stenographer and telegrapher, and to know all the details of printing and book publishing. His story is authentic, for he is said to know the characters personally.

MR. JAMES H. ROSENTHAL, manager of the British end of the Babcock & Wilcox Company, is now on a short visit and can be found at the Babcock & Wilcox Companies' export department. While on this side he is expected to place some fair sized orders for separators and other steam plant equipment. Mr. J. F. Alexander, who represents the Babcock & Wilcox people in the West Indies, is also in New York at present. He expects to be here for about 10 days.

MR. SEWARD BABBITT, who for a number of years has been general sales agent for the William Tod Company, of Youngstown, O., has resigned his position to take effect January 1, 1904, and has accepted a position with the De La Vergne Refrigerating Machine Company, of New York City, where he will devote his time to the sale of the Koerting gas engine; the De La Vergne Company having secured the right for the exclusive manufacture and sale of this engine in this country.

REAR ADMIRAL MELVILLE, ex-chief of the bureau of steam navigation, U. S. Navy, has consented to act as engineer-in-chief of the Audit & Appraisement Company of America. Admiral Melville has a national reputation as consulting engineer in all branches of engineering science, and his connection with the Auditing & Appraisement Company of America is an assurance that its examinations and reports will be of the highest order. He has returned recently from a trip to Mexico, where he was engaged in making an inspection of some of the properties of the United Mining & Development Company of America.

Trade Notes.

ELECTRIC STORAGE BATTERY COMPANY has removed its sales office from the Nevada Block, San Francisco, to the Rialto Building, corner of New Montgomery and Mission Streets.

NEW ENGLAND ELECTRICAL WORKS, Lisbon, N. H., Goldmark & Wallace, general agents, New York, have issued a striking calendar in yellow, red and green, broad sheet size, for 1904, with month pads.

THE GORGEOUS CALENDAR of the year is that put out with the name of the National Electric Company, of Milwaukee. It is a reproduction in colors of a painting by Asti and is a splendid piece of work. The effect of the picture is heightened by the method adopted of framing.

STERLING ELECTRIC COMPANY, of Lafayette, Ind., has just put forth a new catalogue illustrating its new lamp signal magneto switchboard. This board is a fine example of the further development in telephone practice and the pamphlet brings out a number of its essential and leading features. The booklet can be had for the asking.

THE ELECTRIC APPLIANCE COMPANY, Chicago, calls attention to the "points" in connection with Adams-Bagnall arc lamps. Among the points in a bulletin just issued are: "125,000 lamps in successful operation; no change of model in past five years; 75% of the parts of these lamps are interchangeable; no delay in getting parts 10 years hence; positive value in non-changing model." The complete bulletins will be sent upon request.

THE NATIONAL GAS ENGINE, manufactured for the Savage & Love Company, Rockford, Ill., is one that has been put to a very severe test as to uniformity of speed where the variation of the load has run between wide limits. The machine has answered every requirement and has proven decidedly popular for belted or direct connection to dynamos in isolated plants and for use in machine shops. One good feature of the machine is the interchangeability, whereby any part may be changed at any time should the machine become damaged in any way.

THE J. LANG ELECTRIC COMPANY announces that it has secured the services of Mr. Edward N. Lake, formerly chief switchboard draughtsman of the Western Electric Company, and more recently upon the Chicago Edison Company's engineering staff, who will assume the management of its switchboard department. It states that it will be pleased to furnish designs and estimates upon switchboard equipment for any system of generation and transmission. The usual prompt and cheerful attention will be paid to all orders, whether for the smallest tablet boards or the largest switchboards. With its facilities, experience and equipment the concern feels certain it can meet the most rigid requirements upon this class of apparatus in the point of workmanship, finish and in the time of execution.

THE N. S. STORAGE BATTERY COMPANY, LTD.—A new storage battery invented by Mr. J. T. Niblett, the well-known author of a book on the storage battery, is being placed on the market by the N. S. Electric Storage Company, Ltd., which has its headquarters at 139 Queen Victoria Street, London, E. C., and has, we are given to understand, ample backing by gentlemen of considerable means. Mr. Fred J. Down, of Harpenden, Herts, has associated himself with this company in the way of introducing the battery to consumers in Great Britain, where he has a very extensive acquaintance among electrical engineers. Mr. Down will perhaps be best remembered as having been a partner in the firm of Laing, Wharton & Down, and has during the past few years introduced a great many electrical specialties to the notice of electrical engineers in Great Britain.

CINCINNATI AIR AND GAS COMPRESSORS are described in pamphlet L-26-A just issued by the Laidlaw-Dunn-Gordon Company, of 114 Liberty Street, New York City. These machines are of medium and small sizes, the steam ends being equipped with plain slide valves and Meyer valve gears and the air ends with poppet valves. One of the compressors is of an entirely new type in that the air cylinders are provided both with mechanically moved valves and with poppet valves, all points in the compression cycle being determined by the mechanically moved valves, with the exception of the opening of the exhaust, which is determined by the poppet valves. This arrangement combines the positive action, noiseless operation and durability of mechanically moved valves with the elasticity of poppet valves, at the same time avoiding the noise and rapid wear. This pamphlet, which is of convenient pocket size, will be sent upon request to those interested.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 5, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

748,571. ELECTRIC SOLDERING IRON; James I. Ayer, Cambridgeport, Mass. App. filed Nov. 13, 1902. The tip is of small diameter but given large surface of contact with the heating core by means of a clamp attached to the core and making elongated annular contact with the tip.

748,572. APPARATUS FOR CONTROLLING CURRENT SUPPLY TO ELECTRICALLY HEATED TOOLS; James I. Ayer, Cambridge, Mass. App. filed June 1, 1903. A rheostat on the wall is so connected with a portable tool that when the tool is in use, it gets the full current, but when it is deposited upon a stand, a switch automatically cuts in the rheostat and reduces the current supply.

748,573. ELECTRICALLY HEATED TOOL; James I. Ayer, Cambridge, Mass. App. filed June 15, 1903. The coils of the controlling resistance are thrown into series or parallel as desired for varying the heat.

748,574. APPARATUS FOR PRODUCING ELECTRIC ARCS FOR HEATING AND LIGHTING PURPOSES; James I. Ayer, Cambridge, Mass. App. filed June 22, 1903. The arc is produced between the edges of two disks of carbon, they being rotated slightly to present new surfaces at each operation, by the movement of the disks in a lateral direction to their working position.

748,591. THIRD RAIL COVER; Henry F. Duffy, Seattle, Wash. App. filed June 20, 1903. The sections of a sectional cover are successively raised and lowered by the car to permit the contact shoe to make uninterrupted contact with the rail.

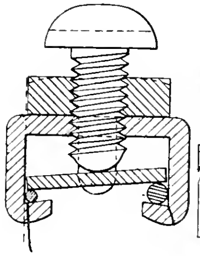
748,592. THIRD RAIL PROTECTOR; Henry F. Duffy, Seattle, Wash. App. filed June 20, 1903. A modification of the preceding patent.

748,597. WIRELESS SIGNALING DEVICE; Lee De Forest, New York, N. Y. App. filed Dec. 24, 1902. The radiated energy is concentrated in the direction desired by the use of a reflector of the waves and of a horizontal directive and concentrating conductor.

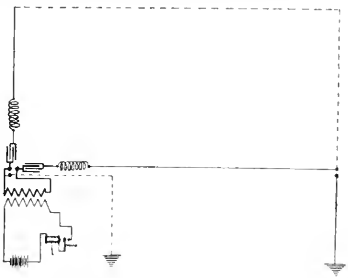
748,599. INCANDESCENT ELECTRIC LAMP SOCKET; Henry A. Framburg, Chicago, Ill. App. filed April 9, 1903. Details.

748,609. PRODUCTION OF HYDROXIDS AND OXIDS OF METALS BY ELECTROLYSIS; Frederick F. Hunt, New Brighton, N. Y. App. filed Jan. 22, 1903. (See page 136.)

748,619. ELECTRIC RAILWAY; Charles J. Kintner, New York, N. Y. App. filed Sept. 22, 1899. The sections of the working conductor are held in a strained and bowed condition by springs acting on rock-shafts connected with their terminals. The contact shoe presses the section downward to connect it with the feeder.



748,716.—Wire Connector.



749,131.—Wireless Signaling Apparatus.

748,620. ELECTRIC RAILWAY; Charles J. Kintner, New York, N. Y. App. filed March 10, 1902. A feature of this invention is the provision of circuit closers which automatically connect and disconnect turn-out third rails when the track switch is thrown.

748,621. SAFETY SYSTEM OF ELECTRIC RAILWAYS; Charles J. Kintner, New York, N. Y. App. filed Nov. 15, 1902. Circuits and circuit connections whereby the current potential is always maintained substantially constant to the motor on the car and each sectional conductor is automatically disconnected from the current feeder only after electrical connection has been severed between it and the current collecting means carried by the car.

748,635. AUTOMATIC BRAKE FOR CONTROLLING SWITCHES OF ELECTRIC MOTORS; Frederick A. Muschenheim and Wm. F. Hendry, New York, N. Y. App. filed June 2, 1902. An electro-magnetic brake in circuit with the motor armature determines the speed of movement of the rheostat arm in accordance with the speed of the motor.

748,638. ELECTRIC CIRCUIT CLOSER AND BREAKER; Thomas H. McQuown, Biggsville, Ill. App. filed Sept. 26, 1902. A contact device for electric clocks.

748,639. FUSE FOR ELECTRIC CIRCUITS; Theodore Nagel, Chicago, Ill. App. filed April 24, 1903. Detail construction of the terminal parts of an inclosed fuse.

748,688. STREET RAILWAY SWITCH; Walter J. Bell, Los Angeles, Cal. App. filed May 7, 1903. Structural features in a switch throwing apparatus operated by hydraulic cylinders controlled by electric valves.

748,690. TELEPHONE TRANSMITTER; Charles F. Bennett, Waterloo, Ia. App. filed Nov. 29, 1901. (See page 136.)

748,716. WIRE CONNECTOR; James S. Ford, Chicago, Ill. App. filed Oct. 9, 1903. A connector by which wires of different sizes may be clamped against two fixed jaws by a single movable paw, the latter consisting of a freely moving plate against the center of which a clamping screw presses.

748,718. EXTENSION LAMP HANGER; Fernando H. Geisler, Dayton, Ohio. App. filed Oct. 5, 1903. A telescoping tube having a ball and socket connection at the ceiling.

748,749. ELECTRICAL SYSTEM OF HEATING; Edward H. Kitfield, Swampscott, Mass. App. filed Oct. 26, 1903. Thermostats switch the heaters into and out of circuit as the temperature of the heated apartment requires.

748,810. ELECTRIC CAR PLOW; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. The plow has a main contact for the propelling current, and subsidiary contacts for engagement with extra rails in signalling circuits.

748,811. SWITCH; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. A track switch moved by motors in the roadbed to which current is delivered from the trolley wire through hinged arms on the car which drag over contact plates in the roadbed.

748,812. SWITCH THROWING MECHANISM; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. A special arrangement of gearing actuated by an electric motor to throw a switch tongue.

748,813. CONTACT SHOE; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. The shoe is suspended by overhead supports to be engaged by a trolley, the invention residing in the details of construction.

748,814. SEMAPHORE MECHANISM; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. A motor which moves a semaphore arm is cut out when the arm moves a switch at the end of its motion.

748,815. RAILWAY BLOCK SIGNAL AND SWITCH; William F. Taylor, Jr., Providence, R. I. App. filed March 30, 1903. Both signals and rail switches are operated by a suitable controller on the car platform.

748,824. BLOCK SIGNAL SYSTEM; Joseph Weatherby, Jr., Wilmington, Del. App. filed July 24, 1902. Details.

748,872. ELECTRIC RAILWAY SYSTEM; Wm. G. Lowrie, New York, N. Y. App. filed June 21, 1901. A trolley moves through a closed conduit in contact with conductors therein, the motion being obtained by the attraction of a magnet carried by the car, the invention relating particularly to the construction of the trolley.

748,904. ELECTRIC ARC LAMP; Luis Wirtz and Thomas Hamilton-Adams, London, England. App. filed Feb. 4, 1903. Details.

748,906. TRANSMITTER; Ernest E. Yaxley, Chicago, Ill. App. filed April 13, 1901. (See page 136.)

748,907. ELECTRIC DYNAMO OR MOTOR WITH ALTERNATING FIELD; Rudolf Ziegenberg, Schoneberg, Berlin, Germany. App. filed April 25, 1903. A double brush on the commutator has its two parts connected through an induction device for producing an electro-motive force equivalent to and opposite in phase, from the electro-motive force generated in the coil which at any moment is short circuited; this to prevent arcing.

748,915. ELECTRIC ARC LAMP; Edward H. Belden, Dayton, Ohio. App. filed April 28, 1902. Carbon lifting means embodying an electro-magnet so disposed with reference to its armature and other connected parts as to counter-balance the latter, so that they may be operated by a weaker magnet than would be necessary under ordinary conditions.

748,940. METHOD OF PRODUCING ELECTRODES FOR STORAGE BATTERIES; Frederick A. Feldkamp, Newark, N. J. App. filed April 17, 1903. (See page 136.)

748,941. ELECTRIC SIGNAL SYSTEM; Howard A. Fessenden, Detroit, Mich. App. filed Dec. 16, 1901. The system comprises transmitters at different stations for a plurality of corresponding signals, an alarm at a receiving station operating continuously, a circuit controlling the alarm extending to the various transmitters and means for respectively closing and opening the circuit whenever the transmitters are in or out of registration with each other.

748,961. ELECTRIC COUPLING; George A. Le Fevre, New York, N. Y. App. filed Jan. 28, 1903. A gang of female socket couplings mounted on a fixed support and a gang of male couplings carried by a movable support and corresponding respectively with the female couplings, whereby a number of circuits may be simultaneously connected up.

748,970. AUTOMATIC SIGNALING APPARATUS; Ira A. Michael, Chicago, Ill. App. filed June 27, 1902. A signal member adapted to be moved in opposite directions is actuated in a given direction by a current impulse of a certain duration; after the direction of motion is determined, a step by step mechanism continues the motion under further pulsations to finish the movement.

748,980. TELEPHONE EXCHANGE; Nils Emel Norstrom, Chicago, Ill. App. filed March 16, 1901. (See page 137.)

748,985. APPARATUS FOR ELECTROLYTIC DECOMPOSITION OF ALKALI CHLORIDES; Johan Jacob Rink, Elsinore, Denmark. App. filed April 4, 1902. (See page 136.)

748,987. TROLLEY HARP; Edward D. Rockwell, Bristol, Conn. App. filed Nov. 7, 1903. The wheel bearings are slid into notches in the harp and the wheel is free to rock to follow curvatures in the wire.

749,016. ELECTRIC ARC LAMP; Edward H. Belden, Fort Wayne, Ind. App. filed April 17, 1901. The humming of an alternating current lamp is prevented by supporting the operating mechanism independently of the casing and cushioning the various parts.

749,017. ELECTRIC ARC LAMP; Edward H. Belden, Fort Wayne, Ind. App. filed Aug. 6, 1900. The sensitiveness of the controlling mechanism is increased by the tendency of the shunt field to neutralize the influence of the series field by reversing the polarity of that portion of the armature which moves in a series field.

749,018. ELECTRIC ARC LAMP; Edward H. Belden, Fort Wayne, Ind. App. filed Aug. 13, 1900. A novel arrangement of series magnet coils and a rocking armature operatively connected with the movable carbon and arranged in the upper portion of the casing.

749,031. TELEGRAPH APPARATUS; Frederick G. Creed, Lenzie, Scotland. App. filed Sept. 3, 1901. The tape perforating punch of the receiver and the tape feeding devices are given a corrective motion at the moment of receiving signals to insure that the perforations in the receiving tape shall be similarly located to those in the transmitting tape.

749,032. PERFORATING TELEGRAPHY; Frederick G. Creed, Lenzie, Scotland. App. filed Aug. 4, 1902. In this receiving apparatus the punches are operated by motors and not by the armatures of electromagnets, the latter being used to control the operation of the motor and punches, any error in the position of the tape is corrected by suitable synchronizing means.

749,033. TELEGRAPHIC RECEIVING APPARATUS; Frederick G. Creed, Lenzie, Scotland. App. filed Aug. 9, 1902. Relates to the system of the two preceding patents.

749,042. ELECTRIC RAILWAY SYSTEM; William M. Eader, Middletown, Md. App. filed July 27, 1903. A collecting device for engaging a third rail, consisting of spring mounted rollers spaced apart and arranged to readily engage a second section of the rail when passing from one section to another.

749,085. ELECTRICAL CUT OUT; Columbus B. McPherson, Birmingham, Ill. App. filed Nov. 14, 1902. Details.

749,105. ELECTRIC SIGNAL; Baptist H. Scott, Allegheny, Pa. App. filed Jan. 20, 1903. Details of an annunciator operated by a motor.

749,111. APPARATUS FOR SIGNALING ON LOCOMOTIVES; Hermann Stadelmann, Jr., Apolda, Germany. App. filed Feb. 21, 1903. Details.

749,131. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed March 6, 1901. Direction is given to the projected waves by using a vertical and a horizontal conductor in series with the earth which thereby causes the waves to travel in a single plane which includes the two conductors, and to assume a direction corresponding to the position of said conductors.

749,138. ADJUSTABLE ELECTROLIER; George Andersen, Denver, Col. App. filed March 27, 1902. A telescoping stem through which the flexible conductors lead to a coiling up drum and ratchet at the ceiling.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JANUARY 23, 1904. No. 4.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office. In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, JANUARY 23, 1904.

CONTENTS.

THE AUTOMOBILE SHOW.

The general interest in automobilism and the magnitude of the new industry are well exemplified in the fine show now being given in this city at Madison Square Garden. In many respects the fourth show far surpasses its predecessors, and there are many indications which go to prove that the interest shown by the public is not fugitive and ephemeral, but deep-seated and permanent. The bicycle now seems to have been a craze, though we cannot personally understand why people have dropped it so generally as a means of exercise; but the automobile appears to meet many human wants and necessities, and we can see no reason why its ability to fill them should not make it a lasting and enormous industrial success. We find encouragement also in the large display of electric vehicles. Out of 250 in the show, nearly 50 are of the electric class, and barely a dozen are steam, while gasoline claims about 175, the others being also gasoline, but of the motor bicycle type. There is nothing in such figures to make electrical engineers despair of the future, especially as a large proportion of the electrics are not of the fancy type, but strictly industrial and utilitarian. A great deal has been said about the inadequacy of the storage battery for such work, but these statistics are more or less of a vindication for it.

GERMAN PROGRESS IN ELECTRIC LIGHTING.

We are wonted to think of our German friends as in the very front rank of technical progress and so, indeed, they are; but the brief abstract of the statistics of central station lighting which was given in the Digest last week is not a little surprising. One would suppose that in an enterprising country of vast technical achievements where both apparatus and labor are far cheaper than with us, the electric lighting industry would have already shown a very complete stage of growth; but a comparison with the admirable data of Census Bulletin 5, dealing with American central stations, shows that the art here has reached at least a far completer stage of exploitation than in Germany. To begin with, there are 3,620 American stations, against 971 German stations, giving nearly twice the number of plants in proportion to the population and nearly four times the absolute number to our credit. This of itself is significant, but it is still more important to note that in spite of the large number of small plants in this country, the output holds fully up to the standard set by numbers. We have over 18,000,000 incandescent lamps connected, as against the 5,000,000 in the German stations, and 385,000 arcs, against their 93,000. In electric power we more than make up any deficit that might show elsewhere, for the American stations have about 620,000 hp connected to central stations, aside from the many private power plants, while Germany shows about 219,000 hp. It is thus evident that the average size of the American stations is not much less, in spite of the difference in density of population. This is borne out by the total capacity of the central station generators in the two countries, the American total being about 1,225,000 kw, the German total 395,000. It is apparent, however, that the many small American plants somewhat more than offset the effect of the very large plants in important centers. Reduced to round figures, the American plants average about 338 kw, the German about 420. We should have anticipated a larger difference.

The upshot of the matter is that in proportion to the population electric lights are used almost twice as freely here as in Germany.

In particular we use arc lights conspicuously more extensively, in which work the small plants take a very important part. As regards the general character of the installations, there are some very notable differences in the practice of the two countries. The German stations, thanks to the general density of the population, adhere far more closely to direct-current machinery than we do here. Five-eighths of the total dynamo capacity in Germany is in direct-current generators, while here five-eighths is in alternating generators, polyphase and other. As a natural result of this preponderance of direct-current working, the German stations use storage batteries far more freely than they are used here, not only relatively, but absolutely. In fact, they employ battery capacity aggregating 87,000 kw, while here the meagre total is barely over 30,000 kw. Likewise, they use gas engines relatively more than we do, 61 stations aggregating 6,378 kw, reporting gas as a motive power, while the American total is 1,218 rated hp in the engines. Moreover, there is a preponderance of German effort in wind power, one station of 220-kw capacity reporting that unique condition. A full report on this curio would make interesting reading. In the use of water power we are at an obvious advantage in the matter of natural resources, and in fact 22.2 per cent. of our total capacity is in water wheels, the German figure being about 15 per cent. As regards the sale of the product, it is noticeable that the Germans use meters far more freely than is the custom here. To be specific, they employ 203,758, while those reported here amount to 582,689. This perhaps is the result again of the many small American stations doing a disproportionate amount of arc lighting, and letting things go on the contract basis. Certainly our large stations have long ago learned the necessity of metered service.

In spite of the relatively smaller use of electric lighting in Germany, the growth of the industry there has been striking. It must be remembered that Germany, with all its splendid standing in the world's work, is not a rich country as regards the mass of its people. It is burdened with militarism and has a vast amount of unproductive capital and worse than unproductive labor devoted to preparations for the discomfiture of possible obtrusive neighbors. Considering this, Germany's progress in the arts of peace is doubly creditable. The growth of central station lighting shows nothing of the tremendous impetus given to American lighting by the introduction of the alternating system; but oddly enough, 1898 was the banner year for construction in both countries. In that year 150 central stations were built in Germany and 277 in the United States. Since then there has been less activity, but the growth in output has certainly been very great. At present in both countries the profitable field is doubtless fairly well covered; but existing plants are growing rapidly. The many undeveloped American water powers give promise of great increase in central stations devoted mainly to power distribution, but neither here nor in Germany can there be expected a rapid increase in the number of lighting stations. As we glance over the German report the impression is brought to us that the German development has been along more conservative lines than our own. It has been there more confined to the larger cities and towns, has had to cover less unproductive territory and has steadily followed the line of least resistance. In some respects it has had to meet severer competition than that encountered here, for Germany is the home of the Welsbach burner, which has made here relatively little impression. A pfennig looks bigger in Germany than a cent does here, and the closer competition has tended to economical practice in station design and operation. But we doubt whether the big German stations show better results than the big stations here, although our small stations might suffer by a comparison.

Wireless.

About once in so often we feel it incumbent upon us to stir up our wireless friends with a sharp stick, and to inquire politely but firmly what they are doing about it. We are not aware that wireless telegraphers have acquired the habit of hibernation, but so little has been heard from them of late that we fear they may be emulating the woodchuck. If so, will they come out temporarily as per schedule on Candlemas day? Possibly the Donnybrook Fair inaugurated at the yacht races, where a dozen or so syntonic culturists indulged in a free extra terrestrial fight, may have left some of the participants in a state of coma; or the language which then belabored the ether—language we understand that would make Dr. Parkhurst turn pale and Anthony Comstock throw a fit—may have shocked some sensitive souls into silence. Be that as it may, it is certain that, for several months little has been heard from the wireless contingent, save the usual nautical dispatches sent when the apparatus happens to be working. We have described a new system or two and will joyfully describe their practical operations when we get a chance. But the great transmissions, conquering sea and land with their well-marshalled etherial battalions seem to be in the state cheerfully referred to by Artemus Ward as non-ester. Really, we should begin to get discouraged were it not for our faith in the useful future of the art and our keen remembrance of the dreary early history of the telephone. That great invention knocked about at least a half a dozen years before it really got anywhere, and wireless telegraphy, for its age, is relatively in better case than the telephone. On the other hand, a great electrical discovery should be far more quickly turned to account now than a quarter century ago. More than anything else, wireless telegraphy needs a careful non-partisan study of working conditions. We understand that the British Post Office is testing very thoroughly various systems and we hope in due time that the results in detail will be given to the public. This is good as far as it goes, but the relation of conditions external to the apparatus to results obtained is a matter of more vital interest, as disclosing the nature of possible limitations, if such exist.

A Method of Photographing Alternating Current Wave Forms.

The adoption of alternating-current machinery for power transmission, due to the convenience and reliability of the alternating-current transformer, has rendered the study of the wave forms of alternating current very necessary. There are particular cases in which a ripple on the back of an alternating-current wave may play a more important part than the fundamental wave to which it belongs. A great variety of devices have been suggested and employed for detecting, or recording, the wave form of alternating currents. Where the waves have ample power, as in power transmission circuits, there are several forms of instruments in practical laboratory use which accomplish this result. Where, however, the current waves have but little power, as in telegraph circuits of earth and wire, or still more, in wireless telegraph circuits of earth and earth, or earth and upper atmosphere, there is no known apparatus, either for indicating, or for recording the wave form. Moreover, in telephone and wireless telegraph circuits the frequency is very high, often far above the frequency of oscillation of material vibrating systems. The periodic time of an oscillograph mirror is often about 100 microseconds, and any wave or ripple to be recorded should, therefore, have a period of at least several hundred microseconds. But a microsecond is a long dreary waste of time to a wireless telegraph wave, and 250 complete waves of wireless alternating current can comfortably find room within a hundred microseconds, from a hundred-foot mast or sending antenna.

Leaving, however, to the tender mercies of future time the care of the short and delicate wave forms in electric communication, the interest of to-day lies in the methods of recording the forms of waves that each occupy many miles of free space for their development. The Blondel oscillograph is a typical apparatus. A tiny mirror is supported on a loop of wire, the loop being held in a very intense magnetic field, and being traversed by the current to be investigated. The natural period of vibration being so short, the loop and mirror deflect at every ripple in the wave, and throw a tiny ray of light upon the surface of a steadily rotating drum, carrying a strip of sensitive kodak film. In order to obtain sufficient photographic action from so small a ray, moving with great speed over the film, the most intense luminous ray of the arc lamp is employed. In the ordinary oscillographic trace, as photographically developed and printed, the scale of time is given by the fundamental wave, which intersects the zero or middle line at definite intervals, the frequency of which is supposed to be known with a suitable degree of accuracy.

In the article appearing on page 169 of this number, Mr. C. J. Spencer describes a particular modification of an oscillograph of his own construction, in which the feature of particular interest lies in the method of marking off the time. It consists in employing an alternating-current arc lamp as the source of light for the reflected protographing ray. This has the advantage that when the wave to be recorded has a relatively long and somewhat uncertain or variable period, as in the secondary member of an induction motor, the time can be reckoned from the dotted photographic line of an alternating-current arc lamp, knowing the frequency of that current; whereas, the full photographic line obtained from a direct-current arc would require separate and additional means of determining the time measure. This device of a dotted photographic line might be very serviceable in some researches on long and variable wave lengths. It seems to have a lessened or doubtful value for short waves of readily measurable and definite lengths. Every device of this character becomes of greater interest as our knowledge of wave forms increases and the pursuit of that knowledge is pushed further afield.

INDUCTION MOTOR DESIGN.

Mr. Hobart's paper on the armature diameter of induction motors is an effective disclosure of some painfully common faults in design. The history of induction motor design is a curious story of the effect of fads and prejudices in forcing design into devious and unpleasant paths. Mr. Hobart, who was in the art almost at the beginning, must have a keen appreciation of this and could doubtless tell many an interesting tale if he were so disposed. In the beginning the induction motor was looked upon with ill-concealed distrust, not to say contempt, by the average electrical man. It came to us here labeled "Made in Germany," backed by the fame of Brown and the sonorous name of Dobrowolsky, and in spite of the earlier work of Tesla in this country, it was looked upon as an ill-omened intruder. The first accusation brought against it was that it gave no starting torque to speak of and hence was inapplicable to all the ordinary cases where direct-current motors could give plenty of torque, although in fact they generally did not need it. Hence, almost the first effort of the designer was to produce an induction motor which would give a powerful starting effort. This was successfully accomplished, and the motors were then grudgingly admitted to be capable of starting, but were alleged to require for that purpose enormous currents, so great as to render the whole class quite impracticable. A little attention to the starting resistance question soon settled this, and with it the accusation of bad power factor. A simple and robust motor had been produced capable of giving a powerful torque at starting without excessive current and of giving both good efficiency and good power factor. In these respects some of the early motors were as good as any of the later types, but they had, as a rule, high rotative speed.

This speed factor, of course, was the point next attacked by the direct-current contingent, and there was at once in every competitive case a cry for motors of abnormally low speed. This had to be met by extreme multipolar motors and then the problem of induction motor design was opened up in its broadest aspects. But even more trouble was in store, for there began to be a cry for small variation of speed with change of load, and as this property unfortunately could be easily obtained the demand was met, to the designer's great annoyance. We say unfortunately, for the result was the common introduction of speed specifications of a kind utterly needless for most practical purposes, and not then or at any time since commercially filled by direct-current machines. And thus the problem of design came up to the point where Mr. Hobart's paper is particularly pertinent. The fault of abnormally large inductance due to needlessly long end connections was a natural result of attempting to produce low-speed motors of moderate size with low armature resistance. In spite of skillful shaping of the teeth and reduction of the air-gap to the lowest possible figures, a good power factor became difficult of attainment, and as Mr. Hobart shows, the end connectors were chargeable with no inconsiderable part of the difficulty, although the fact was unrecognized. The resulting faults were beautifully emphasized in some of the motors produced a few years ago, when, in the struggle for simplicity of manufacture, several sizes of motor were built up from the same size of armature and field punchings. The more powerful machines of such a series were admirable, but as the cores were made shorter and shorter upon the same diameter and pole pitch, the area of the polar air-gap was reduced and the relative length of the end connectors increased, to the utter demoralization of the power factor.

If an induction motor must have low rotative speed the most favorable condition for obtaining it is a reduction of the frequency. If this be impracticable, the number of poles must be increased and then the trouble begins. Other things being equal, a large polar pitch is an advantage and hence the tendency is in the direction of a rather flat motor of rather large diameter. But as Mr. Hobart shows, this modification of proportions soon reaches its limit, since increase in the relative length of the end connectors brings its penalty in increased inductance just as surely as does decreased polar pitch. Here, as elsewhere, the designer is perpetually between Scylla and Charybdis, and whichever he chooses he is likely soon to adjudge the other preferable. Probably the most valuable means of getting a little leeway in the design of induction motors is to let up on the extreme requirement for constancy of speed, i. e., slightly to increase the losses in the secondary winding, compensating for the loss elsewhere. It makes a vast difference in the ease of design and in the cost of getting other good qualities whether the slip at load is two per cent. or four per cent., while as a practical matter of every-day use, the latter specification is, in nineteen cases out of twenty, quite as appropriate as the former. Mr. Hobart has done the art of design a service in forcibly pointing out one of the limitations which is sure to be encountered in building motors of the freak class sometimes demanded. Induction motor design, like all design of electromagnetic mechanisms, is a matter of finesse, of adroit compromise between conflicting requirements, and he is most successful at it who knows best the lengths to which he can go in any direction without defeating his ends. Practical papers like the one under discussion are, therefore, very important in bringing to hand the data on which construction must be based, and in defining the bounds of improvement.

Radium at the Technology Club.

The Technology Club of New York, composed of graduates of the Massachusetts Institute of Technology, has held some very interesting meetings this winter, the last of which was devoted to the subject of radium, and was held at the consulting rooms of Dr. W. J. Morton, professor of electrotherapeutics in the New York Post-Graduate School and Hospital. The unusual facilities of the doctor's laboratory enabled some very striking demonstrations to be made.

Dr. George F. Kunz, of Tiffany's, who has devoted so much time lately to radium and radioactive materials and the problems of the subject, gave first an interesting address on the general theme of his researches, to which attention has been called from time to time in these pages. He exhibited a number of specimens of radium and demonstrated their activity, including the first sample of American radium, and some radium ore obtained from deposits discovered in Colorado. He also made an exhibition of a sample of actinium, this being the first time it is said that it had been shown in New York. One striking experiment was where Dr. Kunz enclosed a minute sample of radium in its glass and rubber tube within three heavy outer tubes of lead, copper and iron, and then succeeded in making a diamond fluoresce brightly in the dark. This experiment was also repeated with success after placing the diamond at the bottom of a goblet of water. Dr. Kunz also made a very pretty illustration of radioactive effect by causing the diamond to fluoresce in contact with the mass of pitchblende which he had on his table. He also had a fine specimen of willemite and samples of Kunzite to demonstrate their sensitiveness and responsiveness to radium.

Dr. Morton made a most brilliant and charming address on the general subject of radium in relation to medicine, and expressed great hopefulness with regard to the treatment of cancer and diseases of that type by radium and the X-ray. He spoke of results in several cases of disease not far advanced in which certain improvement, if not entire cure, had decidedly resulted; and he exhibited to the engineers present the apparatus employed in such work, explaining as well the various methods and principles upon which such cures could be attempted and effected. He created the utmost interest by referring especially to his own original work on the utilization of the artificial fluorescence of living tissue. It will probably be remembered by our readers that as far back as last June he contributed to our pages an article on this subject, in which he stated that he had then been treating cancer for over a year on this basis with results which could not be obtained by the X-ray alone. We may refer our readers to the article in the issue of June 20.

Dr. Morton exhibited five bottles of fluorescent liquids or solutions of quinine, æsculine, fluorescin, resorcin, etc., all of which he described as beautifully fluorescent under radioactivity. Hence, if taken internally and the patient be then exposed to radioactivity, the violet rays are, so to speak, liberated or produced within the body and all the internal tissues are, in effect, bathed in sunshine. In this way there is set up in the part affected that actinic stimulus which is so beneficial to the human tissues if applied in the proper way and quantity. Dr. Morton referred to other work of this character, especially that which has been done in connection with the Curie laboratory in Paris, and did not hesitate to express great hopes as to what might come of such work in the future. His remarks were full of suggestiveness, as, for example, in regard to the immemorial use of mineral springs, whose waters he thought from the fact that they gave helium emanations might be regarded as especially radioactive, and for that reason, more than any other, beneficial in their inward and outward effects. The bottles of fluorescing liquids were exposed by Drs. Morton and Reeves to the influence of the X-ray, so that the whole audience could see the row of them vividly fluorescing under the action of the ray in the darkness, confirming the statements that had been made as to this phenomenon.

The publication of Dr. Morton's statements in all the newspapers the following morning was followed by a perfect storm of publicity, criticism and discussion all over the country, from which it may be inferred that the authenticated facts given to the engineers, and the theories advanced may be productive of a great advance in the science of electrotherapeutics, particularly as related to radium and the X-ray. The remark of Dr. Morton that these liquids had been humorously dubbed "liquid sunshine" has been caught up, and the phrase has already gone into the popular slang of the day.

The Institute Annual Dinner.

Preparations for the annual dinner of the American Institute of Electrical Engineers on February 11, at the Waldorf-Astoria, are being pushed actively, and provision is being made for 500 guests on that very interesting occasion. The notices to members, with details, will be issued in a few days. In the meantime some particulars can be given as to the arrangements. Tickets for the dinner will be $7 per cover, without wine, and $5 for ladies. A great many ladies are expected, as members are making frequent requests for such tickets. The ball room at the Waldorf is to be occupied, and Mr. Arthur Williams, chairman of the committee on decorations, is making admirable plans in regard to enhancing the beauty of that stately chamber. Mr. Calvin W. Rice, chairman of the Institute reception and entertainment committee, has already completed his plans for the exercises, which may now be briefly outlined. President Arnold will make an address and then Mr. Samuel Insull, chairman of the Edison Medal Association, will present to the Institute, on its behalf, the Edison medal, of which the Institute has already accepted the trusteeship. The gift will be accepted on the part of the Institute by Dr. A. E. Kennelly, of Harvard University, past president. The medal having been founded for the competition of electrical engineering graduates in universities and colleges in the United States and Canada, it will also be accepted in that respect by Prof. C. F. Brackett, of Princeton University, who was the first to make scientific tests in this country of the incandescent lamp. Mr. J. B. McCall, of Philadelphia, president of the Association of Edison Illuminating Companies, will then respond for that body, and Mr. C. L. Edgar, of Boston, president of the National Electric Light Association, will speak on behalf of the interests represented by that influential organization. Mr. T. C. Martin has been appointed toastmaster. Music is to be liberally interspersed throughout the proceedings, and the speeches, while brief, will derive unusual interest and importance from the occasion, which is intended to celebrate the twenty-fifth anniversary of the successful development and introduction of the incandescent lamp. There is also being prepared a handsome and artistic menu, which will embody several features of interest, and which will deserve being preserved as a souvenir of the event. Mr. Edison is to be present as a guest, but it is to be doubted whether he will break his invariable rule of never making any speeches.

Annual Meeting of Contractors.

The annual convention of the Electrical Contractors' Association of New York State was held this week at the Building Trades' Club in New York City, and was largely attended by contractors from all parts of the State, while many others from all parts of the Union were present for kindred national purposes, including Mr. E. McCleary, of Detroit, president of the National Electrical Contractors' Association. As our readers are well aware, the proceedings of these bodies are not of a public character; but it may be noted that changes among the New York State officers were made as follows: President, Marshall Barnes, Troy; vice-president, J. R. Strong, New York City; secretary, F. Fish, Rochester.

On the evening of January 19 the association gave its annual dinner, Delmonico's being the place selected, and some 120 sat down to the tables in the red room, the table reserved for the "baldheads" being illuminated with a "Hylo" lighthouse flashing a red light, over which a Tammany tiger appropriately wagged his tail and licked his chops. The only speech of the evening was an admirable address before dinner by Mr. J. C. Hatzel, although Mr. C. L. Eidlitz was perforce compelled to deliver several brief speeches in declining to deliver any. Among the guests were representatives of the inspection and insurance interests of the city: Prof. G. F. Sever, of Columbia University, and consulting engineer of the Department of Gas, Water and Electricity; Mr. G. H. Guy, secretary of the New York Electrical Society, and the technical press in the persons of W. H. Morton, Charles W. Price and T. C. Martin. After dinner, instead of speeches and toasts, there was a splendid vaudeville show with Mr. Eidlitz as impresario. The songs and dialogues abounded in clever personal "roasts" and gags, which were hailed with thunders of applause and laughter by all, even the victims.

Plant of the Columbus Power Company, Columbus, Ga.

THE city of Columbus, Ga., is an example of a thriving municipality which owes its existence very largely to the natural advantage of proximity to a large water power. Though it is located in a fertile cotton region and at the head of navigation on the Chattahoochie River, so that it has, on that account, a leading cotton shipping business, it also stands opposite a remarkable series of shoals in the river carrying a large amount of water. The Chattahoochie River drains a watershed of something like 3,500 square miles, and while it has the disadvantage common to most of the rivers of this section that it must pass great, quick-rising floods, it possesses a low-water flow that has encouraged several comparatively large power developments. Its channel for a long distance approaching Columbus is lined with precipitous rock banks confining the water in a way that causes quick changes of level, but otherwise favors impounding the water for successive utilization or periodic storage.

For a distance of 34 miles above Columbus, that is, to West Point, Ga., the power possibilities of the river may be apprehended from the fact that in this stretch there is a fall of 362 ft., 120 ft. of this occurring in the last four miles above navigable water. This last fall is distributed in a number of shoals which have long been harnessed to a greater or less extent, notably by the Eagle & Phœnix Mills. The low-water flow is probably 1,000 cu. ft. per second, so that there are available in the immediate vicinity of the city for the 120-ft. fall, some 13,500 gross hp. The average power, however, for the four miles of river in question would seem to be about 75,000 gross hp, this calculation being based on observations made at West Point for the State Geologist under the direction of Mr. B. M. Hall, hydrographer, and during 1896, which was a dry year. These figures indicate that the average flow for that year was about 4,650 cu. ft. at West Point, or, allowing 18 per cent. increase for the tributary streams between the two places, about 5,500 cu. ft. at Columbus. The flood water is sometimes ninety times greater than the low water.

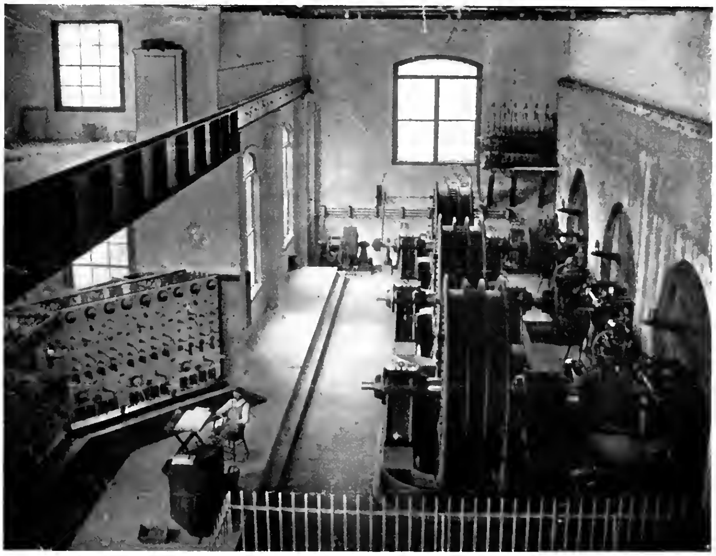


FIG. 1.—INTERIOR VIEW OF COLUMBUS POWER HOUSE.

The power plant which forms the subject of this description was built by the Columbus Power Company to furnish electric power for public sale and to drive a mill constructed on the Georgia bluff of the river. The plant, which has been in operation for about three years, is located at a shoal known as Lovers' Leap, just beyond the limits proper of Columbus, and it was planned to obtain a head of 40 ft., so that when there is a multiplicity of plants on the river above it or the number of storage dams are sufficient to regulate the discharge of the river, an average of 25,000 hp can be approached. The development is of the class in which the power house is located at one end of the dam, so that the forebay is impounded by the dam and power house structure and no penstocks are necessary. This, however, applies to the main power house or power house No. 1. The power utilization for driving the mill has been made without employing electricity, the power delivered by the wheels being transmitted to the mill by means of a rope drive. The power house for this purpose, No. 2, is located a short distance down stream from power house No. 1 and is supplied with pressure water by means of penstocks let through the bulkhead wall which extends from house No. 1 to the river bank. In both cases tail water is discharged into the excavated river bed beneath the houses and the tail water reaches the main current a short distance below, the tail race channel being separated from the main stream by a wing wall formed by the rock excavation from the tail race. Power house No. 1 is designed to develop 6,000 hp in six units and No. 2 about 3,000 hp, mainly in two units. Half of each installation is now in place.

The dam is an interesting structure of boulder concrete masonry with a cut stone spillway surface. It stands at an average of about 33.5 ft. above the stream bed, bringing its crest at elevation 138.5, and it has a length of 975 ft. 8 in., with a rollway 727 ft. 8 in. long.

Power house No. 1 is 137 ft. long and 52 ft. wide and stands at the ends of the dam at an angle of 103° with it. It rests on heavy stone masonry foundations, the up-stream portions of which form the heavy bulkhead, which is continued beyond the power house into the river bank. This bulkhead is pierced by the six openings for the six units which will form the ultimate installation of the plant, a smaller opening for the exciter units and a large opening for the penstocks leading to power house No. 2. The openings in the bulkhead for power house No. 1 are short flumes or chambers in which are set the turbines, and the back end of each of the wheel chambers is closed, as usual in plants of this type, with a heavy plate or cover of cast iron and steel, on the other side of which is the main generator room. The power house proper is thus really located immediately beyond the bulkhead containing the wheel chambers and spans the beginning of the tail race, into which the wheels discharge by draft tubes inclined through the masonry of the bulkhead from the wheel chambers. The interior view of the station thus shows a row of alternators, which are direct-connected to the wheels, and presents an unusually pleasing aspect owing to the uniformity of apparatus and the general interior finish. The walls above the windows, which are unusually large for a water power plant, are of brick and the upper parts are painted white; the lower parts and the inner side of the roof are painted drab and the steel members of the roof trusses are black. At the middle of the station there is an extension 43½ ft. wide, giving the room at the center a width of 45 ft. This was provided for the switchboard on the main floor, switching apparatus below and lightning arresters and other devices above, where the transmission lines leave the building. The roof is of the ridge form with a hip over the switchboard addition, and monitors are provided for both the main and hip roofs.

The racks are of the usual construction supported on a framework of I-beams, giving the racks an inclination of about 12° with the vertical. The wheel chambers have a depth equal to the width of the upper part of the bulkhead, 21 ft., and are built with concrete floors, stone walls and brick arches 2 ft. thick, the arched roof on a 6-ft. radius. The gates to the entrance of the wheel chambers are of planking and are lifted by hand by means of a rack and pinion. The gates have cast-iron guides, bolted through the masonry to the cast-iron head at the down-stream end of the wheel chambers.

Each of the main wheel chambers contains a pair of horizontal 39-in. Hercules turbines made by the Holyoke Machine Company. They discharge into the same draft tube. The center of the wheels is 15 ft. below normal head water level and 25 ft. above normal tail water level. Under the total head of 40 ft. each pair of wheels develops 1,484 hp at 200 r.p.m. Each draft tube is 7½ ft. in diameter at the turbine casing and expands to 10 ft. at the discharge end. It is embedded in concrete in the bulkhead wall, but the exposed surfaces of the masonry are faced with brick work. The discharge chamber in each case is 16 ft. wide and has a brick arched roof carried by piers 4 ft. thick. The piers and the arches support the floor and machinery in the generating room. On the assumption of 80 per cent. efficiency in the turbines, it will be seen that 410 cu. ft. of water are passed per second, which gives a velocity of flow into each wheel chamber of 3¼ ft. per second and through each draft tube from 9¼ to 5.2 ft. per second. The bottom of the discharge chamber was excavated to give a depth of water under normal conditions in the tail race of 10 to 15 ft.

Each pair of wheels is direct-connected to a two-phase alternator built by the Stanley Electric Manufacturing Company. At present three of these are installed. Each machine has a rated capacity of 1,080 kw at 6,000 volts and driven at 200 r.p.m. gives current at 60 cycles. Each is joined to the shaft wheels by a flexible leather coupling of the star shape. Under present demands two of the machines suffice, leaving the third as a reserve. Ordinarily, one of the units is run under constant gate at the turbine, while the other is controlled by a governor made by the Schenck Governor Company, of Meriden, Conn., which takes up the variations of the load by means of gate movements on the second pair of turbines. To the governed alternator a Queen recording tachometer is attached, this as a safeguard in the matter of speed, as most of the motors driven by the station are of the synchronous type. Both of the generators are started a little before 6 A.M. and one is shut down at 5.30 P.M., and the other at 11 P.M. During the noon hour one-half to two-thirds of the load is dropped and a similar drop takes place at 5.30 P.M., when the mills close, in case a few of the mills are run over-time; otherwise the load drops to one-sixth, being largely a demand for lighting.

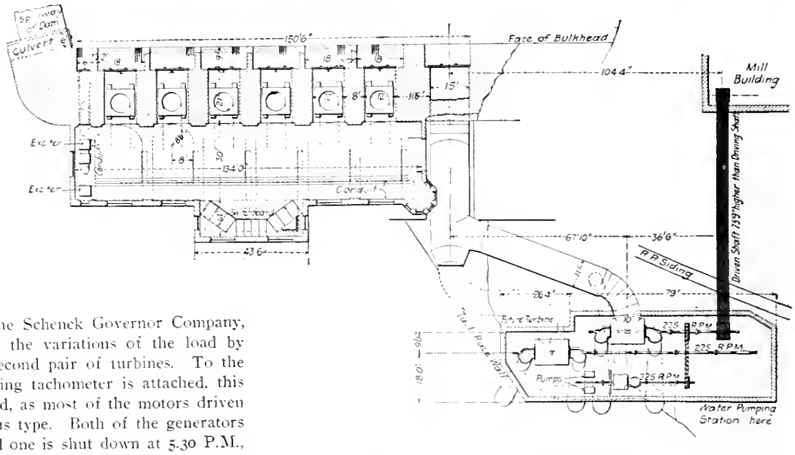


FIG. 3.—PLANS OF STATION OF COLUMBUS POWER COMPANY AND OF THE BIBB MANUFACTURING COMPANY PLANT.

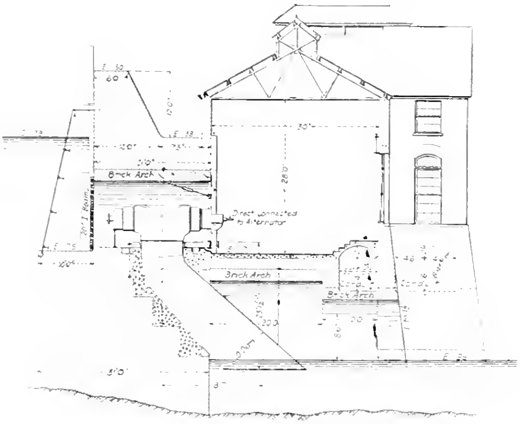


FIG. 2.—CROSS-SECTION OF COLUMBUS POWER STATION.

There are two exciters directly connected to a single 18-in. Hercules wheel located in a chamber 4 ft. wide at the end of the station nearest the dam. Each exciter, which is of the Eddy type, has a capacity of 60 kw at 75 volts running at 450 r.p.m. They are at present operated at 60 volts and each generator takes at the present normal running from 70 to 80 amp. for the field current. During May the output of this plant was about 1,350 kw, so that power required for the field is less than 1 per cent. of the total. The modest requirement of energy for the field is in part due to the fact that the load is nearly all of synchronous motors, except for some lighting. The comparatively few induction motors in use are small and do not cause a noticeably lagging load. The exciters are operated under the control of mechanical governors.

The main generators have an efficiency of 96.4 and 96.5 per cent., and it is stated that the temperature rise in the armature coils has never been more than 15° above that of the room. This statement applies to a case where the load was seven-eighths of the rated and the room temperature 99°. The generator room is served by a 10-ton hand power traveling crane built by Chisholm & Moore, of Cleveland, and running the entire length of the room.

One of the interesting points in connection with the hydraulic equipment is the provision made for operating one of the flood gates in the dam by means of oil under pressure. Above the flood gates there is attached to the dam an hydraulic lift which consists of a large heavy cylinder and piston for lifting and lowering the flood gate by hydraulic pressure. Oil is used instead of water, so that difficulties due to freezing are obviated. The system is designed for 750 pounds' pressure and the piping is extra heavy with malleable footings. Pressure is maintained by a Stilwell-Bierce 1 x 6-in. triplex pump belt driven from one of the exciter units.

One of the features of the plant is the arrangement of the switchboard. When entirely completed this will consist of ten marble slabs erected to form three sides of a polygon, so that the switchboard attendant standing toward the center of the polygon can readily see all panels from the one position. Two sides of the polygon are at present installed and when the remaining three alternators are in place the third section will be erected. Another of the features of the plant is the provision of large cement-lined conduits under the floor of the station for the passage of conductors. These are virtually tunnels running lengthwise of the building, one under the generator room and the other under the switchboard ell, both painted white, lighted by incandescent lamps and nearly large enough for a man to walk through. As shown in the accompanying illustration, the wires and cables are neatly arranged on supports, which are creosoted wood easily distinguished against the white interior.

The section of the switchboard at the right consists of three generator panels. Each of these is divided into three parts, the uppermost carrying the indicating instruments, the middle the circuit-breakers, and the bottom instruments employed for the field current. The indicating instruments comprise two ammeters, one for each phase, and one voltmeter with the usual plug switch. There is also a pilot lamp and a synchronizing lamp. The circuit-breakers are of the oil-brake type used as switches and each is of the double-throw pattern, as there are two sets of bus-bars. On the bottom panels is a field ammeter and a rheostat wheel. An interesting point in this connection is the use of a small pulpit facing the switchboard, containing three rheostat wheels. Each of these is connected by shaft and gear under the floor with the gearing actuated by the rheostat wheel on the generator panel, so that the field current can be regulated either from the pulpit or from the switchboard. The connection of these two wheels is indicated when the operator moves the wheel on the pulpit, as the wheel on the switchboard turns simultaneously with it.

The center section of the switchboard contains a panel for the exciters and space for three feeder panels, of which two are now in position. The exciter panel at the upper part contains a voltmeter and two ammeters, these for the two dynamos; at the middle two three-pole, single-throw switches, one for each machine, including the equalizer connection; and at the lowest the field rheostat controller. Each of the feeder panels is similar to the generator panel except that it also has two ground detectors and two recording wattmeters.

As already stated, the power from the plant is delivered largely to synchronous motors. Two of the largest motors driven by the plant are located about 1,500 ft. distant in a comparatively new mill erected by the Columbus Manufacturing Company. One of these is of 600-hp capacity at 225 r.p.m., and the other of 400 hp at the same speed. Each is started by an independent induction motor spur-geared to it, these operated from the plant through transformers, which step down the pressure to 575 volts. The pressure at which the synchronous motors are designed to run after the synchronous speed is reached is 5,500 volts. Exciting current is obtained from a 9-kw, 125-volt dynamo, belt-driven from the main shaft. The synchronous motors are placed in line with each other, the switchboard faces them, the transformers are located in a separate room and the power plant generally for this mill presents a very fine appearance. The motors drive large sheaves carrying an European rope drive for the mill proper. The electric apparatus in this plant is of the General Electric manufacture and the switchboard is equipped with standard apparatus.

FIG. 4.—POWER DAM ON THE CHATTAHOOCHIE RIVER.

Power house No. 2 was erected to furnish power direct to the plant of the Bibb Manufacturing Company, whose mill is located on the bluff above Lovers' Leap, and to furnish light and water to this mill and the mill village. It contains space for two pairs of large water wheels and one smaller one, all of which are supplied with water from the forebay by a 15-ft. steel feeder pipe brought through the bulkhead alongside the inner end of power house No. 1. This feeder passes underneath the entrance to power house No. 1 and is divided into two branches, one 10 ft. in diameter and the other 11 ft. Each branch is planned to conduct the water to one of the large pair of wheels, and the larger penstock, in addition, serves the single wheel through a branch pipe 5 ft. in diameter. Power house No. 2 is located about 40 ft. below power house No. 1 and about 100 ft. below the forebay; the penstocks are, accordingly, short, and they are supported on brick piers 6 or 7 ft. apart and 3 ft. thick, with a rock fill between piers. The comparatively complex run of pressure piping and draft tubes resulting is indicated in the accompanying drawings. Each pair of the larger wheels, which are 36-in. horizontal Hercules wheels, is designed to drive a horizontal shaft at 225 r.p.m.; one of the units has been installed and is capable of developing 1,500 hp, which is transmitted to the Bibb mill by means of a rope driven on the American system installed by the Dodge Manufacturing Company. The single wheel is a 24-in. horizontal turbine and is used to drive the water-pumping machinery and the lighting generator.

The rope drive for this mill is an interesting one. The receiving shaft for the power transmission is 60 ft. higher than the driving shaft and approximately 116 ft. from center to center of the sheaves. Altogether there are about 7,000 ft. of rope carried in the drive, consisting of 30 wraps of 1½-in. manila rope. The driving sheave in the power house has a wooden enclosure fitted with window glass, while the transmission line between plant and mill is protected with a sheet-iron covering. This is stiffened by lateral angle irons, which also serve to discharge rain sidewise, so that it does not fall in a continuous stream toward the power house. The turbines are controlled by a Schenck governor to maintain a constant speed. The second unit to be installed is to have a capacity of 1,000 hp and the driving sheaves in the rope tower are mounted on quills with this idea in view, so that various drives can be shut down while allowing others to run, the drive in the mill building being of the usual class in which floors or departments are made independent. The quills are carried on an 8½-in. forged shaft which runs at 300 r.p.m. These various sections of rope transmission are provided with the usual electric tell-tales, so that any defects can be located and electric push buttons are conveniently located on each floor of the mill to signal the power house for stoppage of machinery at any time.

The single wheel in power house No. 2 has a capacity of 225 hp and drives a shaft from which the rest of the machinery is driven by belt. This includes a Stanley lighting unit of 150-kw capacity, giving three-phase alternating current at 250 volts and 75 cycles, running at 1,000 r.p.m., a Holyoke rotary duplex fire pump and a centrifugal pump and a triplex pump for the general water system. The Stanley machine is excited from a Northern Electric dynamo of 2-kw capacity and 120 volts belted to the generator.

FIG. 5.—POWER HOUSE, COLUMBUS, GA., BIBB MANUFACTURING COMPANY PLANT AT RIGHT.

The lighting system for Bibb City and mill is controlled from a switchboard in power house No. 2. There are eight feeders all told, five for mill lighting, one for arc lighting, one for the village houses and one for the office and boiler house. Each of the feeders is controlled by a three-pole, single-throw switch. The switchboard contains panels for the generator and standard instruments throughout. There were 101 houses in Bibb City in May for the mill operatives, each of which is supplied with water and with electric light free of charge. It will be interesting to add that the rent of the houses is based on the number of rooms and is 25 cents per room per week. Power house No. 2 has white brick walls with a slate-color wainscotting around the bottom and the under side of the roof is drab with a black striping on the roof members, which are of timber.

The water works comprise a large centrifugal pump for drawing water from the wheel case of the Bibb mill unit, a Deane triplex pump for lifting the water to the tank on the bluff and a New York filter of 500,000 gallons daily capacity. The centrifugal pump is only used when the pressure of water in the wheel case is insufficient to pass the water through the filter, which carries 7 ft. of sand. Besides the filter there is the usual settling tank and clear water basin, and from this the Deane pump, which has 6 x 8-in. plungers, discharges to the storage tanks. One of these is of 100,000-gallons capacity for the general water supply of both the mill and the village, another is of 35,000-gallons capacity for fire purposes and a third is of 5,000-gallons capacity, situated in a tower of the mill and used for flushing purposes. The fire tank is, of course, connected independently to the fire pump. The large general storage tank is about 233 ft. above the pump and the smaller tank about 50 ft. lower than the large one. The discharge pipe from the pump has two branches, one to each tank. The flushing tank is provided with a large float gauge which is visible from the pump house and six or eight times a day the tank has to be filled. For general purposes between 60,000 and 70,000 gallons are pumped twice a day and the pump is operated on the branch that leads to this tank about two hours at a time. The centrifugal pump and both the filter and settling tanks can be by-passed at any time. The fire pump has two shafts which carry grooved wheels for friction driving.

The plant was designed by Mr. William C. Whitner, chief engineer of the water power development for the Virginia Passenger & Power Company, of Richmond, as chief engineer, and was constructed under the direction of Mr. William S. Lee, Jr., now chief engineer of the Catawba Power Company, near Rock Hill, S. C., as resident engineer. The officers of the company when the plant was erected were as follows: H. M. Comer, president; J. F. Hansom, G. Gunby Jordan, E. T. Comer and John Hill, directors. Mr. H. A. Tibbs is engineer of the electrical department.

The dam and power house were erected by Hardaway, Jones Company, of Columbus, contractors. The cost of the development completed will be about $450,000, or $50 per horse-power.

Radioactivity and Radiation.

By Dr. Louis Bell.

WITHIN the past year or two experiments on radium and other sources of radioactivity have been so multiplied and so diverse in methods and objects that it has been well nigh impossible to keep track of the work, much less to arrive at a clear appreciation of its significance. We have all got to speaking so glibly of electrons and ionization and such like things that we almost forget the distinction between hypothesis and fact, and take seriously a great deal of hasty deduction from imperfect data. Unhappily, the non-technical press has promulgated columns of misinformation under "scare" head lines. It is my purpose here not to discuss theories of radioactivity or to summarize the great mass of experiments upon the subject, but rather to call attention to some of the collateral researches which have thus far been lost in the shuffle or hastily assumed to confirm preconceived notions.

The point of view assumed in most recent work on radioactive substances has required that their properties should be explained in terms of electrically-charged atomic fragments. This line of work has certainly been fruitful, but in pursuing it very many experimenters have lost sight of everything else and particularly have forgotten the very existence of ordinary radiations of which visible light is the type. I long ago predicted that there would be a recrudescence of the emission theory of light as a result of this tendency to jump at conclusions, and such in fact there has been, but the wave theory is too firmly grounded to be shaken on any casual disturbances, and no one as yet has had the temerity to risk a serious assault.

Meanwhile some very important work has been done upon forms of ordinary radiation hitherto unknown or neglected, and the results are such as to demand attention. The work of Blondlot on the N-rays in particular is very far-reaching in its results, and throws much light on our hitherto very imperfect knowledge of the possibilities of wave radiation. Oddly enough, his work has attracted extraordinarily little attention outside of purely scientific circles.

The substance of it is that a large group of rays has been detected which has, as a whole, properties closely akin to those manifested by radioactive substances, but which is subject to the ordinary laws of radiant energy. The N-rays have a profound effect upon the conditions of electrical discharge, and were, in fact, detected by their accentuation of the electric spark; and yet they are reflected, refracted and polarized precisely like ordinary light. They produce a vigorous secondary activity in virtue of which bodies upon which they fall continue for a time to give out N-rays by a species of phosphorescence. One of the curious effects of this property is that the N-rays may seem to penetrate bodies in reality highly opaque to them, although their penetrative powers are actually rather conspicuous, yet selective in a way totally different from that found, for instance, for radium radiation. The N-rays seem to be received as part of the solar radiation, and hence are very widely found aside from their occurrence in the radiation from ordinary flames. Blondlot has not definitely determined their wave length, which probably varies over a considerable range, but it appears to be very great, forming a sort of connecting link between the low heat rays and the Hertzian waves of appreciable dimensions. They are very strongly refracted by quartz, which seems to present the phenomenon of anomalous dispersion for waves of this length.

Truth to tell, the spectrum from no source of radiation has as yet been completely investigated. It may be well known within a limited range, but that is all. Opacity is purely a relative term, and a given substance may stop completely ordinary forms of radiation and yet transmit energy of particular kinds with the utmost freedom. In view of such facts as these it is wise to go very slowly in the study of unusual manifestations of energy. Moreover, the theory of anomalous dispersion indicates that a substance may transmit certain wave lengths substantially unrefracted and inferentially unreflected, so that while the presence of reflection and refraction indicates that a given radiation is of the general nature of light, the absence of reflection and refraction does not necessarily remove it from this category.

A case somewhat analogous to the N-rays is found in a type of radiation recently studied by Sanford and reported in the *Physical Review*. The radiation in question proceeds from the cathode of an air condenser under high electric stress. It possesses strong photographic activity, and sets up strong secondary radiation of a similar but not identical kind. It has strong penetrative powers as regards some opaque bodies. When first announced it was regarded by some notable authorities as a clear case of cathode rays consisting of electrons, but on more complete investigation it turns out that it can be refracted, reflected and polarized, and is very probably ordinary radiation of short wave lengths, although the actual wave lengths have not yet been determined; and it is possible that anomalous dispersion may be concerned here, as with the N-rays whose index of refraction would have assigned them to the extreme violet at first sight.

The concurrent existence of material stream rays and ordinary rays like this and in the emanations of radium and the like make the resulting phenomena very difficult to diagnose. There is especial danger of confusing cause with effect and secondary effects with primary ones. For a complete solution of the problems presented, a far better knowledge of generalized ordinary radiation is necessary than is yet available, and in the case of radium et al. the chemistry of the substances needs persistent study to a degree which is very difficult considering the rarity of the materials. How much would we know of the wonderful and intricate phenomena resulting in the production of the photographic image if metallic silver had never been isolated and a rather impure silver bromide brought a hundred dollars a gram? It is a terrible handicap in the investigation to be cut off from ordinary chemical methods, and without their aid it would be little short of miraculous if serious blunders were avoided. As regards radium, the latest point is its breaking up, with the production of helium and another gas as yet unknown. As to the result there is no doubt, but it is quite another matter to explain where the helium comes from and whether it resulted from the decomposition of a chemical compound or the disintegration of an element into its primal constituents. A hundred grams of radium in skillful hands would answer many questions, but it is not forthcoming at present, and it is worthy of note that the Curies, who know the most about the chemistry of the wonderful stuff, scrupulously avoid sensational hypotheses and hold open minds for further developments. Their example is a good one for those less well informed to follow.

This is not written in the least as a counterblast against the very important and beautiful work that has been done in the study of radioactivity, but merely to call attention to the very imperfect knowledge of some of the possibly essential factors in the phenomena.

It is always unsafe in science to build too fast, lest the foundations prove faulty, and in the rapid progress made in the study of radio-activity a good many gaps have been left perilously near the bottom of things. In due time these may be filled up—or not, as the event may prove. But the material gathered is priceless and science can well afford for the sake of it to forgive any errors that may prove to have been committed in haste and enthusiasm. It is the final result that is important, not the peccadillos of the workmen.

A Method of Photographing Alternating-Current Wave Form.

By C. J. SPENCER.

MOST central power stations are equipped with alternating-current machinery. Records are kept of ammeter, voltmeter and wattmeter readings, but very few have any records of curve shape. The shape of the curve often differs from the pure sine wave form. A peaked wave may have a maximum value considerably greater than that calculated from instrument readings, which are usually the square root of the mean square value. Thus two sources of e.m.f., giving the same value by voltmeter, may have such different maximum values as to require different insulations. Transformer losses are less for a peaked wave than for a flat-topped wave. It is, therefore, important that the wave shape be measured.

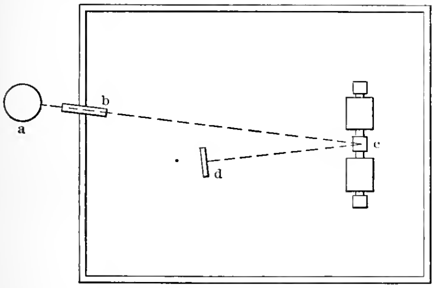


FIG. 1.—GENERAL ARRANGEMENT OF APPARATUS.

The following method of photographing alternating-current wave form was devised by the writer while at Johns Hopkins University during the winter of 1897-98:

Fig. 1 shows the general arrangement of apparatus. An arc lamp is placed at *a*, a telescope at *b*, galvanometer at *c*, and photographic apparatus at *d*. The heavy lines show the boundaries of a dark room and the dotted lines show the path of light.

The arc lamp has no points of interest except that it must be alternating if a measure of time is desired. The telescope is intended to focus the light of the arc lamp on the galvanometer mirror. The galvanometer consists of an electromagnet and a moving coil with mirror, as shown in Fig. 2. It is essential that the moving parts be light and sensitive and that the suspension be stiff.

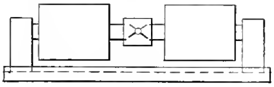


FIG. 2.—DIAGRAM OF GALVANOMETER.

A kodak film on a roll, *a* (Fig. 3), with the end of the black paper attached to the film, fastened to roll *b*, which is turned by the spring, *c*, constitute the photographic apparatus. The path of light is at *X Y*.

The method of procedure is to connect the e.m.f. terminals to the galvanometer coil through a suitable non-inductive resistance. The arc lamp, galvanometer mirror and photographic apparatus are then adjusted until the light is seen to move along the path *X Y*. Roll *a* is then released and the film allowed to roll on *b*.

One-half of a period of an alternating current wave taken by this method, with the zero line drawn afterwards, is shown in Fig. 4. The light and dark spots are caused by the alternations of current in the arc lamp, and are an excellent measure of time. A 133-cycle current supplied the arc lamp, so the space between centers of dark spots represents 1/266 of a second. It might be supposed, on inspecting this curve, that the shape is due to the galvanometer period being too long. This is not the case, however, for the same curve taken by different methods had the same appearance for reasons given below.

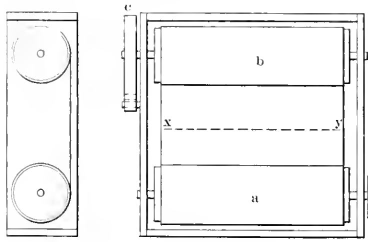


FIG. 3.—KODAK FILM.

The curve is that of the e.m.f. induced in the secondary of an induction motor. This was first investigated by Dr. Louis Duncan, who published the results of the test in the *Transactions* of the American Institute of Electrical Engineers in 1892, though he used a point and contact method for obtaining his results. The motor had collector rings attached to the secondary, for inserting resistance at starting, and was geared to an inverted rotary converter, supplying alternating current to the induction motor primary, with a gear reduction to give a known percentage slip. The converter thus drove the motor as a dynamo, with the secondary circuit practically open, one pair of slip rings being connected to the galvanometer through a high resistance. The reason for the curve being so irregular was on account of the construction of the motor, which had inwardly projecting pole pieces. The strength of the magnetic field decreased as it moved from a pole piece to the space between poles, and again increased at the next pole, thus giving a pulsating e.m.f. superimposed on the alternating e.m.f.

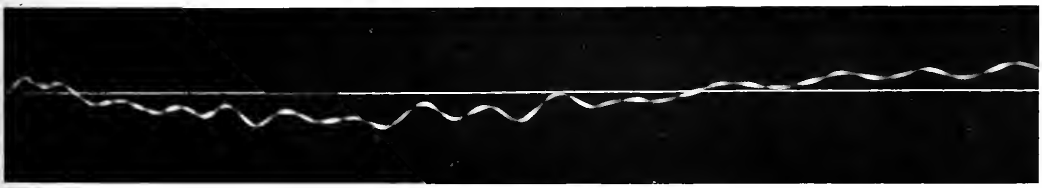


FIG. 4.—ALTERNATING-CURRENT WAVE.

My apparatus for taking curves consisted in what I could find in our laboratory. The telescope was an iron gas pipe with a concave and a convex lens, of different focal lengths, stuck on opposite ends with sealing wax. A large electromagnet weighing about 100 pounds and intended for making experiments in magnetism, where great magnetic densities were required, served for the main part of the galvanometer. I made the coil with No. 36 B. & S. insulated wire, by winding the wire on a rod in a lathe, then pulling the coil thus formed out straight and wrapping a piece of No. 26 spring brass wire around each end. These pieces of wire when pulled taught made a very stiff suspension. Fig. 5 shows the coil in place. The suspension wires were fastened to fibre pieces, which were adjustable on a continuously-threaded brass rod, all being fastened in a brass box painted black. The mirror was very light and thin, about one-eighth inch in diameter, and fastened to the coil with wax. I did not photograph the reflection from the galvanometer at its own period, for it would have only shown a band of light. The period was very short.

I would suggest several improvements on the above apparatus. It should plot the zero line at the same time as the curve. This could be done by focusing a second spot of light to coincide with that reflected from the galvanometer mirror, when the coil is at rest. The line traced by this stationary source of light would serve as the zero line. It would be preferable to have the zero line traced by light from an alternating-current arc lamp, supplied by current of known frequency, and the curve plotted by reflected sunlight, or other light of great intensity. A second desirable addition would be to calibrate the curve with a direct current of known voltage. This could be done by impressing the known direct e.m.f. on the

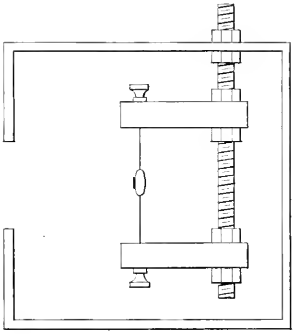


FIG. 5.—DIAGRAM SHOWING COIL IN PLACE.

galvanometer coil, while the film is moved a short distance, then reversing the e.m.f. on the galvanometer coil, while the film is again moved. Several values of e.m.f. can thus be photographed before taking the curve.

The above galvanometer is only suitable for tracing e.m.f. curves. In case it should be desired to trace a current curve, the field could be produced by a coil carrying the alternating current, provided the inductance due to producing the magnetic field is small compared to the rest of the circuit, and the moving coil is actuated by a direct current of constant value. A combination of alternating-current field and alternating e.m.f. impressed on the coil would give the power curve.

The Choice of Air Gap Diameter for Induction Motors.

By H. M. Hobart.

A COMMON error in induction-motor design consists in employing too great a rotor diameter with the intention of obtaining a high-power factor. The desired result is not necessarily thereby achieved, as the inductance of the end connections—a by no means inconsiderable percentage of the total inductance—increases with increased pitch.

It is the purpose of the present article, first by the method of treatment, to show the very great percentage which the inductance of the end connections may form of the total inductance;[1] and, secondly, to propose a practical and simple method by which the best proportions may be determined.

In Behrend's excellent treatise[2] on the induction motor, the following formula for the leakage factor is given:

$$\sigma = C \cdot \frac{\triangle}{\tau}$$

in which C is stated to be a constant depending upon the shape and size of the slot, and upon other conditions, $\triangle$ the radial depth of the air-gap, and τ the polar pitch. It is stated that C varies between 10 and 15 for half-open slots. Owing to its brevity this formula is exceedingly useful if judgment is used in the choice of the constant C.

In attempting to apply to the estimation of the inductance of the windings of an induction motor, principles analogous to those he has found very useful in estimating the inductance of the short circuited turns in commutating machines, the writer compiled Table

TABLE I.—LINES PER AMP.-TURN PER CENTIMETER OF "EMBEDDED" LENGTH.

Polar pitch in centimeters.	Wide-open slots.	Half-open slots.	Completely closed slots.
20	0.86	1.04	1.24
25	0.69	0.83	1.00
30	0.57	0.69	0.83
35	0.49	0.59	0.71
40	0.43	0.52	0.62
45	0.38	0.46	0.55

I, in which the lines per ampere-turn per centimeter of "embedded" length are taken as inversely proportional to the pitch, and has found it to give results in fair agreement with practice. Lines per ampere-turn per centimeter of "free" length may be taken at 0.4 for all values of the pitch. Of course, the mechanical arrangement (*i. e.*, grouping, etc.) of the end connections occasions considerable variations in this constant. Motors with squirrel-cage rotors take 0.3 lines per ampere-turn per centimeter of "free" length, taking as "free" length that of the stator winding.

The predetermination of the inductance of the windings of an induction motor, is analogous—so far as relates to the component quantities to be considered—to the predetermination of the magnetizing current which would be required for one phase of the stator winding, were the reluctance of the magnetic circuit that offered by all the paths exclusive of that path leading through the secondary winding.

This much more restricted available magnetic path largely accounts for the low values for the lines per ampere-turn per centimeter of "embedded" length, as set forth in Table I, as compared with the average values applicable to the short-circuited turns in commutating machines, namely, 4.0 c.g.s. lines per ampere-turn per centimeter of "embedded" length, and 0.8 c.g.s. lines per ampere-turn per centimeter of "free" length.

Furthermore, in induction motors we are concerned with the inductance, not of small compact groups of conductors occupying two or three centimeters of the periphery, but of the more or less spread-out groups corresponding to the conductors per pole per phase. In most induction motors, the polar pitch, τ, i. e., that portion of the periphery devoted to one pole (the gap periphery divided by the number of poles), amounts, according to the periodicity, the normal speed, the output and the designer's choice, to from 10 cms to 45 cm.; hence the belt of conductors belonging to one phase, occupies a peripheral width of from 6 cms to 15 cms.

The radial depth of winding is not generally different from that customary in continuous-current machines. The greater width contributes in a considerable degree to the small values to be employed for the lines per ampere-turn per centimetre of "embedded" length and "free" length, in deriving the inductance.

An example of the estimation of σ is—for illustrative purposes—worked out from the constants in Table I as a basis:

Diameter of air gap	102 centimeters
Periphery of air gap	322 centimeters
Number of poles	8
Polar pitch	40.2 centimeters
Effective length of core parallel to shaft	25.4 centimeters
Mean length of one stator turn	181 centimeters
"Embedded" length per turn	51 centimeters
"Free" length per turn	130 centimeters
Lines per ampere-turn for "embedded" length	51x.44=22
Lines per ampere-turn for "free" length	130x.40=52[3]
Total lines per ampere-turn	74
Number of stator slots	120
Number per pole per phase	5
Conductors per slot	4
Turns per pole per phase	10
Lines per coil per ampere = 74 x 20	1480
Inductance per coil = 20 x 1.480 x 10^{-8}	.000296 henry
Inductance per phase = .000296 x 4	.00118 henry
Periodicity	40 cycles per sec.
Reactance per phase = 6.28 x 40 x .00118	0.296 ohm.

The slots are about three-quarters open, and we shall employ the values: 0.44 line per ampere-turn per centimeter of "embedded" length, and 0.40 line per ampere-turn per centimeter of "free" length.

But the winding—so far as relates to the estimation of its inductance—is equivalent *not* to 8 coils of 10 turns each (*i.e.*, to one 10-turn coil per pole), but to 4 coils of 20 turns each, that is, to one 20-turn coil *per pair of poles*.

The motor is for 550 terminal volts, and the stator (primary) windings are Y-connected, there being, therefore,

$$\frac{550}{\sqrt{3}} = 318 \text{ volts per phase.}$$

$$2 \times \text{reactance per phase} = 0.592 \text{ ohm.}$$

Amperes at standstill and normal primary voltage for resistance less windings $= \dfrac{318}{.592} = 536$ amperes $= A$.

CALCULATION OF THE MAGNETIZING CURRENT.

Primary voltage per phase (E)	318
Turns in series per phase (T)	80
Periodicity in cycles per second (N)	40
Flux per pole (E = 4.2 x T x N x M x 10^{-8}) (M)	2.37 megalines
Net length laminations between flanges (λ)	25.4 centimeters
Diameter at air gap	102 centimeters
Polar pitch (τ)	40.2 centimeters
Stator slot pitch	2.68 centimeters
Rotor slot pitch	2.23 centimeters
Stator slot opening	0.9 centimeters
Rotor slot opening	0.8 centimeters
Exposed iron at stator surface	66 per cent.
Exposed iron at rotor surface	64 per cent.
Mean percentage exposed iron (p)	65 per cent.
Mean cross section exposed iron per pole at air gap ($\lambda x \tau x p$)	660 sq. cms.
Correction factor for spreading of lines in gap	1.20
Corrected mean cross section of air gap	790 sq. cms.
Average air gap density	3000
Maximum air gap density (1.7 x average density)	5100
Actual radial depth of air gap	.32 centimeters
"Equivalent"* depth, air gap	.35 centimeters
Required total magnetomotive force	1430 amp.-turns
Required for one phase	715
Turns per pole per phase	10
Maximum current per phase	71.5 amperes
R.M.S magnetizing current per phase	50 amperes = B

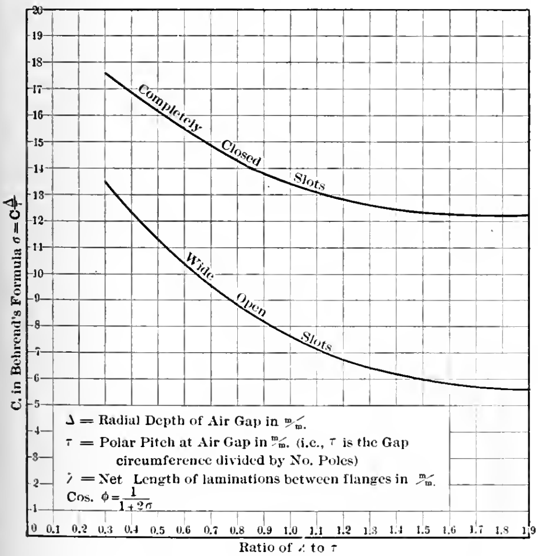


FIG. I.

"Diameter of Circle" (in amperes) $= A - B = 486$ amperes.

$$\sigma = \frac{B}{A-B} = \frac{50}{486} = .103 \; cos\,\phi \; 0.83.$$

Now, it is evident that in Behrend's formula,[4]

$$\sigma = C\frac{\Delta}{\tau}$$

it is assumed that the inductance is directly proportional to the "embedded" length alone. We know from the above method, which takes clearly into recognition the effect of the "free" length, that it is only the inductance of the so-called "active" portion of the winding that is thus directly proportional to the "embedded" length. The inductance of the "free" length is directly proportional to τ. Hence, the total inductance decreases with increasing values of τ much less rapidly than is shown by Behrend's formula, and may ultimately even increase with increasing values of τ.

Nevertheless, Behrend's formula, in virtue of its great simplicity, permits of a much more rapid and satisfactory pre-determination of σ than is practicable by the method of working from the inductance as expressed in lines per ampere-turn per centimeter of "free" length and "embedded" length, owing to thus avoiding the necessity for an independent pre-determination of the magnetizing current. It is only necessary to employ suitable constants for C, and those given in Table II have been so chosen as to give results in fair agreement with those obtained by working from the values in Table I.

TABLE II.—VALUE FOR C IN BEHREND'S FORMULA FOR

$$\sigma = C\frac{\Delta}{\tau}$$

Net length λ of core between flanges in % of Pitch (τ).	Wide open slots.	Completely closed slots.
150	6.0	12.5
140	6.2	12.6
130	6.4	12.7
120	6.7	12.9
110	7.1	13.1
100	7.5	13.4
90	8.2	13.8
80	8.8	14.3
70	9.5	14.8
60	10.3	15.4
50	11.3	16.1
40	12.2	16.8
30	13.5	17.7

These results are plotted in the curves of Fig. 1, and constitute a useful basis for the calculation of σ.

A Record for Jablochkoff Candles.

A Calcutta correspondent of the London *Electrician* says that an installation of Jablochkoff candles at Calcutta has just been superseded by enclosed arc lamps after more than 22 years of service. The installation was put down some time in 1880 or 1881 to light the grounds of the Eden Gardens and gave admirable service up to November 14 of last year, when a modern plant was put in. The original installation consisted of some 30 lamps, the wiring being carried in iron pipes to the engine house close by. After about a year the cables developed faults and had to be abandoned, and new cables were laid in teakwood troughs run in solid with pitch. To this day they are still good. There is no telling how long the old arrangements might have been adhered to had not one of the boilers been finally condemned by the inspector. There are a few more lamps of the same era still working in Bengal.

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[1] Of course this has in a general way been recognized by numerous designers—see, for instance, a review of Behrend's treatise, contributed to *Elektrotechnische Zeitschrift*, 1903, Heft 24, by M. Breslauer—but it is doubtful whether it has been recognized that the percentage is so high.

[2] "The Induction Motor," New York, ELECTRICAL WORLD AND ENGINEER, 1901.

[3] This example is an extreme instance of the preponderating effect of the inductance of the end connections. A decidedly better motor, especially as regards higher power factor, would have resulted from the employment of a smaller diameter and a greater length of laminations between flanges.

* That is, making allowance for reluctance of teeth and core in the manner suggested by Kapp in Elektromechanische Konstruktionen."

[4] It would appear that the simplest formula which could really be said to approximately represent the facts, would be of the form

$$\sigma = k\,\frac{\Delta(\Delta + k^1)}{\tau^2}$$

k and k^1 being constants proportional respectively to $\frac{\lambda}{\tau}$ (where λ is the length of lamination between flanges), and to the depth of the slots. But it is decidedly preferable to use as simple a formula as practicable, and it is thought that Behrend's original formula $\sigma = C\frac{\Delta}{\tau}$ with the correction for the free length set forth in Table II and Fig. 1, constitutes a fairly satisfactory basis.

The New Automatic Telephone Exchange at Grand Rapids, Mich.

BY EDWARD J. HART.

The new automatic exchange of the Citizens' Telephone Company, of Grand Rapids, Mich., was "cut over" at 12:30 noon, Saturday, January 9. The complete exchange of more than 5,000 telephones was thrown into operation at that time, and only seven minutes of time were required to cut off the old manual exchange and switch in the new one. The occasion marked an epoch in the progress of the telephone industry. In point of number of telephones in operation, the exchange is the largest automatic system in the world, and the officials of the company that installed the automatic exchange state that it is the first time a large automatic plant was ever cut over in one operation; the usual practice being to cut in banks of 1,000 telephone switches according as they are ready for operation. The same officials stated that it may be a lifetime before a similar cut over is made, of 5,000 automatic telephones at one time, since conditions are usually so different, and it is usually so much more desirable to switch in fractional portions of the exchange at a time. Of the 145 telephone operators in the employ of the Citizens Company, 48 were retained to fill positions in the toll line operating room and at the information desks, and the others left their switchboards as they "died" and went out into the world to seek other employment—a regretful incident of the change to the telephone company.

The Citizens Telephone Company of Grand Rapids is essentially a home institution, owned by more than 1,200 Grand Rapids stockholders. Aside from the local exchange, it operates a large number of others in towns and villages of the state, and reaches 250 exchanges and toll points within 50 miles of the city and a large number in all parts of western and northern Michigan. It connects also with a large number of telephones in farmers' homes, including two exchanges of 60 each of "farmers'" telephones. The company was organized in May, 1895, and incorporated the following September. Its service was established in June, 1896, with 832 telephones. Its capitalization then was $100,000, but it boasts now of an authorized capitalization of $2,000,000, of which $1,400,000 is paid in, and stock is still selling. With its local service and the companies in which it is interested, it controls 15,000 telephones.

The new automatic system is installed under the Strowger patents, by the Automatic Electric Company, of Chicago. The contract for the system was entered into in December, 1902, and last May the erection of a new exchange building was begun, which was completed in November. It is centrally located, not far from the site of the old exchange, and is a model telephone building in every respect. The work of installing the automatic apparatus and connecting the exchange lines through the new system instead of directly to the old was taken up at once and hurried along by a large staff of electrical workers with no delay.

As already stated, the Grand Rapids automatic exchange is the largest in the world as regards the number of telephones in service. The New Bedford and Fall River, Mass., exchanges, the first installed in this country, are operating respectively with 1,400 and 800 subscribers. An exchange at Dayton, Ohio, opened recently with 2,800 subscribers, and one in Chicago with an ultimate capacity of 10,000 subscribers is now operating with about 3,000, while there are a few smaller exchanges in various parts of the country. But Grand Rapids cut in 5,300 telephones, including instruments on party lines and those in outlying districts accommodated on a "rural switchboard."

The new exchange building is a handsome structure of red brick with stone trimmings, 68 by 143 ft. in dimensions, and two stories high, with a finished basement that makes it practically a 3-story building. The basement is of masonry, finished in cement and provided with cement floor. It is divided into a large supply room and a furnace room, and out of it opens the tunnel through which the cables enter the building. The tunnel is a remarkable piece of subterranean engineering work. Many feet under the ground it stretches from the basement to a point 250 ft. distant where is located the manhole in which the extensive conduit system terminates. It is 7 ft. in height and nearly 5 feet in width. Along the walls are carried 36 permanent cables, each of 200 to 400 pairs of conductors. The tunnel is electrically lighted and a switch at the basement entrance controls the illumination.

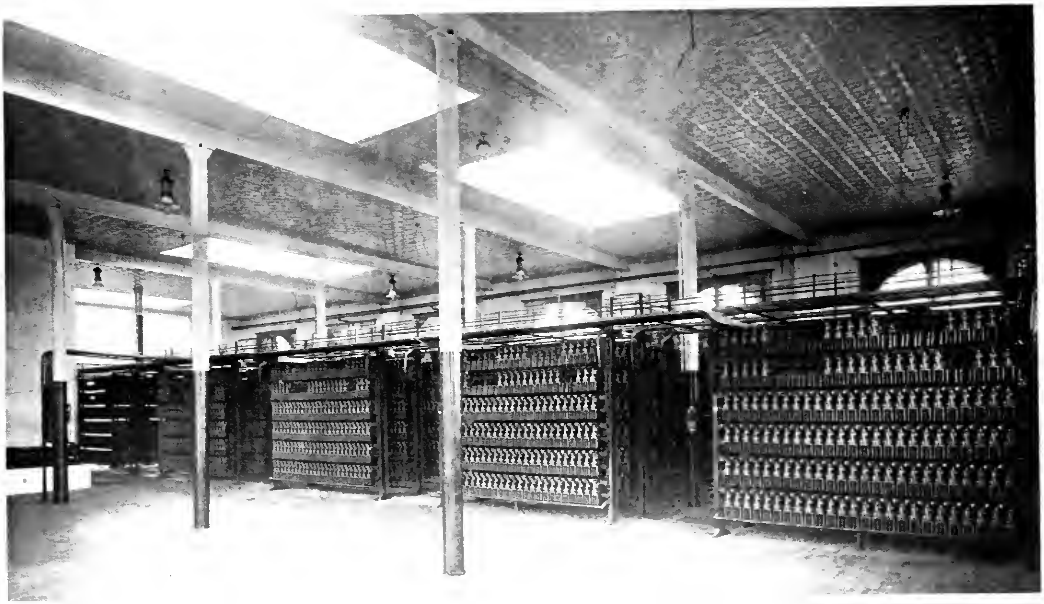


FIG. 1.—INTERIOR OF SWITCH ROOM, GRAND RAPIDS EXCHANGE.

The first floor of the exchange building is given over to the general offices, private offices of the company officials, draughtsmen and electricians, and to a spacious repair shop in the rear. The offices are fitted throughout in antique oak with white finished walls, and the general offices directly in front of the main entrance are equipped with furniture of the bank variety. Everything is of a modern and practical type and convenience appears to have been the keynote in its selection. The shop in the rear is a large room equipped with machine tools, work benches, and the various appliances and accessories with which machinists carpenters and electricians work. The company does not only its own repair work, but that of the smaller exchanges on its toll lines; and a large staff of repair men is employed. The stairway leading to the floor above is convenient to all the departments down stairs, and also opens upon a side entrance to the building for the use of the toll room operators and others employed on the second floor. The latter floor is apportioned to the exchange or switch room, the toll operating room, women employees' club rooms and inspectors' room. The stairway on this floor opens upon a long corridor which separates the switch-room from the other deaprtments.

Entering the switch-room, one confronts the desk of the wire chief,

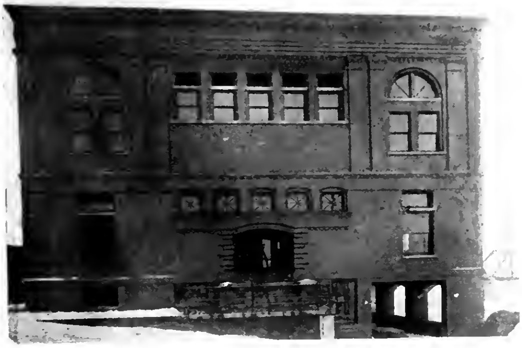


FIG. 2.—EXTERIOR OF EXCHANGE BUILDING.

who is the head "trouble man." At one end of his desk is a small window which opens into the inspectors' waiting room, the convenience of which arrangement is obvious. Near by is the main distributing board, reached on one side by the cables from the tunnel and on the other by the switch-room cables. It is a board of the most modern design, and the terminals are arranged in such a compact way that it is only 10 ft. in height and about 12 ft. in width. It is made in sections, and its ultimate capacity is practically unlimited.

The small cables from this board do not lead directly to the banks of automatic selector switches, but first cross the hall to the tool line operating room, where thew are tapped upon the toll room exchange switchboard. Again they cross the hall to the switch room and find their way to the subscribers' selectors. Here are provided five banks or frames of selector switches, or selectors, with 1,000 to each bank,

FIG. 3.—TOLL LINE OPERATING ROOM.

and additional ones known as trunk selectors. The frames are of heavy angle iron and hardwood. The lower four rows or 100 selectors, and the upper ones are the trunking selectors. Of course, in the Grand Rapids exchange, as in any automatic exchange having more than 999 telephones and consequently having numbers of four digits, two sets of trunking selectors are necessary. There is ample floor space for at least three more banks of 1,000 selectors, so that the exchange has a capacity of 8,000 telephones, and by the removal of some partitions even this could be increased.

Just in front of the main distributing board and between it and the selector banks is the generating plant with its switchboard. One generator is provided to charge the storage batteries used in the toll service, the motor side operating on the Edison 220-volt circuit.

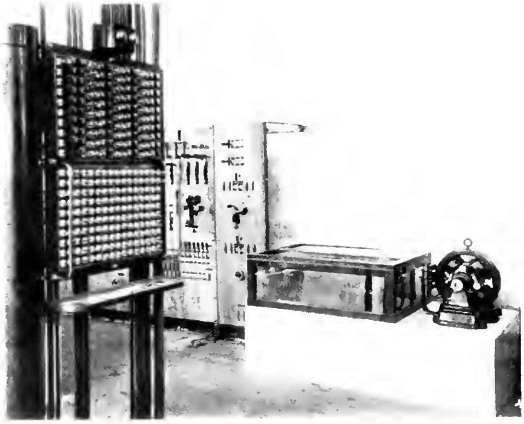


FIG. 4.—AUTOMATIC TELL-TALE BOARD AND CURRENT INTERRUPTERS.

Two other rotary converters are provided for charging the storage battery plant that operates the selectors. In addition to these, two sets of motors and generators provide the alternating current for the magneto bells, and a third of similar style but smaller is provided for the night service. An important piece of apparatus in this department is the interrupter and its reserve duplicate. These are

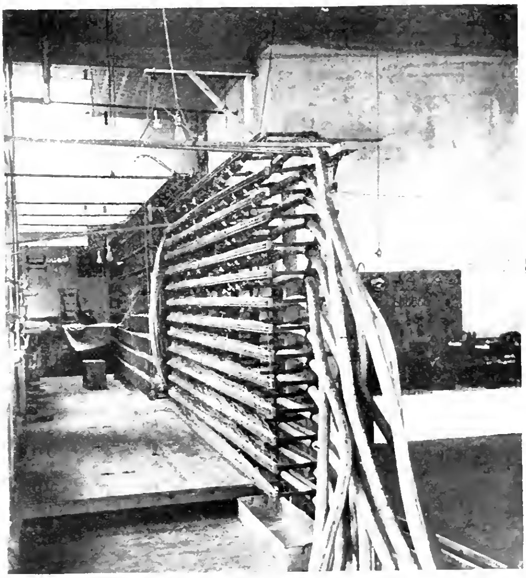


FIG. 5.—TEMPORARY WORK TO FACILITATE THE CUT-OVER.

contained in a glass case, and are revolving commutators of special design that furnish the intermitting or pulsating storage battery current that operates the rotating, trunk-selecting arms of the selector switches. The interruptors contain also a device which produces the current that gives the "busy" test, or "busy buzz," as it is called. Small electric motors revolve the commutators of these interrupting machines. A handsome marble panel switchboard is provided nearby upon which are mounted the switches, volt- and ampere-meters, lightning arresters and other accessories of the generating plant. A "tell-tale" board stands not far distant from this, upon which are miniature lamps and a magneto bell to detect and locate grounded lines. At a glance the switch room employees can tell in what set of 100 selectors one may be found in which the delicate protector fuse is blown.

Across the hall is the toll room, one of the prettiest departments of the whole plant. Here are switchboards for a variety of purposes. The contract for this apparatus was placed through the Automatic Company, but the switchboards were manufactured by the Kellogg Switchboard Company. First in the line is the exchange switchboard, upon which is spread out a system of contacts representing the entire city exchange. Adjoining this are three recording operators' positions, and next to that is the "through" board, on which one toll line is connected with another. Continuing down the side of the room from the "through" board are ten toll operators' switchboards, upon which the toll lines come in. Calls from outside come over these, and are "trunked" to the main exchange switchboard, where the subscriber is called. On the other hand, calls from subscribers for toll lines are received at the recording operators' boards, recorded, and trunked to the toll line boards. The telephone instruments in use are provided with calling dials that have finger-holes not only from 0 to 9, but an additional one for "long distance." A turn of the dial to this point gives a connection with one of the recording operators' boards. It is the first time the Automatic people have installed telephones provided with this special long distance call.

At the end of this toll room is the "rural board." This is provided to accommodate subscribers located in the outlying districts or a long distance from the exchange. It appears that the automatic service does not operate so well over very long circuits, and a complete automatic system in a large city would mean a number of branch exchanges with trunking systems. The board has a capacity of 132 rural subscribers, but there are not nearly that many located so far away from the central exchange that they lose the advantage of the automatic service. These few have "Rural 25" or "Rural 30," or some other number affixed to their regular number in the directory, and their service is in part through this board.

In addition to this array of switchboards, the toll room is provided with three large double desks arranged to accommodate six persons. They are the positions of the toll traffic manager and five information clerks.

Adjacent to the toll room is a locker room for the young women employees, in which are provided black enameled lockers of expended metal. It may be noted at this point that lockers of the same style are provided in the inspectors' room and in the shops and offices. Passing through the women's locker room one reaches a beautiful suite of rooms elaborately furnished and fitted out as club rooms for the women employes of the company. A reception and dining room are finished with woodwork of dull black oak and walls of rich green. The walls are hung with pictures of high colored poster style, framed to match the finish of the room, and polished wood floors are covered with rich rugs. The furniture is of dull black oak, and is of the quaint and artistic design so popular for "dens," beer rooms and the like. Some of it is richly upholstered with leather cushions. Handsome electric chandeliers and fixtures of odd design match the general effect. The dining room is provided with a china closet well supplied with china and cut glass, and just off this room is a kitchen with its pantry and a large gas range. It is the plan of the company to keep the canisters of the pantry filled with tea, coffee and other beverages, and a matron will be in charge of this department.

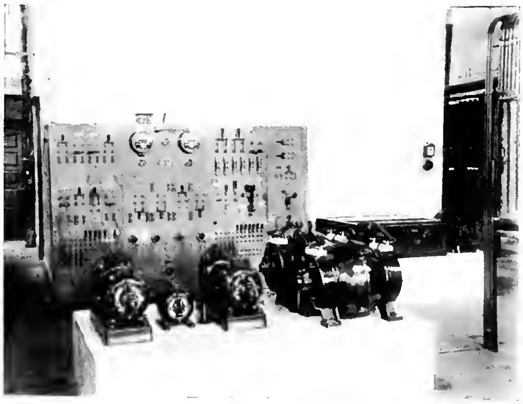


FIG. 6.—GENERATING APPARATUS AND SWITCHBOARD.

The method by which the inauguration of the new system was effected and the "cut-over" made in the short space of seven minutes, is quite interesting. For some weeks prior to the "cut-over," Citizen's telephone users had been talking through the new exchange, although not using it. The conductors of the necessary number of temporary cables were tapped to the terminals of the main distributing board in the new exchange. These cables were conducted through the tunnel and a temporary conduit system to the old exchange. The terminals of the new distributing board are provided with spring contacts that may be separated by the insertion of an ordinary wooden toothpick, and this was done. Thousands of toothpicks were arranged in these terminals. When the "cut-over" was made the toothpicks were withdrawn and the temporary wires to the old exchange were cut off.

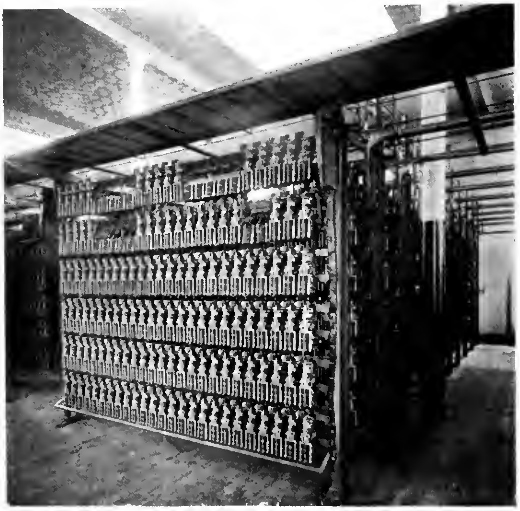


FIG. 7.—ONE OF THE BANKS OF SELECTOR SWITCHES.

Grand Rapids had long been waiting for the new system and it seems that most of the subscribers were at their telephones waiting to try them as soon as the system was switched in, which it was announced would be at 12:30 sharp. Fifteen minutes after the system was cut in, General Superintendent Keith, of the Automatic Company, estimated that 1,700 switches existed or twice that many telephones were in use, simultaneously, out of approximately 5,000 lines connected to selectors. The largest number of simultaneous connections that was ever counted in the old exchange was 204. For the few days that have elapsed since the inauguration of the automatic service it had worked splendidly, and Grand Rapids telephone users have nothing but words of praise for it. Officials of the local company say the "trouble" is not nearly what was expected and what had been provided for, and that it amounted, even during the first two or three days, to little more than the normal under the old system. Some difficulty comes from the fact that many numbers—about 1,200—were changed; four digits are necessary to each automatic number, to insure four turns of the calling dial, and 5,000 was added to all the old numbers from 1 to 999. Some other numbers were altered for various reasons.

The new telephone exchange building cost the company $60,000. The cost of the automatic exchange and apparatus is not given out by the officials, but it is believed by some competent to judge that the price approximated $200,000.

FIG. 1.—EAST END AND NORTH FAÇADE, PALACE OF MACHINERY.

The Westinghouse Service Plant at the St. Louis Exposition.

Although a large amount of power for the use of the Louisiana Purchase Exposition will be derived from exhibition apparatus in Machinery Building, with boilers located in the Steam and Fuels Building, near by, it was decided by the Exposition authorities that it would be best for the Exposition to erect under contract a service power plant for the use of the Exposition, which would be more directly under the control of the Department of Works than exhibit apparatus could be. Such a plant is needed for the service of the Exposition, and it is essential that it should be completed and in operation before the Exposition opened without any of the uncertainties attending the completion of exhibits. It was finally decided to award the contract for such a plant, with a capacity of 8,000 kw, to the Westinghouse Electric & Manufacturing Company. This contract covers the entire power plant equipment with the exception of the buildings and stacks. The engines and generators will be placed in Machinery Hall in a space set aside for the service plant. The boilers will be located in the Steam and Fuels Building, 100 ft. distant, which is the building in which all boilers and gas-producing apparatus will be placed.

Although this is a service plant in name, it will, of course, be an interesting exhibit. While there will be nothing radically new in its essential elements, it will represent good modern power house engineering practice. The reasons urged for the award of this contract to the Westinghouse Electric & Manufacturing Company were that, on account of the many allied Westinghouse interests, it would be possible for this company to handle a large part of the contract without going outside of the Westinghouse companies and chances for coherent design and prompt completion were better than if the contract were awarded to several companies. Thus, the steam engines will be furnished by the Westinghouse Machine Company, and the engineering and construction of the plant will be done under the supervision of Westinghouse, Church, Kerr & Co. The plant will contain four units of 2,000 kw each. These will be 25-cycle, three-phase, 6,600-volt generators, direct-connected to Westinghouse Corliss engines. The generators will weigh, without the bed, 132,000 pounds, and with the bed 190,000 pounds. The efficiency guarantee is 96 per cent. at full load, 95 per cent. at three-fourths load, and 93 per cent. at one-half load. They will operate at continuous full load with not over 35° C. rise in temperature. The engines will be Westinghouse vertical, cross-compound, condensing, Corliss, running 83 r.p.m. They are rated at 2,800 hp and have a maximum overload capacity of 5,200 hp, the latter capacity being reached at three-fourths cut-off in the low-pressure cylinder. The cylinder diameters are 38 and 76 in., with 54-in. stroke. The shaft will be hollow forged steel 31 in. in diameter. In addition to the fields of the generators, the engine will have a fly-wheel of 175,000 pounds weight. The total weight of the engine is 750,000 pounds. It is guaranteed to operate on $13\frac{1}{2}$ pounds of steam per indicated hp-hour. Water for condensation will be supplied from a cooling tower having fans driven by electric motors, to furnish air circulation.

The boilers in the Steam and Fuels Building which will supply this plant are 16 in number, of 500 hp each, of the B. & W. water tube type. Smoke flues will be placed under the floor and led to the stacks built by the Exposition. In addition to the natural draft, fans will be installed to produce artificial draft when needed, in accordance with Westinghouse practice. Roney mechanical stokers will be used under these boilers. That part of the Machinery Building devoted to the service power plant is spanned by a 40-ton traveling crane. Besides the main units, there will be three 80-kw exciter units, any one of which is sufficient for the entire power plant. These units will be direct-connected to vertical cross-compound, condensing, West-

FIG. 2.—INTERIOR OF MAIN ENTRANCE, PALACE OF MACHINERY.

inghouse engines running 300 r.p.m. The weight of a unit complete is 38,000 pounds.

A Westinghouse switchboard will be installed consisting of three exciter panels, four generator panels, two main load panels, two incoming feeder panels and twenty-four outgoing feeder panels. The incoming feeder panels are for the current which is to be purchased by the Exposition from the Union Electric Light & Power Company.

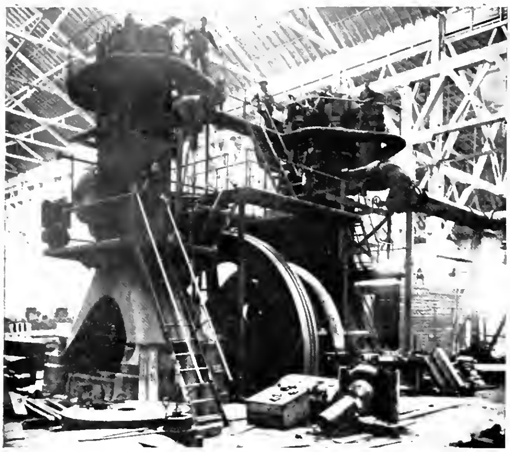


FIG. 3.—2,000-KW DIRECT-CONNECTED GENERATOR, PALACE OF MACHINERY.

The two load panels will pass the entire load, one panel being used for each of the two sets of bus-bars. Solenoid-operated oil switches are to be used for the high-tension alternating current, and these will be controlled in the usual manner by low-tension circuit, with switch handles on the various panels. On each generator panel will be three switches, one controlling an oil switch connecting the generator with one set of bus-bars, the other connecting it with the

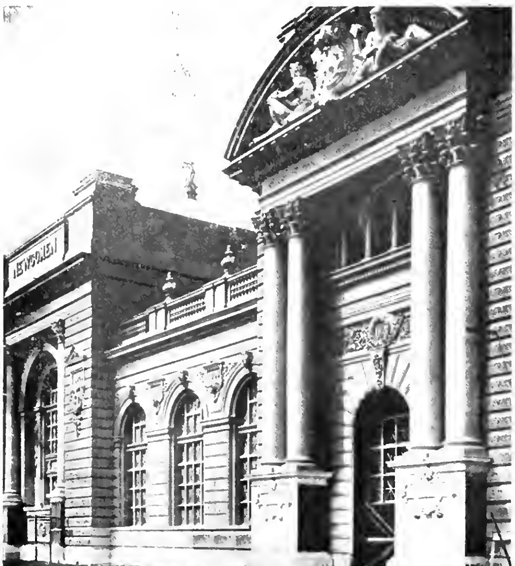


FIG. 4.—PORTION OF FAÇADE, NORTHEAST ENTRANCE, PALACE OF MACHINERY.

other set of bus-bars, the third being in the generator leads in series with the two just mentioned. The switches will be equipped with time limit release for automatically opening the circuit. Each generator panel will have one power factor indicator and three ammeters. Each feeder panel will have three oil switches, two of which are in multiple for connecting to either set of bus-bars, and the third in series with the other two, or the reverse of the generator switching arrangement. Each feeder panel will have also three ammeters and one integrating wattmeter.

Although not a part of the service plant, another interesting contract which this company is filling for the operation of the Exposition is for the 2,000-hp induction motors to be direct-connected to Worthington centrifugal pumps, to supply the Cascades with 90,000 gallons of water per minute. Thhs will be a remarkable installation, not only on account of the size of the induction motors, but on account of the size of the pumps and the high head to which water must be raised, which is approximately 150 ft.

Recent Electrochemical Developments.

FURNACE INVENTIONS.

There is great activity at present in resistance furnace design with an intention to obtain a perfect regulation of temperature and a uniform heating effect. This development is combined with a tendency to apply the electric furnace to processes requiring relatively lower temperatures than heretofore. This means an extension of the use of the electric furnace which was formerly restricted to the production of extremely high temperatures. An example of this development is a method of making carbon articles for which a patent was granted on January 12 to Mr. E. G. Acheson, of Niagara Falls. In manufacturing carbon articles, the customary method is to take some suitable carbon—such, for instance, as ordinary coke, coke produced from petroleum, or lampblack—in a finely subdivided form and mixed with tar or another appropriate binding material and moulded under pressure into the desired forms. These forms are then placed in a gas or coal-heated furnace and slowly raised in temperature until all of the contained volatile hydrocarbons have been driven off, leaving the articles in a solid, dense and coherent condition, for use as electric light points, electrodes, dynamo brushes, etc. In the last step of this process, as the articles are massed together in large volume, much time is reqnired for their efficient packing and considerable difficulty is encountered in obtaining a uniform elevation of temperature throughout the several articles, and the failure to do so frequently results in serious warping or cracking of the goods treated.

Mr. Acheson designs his electric furnace in such a way as to produce a uniform elevation of temperature throughout the mass of the carbon article. In his furnace he is also able to attain a considerably higher temperature than can be obtained in a gas or coal-heated furnace, so that while he does not reach the temperature required for changing the carbon into graphite, yet the temperature is sufficiently high so as to polymerize the carbon and increase its density, electric conductivity and resistance to chemical action. The carbon articles are embedded in a resistance material of granular carbon or a mixture of granular carbon and silicon, etc. The carbon articles to be heated are placed with their longest diameters at right angles to the flow of the current. The intention is not to produce heat in the carbon articles as the result of passing the current through the articles, but rather to produce the heat in the packing material separating the carbon articles. The result is a very uniform raise of temperature.

Three patents have been granted to Messrs. Le Roy W. Stevens and Bernard Timmerman, of Chicago, for an electric furnace for making carbide or the like. The invention contemplates essentially a down-draft furnace in which the falling material is preliminarily heated, the resultant gases being drawn off at a high temperature and used for any desired purpose, an auxiliary chamber into which the material is charged and again treated, the resulting gases from this second treatment being conducted to the main flue, and delivered therein near its top at a high temperature, increasing the temperature and the chemical reaction.

STORAGE BATTERY ELECTRODE.

A patent was granted to Mr. R. Hager, of Halensee, Germany, for a Planté electrode, comprising separate plates coaxially arranged. Each plate is composed of a series of channel-shaped plates arranged one above the other. Each channel-shaped plate is provided with a slit extending transversely of the channel. The object is to prevent injurious tensions being set up during charging and discharging which would cause the active material to break off.

Institute Meeting in Chicago on Storage Batteries.

The Institute meeting held January 12 in Chicago was presided over by President Arnold. Mr. Lamar Lyndon's paper on "The Comparative Behavior of Floating and Booster-Controlled Batteries on Fluctuating Loads," presented at the November meeting in New York, was abstracted by Mr. J. M. S. Waring, of Chicago. The discussion was participated in by a number of storage battery men and served to show the value of a storage battery, not merely from an engineering standpoint, but as an investment as well. Commercial utility was the keynote of the discussion.

President Arnold, in introducing the first speaker, called attention to the wonderful strides made in storage battery engineering in the last eight or ten years and the recognized place the storage battery now occupies. Mr. George Damon, managing engineer of the Arnold Electric Power Station Company, described two installations which have been made by him. The beneficial effect on operation of electric roads was clearly proved and the investment under such conditions shown to be about the same as if no battery had been installed. Mr. Joseph Appleton, manager of construction of the Electric Storage Battery Company, considered the best methods of operating batteries to give results which will yield the best return on the investment, or, in other words, the maximum commercial efficiency. The battery which does the most work is not always the one which gives the greatest commercial efficiency. Continuing, he stated the conditions under which a battery for a railway system may be installed, to be as follows: Increase of capacity of the generating plant; evening up the load on the generator plant to give greater economy of operation; saving of copper and maintaining proper potential on the line.

It depends largely for which of these purposes a battery is installed, as to where it should be located, and how it should be controlled. In addition to this, the location of the battery will depend a great deal on the price of real estate and cost of attendance. All of these things must be taken into consideration before it can be decided where to place the battery. It should also be determined what proportion of the total load the battery should take; this will be governed entirely by local conditions. For example:

Where a generator plant is operated by steam, the capacity of the boilers and units should be taken into consideration, or where current is purchased from a large system, operated by either steam or water power, the terms of the contract under which the power is bought will frequently determine what the battery should do. To illustrate what is meant, two cases were mentioned. One is the Inter Urban Road between Seattle and Tacoma, which is operated from four sub-stations, the power being bought under contract from the Snoqualmie Falls Power Company. In each of the sub-stations there are two motor-generators, of 300-kw capacity; each one of these with the battery in each sub-station is sufficient to run the load under ordinary conditions. The economical maximum load on each of these stations, according to the terms of the contract, is about 600 amp., the actual load varying from 200 to about 1,800 amp. The batteries and boosters in these stations are so adjusted that the battery will not discharge to any extent, until the load on the generator reaches 600 amp., after which point the battery and booster practically take the additional load. These conditions naturally do not show a very good load curve as far as the battery is concerned, but yet it is working under maximum commercial efficiency.

An illustration of the opposite condition can be found in the plant of the Oakland Transit Company, which operates a system of five car trains, running to a ferry, landing in Oakland from San Francisco. In this case the load on the station varies from zero to 2,600 amp. and by the use of the battery and booster the system can be operated by one 600-kw steam-driven generator, the load on which is maintained between 800 to 900 amp. all the time. These two plants illustrate clearly the operation of a battery where close regulation is advisable, and also where it does not pay to get close regulation.

In these days when electric railways are extending so rapidly and the growth of interurban service is so marked, new conditions are arising for the power plants and sub-stations operating such systems. We find two kinds of fluctuations, one due to the local service, where the fluctuations are frequent and comparatively small, and one due to interurban service where the fluctuations are periodical and very great. In such a case it does not pay to adjust the battery and booster to take all the small fluctuations, for if this was done a battery large enough to take all the heavy fluctuations due to the interurban service would mean too great an investment to be profitable.

The average load on such stations is usually more than the local service load, and therefore a portion of the interurban fluctuations can be safely and economically carried by the power house or the sub-stations. The battery, in this case, gives its best results commercially by taking that part of the load which would overload the sub-station too heavily. The rapid growth of interurban service means a greater use of batteries, as without them it is necessary to install generator machinery sufficient to carry the maximum interurban load, while the average is very much less. Generally speaking, if the battery is to relieve the station of fluctuations, it should be located at the station, and if it is to save copper or maintain proper voltage on the line, the battery should be located out on the line.

Each year finds the use of storage batteries increasing very rapidly, and this is due largely to the fact that the proper use and operation of a storage battery which gives the maximum return for the investment, is being understood. The life of a storage battery is practically proportional to the number of kilowatt-hours taken out of it, and consequently the maintenance of the battery can be kept down to a minimum, by only using the storage battery to take part of the load which pays. In other words, by using the battery to give the maximum efficiency of the combined system, and not merely to straighten out the load curve irrespective of the cost of current at different times and under various conditions.

Mr. John. I. Beggs, of Milwaukee, emphasized the commercial aspect of the subject. He heartily concurred in Mr. Appleton's statements and considered that the storage battery has often suffered because it has not always been installed with a view to best meet existing conditions. Mr. Beggs stated that he had been forced to install a battery at Milwaukee a few years ago because of the advent of the steam turbine at a time when he was considering making an investment of $4,000,000 for a new power house. The conditions under which the battery had been installed were severe inasmuch as it had to be used either for street railway work or on an Edison three-wire system, or both at once. The battery had proved of inestimable value and an actual necessity, although the price would lead one to believe it to be a luxury.

Mr. Ernest Lunn, of the Chicago Edison Company, in discussing Mr. Lyndon's paper, considered the storage battery more especially from the operator's standpoint. He said that it would be interesting to know to what extent changes affect the behavior of a battery since its characteristic changes with age, with variations of temperature, specific gravity, and condition of plates. The facts might be different in the case of a battery floating near a station from that at the end of a long feeder. A rise in temperature would cause the battery characteristic to approach the horizontal line and the battery would give a greater discharge for a given drop in pressure than if the temperature remained constant. The characteristic with most batteries would likewise gradually approach the horizontal as the battery ages, further increasing the charge and discharge for variations in line pressure. In discussing Mr. Lyndon's statement that "In any battery used for regulation, it is necessary that the input approximately equal the output, otherwise the state of battery charge is changed and the efficiency of the regulation decreased," he stated that it was quite necessary to have about ¾ full charge if the best results from the battery are to be expected, or at least to have some fixed state of charge. A battery at ¾ full charge will discharge at a higher rate for the same drop in pressure than it will at, say, either full charge or half charge. It is of importance then to be able to adjust the voltage and load, so that the battery may be in condition to float at the proper point of charge, else the desired results will not be obtained, due to the change in the battery characteristic. Batteries, too, are not all alike in regard to initial and final voltage; especially is this true of batteries of different manufacture. Some means, therefore, to compensate for irregularities and unavoidable variations should be provided.

The second feature of the evening was the paper on "Gas Power for Central Stations," by Mr. J. R. Bibbins, an abstract of the paper being read by the author himself. Mr. John I. Beggs, in opening the discussion, stated that personally he was more especially interested in what had been accomplished in the way of large gas engine units. As compared with steam engines of small size, as usually operated, the gas engine no doubt is far more economical, and he was ready to concede all that was claimed for it, and more, too. The units and results considered in the paper, however, were not such as to admit of predicting what these would be with, say, 5,000-hp units. When a company must sell current for as low a price as 1 cent per kilowatt-hour at the switchboard, small units, whether of the reciprocating steam engine or the gas engine, are out of the question. There was a question in his mind as to whether the steam turbine or the gas engine will eventually prove the more economical. Three or four years ago he had, as already stated, delayed the building of a power house to cost $4,000,000, as the steam turbine was then looming up. Now he was disposed to further delay action on account of the advent of the gas engine. He had received a proposition to install a 5,000-hp gas engine, a size to be considered. The men in charge of the financial operation of great properties had to contend with not only such problems, but others as well. Milwaukee is seeing the building of a coke oven plant which will turn out fuel gas as a by-product. The competition which such an enterprise will develop may prove serious, and there is a question in his mind whether it would not be profitable to buy the entire output of the plant for a gas engine power plant.

Mr. George N. Eastman, of the testing laboratories of the Chicago Edison Company, compared the efficiencies of the various prime-movers emphasizing the greater economy of internal combustion engines. Mr. C. E. Sargent outlined the development of the gas engine and ascribed the lack of greater progress to the fact that the original patents had expired but recently. With the double-acting tandem horizontal engines now being put on the market, a uniform turning moment is obtained and a regulation as good as with the steam engine. Mr. W. L. Abbott, chief operating engineer of the Chicago Edison Company, predicted that if gas engine development in the next three years would be as rapid as that of the turbine in the same length of time, a great deal would be accomplished. He pointed out that whereas the steam turbine had been known for 2,000 years, the gas engine was a product of the last twenty years. Mr. C. H. Williams gave the result of his experience with small gas engine units at Madison, Wis. Mr. Bibbins, in concluding the discussion, made the point that if the showing in the case of small gas engine units is good, it is safe to say that large units will do as well if not better. He ascribed the lack of development in the past as due to a great extent to the lack of an improved gas producer. The question as to the relative value of the gas engine and the steam turbine was in reality foreign to the subject of his paper. In fact, the prime-mover should be chosen with a view to its suitability for any given set of conditions.

The meeting was one which showed the Chicago membership well alive to the subjects considered, and it was well attended. The next meeting will be held February 2 and will be devoted to a discussion of the important question of manual versus automatic telephone operation. Mr. Frank Dommerque will present a paper on "Commercial Aspect of an Automatic Telephone Exchange."

General Electric Foremen's Banquet.

The Foremen's Association of the General Electric Company held its second annual banquet at the Edison Hotel, Schenectady, N. Y., on the evening of January 9. At the conclusion of the dinner Mr. T. E. Leavitt, president of the association and toastmaster, called upon several gentlemen present to respond to toasts. Mr. E. W. Rice, vice-president of the General Electric Company, took as his theme "The General Electric Company at Home and Abroad." He referred to the history of the joint companies of the plant, mentioning the pioneer enterprise such as the Edison works and giving an idea of what each contributed to the work done by the larger plant. He also told of the work done by the branches in the other parts of the world, such as Japan, Egypt and India.

He delved into statistics and said that if all the buildings of the General Electric Company in the United States were joined in one structure 50 ft. in width they would extend from Schenectady to Albany, 18 miles. He further stated that the company employed between 18,000 and 20,000 men in the different works throughout the United States.

On the subject of incandescent lamps manufactured by the company in the last 10 or 12 years, he stated that no less than 125,000,000 had been turned out. To show that the stockholders of the company were not taking in all the profits made by the works, Mr. Rice said that the immense sum of $75,000,000 had been paid to their employees in the United States within the last 12 years, while the stockholders had received $15,000,000, but one-fifth of that sum, during the same time.

Mr. G. E. Emmons, general manager of the works, was next called upon and gave a retrospection on the company's work during the last year. He said:

"The business of 1903 was greater than that of 1902. This was due, however, to the fact that a number of old contracts were carried over, as the current orders received were not as great as in 1902. From the indications it looks as if the business would be light for the next few months, but will probably soon pick up."

He thanked the men for their efforts, giving them much credit and attributed much of the good showing made by the company to the work done by the foremen.

"During 1903," he said, "we spent much for new and improved machinery, for it is the policy of the company to do so whenever it is shown that it can thereby lessen the cost of production. Competition is very strong and in order to keep in the flock and lead competition, it is necessary to be constantly employed in introducing improved methods, improved machinery and any other change that would tend to lessen the cost of the output. Watch closely for economy, but remember it is economy to spend freely when a saving can thereby be effected."

"Electricity as Applied to Machine Tools" was the topic of Mr. A. L. Rohrer, superintendent of electrical construction. "At present," he said, "we have about 6,000 machine tools in the works, run by 900 motors. Six hundred and eighty-seven of these are driven by individual motors. In 1900 we had but 460 motors and even since 1902 the increase in our power is fully 30 per cent." In speaking of the arc lights which are used in the plant, Mr. Rohrer stated that no less than 2,000 of them were in use, fully as many as are employed to light an entire city of 300,000 people.

Among the other speakers who were called upon were E. B. Raymond, foreman of the testing department, who spoke upon "The General Utility of Electricity as Applied to Modern Industries"; J. Riddell, who addressed the men on "High Speed"; L. Gibson, superintendent of the producing department, and B. Morrow, foreman of the testing department, whose subject was "What I Know About Water."

Radium Mines in London.

A cable dispatch from London says: "The possibility is suggested that London may become the center of a peculiar mining industry. There are houses somewhere within the metropolitan area whose foundations are imbedded in a precious substance, which, if it could be recovered, would be worth more than a whole street of houses. The very roads along which London's unwitting millions hurry about their daily business lie on artificial beds of radium, put down many years before the nature or value of the element was discovered. Sir William Ramsay is authority for the statement that a London firm of analytical chemists has thrown away for many years the by-products obtainable from pitchblende in the process of extracting uranium. The firm which thus unknowingly has flung probably many great fortunes to the wind is Johnson, Matthey & Co., Limited, of Hatton Garden, but, as one of the principals remarked the other day, radium had not been discovered at that time. "As a matter of fact," he added, "we actually paid, I believe, three shillings and sixpence a ton to have the stuff carried away in dust carts. It was used for leveling and laying out roads in the city and for filling in the foundations of houses." For twenty-five years the firm was engaged in extracting oxide uranium from pitchblende. The oxide was used mainly to color expensive glassware, to which it gave a yellowish-green fluorescent appearance. The use of uranium for this purpose has been long discontinued in favor of cheaper methods. Much of the pitchblende worked upon by Johnson, Matthey & Co. was obtained from the mines at Joachimsthal, Austria."

Wireless Telegraph on the Pacific.

A special dispatch from San Francisco says: "Apparatus for wireless telegraphy has been installed at Point Reyes, forty miles north of San Francisco, on the coast line, and on the southeast of Farallon Island, which works perfectly. Prof. Alexander G. McAdie, in charge of the local branch of the United States Weather Bureau, assisted by Alfred H. Triessen, the government wireless telegraph expert, installed the plant."

Curious Action of Static Charge.

We are indebted to Mr. Fred R. Cutcheon, superintendent of the electrical department of the St. Paul Gas Light Company, for the following item and the photograph which accompanied it:

I enclose herewith a photograph of a peculiar electrical phenomenon; it was taken from the inside surface of a hard rubber box upon which was mounted a choke coil, of 28 turns, this choke coil being located at the point where our 25,000-volt overhead line, 30 miles in length, passes into an underground cable. Ordinarily, the drop

CURIOUS ELECTRICAL EFFECT.

over this coil is only a fraction of a volt, and the photograph shows what an enormous resistance the coil must offer to heavy static charges. The actual distance between the terminals is 9 in. The white appearance of the rubber is due to a white sooty deposit; the black radiating lines are charred rubber, which is raised up in ridges about ⅛ in. high.

There was no evidence of any discharge between lines. This same phenomenon occurred on all of the six choke coils, and was observed to a less extent on coils of the same make at the generating end of the line. The photograph was taken by Mr. George B. Overton.

New Telephone Patents.

TELEPHONE REPEATER.

A modification of the telephone microphone repeater has recently appeared which attracts attention because of the particularly ingenious arrangement of its various component parts. As may be seen from Fig. 1, a single diaphragm serves for both telephone and microphone parts, while the coil, *I*, shown inclined to the horizontal also serves a double function, viz., as induction coil and as receiver coil. The transmitter button, *c*, contacts with the diaphragm through three small contact joints and thus it follows any motion of it. The diaphragm in turn receives its motion under the magnetic influence of the induction coil core, which has a permanent polarization under the influence of its primary coil and a varying magnetization under influence of the secondary coils, one of these being in each of the circuits to be interlinked. The letters, *X* and *Z*, indicate the two widely distant stations which are to communicate through the repeater, while *T R* is a supervisory station connected in the primary circuit. This repeater is the invention of Merritt Gally, of Brooklyn, N. Y.

RINGING FACILITIES.

With "two-wire" central energy switchboards of some kinds, the energization of a so-called cut-off relay serves to maintain the only connection between the subscriber's station and the switchboard jacks. The coil of this relay is bridged across the jack and it receives its actuating current from the central battery through the cord circuit. Now, when an attempt to ring the subscriber is made, as the ringing key serves the cord circuit and disrupts, therefore, the connection between the battery and relay, this latter falls back and opens the line, thus defeating the ringing, unless some special arrangement is made to prevent. One such arrangement is that recently patented by A. D. T. Libby, of Chicago, which provides an extra outside contact for his ringing key, from which a connection is made to the battery, a retardation coil being included in the circuit. This connection provides a constant battery supply during ringing, while the presence of the retardation coil renders the circuit impervious to the ringing current. Mr. Libby has assigned his patent to the Kellogg Switchboard & Supply Company.

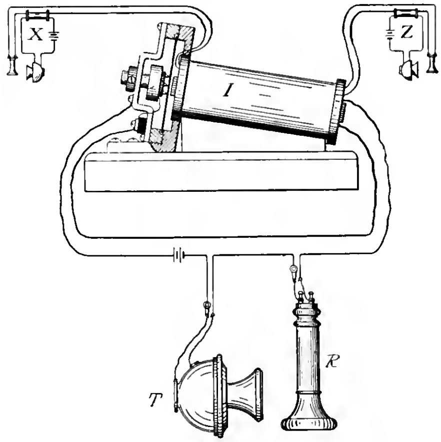


FIG. 1.—GALLY TELEPHONE REPEATER.

A second patent relating to ringing describes a new type of ringing key, which has been designed by W. Meyer, of Chicago. This key, which combines both ringing and "listening-in" is of the lever type, the most novel feature being the bending of the upper end of the contact springs on the "listening-in" side of the key in a manner such that when the lever is thrown, their pressure is normal to the lever pivot, and thus the lever remains in the thrown position in this direction without the use of auxiliary devices. The Stromberg-Carlson Company has obtained by assignment the patent for this key.

A SWINGING TELEPHONE SUPPORT.

Some years ago a few telephone companies produced a swiveled desk telephone, which, while supported at the side of a desk, could be swung over its top without the user being annoyed by the entanglement of the flexible cords with papers, etc., upon the desk. Recently almost none of these have been put into service, and, therefore, the telephone support, which has been patented by C. H. Pelton and W. Ramsey, of Springfield, Ohio, and which seems to provide

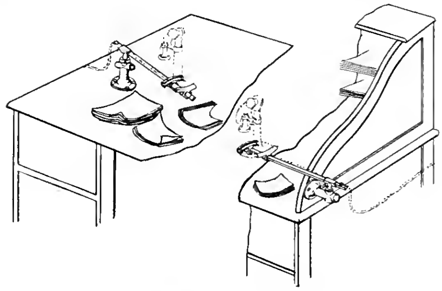


FIG. 2.—PELTON AND RAMSEY TELEPHONE SUPPORT.

all the features of the old swinging arms, should "fill a long-felt want." Fig. 2 shows the support applied to two desks and indicates the principles as well as could any further description.

TELEPHONE LOCK.

A new variety of telephone lock has been patented by S. J. Larned and J. S. Ford. This lock is to serve for the protection of the telephone company rather than for that of the subscriber, as it is to be used to lock a telephone from service in case of non-payment. A bolt or block is designed to fill the escutcheon above the switch hook, being held in place by a hasp hinged thereto and threaded through the rings now customary upon the ends of the prongs of switchboards. The hasp is then secured by a padlock. The lock not only holds the hook in the depressed position, but prevents the removal of the receiver from the hook. The American Telephone & Telegraph Company have been assigned this patent.

REVERSE-CURRENT TRANSMITTER.

Phillip G. Randall, of Boston, is the patentee of a transmitter designed to cause actual reversals of current in the primary of its associated induction coil. The diaphragm is a stiff plate of carbon suspended in spring clamps engaging its periphery. The vibrating air impinging on the diaphragm causes its movement as a whole. Opposed to either face of the diaphragm are several microphone buttons mounted upon springs. All of these buttons upon one face are associated in one part of the circuit, while those upon the other face are associated in another group. These two groups of buttons are then so connected to the circuits and batteries and induction coil that the combined effect of the whole apparatus is an alternating indulatory primary current.

STEP-BY-STEP PARTY LINE SELECTORS.

Two selective party line systems, both depending for selection upon switches moved by steps under the influence of current impulses in an electromagnet are described in patents of last week's issue. Of these one requires three line conductors, while the other uses the ground in lieu of one of these for both the ringing and talking circuits. Messrs. F. A. Lunquist and J. K. Norstum are the patentees of this latter, while the former is the joint invention of Messrs. H. Redmon, R. L. Hall and R. H. Conway.

Marconi Wireless Telegraph Work.

Mr. John D. Oppe, general manager of the Marconi Wireless Telegraph Company of Canada, who is also a director of the American company, has been in New York recently. When asked about the operations of his company at Glace Bay, Mr. Oppe said: "While we are not yet in active commercial operation between Poldhu and Glace Bay, we frequently exchange signals and are in constant communication with the American station at South Wellfleet, a distance of over 800 miles of land and water. Mr. Marconi has been devoting his time to perfecting communication between Poldhu and Gibraltar, a matter of great importance to the British Admiralty, and has not been able to devote his attention to the American station as intended. A large demand upon his time arises from his contract to install the long-distance station at Pisa to communicate with the Argentine, 6,200 miles. Notwithstanding these two important projects he is expected to return to America soon, and I confidently expect that regular communication across the Atlantic will be established soon. The Canadian Government, it is understood, has in contemplation the establishment of a number of stations in the Gulf of St. Lawrence for the purpose of aiding navigation, including one at Sable Island, which is situated 100 miles from the main coast of Nova Scotia in the direct line of vessels sailing from St. John and Boston, and within easy communication of the route traversed by New York and Liverpool vessels. A station will also be erected in Nova Scotia to connect with that at Sable Island, and one may be established at Cape Race."

Mr. Oppe said that the reason another station might be needed on the Nova Scotia mainland was that the Sable Island station would be tuned differently to the one on Glace Bay, thus avoiding interference with one by the other.

Electric Power at the Charlestown Navy Yard.

A large plant to supply power to the various buildings and shops in the Charlestown Navy Yard at Boston is being installed. It will cost about $300,000 when completed. The equipment will include a 750-kw Westinghouse-Parsons steam turbine, direct-connected to an alternating-current generator. It is intended to add three more machines of the same size later on. Two 100-kw motor generators, for transforming the alternating to direct current are now being built and others will be installed. From this plant, besides the power for operating the machinery in the large shops, power is to be supplied for running machinery along the water front and also on board any ships that may tie up at the piers. The power for the ships will be conveyed through heavy flexible cables.

Work has been begun on the pump well for the new dry dock, which is to be made of glazed brick, and will be 43 ft. in diameter and 55 ft. deep. The two great pipes, shaped like Ys, and each weighing 26,000 pounds, which are to go on the bottom of the well, have been successfully cast and will be laid at once. The pump, which will have a capacity for discharging 65,000 gallons of water per minute, will be electrically driven. The motor which will run it will be of 500 hp and will be directly connected on the same shaft. The pump will be able to remove all of the water, about 14,000,000 gallons, from the basin in four hours, and will also be connected so as to empty the old dock.

Traction in Massachusetts.

The annual report of the Massachusetts Railroad Commissioners for 1903 shows that during the twelve-month periods covered the operations of both the steam and electric roads were the largest on record. A notable feature of the report is that the number of passengers carried by the steam roads is, for the first time in ten years, larger than the number carried in 1893, when the electric roads began active competition. The increase in the number of passengers carried by the steam roads during 1903 compares with that of the electric roads as follows:

PASSENGERS CARRIED

	Steam roads.	Electric roads.
1903	123,162,793	504,662,243
1902	115,645,897	465,472,382
Increase	7,516,896	39,189,861
Per cent increase	6.5	8.4

The number of passengers carried by the steam roads in 1903 compares with 119,779,947 carried in 1893, the previous high record, showing an increase of 3,382,846, or less than 2 per cent. The increase in the number carried by the electric roads in the same period was 294,110,234, or 136 per cent. The increase in passenger earnings during 1903 compares as follows:

PASSENGER EARNINGS.

	Steam roads.	Electric roads.
1903	$42,524,082	$27,027,651
1902	41,440,170	24,918,865
Increase	1,083,912	2,108,967
Per cent increase	2.6	8.4

The percentage of total net earnings to gross liabilities (capital stock, and funded and floating debt) compares as follows:

	Steam roads.	Electric roads.
Gross liabilities	$394,277,139	$133,121,411
Total net earnings	37,866,139	9,508,284
Per cent net to liabilities	9.5	7.1

A comparison of surplus available for dividends and capital stock compares as follows:

	Steam roads.	Electric roads.
Capital stock	$235,834,466	$68,404,480
Surplus after charges	13,748,969	3,602,916
Per cent surplus to stock	5.8	5.3

Trolley for Calais, France.

The quaint old French town of Calais is to have trolleys. U. S. Consul Milner writes: "Calais still has horse tramways, operated by an English company that has a franchise to run for seventeen years. The municipality projected an electric tramway system and was granted the concession by the French Government. The contemplated system is estimated to cost $600,000, in which three lines were comprised, having a length of 16 miles—8 miles within the corporate limits of the city—the contemplated system of traction being the Dickinson trolley. It was intended to commence the construction next spring and have the same in operation within one year. These plans have been upset by the death of the contractor, whose heirs are now trying to sell his rights. This leaves an opening for some company to become his successor by arranging with his heirs. An opportunity may exist here for some enterprising American company."

Annual Meeting of the Northwestern Electrical Association.

(*By Special Telegram.*)

The twelfth annual meeting of the Northwestern Electrical Association was called to order in the club room of the Pfister Hotel, Milwaukee, Wis., Wednesday, January 20, with the president, F. W. Bowen, in the chair. A satisfactory report from the secretary and treasurer, Mr. Mercein, was read and adopted. The president's address was devoted to the subject of making the programme of the association at its meetings of the greatest value to the members, and it also considered several phases of central station business in relation to the public and the prosperity of the operating companies. It was heard with much attention and interest. The meeting adjourned until 1.45 P.M.

The Nomination Committee appointed by the chair consisted of R. N. Kimball, of Kenosha, Wis.; H. W. Frund, of Vincennes, Ind., and P. H. Korst, of Janesville, Wis.

The Membership Committee was constituted as follows: J. H. Harding, of Laporte, Ind.; W. H. Schott, Chicago, Ill.; Irving P. Lord, Waupaca, Wis.

The Committee on Uniformity of Advertising Matter reported and was continued, Mr. Harrow Almert being added.

The report of the Legislative Committee, although one which should be of much interest and importance, was not received.

The first paper read was that on "Central Station Heating," by W. H. Schott. It evoked a very spirited discussion regarding the operating features of heating plants in connection with central station work. The next paper read was an interesting one on "Coil Winding for Electrical Purposes," by Messrs. Richard Varley and Charles R. Underhill, the latter of whom presented it. There was no discussion. This paper treated on the rather undeveloped subject of the accurate design of electromagnets for general use and showed that the best method of obtaining data regarding the general behavior of electromagnets is to construct actual magnets, solenoids, etc., and obtain the data by making actual tests. As the magnetizing force necessary to operate any magnet is proportional to the ampere-turns in the winding, the ampere-turns once having been found, it is comparatively easy to design any winding for different voltages. If the current is to be left continually on the winding, the winding will heat considerably; therefore, in order to design a winding which will give the best result with minimum heating, it is also necessary to make actual tests from the various magnets to determine just how much heat they will radiate under various conditions. The economy of the winding was also referred to, and the relation between the actual winding space occupied by copper and by the insulation compared. Some formulæ were also given from which tables of constants have been made whereby the windings may quickly and easily be calculated. Stress was laid on the importance of detail, which shows that it is necessary to have accurate data in order to make the practical results check with the theoretical.

The next paper presented was that of Mr. W. Scheidel, on "Rectifiers." This was read by the secretary, and there was no discussion on the subject. An interesting paper was presented by Mr. John C. Keech on incandescent lamps in general, and their smashing point in particular. The address pointed out the universal adoption of the idea that 80 per cent. of the initial candle-power was the point at which the limit was reached of the useful life of a lamp. The lamp should be smashed when the cost of maintenance was greater than the actual profit from keeping the same up. Users, however, do not carry out the idea, which results in the company furnishing the current being condemned. There was no question of the fact that periodical renewals at the right moment were profitable, and he described improvements in make which aimed at and resulted in lamps burning out automatically at the smashing point. There was a lengthy discussion regarding the proper use of the lamps, in which many useful and interesting points were brought out by hard-headed practical members. The convention then adjourned until 10 o'clock on Thursday morning.

In the evening there was a theatre party given, to see the "Fortune Teller," at the Alhambra Theatre. On Thursday morning the session was arranged to begin with Mr. J. H. Waring's paper on "Storage Batteries for Central Station Work." The other papers will be carried out as per programme, already printed.

Mr. W. Sheidel, of Chicago, read a paper entitled, "The Electrolytic Rectifier and Interrupter," in which he described the Churcher alternating-current rectifier. It is stated that this device rectifies both waves of alternating current and consists merely of one jar, one solution and one set of electrodes. A transformer is required with a secondary of twice the direct-current voltage required plus the resistance loss; the secondary coil is tapped in the center, this tap remaining always positive. The rectifying cell is of the aluminum type and the active electrodes are attached to the secondary terminals of the transformer, the number depending upon the phase of the alternating current supplied. Between the active electrodes, but insulated from them, is placed an inactive electrode, preferably of platinum. Connected between this electrode and the center tap of the transformer is the battery to be charged, the direct-current motor or other apparatus to be operated.

In operation the current passes from the center tap of the transformer to the motor, from the motor to the inactive electrode in the rectifying solution; thence through the solution to one or the other active electrode, depending on which at that instant is negative to the center of the transformer. Inside the rectifier the current passes from the inactive electrode first to one then to the other active electrode, as the alternations of the cycle take place, the center of the transformer remaining positive at all times. It will thus be seen that one side of the transformer is active while the other is inactive during one alternation, and vice versa. The regulation of the direct current is best attained by placing an adjustable inductance between the transformer terminals and the active electrodes of the rectifier. The limit of the voltage of one cell of the Churcher rectifier is stated to be about 70 volts direct current. Through the use of two cells and two secondaries in one transformer, twice the voltage can be obtained, and by increasing the number of cells and the secondaries still further, higher voltages may be obtained.

The paper also refers to the interrupter invented by Mr. Churcher, which will work with any potential or frequency of alternating current and deliver a rapidly and completely interrupted direct current through the primary of an induction coil. The construction and method of operation is similar to the Churcher rectifier, the only difference being in the area of exposed contact of the positive electrode, which is so restricted that instantaneous interruption of current is obtained by the well-known Wehnelt effect.

In spite of the inclement weather experienced in the West, the attendance was good, and the association is to be congratulated, as before, on the practical character of its work.

Further Gift for the Union Engineering Building.

The committee of fifteen, representing the four national engineering societies and the Engineers' Club, on the gift by Mr. Carnegie of $1,000,000, have been doing a great deal of hard work, and this week it became known that notable progress could be reported by them. The plans prepared for the Union Engineering Building and for an entirely separate club house have brought out the fact that, with their large growing memberships this munificent sum would hardly cover all the wants of the various bodies, especially if the Civil Engineers should finally decide to come into the scheme. On Monday last this was brought to Mr. Carnegie's attention, when, with characteristic generosity and promptitude, he added immediately in writing to his previous famous letter, the statement that to make adequate provision for the Civils he would add another $500,000. He also provided at the same time for further purchases of property for the site.

The American Society of Civil Engineers held its annual meeting in New York City this week at the Carnegie Lyceum and then voted to send out a circular of pros and cons on the project and to take a letter ballot returnable in March as to whether the Civils should or should not join the sister societies. There was a great deal of animated argument at the meeting on the subject, some of the older members having apparently very strong views against accepting the gift or against joining hands with the other bodies. The action of the Civils in regard to the acceptance by them of the gift will be watched with great interest.

Bell Telephone Laundries.

An unusual state of affairs exists at Mansfield, Ohio. Spurred by the action of the laundry proprietors, plumbers and the gas fitters, who have pledged their support to the independent local telephone company, the Bell Telephone Company has rented stores and will engage in these businesses.

CURRENT NEWS AND NOTES.

GERMAN LAMPS.—A firm located at Cologne has just received an order from the City Council at Edinburgh, Scotland, for 10,000 incandescent lamps. It is reported that 34 firms submitted bids upon this order.

THE INDIANAPOLIS ENGINEERING SOCIETY has been organized at Indianapolis, Ind., to include in its membership civil, mechanical and electrical engineers and architects. The society starts with fifty members. Charles C. Brown is president and W. E. Buehler, secretary.

DEATH OF DR. HEFNER-ALTENECK.—Dr. Friedrich von Hefner-Alteneck, the distinguished German electrical engineer, died of apoplexy on January 7, at the age of 58 years. In 1872 he invented the drum armature for dynamos. He also invented one of the first differential arc lamps; a transmission dynamometer, and, in 1883, the "Hefner" amyl-acetate standard of light.

AN "OLD VINTAGE."—Mr. W. L. Frazee, superintendent of the government electric light plant and the police and fire alarm telegraphs at Honolulu, Hawaii, in a recent letter to this country says: "This plant is about the same as when first installed—no improvements whatever since 1886—using the same old transformers made by the Thomson-Houston Company. It has always been my desire to remodel it with the latest improved apparatus. I think it would make an interesting exhibit at the St. Louis Fair."

MAGNET STEEL.—In a paper read by Mr. N. Lilienberg before the Philadelphia Foundrymen's Association it is stated that it is possible to produce by superheated side-blown process steel uniformly lower in carbon and manganese than by any open-hearth or bottom-blown process. Many tests have shown by this process it is possible to increase the magnetic qualities of steel by 10 per cent. M. Tropenas has stated, and the claims have been corroborated by others, that the permeability and hysteresis curves of such steel approach those of Swedish iron.

SECRETARYSHIP OF AMERICAN ELECTROCHEMICAL SOCIETY.—As recently reported in these columns, Mr. C. J. Reed has announced that owing to pressure of professional work he cannot accept re-election to the office of secretary of the American Electrochemical Society. Among the names brought forward as candidates for the position are Dr. J. S. Richards, now president of the society; Dr. S. S. Sadtler and Dr. E. F. Roeber. Owing to the growing work of the secretaryship it is probable that a salary will be attached to the position hereafter.

TROLLEY IN SWEDEN.—Mr. E. L. Adams, United States Consul-General at Stockholm, Sweden, writes: "Stockholm's electric tramways now in construction are to be ready for use early next year. The tenders accepted for the new lines were made by Swedish and German contractors in combination. The American bidders were unsuccessful in securing the contracts. The amount to be expended in this work is about 3,000,000 kroner ($795,000). Several other cities in Sweden—Gefle, Malmo, Norrköping, Sundsvall and others—are contemplating exchanging their street railway lines from horse power to electric power."

ICE DAMAGES A NIAGARA POWER HOUSE.—A mass of ice in the form of a huge icicle which collected on the side of the bluff overhanging the power house of the Niagara Falls Hydraulic Power & Manufacturing Company, at Niagara Falls, became detached from its support and crashed through the roof of the power house, on Tuesday of this week. Press dispatches state that two roof girders were broken and a hole 60 ft. wide made in the roof. The ice and debris fell upon the machinery in the generating room, temporarily disabling some of the machines. The station was shut down for a short time to avoid short-circuits from the ice and water, but afterwards resumed operations.

A. I. E. E. JANUARY MEETING.—The January meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West Fifty-fifth Street, New York, on Friday evening, January 29, at 8.15 P.M. The following papers will be presented at this meeting: "The Alternating-Current Railway Motor," by Charles Proteus Steinmetz; "Speed-Torque Characteristics of the Single-Phase Repulsion Motor," by Walter I. Slichter. These two papers relate to the latest and most interesting advance in electrical engineering as applied to traction purposes. Mr. Steinmetz's paper deals with the subject from a simple mathematical point of view, and Mr. Slichter's paper from a more general point of view. It is expected that these two papers will provoke an exceptionally interesting discussion.

ELECTRICITY AT EXPOSITIONS.—Prof. W. E. Goldsborough, chief of the Department of Electricity, World's Fair, St. Louis, Mo., will lecture on "The Influence of Electricity upon Expositions" before the New York Electrical Society on January 27, at 19 West Forty-fourth Street. He will discuss the use of electricity in connection with exposition work since the introduction of electric power, starting with the very earliest and most primitive applications. The evolution which has taken place in the making of exhibit installations will be brought out, leading up, as it will, to an estimate of the installations which will be made in the Electricity Building at St. Louis. A general view of the electric decorative effects in connection with the interior and exterior illumination of exposition buildings will also be given. The lecture will be profusely illustrated by lantern slides. Ladies are specially invited, and aside from the general popular interest of the subject should enjoy the beautiful pictures presented.

SIGNALS UNDER WATER.—A special telegram from Boston of January 24 says: "Tests of the Gray system of submarine signalling were made to-day on board the steamship *James S. Whitney* during her trip from New York to this port. Submarine communication by bell signal was established with three lightships while the steamer was some distance from them, apparently showing that the system may be useful in averting collisions. On board the *Whitney* were representatives of the Canadian Government, who made the trip to test the efficiency of the system. By permission of the United States Government, four lightships on the course had been equipped with submarine bells, which were to be tolled automatically. The *Whitney* left New York at midnight last night, and at 2 o'clock this afternoon as the ship approached the Pollock Rip Lightship the distinct sound of a tolling bell was heard in the receiver in the pilot house. A few minutes later another bell was heard which, the officers said, was submerged at the Pollock Rip Shoals Lightship. At 7.20 o'clock to-night, as the *Whitney* neared Boston Harbor, the sound of a bell was heard clearly in the receiver, and the captain altered his course at intervals so that the sound of the bell was heard both from the port and starboard sides."

TURBINE ELECTRIC GENERATOR.—Some weeks ago we noticed a patent issued to Messrs. E. H. Porter and Burleigh Currier on a novel steam turbine generating set, and last week another patent was issued to the same inventors on another type of combined steam turbine and generator. On the peripheries of the turbine blades are carried toothed inductors similar to those used in the well-known types of inductor alternators. These, when driven by the turbine blades, act in multiple to vary the inductance between two stationary windings, one separately excited and acting inductively on the other, the generating winding. Bar windings are threaded through porcelain tubes laid through the magnetic circuit of laminated plate construction. In this machine the energy is thus transmitted direct from the turbine blades electrically. The ordinary iron and copper losses are increased above what is usually considered good practice in dynamo design so as to have the turbine blades heated to a temperature slightly in excess of that of the steam to prevent condensation on the blades, this superheating process thus enabling the heat of the so-called generator losses to be absorbed by the steam in its passage through the turbine. The generator shown in this patent differs from the previous one in being a combined turbine and a synchronous, separately-excited type of alternator, the first-mentioned having the turbine combined with the synchronous induction generator best adapted to operate in multiple with other generators of the synchronous type. The shaft of the turbine does not extend out of the case, the transmission being entirely electrical and the ends of the bearings are closed to prevent the escape of steam.

WIRELESS TELEGRAPHY IN PORTO RICO.—The wireless telegraph stations at San Juan and Culebra, Porto Rico, have, according to a dispatch from San Juan, been opened, and are working satisfactorily.

TO THE FRONT.—It is stated that the Japanese Government has ordered back to Japan twelve of the fifteen Japanese engineers who are at the Westinghouse Electric Company's plant at East Pittsburg, on account of the threatened war.

LIGHT FOR VENICE.—Mr. R. W. Bliss, United States Consul at Vienna, reports that for two years past a company has been steadily working to harness the water power of the River Celina electrically and promises to turn on current by January next. He thinks this will make an opening for many electrical appliances of American type and origin.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Secretary Davis, of the National Electric Light Association, visited New York last week to look after association affairs. He reports that the association is in a very flourishing condition. The programme for the 27th convention is being rapidly formulated, and will contain many novel features. The Question Box, in the able hands of Mr. H. T. Hartman, is already pretty well filled up with queries, but there is room for as many more as members wish to ask, and it is hoped that they will avail themselves freely of this means of gaining useful information.

ELECTRICITY AT TRIESTE.—Mr. F. W. Hossfeld, United States Consul at Trieste, reports a large plan on foot for the extension of the dockage and warehouse facilities at Trieste, all the cranes, hoists, capstans and other machinery of which will be driven by electrical power. He also states that the commission which the Austrian Minister of Railways sent recently to Milan to investigate and report on the electric railways of Lombardy, has recommended the adoption of electric traction for the new lines of railway of which Trieste will be the terminus. In the event of carrying out this recommendation, the new railways will be supplied with electric currents from the same power plant as the harbor.

TELEPHONY IN CALIFORNIA.—The city of Bakersfield, in proportion to its population, has, according to the report of the manager of the Sunset Telephone Company, more telephones in use than in any other city in California. It has 1,550 telephones in operation, and, based on the census of 1900, this means something over 36 to every 100 inhabitants. On the same basis Santa Cruz has less than 13 to the hundred, San Diego 12, Oakland 11, Los Angeles 12, San Francisco 12, Sacramento 11, Redlands 12, Napa 10, Hanford 28, Chico 23, Visalia 21, Fresno 21, Eureka 20, Pasadena 20, Salinas 17. All of these proportions are high. The Bakersfield ratio would give about 25,000,000 telephones for the United States, instead of the present 5,000,000.

NEW TUBE FOR LONDON.—A cable dispatch of January 16 says: "Another twopenny tube is to be thrown open to the public on February 1. This is the Great Northern & City Railway, between Finsbury Park and Moorgate Street, which is so near completion that a party has been taken over the whole route in a model train for a tour of inspection. The road is nearly four miles long and brings a very populous district in touch with the city. This tube is a distinct advance on the similar railways already working in London. Some of those who made the trip pronounced it the best underground railway so far constructed in the world. The tunnels have a 16-ft. diameter, as compared with the 11 ft. 8 in. of the Central London Railway, and this permits the use of larger rolling stock. The cars are somewhat longer than those in use on other tubes. They are built of teak, with a height of over 12 ft., which makes them roomy and airy. They are, in fact, of equal width with the widest carriage that can be run on any British railway, the bulging sides making for greater comfort. All the seats are crosswise, with a center aisle. There are doors in the center of the cars for emptying and filling with great celerity at the terminals. The stations along the route are roomy, with big lifts and wide staircases. All the structures underground, including even the signalmen's cabins, are fire-proof. The trains are made up of seven coaches, three of which are motor carriages. One of these is placed in the middle of the train. 'An all-British twopenny tube!' cries the *St. James Gazette*, describing the railway. The Brush Electrical Engineering Company built many of the carriages at its English works. They are supplied with Westinghouse air brakes and the motors were built by the General Electric Company, while the driving system is the Sprague multiple unit."

LETTERS TO THE EDITORS.

Resistances in Transformer Circuits.

To the Editors of Electrical World and Engineer:

SIRS:—On August 8, 1903, you published my article on "The Effect of Series Resistance in the Transformer Circuit." I learned just a few days ago that the *Elektrotechnische Zeitschrift* brought out in its issue of September 10, 1903, page 753, an abstract of that article, pointing it out as an interesting one. Later, in their issue of October 8, 1903, page 854, Mr. Gustav Benischke discussed the article fully under the heading "Letters to the Editor," and his conclusion is that my statements are wrong. Furthermore, in their issue of November 12, page 949, Mr. Hugo Grob wrote that Mr. Benischke made a ridiculous failure in the objections brought up against my paper, because its exactness is evident not only by the theory, but by the results of the experiments given in the paper.

I would beg to suggest the propriety of the *Electrotechnische Zeitschrift* communicating with ELECTRICAL WORLD AND ENGINEER under such circumstances, so that the author may either explain or defend his standpoint under such circumstances.

PITTSFIELD, MASS. HENRY PIKLER.

[It is not customary for editors to adopt the practice suggested by Mr. Pikler.—EDS.]

Reduction of Fire Losses by Proper Inspection.

To the Editors of Electrical World and Engineer:

SIRS:—The recent disaster at the Iroquois Theatre in Chicago carries grave lessons home to every thoughtful resident of our large cities. It is appalling to realize that the latest and most scientific methods of construction do not of themselves always insure safety, and this horrible catastrophe is a tragic commentary on the imperfections of human knowledge. We are too inclined in these days of wonderful material progress to take it for granted that the great forces of nature are so well tamed that they need little watching when applied to the service of man.

Of all the natural elements, fire is perhaps the best friend and the bitterest enemy of the human race. The annual losses in life and property from this source reach a tremendous total. Gradually the world is awakening to the importance of devoting its best thought to fire protection and prevention, and in the last few years a new profession has come to the front with this in view—Fire Insurance Engineering.

Whatever the final cause of the Chicago calamity may have been, the one tremendous lesson of the hour is the vital importance of expert inspection in every building where heat, light and electricity are utilized. The careless handling of such forces by dishonest contractors and ignorant, underpaid employees is simply a free invitation to a tragedy—it is insanity flying in the face of Providence.

Accidents like the breaking of a steel rail or a steamship shaft are at times unavoidable, and cannot always be foreseen. They are a part of the price which we pay to nature for making use of her exhaustless power and wealth. Little, if any, excuse exists, however, for fire in a modern building properly constructed and inspected. The fire underwriter should know this if the public does not, and upon him rests an immediate responsibility—he must bend every effort to secure expert inspection of each structure which he insures, and not one cent of insurance should be placed until the building is pronounced safe by an experienced fire insurance engineer. Let the underwriter take this decided stand, insisting on safe construction throughout, and the public will soon demand the same thing on its own account. Nor should the precautions end here. Frequent inspection should be made of every building where forces capable of causing fires are in operation, especially in buildings where large numbers of people congregate. Thus, no scenic application of electricity should ever be permitted in a theatre until the arrangement of the apparatus and wiring satisfies the fire insurance engineers' most rigid requirements of safety.

Already two laboratories for the study of fire prevention are in operation in this country. One of these is connected with the Massachusetts Institute of Technology, in Boston, and the other is located in Chicago, both being supported by powerful insurance interests. In order to provide the systematic inspection required, however, many trained men are needed. This will cost a large amount of money each year, but the reduction in fire losses ought to more than offset the expense. Surely, the saving of many human lives each year is a sufficient object in itself.

It is time for the philanthropist and the underwriter to invest capital in proper inspection. It is time for the technical school and college to add to its curriculum a course in fire insurance engineering. It is time that some of the young men who are facing the overcrowded condition of the older professions should make fire prevention their life work, and it is time that the great public realized the importance of systematic and scientific efforts to rid the world of fire losses.

DENVER, COLO. HOWARD S. KNOWLTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Commutation.—PICHELMAYER.—An illustrated paper read before the Electrical Society of Vienna. He discusses the electric causes of sparking at the commutator. If an ordinary direct-current dynamo, the brushes of which may spark somewhat, is run at a gradually decreasing speed, while the current output and the excitation remain constant, it is found that the sparking becomes less and less and disappears entirely at very low speed. In this case, if we consider the local circuit in which commutation takes place and which contains the brush, the two commutator segments touched by the brush, their connections with the armature, and the short-circuited armature coil, then the only e.m.f.'s to be taken into account at very low speed in this circuit are those consumed by ohmic resistance, while at higher speeds two other kinds of e.m.f.'s come into play, namely, the e.m.f. of self-induction and the e.m.f. induced from the external field, which is generally small at this point. As long as the speed is low and only the volts lost by ohmic resistance are to be considered, the current distribution may be easily found by Kirchhoff's rules. The author shows that in this case, if the current flowing in the short-circuited coil is plotted in a diagram as a function of the time, it is represented by a nearly straight line, as long as carbon brushes are used and the transition resistance from the brush to the commutator is at least twice as great as the ohmic resistance of the short-circuited coil and its connections with the commutator segments. The greater the transition resistance, the more will the time curve of the current of the short-circuited coil approach a straight line. He calls the condition under which the curve is a straight line, the "pure resistance commutation," and considers this condition as the ideal case, since the current density at any point of the brush is then constant during the whole period of commutation, so that no sparks can occur, the produced heat being a minimum. The problem is now to produce the same condition at higher speeds. Since here the e.m.f. of self-induction and the e.m.f. induced from the external field are to be taken into account, the problem is to arrange matters so that the latter two e.m.f's are exactly equal and opposite. The result will then be that we have again the condition of pure resistance commutation. If the curve mentioned before representing the current in the short-circuit coil as function of the time is a straight line, then the e.m.f. of self-induction will be constant during the whole period of commutation and the problem is to make the e.m.f. induced from the external field also constant and exactly equal to the e.m.f. of self-induction. The well-known means by which sparking has been counteracted for many years is to advance the brushes from the neutral zone; in the light of the author's theory, the object is to bring the short-circuit commutating coil into a somewhat stronger field, so that the e.m.f. induced from this external field will counterbalance the e.m.f. of self-induction. The author points out that all designers have arranged to have the field at the point where they place the brush nearly constant or at least increasing only slightly. For special machines which run at very high speed, like those coupled to steam turbines, this remedy is, of course, not sufficient, and it is then necessary to provide a special "commutating field" at the place where the commutation takes place, and of such a size that the e.m.f. induced by it in the short-circuited coil exactly counterbalances the e.m.f. of self-induction induced in the same. This may be done by means of special commutation poles, as shown in Fig. 1 for a bipolar machine. They are supplied with the armature current, and by a suitable design it is easy to insure that the commutation field is constant over the whole commutation zone. For calculating the e.m.f. of self-induction the author recommends the

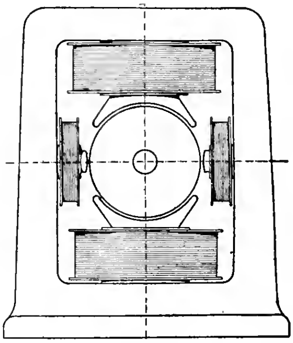


FIG. 1.

formula of Parshall and Hobart, and one of the main results of his paper is that the so-called reactance voltage (which, according to older theories, should be below a certain limit) may assume any value whatever as long as a commutating field of such a size is provided that it counterbalances the reactance voltage. In the discussion which followed, Deri remarked that the theory of the author exactly corresponds with what he has done for years in his direct-current dynamos in which he annuls the armature reaction and also provides a commutating field for counteracting the reactance voltage in the short-circuited coil. He states that many machines of his system are in practical use, and that direct-current dynamos driven by steam turbines, and running at 4,000 r.p.m., with a capacity of 1,500 kw, have proven practically successful. He also mentioned experiments in which he found that by means of the improved commutation device, it is possible to produce in shunt machines with ordinary commutator much higher voltages than heretofore. On account of the annulment of all obnoxious and dangerous e.m.f's produced during commutation, it is possible to increase the voltage between commutator segments far beyond those values which were heretofore considered as a limit. Orgler gave some details of the successful operation of compensated Deri machines in connection with the Orgler system of hoisting. Pichelmayer replied that he did not want to minimize the merit of Deri, but it is important to know that the accomplishment of Deri can also be obtained in other ways if only the general principles explained in his theory are followed. Reference was also made to a device of Seidener, who uses an auxiliary armature, running between the main armature and the commutator within the poles of a special magnetic field. The connections between main armature and commutator form the windings of the auxiliary armature. Seidener stated that Edison had patented a similar arrangement in 1887.—*Zeit. f. Elek.* (Vienna), January 3. A shorter account of the principles given in

Pichelmayer's paper is given in an article in *Elek. Zeit.*, December 31.

Determining the Lengths of the Poles of Field Magnets.—COOKE.—A communication in which he gives a formula for determining the lengths of the poles of field magnets by a more direct method than is at present adopted. Since the length of the pole depends entirely on the length of the bobbin to be put on it, the method now used is to assume a trial value, then make a drawing of the machine, and from this calculate the mean magnetic paths, from which are deduced the total number of ampere-turns required per pole. Assuming a suitable magnetizing current, it is now possible to find the number of turns and hence to design the bobbin. This gives a new and final value for the pole length which necessitates a new drawing, and alters the mean magnetic path in the pole cores and yoke. The schedule has now to be altered and the current changed to suit the new number of ampere-turns. The formula given by the author states that the length of one layer of wire equals a numerical constant multiplied by the product of magnetizing current and number of turns of wire per bobbin, divided by the product of depth of wire on the bobbin and current density in the wire. The numerical value varies between 2 and 1.5, being 2 for a magnetizing current of 1 amp. and 1.5 for a current of 10 amp. for a current density of 700 amp. per sq. in. The method of using this formula is as follows: Make a drawing of the armature as before, and from it calculate the number of ampere-turns required for the gap, teeth and armature body. This gives the product of magnetizing current and number of turns of wire per bobbin, required for the formula. The depth to which the wire may be wound is governed by the permissible heating, and depends, therefore, on the specifications. The length of the bobbin can thus be found; to this must be added the thickness of the two bobbin ends and the insulation between the wire and the bobbin to obtain the true length of the pole. The field magnets are then added to the drawing of the armature.—Lond. *Elec.*, January 1.

REFERENCE.

Repulsion Motor.—BLONDEL.—Continuations of his long illustrated serial on single-phase commutator motors. In the present installments he deals with the theory of the repulsion motor. In view of the highly mathematical character of the paper, an abstract is impracticable.—*L'Eclairage Elec.*, December 12, 19.

LIGHTS AND LIGHTING.

Efficiency and Temperature of Nernst Lamp.—INGERSOLL.—An account of a determination of the efficiency of the Nernst lamp by the method of Angström, in which the total spectrum of the light is dispersed in order to screen off all but the visible spectrum and the visible rays are then recombined into white light by means of a cylindrical lens and balanced photometrically against the total radiation from another exactly similar source. The energy of the two radiations can then be compared by replacing the photometer screen with a bolometer or thermopile. The filaments were burned freely in the air, without heaters, on a 100-volt alternating-current circuit. He found that Nernst filaments are by no means uniform, since new filaments show an efficiency of from 4.35 to 4.70 per cent., while the efficiency falls rapidly for about the first 20 hours, decreasing to a mean of 4.3 per cent. and varying only slowly after this. Tests of filaments of 40 hours and upwards give a mean efficiency of 4.17 per cent. Some very old glowers gave only 3.6 per cent. After a glower has been burned upwards of 20 hours it obtains a marked crystalline appearance, and it is probable that a fall in efficiency is due to a greater radiating surface and consequent lower temperature afforded by the crystalline structure. If, as is now proposed by the Westinghouse Company, the glowers are aged before they are sent out, the deterioration with time may no longer be observable. The energy curve plotted from Wien's law, which gives the efficiency 4.17 per cent., i. e., which gives the ratio of visible energy to total energy = 0.0417, is that corresponding to the temperature 2360° C. This, then, would be the temperature of the Nernst glower, considering it as a "black body" in the sense of thermodynamics. This value lies well within the limits 2200° and 2450° C., given by Lummer and Pringsheim.—*Phys. Rev.*, November.

Distribution of Light from Incandescent Lamps.—WILD.—An article in which the author gives a table comprising the results of measurements of the candle-power of eight lamps in all directions, with diagrams of the filaments of these eight lamps. This table shows that the candle-power measured normal to the mean plane of the filament (called by him the normal candle-power) can generally be accepted as a measure of the mean spherical candle-power of the lamp. In practice the light emitted in any direction is not strictly proportional to the apparent surface of filament presented to that direction; the cause of this discrepancy is that the glass bulb does not transmit all the light rays that fall upon its surface, but reflects back a portion. The surface being curved and the filament not being equidistant from all parts of the bulb, the reflected light is to a certain extent concentrated into particular directions. When the direction in which the best illumination is required is not specified, lamps should be tested for mean spherical candle-power. As, however, this measurement is somewhat tedious, many substitute for it the measurement of the mean horizontal candle-power of the lamps to be tested. The mean horizontal candle-power is, however, very far from being proportional to the mean spherical candle-power. A far better plan is to measure the normal candle-power (as defined above). Speaking generally it appears from the table that when the mean horizontal candle-power is high, the vertical candle-power is low and vice versa, but no distinct law can be traced. For the general illumination of a room, a lamp should be chosen giving high candle-powers horizontally and at 30° below the horizontal. When a lamp is required to illuminate a small area, such as an office table, a filament should be chosen giving as large light as possible vertically downwards and also at 60° below the horizontal.—Lond. *Elec. Rev.*, January 1.

POWER.

Development of Small Water Powers.—BELL.—An article on the development and utilization of water powers having a capacity of less than 500 hp. The author assumes a stream having a reliable flow of 100 cu. ft. per second during the dry months and a working head of 25 ft., the maximum flow being 400 cu. ft. The assumed average minimum flow would yield just about 225 hp if utilized with a first-class turbine, and the electrical product of this power—a little over 150 kw—could be sold twenty-four hours per day, save for a few days at a time in very dry years. For nine months of the year twice this output could be delivered. Since an electric light plant would be the best customer for this power, the author considers how far storage can be brought into play to build up an output big enough to be of some use. With a normal minimum flow of 6,000 cu. ft. per minute the working power for a 12-hour run can be developed by storing a little over 4,000,000 cu. ft. of water. This would mean drawing down a 100-acre pond one foot at night and letting it fill up when the load is substantially off during the day. In a very dry year there may be a further deficit of flow amounting to a little over 2,000,000 cu. ft. in every twenty-four hours, so that the storage pond can be planned for if feasible. The development of the power does not require a large outlay. A well-ballasted timber crib is recommended for the dam. A small penstock is recommended. The number of hydraulic units should be so chosen that the temporary crippling of one will not cause serious inconvenience. The total capacity should be put, say, in four 150-kw machines. Any more than this would probably lead to increased expense, and any less might cause too severe an overload in case one machine shut down. Regarding the electrical system to be employed, if the power was to be developed for lighting the system is not of much consequence, direct current answering this purpose; if the power is to be transmitted a moderate distance, and loose pulleys are used on all but the smallest motors, a straight single-phase system answers, but where the power is transmitted a long distance and the actual distribution is carried from a sub-station a 10,000-volt transmission line is recommended. All the requisites for a first-class transmission line are considered. A possible supplementary steam plant is discussed in connection with the sub-station.—*Am. Elec.*, December.

Italian Hydraulic Power Station.—A note on the water power station which has recently been completed at the foot of Mont Cenis for power transmission to Turin, forty miles distant. The head of water is no less than 2,830 ft. and the quantity of water is 35.3 cu. ft. per second; 11,500 hp are thus produced, and by regulating the flow of water by means of a dam, 16,000 hp may be obtained if necessary. In order to avoid excessive pressure in the pipes, the head is utilized in two stages and at present only the lowest stage is completed. Three generating sets, each consisting of a turbine directly coupled to a 1,400-kw alternator, are installed at present, one set acting as reserve. The head of water of this lowest stage is 1,380 ft. and the turbines rotate at a speed of 500 r.p.m. The alternators, which weigh 33 tons each, generate current at 3,000 volts with a full-load efficiency of 96.5 per cent. The exciting current is furnished by a 110-hp turbo-generator set. Water-cooled transformers raise the voltage to 30,000 volts for transmission to Turin.—Lond. *Elec.*, January 1.

Traction.

Alternating-Current Traction.—Bell.—An article in which the writer calls attention to the almost simultaneous production in three different countries of a single-phase railway motor along somewhat parallel lines, although they differ in details. He states the objection to polyphase induction motors and some of the difficulties heretofore encountered in constructing a single-phase motor. Referring to the Lamme or Westinghouse motor, he says that the performance of this new motor is quite comparable with that of standard direct-current motors, and although it is somewhat heavier does the same work and apparently does it well. At starting the power factor is low, but during a two-mile run it is approximately 87 per cent., and at full speed above 95 per cent. He then refers to the Eichberg-Winter motor, which belongs to somewhat the same class as the Lamme motor, but is not an ordinary series motor, being more akin to the Thomson repulsion type of alternating-current motor. The Finzi motor is also referred to.—*St. R'y Jour.*, December 19.

Interurban Road in Switzerland.—Somach.—A fully-illustrated description of the electric road between Wetzikon and Meilen, of 22.5 kw. length in the Zuricher Oberland. The trolley system is used, with the rails for the return, the voltage being 750. Each car is provided with four 22-hp, 375-volt motors, divided into two groups, each containing two motors in series. The power is supplied from the Beznau water power plant in the form of 25,000-volt, 50-period, three-phase current. Three 160-kw transformers reduce the voltage to 460, while two 140-kw rotary converters change the current to direct at 750 volts.—*Le Génie Civil*, December 26.

Electrification of British Railway.—An article on the electric equipment of the Lancashire & Yorkshire Railway, which decided about a year ago to electrify about 23 miles of double track. Operation will be started early this year. The trains will be composed of two first and two third-class cars, the third-class cars being equipped with four motors of 150 hp each. Direct current is supplied from a third rail at 600 volts. The power station contains five steam-driven generating sets, four of 1,500 kw and one of 750 kw, three-phase currents at 7,500 volts with a frequency of 25 periods being generated. Three-core paper-insulated metallic-sheathed cables laid "solid" convey the high-tension, three-phase currents to four sub-stations. The sub-station equipments, similar in character, consist in twelve air-cooled transformers and four 600-kw synchronous converters.—Lond. *Elec.*, January 1.

Traction Plant.—Fumero.—A fully-illustrated description of the Morbegno station, which supplies current to the Valtallina Railway in Northern Italy. Three-phase currents are generated at 20,000 volts and distributed to transformer stations along the line, in which the voltage is reduced to 3,000 volts, which is the pressure at which the current is supplied to the cars. The power station contains three turbine-driven, three-phase generators, each running at 150 r.p.m. and giving 1,500 volt-amp. at 20,000 volts, with a frequency of 15 and a power factor of 0.7. Each machine has 12 poles. The installation is described in detail with many illustrations.—*Elcktrische Bahnen*, December.

Reference.

Cleaning Third Rails in Open Country.—The third-rail system of the Grand Rapids, Grand Haven & Muskegon Railway Company has been kept free from ice and sleet through several storms this winter by the use of a solution of chloride of calcium poured on the rail through tubes extending from reservoirs carrying this solution, which are located in the motorman's vestibule, to a point directly over the third rail. The flow of the liquid can be regulated easily.—*St. R'y Jour.*, December 26.

Installations, Systems and Appliances.

British Central Station.—An illustrated description of the recently-opened electricity works of Christchurch. The power house contains two steam dynamos, each of 100-kw capacity, running at 450 r.p.m., and giving 500 to 550 volts either as compound or shunt-wound machines for supplying power both for lighting and traction. In connection with the lighting supply, two motor balancers are provided, each of 25-kw capacity. There is also a storage battery of 244 cells, giving 175 amp. for one hour. The pressure across the outers of the three-wire system is 500 volts. For public lighting 65 Nernst lamps of 84 cp and 44 of 42 cp have been installed. At present the equivalent of 1,500 lamps of 8 cp are connected to the mains.—Lond. *Elec. Rev.*, January .1.

Electro-Physics and Magnetism.

Eddy Currents.—Thornton.—The first part of an illustrated paper read before the Newcastle local section of the British Institution of Electrical Engineers. He first describes experiments made with massive cast-iron and steel rings, and then discusses tests of direct and alternating-current machines. From his results it can be concluded that if in any machine the field current shows a synchronous variation caused by armature reaction, of about 10 per cent., there will be a loss in the core by eddy currents, which will be a large fraction of the total losses in the machine. In alternating-current machines the chief source of the eddy current loss in the magnet frame is variation of armature reaction, while in direct-current machines there exist four possible sources of disturbance. The first and most important at light load is imperfect centering of the armature or adjustment of the air-gaps; the second is the variation of reluctance caused by the teeth of the armature moving across the pole face; the third is the slight peripheral shift of the cross magnetizing belt to and fro during commutation; and the fourth is the variation of reaction set up by a rise and fall of armature current, caused by phase swinging or uneven turning movement of the engine. He reproduces some curves taken by the oscillograph, showing the instantaneous distribution of polar magnetism in dynamo electric machines. It is shown that when the brushes of a generator under load are moved backward the magnetism in the gap is caused to oscillate at a speed much higher than that of the machine, and in ripples. These are in a state of oscillation, the amplitude of which is greater with strong fields and for brush positions, which correspond to commutation taking place in a strong field. The effect does not depend upon sparking at all.—Lond. *Elec.*, January 1.

Interruption of the Primary Circuit of Induction Coils.—Turpain and Blondel.—Abstracts of two papers read before the French Association for the Advancement of Science. It is on the rapidity of interrupting the primary circuit of an induction coil that the length of the sparks depends, obtained between the terminals of the secondary, other things being equal. If the interruptions follow each other rapidly enough, the condenser of the induction coil may be left out to advantage. Turpain has obtained similar results with the use of an ordinary interrupter, but constructed in such a way that the interruption takes place simultaneously at different points. Blondel describes a method he has devised of using the alternating current of a supply network without interrupters for operating an induction coil. His device is similar to that of Tesla, a transformer being used, the 110-volt primary of which is connected across the mains, while the 5,000 or 10,000-volt secondary is shunted by a condenser and is connected in series with a spark-gap and the primary of the induction coil to be operated. Every discharge of the condenser produces in the primary of the induction coil oscillations of sufficient rapidity.—*L'Eclairage Elec.*, December 12.

Electro-Chemistry and Batteries.

Electricity Direct from Carbon.—Lorenz and Reed.—Two papers on the problem of getting electricity direct from carbon. Lorenz gives a summary of the theoretical considerations to be taken into account in any attempt of solving this problem and discusses in detail the thermodynamical foundation of the theory of galvanic cells. While a carbon cell is theoretically possible, he believes that much work is still to be done before the problem is solved. Reed discusses in detail the two recent cells devised by Jone (Digest, December 5) and Reid (Electrical World and Engineer, December 12). He considers that the regeneration of the substances in Jone's cell would require an enormous amount of work, and that the mere removal of stannous oxide from the cell and its separation from the electrolyte would cost for labor alone more than the coal would cost for producing the same amount of power by steam. "If we were to ignore losses of material altogether and consider only all the losses of energy occurring in the cycle of processes proposed by Jone, the cost of power would appear to be not less than 50 to 100 pounds of coal for horse-power-hour. In his criticism of the Reid gas cell Reed discusses all the chemical reactions which can occur in this cell and shows that, if judged from the heat of reaction, the e.m.f. of this cell could not be accounted for electrochemically. "The e.m.f. which is claimed for this battery is, therefore, entirely an almost entirely thermoelectric."—*Electrochem. Ind.*, January.

REFERENCE.

Reviews of Electrochemical Industries.—Richards and Fitz Gerald.—Two articles giving summaries of the present status of electrochemical industries. Richards discusses the conditions of commercial electrolytic methods and deals especially with the alkali industry and with the refining of copper, lead and gold. Fitz Gerald gives a review of the electric furnace industries in 1903. Much progress has been made in furnace design, and it is probable that in future the electric furnace will be applied to processes requiring only a comparatively moderate temperature, but exact temperature regulation.—*Electrochem. Ind.*, January.

Units, Measurements and Instruments.

Integrating Alternating-Current Wattmeter.—An illustrated description of a new alternating-current integrating wattmeter of the induction motor type, devised by Ferranti. The aluminum rotable disc, *D*, mounted on the spindle, *S*, and geared to a train of wheels, *C T*, actuating the index hands, serves the double purpose of an armature receiving the driving torque of the meter coils and also the retarding torque of the permanent magnets, *P M*. One shunt coil, *Sh C*, placed round the coil, *C*, of a special tubular electromagnet, *T M*, constitutes the shunt system. The core of this magnet has

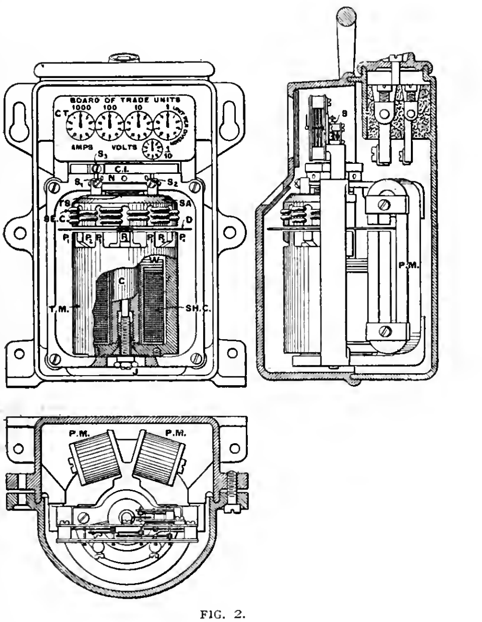


FIG. 2.

three outward radial poles, P^2, alternating with four inward radial poles, P^1, from the shell or tube of the shunt magnet, the plane of these poles being horizontal and parallel to the disc. Since the shunt circuit in the induction motor type of meter must be highly inductive, this special tubular magnet has been adopted, no chocking coils, secondary circuits, resistances or compensating coils being required. The series system consists of a slotted armature, *S A*, above the disc, the series coils, *Se C*, being wound in these slots. The slots of the series armature are almost directly above the poles of the tubular magnets. If the shunt circuit be inductive, the eddy currents produced in the disc by the shunt field will be in phase with the impressed e.m.f. These eddy currents are acted on by the series field, which is in phase with the load current, giving a driving torque on the disc proportional to the e.m.f. of the circuit multiplied by the amperes and by the cosine of the angle of lag of the main current behind the e.m.f., this being the true watts supplied to the circuit through the meter. The retarding torque due to the permanent magnets is proportional to the speed, and the disc, therefore, revolves with a speed which is proportional to the watts. For the purpose of compensating for any dissymmetry in the magnetic system, due to small irregularities in material, workmanship and pivot friction, it is necessary to have some adjustment. The series magnet is left slightly out of center in the direction which gives a slight torque on the shunt alone, and thus can be accurately adjusted to compensate for pivot friction or for any dissymmetry in the magnetic circuit met with in manufacture. The adjustment can be very accurately made by means of the two screws, S^1 and S^2. The constant of the meter is adjusted by lowering or raising the series armature by means of the nut, *N*, on the threaded spindle, *T S*, and after adjustment the series magnet is securely fixed by means of the storing clamp, C^1, and the screw, S^3. The following limits of accuracy are given: 1½ per cent. from 1/10 to full load, and 2½ per cent. from 1/20 to 1/10 load. A 10-amp. meter is said to start with 0.05 amp.—Lond. *Elec.*, January 1.

Localizing Faults in Hooper's India Rubber Core.—Ohlson.—In a cable factory the localization of a fault in an india rubber core often becomes necessary after it has been covered with yarn or metal tape. Occasionally this fault is of high resistance, and cannot be broken down for the purpose of a loop test, even when subjected to great electrical pressure while immersed in water. The author has used the following method with great success for three years: The length is slowly passed through a bath of water or wax at a temperature of about 200° F., and the leakage through the dielectric carefully noted by the deflection of a sensitive galvanometer, using as large a battery as possible. As soon as the fault enters the hot bath the deflection on the galvanometer scale will begin to rise owing to increased leakage through the fault. It will fall again as the fault passes out of the hot bath, so that the operation may be performed several times over at the suspected place to obtain an exact localization. Besides faults of low resistance, due to injury, the most minute imperfections are exactly located by this method, if it is carefully performed. Even in cases where the defect has only been apparent by a slight decrease in the rate of electrification when testing with 1,200 Lèchance cells, giving a galvanometer constant of over 2,000,000 megohms, and the dielectric resistance of even such short lengths as 1,000 or 2,000 yards has been very little altered by its presence, the above method has never failed to localize the defect within a few inches, without breaking the covering of the core.—Lond. *Elec. Rev.*, January 1.

REFERENCES.

Block Signals.—Hart.—An article on steam railroad practice in block signalling on double-track roads. The operation of the trains is not dependent upon the block signals, as they are used as an auxiliary only to train orders which are issued by the train despatcher. He thinks that many electric railway companies believe that with block signal systems train despatching, loses its importance, and he wishes to correct this impression.—*St. R'y Jour.*, December 19.

Wave Meter.—Doenitz.—An illustrated translation in full of the German article recently abstracted in the Digest on an instrument for measuring the wave length of wireless telegraphy waves.—Lond. *Elec.*, January 1.

Telegraphy, Telephony and Signals.

Douglas Exchange of the Chicago Telephone Company.—An illustrated description of this recently-completed exchange. The general features of the equipment follow standard Bell practice. In addition to the regular equipment, the cords in 33 positions are equipped with coin-collecting keys. The number of answering jacks varies from 60 to 160 per operator, depending upon the class of subscribers served. All positions in the office are equipped with breast plate transmitters which are connected to the switchboard through suitable plugs and cords. The incoming trunk board embodies a new system of incoming trunk lines, whereby it is possible to operate 40 trunk lines per position as compared with 25, which has been the usual practice. The most important feature of this circuit is the absence of any keys. A special relay is placed in the circuit of certain lines and this, in connection with the relays on the incoming trunk lines, automatically selects the proper generator for ringing a subscriber's bell. The trunks have the usual guard and supervisory signals. The subscribers' answering switchboard is arranged in the form of a horseshoe around three sides of the room. It is a standard relay, multiple, central-energy, lamp-signal board and consists of fourteen eight-panel, three-position section, with a present equipment of 3,500 lines.

The ultimate capacity of the board will be 9,600 lines, divided into 19 sections. The board does not differ in its general features from the others operated in the city by the company, except in the use of multiples on four-party lines, a separate multiple being provided for each one of the subscribers on such a line. The ten-party lines are multipled, but restricted to the ten-party line trunk board. The exchange is provided with three overflow positions to equalize the load during the busy hours. "Sick" lines are also provided; these are on the subscriber board and are known as the "hospital positions." The exchange is equipped with one hospital position and 200 auxiliary cords to be used during storm troubles. An information position is also equipped.—*Am. Elec.*, December.

Central Energy Intercommunicating Telephone System.—Webb.—An illustrated article in which the author shows how the principles employed in central energy telephone exchange systems have also been applied to intercommunicating systems. He describes an arrangement for use with an automatic switch, where centralized talking and ringing batteries and two-line wires for each telephone station are desired or considered necessary. The switch is of the push-button type and is very positive in action, this arrangement being convenient and fully as good, if not better, than a rotating switch, which, in the case under discussion, would have to be double in some way. The author describes a system suitable for a building requiring only three or four telephones and where communication between a central office and the sub-stations only is required. The system is merely intended as a simple substitute for a speaking tube system and is not supposed to meet the requirements of a regular telephone system.—*Am. Elec.*, December.

Miscellaneous.

Patents Expiring 1904.—A list of British patents of interest to electrical engineers which will expire during the present year. Among them are two dry cell patents of Hitchcock and Hellesen, a patent by Langhans for depositing a coating of silicon or boron on incandescent lamp filaments in order to lessen the effect of oxidation, two patents of Ferranti for electricity meters, two patents of Lemp for electric welding, a patent of Lord Kelvin for a mariner's compass, several patents by Weston, Ayrton and Mather for measuring instruments. The manufacture of switches and fuses will be facilitated, it is thought, by the expiry of the patent for the Mordey powder fuse and of the patent of Drake and Gorham relating to spring contacts for switches. A patent of Dobrowolsky and Mamroth for distribution of electricity by a four-wire, three-phase system and another patent by Dobrowolsky for the insertion of resistance in rotors of induction motors for regulating purposes will also expire.—Lond. *Elec.*, January 1.

Reference.

Gilbert.—An illustrated reprint of part of the chapter on electrics from Gilbert's "De Magnete," with notes of S. P. Thompson and an account of the life and work of "Gilbert of Colchester, father of electrical science."—Lond. *Elec.*, December 11.

New Books.

Der Elektrische Lichtbogen. Bei Gleichstrom und Wechelstrom. By Berthold Monasch. Berlin: Julius Springer. 266 pages, 141 illustrations. Price, 9 marks.

This work—a text-book upon the arc lamp—covering a large amount of ground. There is a short introductory chapter on the history of the arc. Several chapters are devoted to the technics of the arc with direct currents and with alternating currents. Then follow chapters upon the various applications of arc lamps. The final chapters refer to arc lamp mechanisms, projectors, enclosed arc lamps and flaming arcs. A list of German patents on arc lamps and arc lamp applications since 1877 occupies an appendix. The book is clearly written and illustrated. It covers both the theoretical and practical sides of the subject remarkably well, considering the size of the volume. It is excellent as a student's text-book.

Der Drehstrommotor. By Julius Heubach. Berlin: Julius Springer. 356 pages, 163 illustrations. Price, 10 marks.

This text-book on the rotary field, polyphase induction machine is divided into fifteen chapters which relate to the working theory of the induction motor, with the exception of one chapter which deals with the induction generator.

The treatment is both by diagrams and by algebra, mingled with a few arithmetical cases. The treatment is lucid, the text and diagrams clear and the notation methodical. The vector method of diagrams is applied to the illustrations, but the complex vector treatment is scarcely alluded to in the text. The algebraical analysis is consequently different from that usually employed in the United States.

As a text-book by an engineer for engineers on the single-phase, two-phase, three-phase and polyphase induction machine, the book will have much value. Two chapters are devoted to details of practical construction, and a good index concludes the work.

Laboratory Exercises. Primary and Storage Batteries. By Karl E. Guthe, Ph.D. Ann Arbor, Mich.: George Wahr. 58 pages, 18 illustrations.

This is a small laboratory manual, intended to supplement the study of Carhart's well-known textbook on primary batteries. The laboratory course is laid out for students of electrical engineering, so that advanced exercises which would belong more properly to a course of elechrochemistry have been omitted. Nevertheless, the principal electrochemical problems are well placed before the students. The experiments in the first chapter, intended to show the difference of the conditions under which a system made up of the same chemical substances, may give a thermochemical or an electrochemical reaction, are especially very instructive.

The book is divided into four chapters, the first dealing with preliminary exercises and containing general useful information (for instance, on the purification of mercury). The second deals with the different methods of measuring the e.m.f., the temperature coefficient and the polarization e.m.f. of the cell. The third chapter treats of the methods for measuring the internal resistance, and the fourth chapter deals with time tests. The exercises described in the little book should enable a student to make complete tests of a battery, so that, besides its use for universities, the book may be recommended to any one who intends to enter the employment of a storage battery company, and also to those engineers who are using storage batteries in practice and desire to test their batteries themselves.

A Text-Book of Electrical Machinery. Volume I. Electric, Magnetic and Electrostatic Circuits. By Harris J. Ryan, M.E.; Henry H. Norris, M.E., and George L. Hoxie, M.M.E., Ph.D. New York: John Wiley & Sons.

Prof. Ryan's writings have always interested electrical engineers, and the text-book of which the first volume has just been published under his editorship will prove no exception. In clear, concise language the writers lay before the student the elements of the theory of alternating currents in a manner which, in spite of its simplicity, does not lack scientific rigor and accuracy.

The contents of the first volume are divided into ten chapters, headed: "Electricity and Magnetism," "Fundamental and Derived Units," "Periodic Curves," "Complex Quantities," "Laws of the Electric Circuit," "Electric Power," "Magnetomotive Force and the Laws of the Magnetic Circuit," "Rotating Magnetic Fields," "The Electrostatic Field," and "Losses in Electric Circuits." The chapters on units, on complex quantities, on electric circuits, consisting of resistance, inductance and capacity, are written with a didactic skill which deserves our greatest admiration. The chapters on periodic curves, on losses in electric circuits, seem altogether too brief and incomplete. It is much to be desired that the subject of Fourier series be treated by the teacher of electrical engineering rather than by the mathematician, as the wide field of application at the disposal of the engineer is generally a book with seven seals to the mathematician; and if interesting examples are held out to the student as the goal which he can reach only by wading through a mathematical bog, he is much more likely to keep up his courage than he will if he does not know the value and power of the mathematics, which he finds wearisome to study. In the chapter on losses in electric circuits, it is to be deplored that the writers do not give a simple derivation for the electrostatic capacity of parallel wires, as was given by Baum and Perrine in their paper in the *Transactions* of the American Institute of Electrical Engineers, May 18, 1900. The method which Baum and Perrine employ in their paper seems to us to deserve careful attention, and it should be embodied in any text-book in which the electrostatic capacity of long conductors is treated.

It is to be hoped that the remaining volumes of this useful and timely work will soon come out.

The Electric Drive as Applied in a Modern Machine Shop.

The general adoption of the electric drive is a conspicuous feature in the design of modern industrial establishments. A notable installation is the West Allis plant of the Allis-Chalmers Company. As the product of the company, as is well known, consists of the Reynolds type of Corliss engines for all power purposes, pumping and hoisting engines, also flour mill, saw mill and mining machinery, the electric drive is applied principally to the driving of machine tools and the installation, as a consequence, is characteristic of that class of work.

The West Allis plant has been built to increase the capacity of the company's plants and to provide for the future growth, although all of those which were already in operation have been continued. As is well known, these include the Reliance Works, of the former Ed. P. Allis Company, at Milwaukee, the Fraser-Chalmers and the Gates Iron Works, at Chicago, and the works of the Dickson Manufacturing Company, at Scranton, Pa. It is not the intention of the company to supersede the latter, but to confine all future growth to the new plant. Under the conditions existing at the later, and with the modern methods and means employed, the company's product can be manufactured at that point more economically than elsewhere.

The works are situated at West Allis, a suburb of Milwaukee. Two suburban electric lines pass the plant, which is also reached by spur lines of the Chicago, Milwaukee & St. Paul and the Chicago & Northwestern Railroads. As a consequence, skilled labor is readily obtainable from the latter place and has obviated the necessity of building a village for the accommodation of the workmen employed in the shops. The facilities afforded by the connection with the two trunk lines are such that raw materials are readily obtained and the manufactured product shipped to its destination. The site secured contains 100 acres, the plot being about one-half mile wide, and more than one-third mile wide. The soil is a firm clay and has afforded a most excellent foundation for the erection of the buildings and the machinery. It will be possible, because of the extent of the grounds, to increase the capacity of the present plant materially without in any way changing the present lay-out.

In considering the design of the West Allis plant, Mr. Edwin Reynolds, the consulting engineer of the company, decided that the arrangement of the buildings should be such that at whatever time an extension of the plant might be considered, the latter would always constitute a complete unit. It was furthermore deemed advisable that the building of such extensions should in no way interfere with the operation of the plant then existing. These may be considered the governing principles in the design of the plant, although a number of other features have been incorporated, which from an economical standpoint are desirable. To assist in the handling of the material in the various stages of manufacture, the buildings and the equipment have been arranged in such a manner that the least amount of labor is required for the production of a given amount of machinery. This is facilitated by a system of yard tracks connecting with spurs from the railroads and the extensive use of cranes, both in the buildings and in the yards. In fact, the latter feature is a noticeable one in the design of the plant; more than two miles of crane runway have been installed, and some 50 cranes, varying in capacity from one-half to 75 tons, of the traveling, jib, pillar and wall type, are in service. Of these four traveling, ten jib and four pillar cranes were supplied by the Northern Engineering Works. One of the cranes is of Shaw make. The balance of the equipment was furnished by Pawling & Harnischfeger.

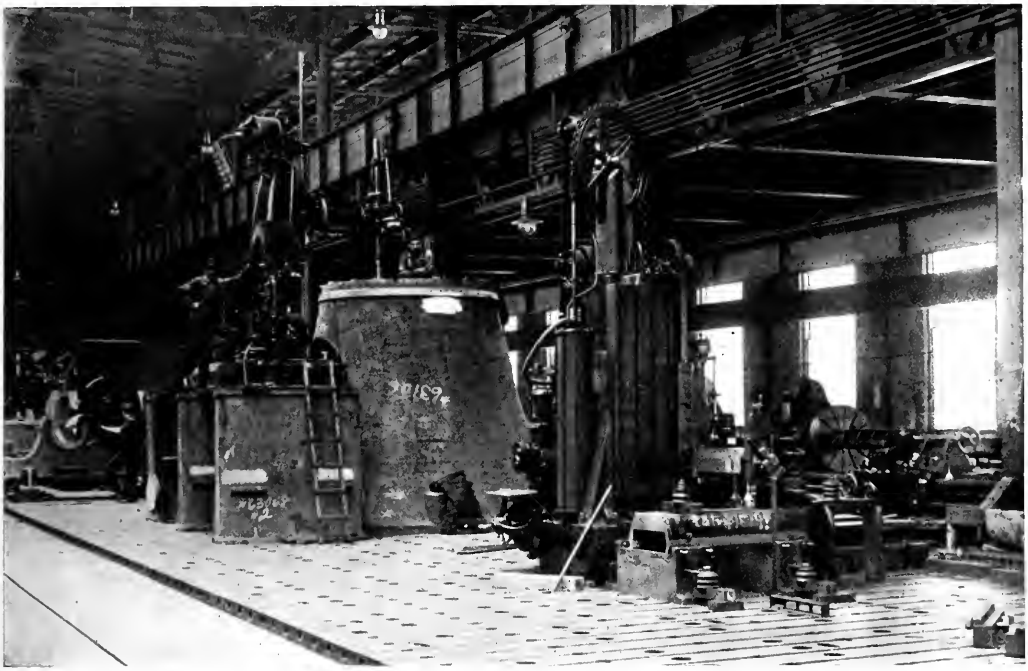


FIG. 1.—ARC LIGHTS FOR TROLLEY AND CRANES. FLOOR PLATE WITH PORTABLE TOOLS IN MACHINE SHOP.

The buildings include at present a storage and pattern shop, a foundry, a blacksmith shop, two machine shops and an erecting shop. Space has been utilized in the blacksmith shop for the power house, which thus is centrally located with respect to the buildings which it serves.

All of the works buildings, with the exception of the machine and the blacksmith shops, are erected in parallel lines, whereas the latter are at right angles with and communicate with the erecting shop. In making extensions, additions will be merely added to the former, but new buildings will have to be erected for the machine and blacksmith shops. In either case it will be seen that such operations will in no way interfere with the manufacturing which is being conducted in the sections previously erected. This is quite important when it is considered that during the erection of such additions, the capacity of the plant will not be cut down and as soon as the additions are completed the output of the plant will at once increase in the same proportion as the increase in capacity.

The buildings are of the steel skeleton, brick curtain wall type of construction, a center bay, with a lean-to on each side, being adopted. The advantages of such a type of buildings have been availed of to place the heavier tools in the main bays, which are commanded by traveling cranes and spur tracks which permit the handling of large and heavy material readily.

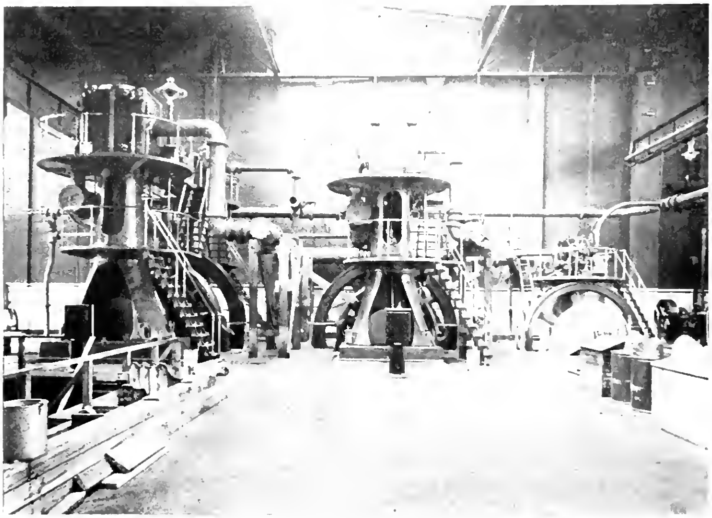


FIG. 2.—INTERIOR VIEW OF POWER PLANT.

The electric drive has been of material assistance in the lighting of the shops, which is further increased by large window areas. Although the buildings have been made as fire-resisting as possible, special attention has been paid to this in the case of the pattern storage building. This is four stories in height, whereas the pattern shop, which is built as a lean-to to it, is but one story in height. Concrete floors are used throughout and fire walls divide the building into sections. The windows consist of wire glass in iron frames, and the roof is covered with the H. W. Johns-Manville Company's asbestos roofing. The various buildings are separated from one another by ground areas of such extent as to serve as storage places for material.

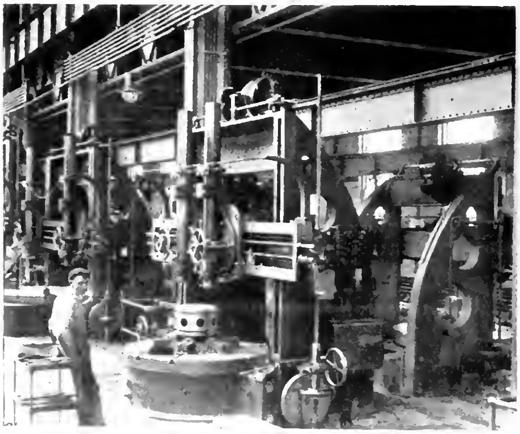


FIG. 3.—ELECTRICALLY-DRIVEN BORING MILLS.

The power scheme for the works is of unusual interest, as revealing a tendency to depart from generally accepted practice. Whether in the construction of power plants for electric light stations or for industrial establishments, it has been the usual course to unite all sources of power in one location. In this instance, however, the works as laid out will eventually have two independent power plants. Such a course has been deemed advisable as certainty of operation has been considered of greater importance than any economy which might result from the concentration of the two plants in one. It, of course, will be readily appreciated that power in such an establishment, although not an insignificant item in the cost of production, nevertheless is not the most important one. Although with modern motor-driven tools, the possibility of a shut-down is not as great as formerly with line shaft-driven machinery; nevertheless, the possibility of an accident to the power plant itself is a factor not to be disregarded,

Except in a few cases where it was not advantageous to do so, the electric drive has been used exclusively. As a large part of the machinery consists of variable-speed tools, and also because of the extensive use of cranes, direct current has been used exclusively. Current is generated at the power house at 250 volts and by means of compensators, a voltage of 110 and 220 is maintained on a three-wire system for the lighting load. For power work, the four-wire system of the Bullock Electric Company is used, balancing sets being installed in the various buildings to furnish the several voltages required. Compressed air is furnished for a few pneumatic tools, where electrically-operated tools would not meet the requirements. Hydraulic power is also used for several of the elevators, but in such cases electrically-operated pumps have been installed at the point where the power is required.

The power house, as already noted, is located in a part of the building devoted to the blacksmith shop. The boiler room at present contains five 300-hp, 96-in. x 24-ft. Reynolds vertical tubular boilers. Provision has been made for installing coal-handling apparatus and mechanical stokers. Coal is delivered in the boiler room on cars run in on a spur track which connects with the general yard system. Steam is generated at 125 pounds and aside from the engine room is also supplied to several steam hammers in the blacksmith shop. An 8-ft. stack, 175 ft. high, of the Alphons-Custodis Construction Company's type, has been built.

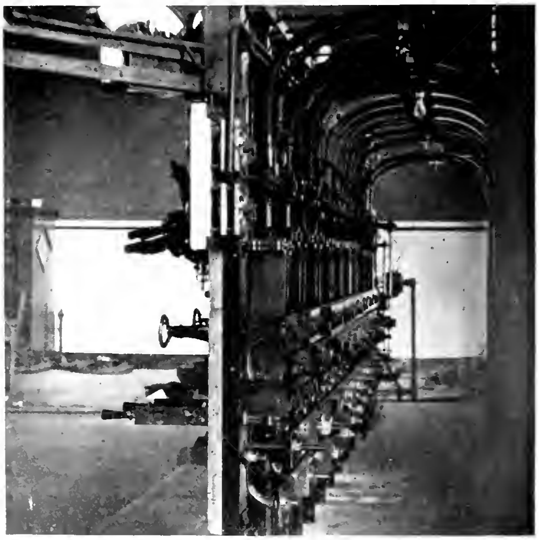


FIG. 4.—REAR OF SWITCHBOARD IN POWER HOUSE.

The engine room contains one 550, one 250 and one 100-kw direct-connected unit, with space for two additional 550-kw units. The engines are of the Reynolds-Corliss vertical type, made by the Allis-Chalmers Company. The smaller engine, although of only 100-kw capacity, has been especially built to conform to the larger units, in type and speed. The engines are non-condensing, the exhaust being used in a hot water heating system, installed by Evans, Almirall & Co. The generators are 250-volt machines, of General Electric and Crocker-Wheeler make. Two Bullock compensators of 12½-kw capacity are installed to maintain the neutral of the lighting system.

The switchboard, although not embodying any unusual features, is of a most substantial construction. Special attention has been given to the finish of the various instruments and the apparatus which has been used in its construction. The special castings which have been used for connecting switch and instrument lugs with the various bus-bars are of special design, and have been buffed so as to receive a high polish. Pressure and other wires on the back of the board are carried in pipes to various points as required. Two sets of bus-bars are provided, so that if necessary the lighting and power circuits can be operated independently of each other. In the generator and the power circuits both switches and circuit-breakers have been employed, whereas for the lighting circuits switches are dispensed with entirely. In order to obtain as compact a board as possible, the I. T. E. circuit-breakers were specially constructed for this installation. The main coil, switch and tripping devices are in line and are operated in gangs of two or three, as required by the various circuits. A Thomson recording wattmeter measures the output of the station; a Bristol recording voltmeter has been installed to record the fluctuation in the voltage on the lighting circuits. The instruments and switches are all of antique copper finish as well as the grill, which is seen below. The switchboard was designed by Mr. Alvan Dings, the electrical engineer of

FIG. 5.—CONTROLLER AND AMMETER MOUNTED ON BORING MILL.

the company, and was made by the Milwaukee Electric Railway & Light Company.

Separate feeders are provided for the power and the lighting load for each building. The feeders consist of Standard Underground and General Electric lead-covered, paper-insulated cables, drawn into a conduit system built of Camp tile; 70 ducts leave the station. The underground system is built in a most approved manner and conforms to the practice of the larger electric lighting companies. The conduit is run into the various buildings to a point level with the floors and after the cables have been pulled in is closed up so that foreign objects cannot be introduced. The cable rack at the station, although built of iron, is covered with split tile, so as to afford sufficient insulation for the cables.

The various buildings are lighted by incandescent and constant-potential arc lamps. The latter are hung in alternate panels on each side of the main bays of the various buildings. In the machine and erecting shops arc lamps have also been hung to light the galleries. This doubles the illumination of the main bays as compared with the lean-tos or the galleries. Incandescent lamps either as pendants or in fixtures are distributed wherever required. To

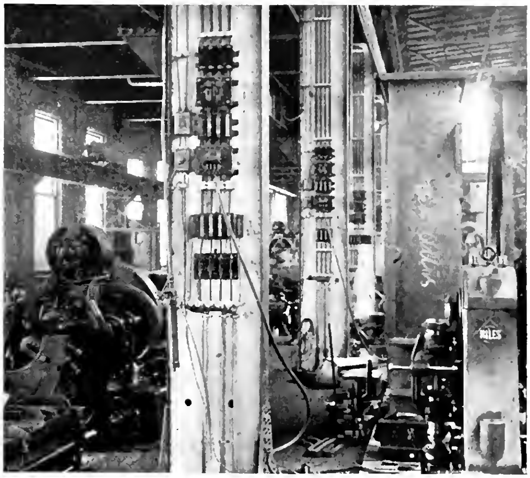


FIG. 6.—POWER CIRCUITS FOR PORTABLE TOOLS.

facilitate work, especially on the larger tools, one or more receptacles are placed on each column, thus permitting the use of extension cords.

The lighting feeders for each building, as already noted, are run independently of the power circuits, directly from the switchboard in the power house to a panelboard installed in each lean-to of each building. From this board circuits are run to various panelboards which control the incandescent and the arc lamps in any one part of a building. The incandescent lamps are controlled from panelboards, of which there are two to each floor and each side of a building. The corresponding arc lamps, however, are controlled from but one such board. All circuits are fused, including the neutral, but not the latter at the centers of distribution. Any section of a building can thus be readily cut out or lighted at will. Enclosed fuses are used exclusively and are refilled by the company's employees. A small repair shop is maintained in which all work required, either for the repair of a motor or any other part of the electric installation, can be readily attended to. The general lighting of the buildings is of the best nature, as very little fluctuation occurs in the voltage due to variations in current for the power circuits, even with the number of cranes which are constantly in operation. The arc lamps are partly of General Electric make, whereas the balance were furnished by the General Incandescent Arc Light Company.

The power feeder for each building is run to a center of distribution, at which the balancing sets for the Bullock four-wire system are installed. As will be seen from the accompanying photograph, the switchboard installed at such points contains the necessary switching apparatus and meters. The ammeters of which one is installed in each leg of the four-wire system are of the differential type, so that the amount of power and the unbalancing in each circuit can be readily determined. The Bullock four-wire system, as is well known, gives six voltages. To prevent mistakes being made, a code has been adopted whereby the east, south and upper wires are always positive. All wiring below and to a distance of several feet above the floor is run in Richmond conduit. For all machinery permanently installed, the wires are run through conduit to such machines. For portable tools, a special receptacle has been installed on the building columns to permit of power being delivered wherever required. As will be seen in the accompanying illustration, the north side of each column has been covered with dressed boards, to which the wiring and other apparatus is firmly attached, and which at the same time serve as insulation. The receptacles for power work deserve special mention, as it was found necessary to develop a design which would meet the conditions existing at the plant. These will not heat with any current required for operating the tools. Their construction, furthermore, is such that the plug must always be inserted in the same way, which prevents a motor from being connected up in any other than the proper way, and without any special thought on the part of the men.

The larger motors of the variable-speed type are equipped with a Bullock controller and, in addition, with an I. T. E. circuit-breaker and a Jewell ammeter. As the frequent blowing of a fuse has been found objectionable, circuit-breakers were installed, which, of course, can readily be closed when the circuit is opened. The ammeters serve a most useful purpose in showing the workman the load which he is carrying, and thus permit the carrying of an overload within limits when necessary, without opening the circuit-breaker. The ammeter reading also at all times indicates whether or not the workman is working his machine to its full capacity. The controllers are placed at such points or mounted directly on the machines, so that the workman at all times can start or stop the machine readily. In the case of lathes with very long ways, the controller can be operated from the tool rest through a spline shaft. In the latter case, a separate series motor has also been provided for operating the carriage travel. In the case of lathes and some other machinery, motors have also been provided for actuating pumps delivering soda water, etc., to the tools.

In nearly every case, each tool is operated by its own independent motor. Group drives have been used in but a few cases where the tools would not readily permit of any other arrangement. In the case of the larger tools, as the boring mills, several planers, etc., two and three motors are provided for various operations. In a great many of the tools the motors are mounted directly on these and drive the former through gears. In other cases the motors, although mounted on the machines, are belted to these, whereas in several instances the motors are placed at some convenient point. Bullock motors are used on the multiple voltage system. Because of the inability to obtain equipment as required, motors of nearly every make are used throughout the plant.

The feeders for the cranes are taken from the centers of distribution in the various buildings without the intervention of switches or circuit-breakers except those at the power house and the circuit-breaker installed on the cranes themselves. One trolley wire which is of the figure 8 section, is placed on each side of the crane runway. A feeder is tapped into this at about a quarter of the distance from each end and every 75 ft. between. The trolley wires are fastened with giant strain insulators and eye bolts and supported every 20 ft. by a clamp fastened to a bolt which has a vertical movement. The bolt is insulated by fibre from the supporting bracket and the whole is fastened to a wood block, secured to the girder runway. In the yards a similar construction is used, with the exception of an insulating bell in place of the giant strain insulators. The collecting wheels on the cranes pick up the trolley wire, thus preventing any serious strains on the latter and also any undesirable flashing. The crane equipment proper is of standard make as supplied with the cranes by the various manufacturers.

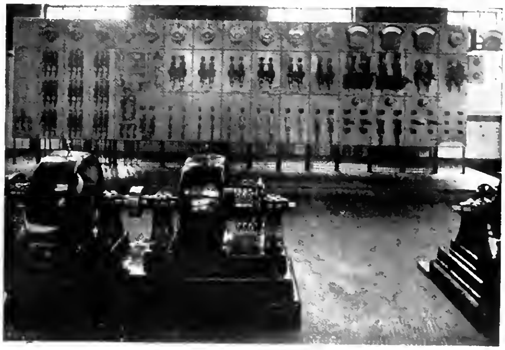


FIG. 7.—SWITCHBOARD AND BALANCING SETS.

A five-ton electric telpher furnished by Pawling & Harnischfeger, has been installed in the pattern shop to facilitate the handling of patterns within the building.

The feed water pumps in the power house are electric-driven. The operation of these has been made automatic in the following manner: In a by-pass around the pump, which connects with the source of supply and the boiler feed pipe, a valve is inserted, which is operated at a higher pressure than that which is maintained in the boilers. As the pressure in the boilers increases, the pump which operates continuously, increases the pressure in the by-pass until it opens the valve located in the same. This, of course, is a waste of energy, as the pump then merely circulates the water in a circle. To prevent this a gauge similar to a steam gauge, which is provided with two concentric rings, has been connected in the by-pass. As the pressure increases the pointer finally reaches a point where it closes a secondary circuit, which in turn opens the motor circuit.

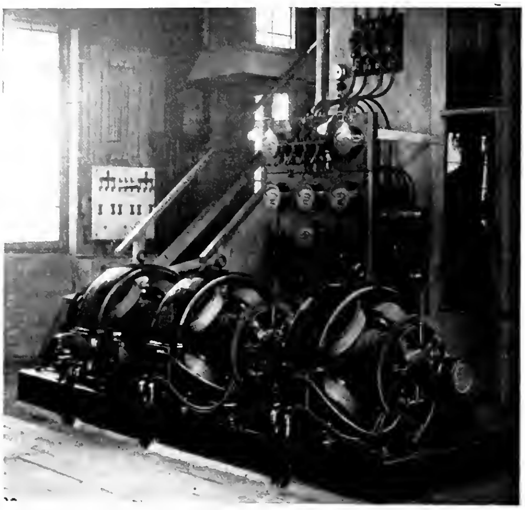


FIG. 8.—BALANCING SET AND SWITCHBOARD.

Several deep well pumps, made by the Downing Pump Company, which are installed at several artesian wells on the company's property, are operated automatically by Cutler-Hammer switches, which are actuated by floats, placed in several cisterns near the power house.

Various tools used about the plant are also electrically operated, among which may be mentioned electric drills of the Hisey-Wolf Machine Company; electric drills, center grinders and hack saws, made by James Clark, Jr., & Co., and babbitt melters and glue pot heaters, made by the United Electric Heater Company. The cranes operated in the yards are heated by electric heaters furnished by the same company. Several portable sand sifters and mold drivers are also electrically operated.

New Sturtevant Plant.

One of the features of the new plant of the B. F. Sturtevant Company, at Hyde Park, Mass., peculiarly indicative of the permanent character of the new works now under construction, is the steam tunnel 4½ ft. in width and 6½ ft. high, extending from the power plant to the most remote part of the manufacturing buildings, a total distance of about 800 ft. The tunnel, which is of concrete construction, will not only accommodate all of the steam piping, but also the electric wires for power, light, telephone, standard time clock, and other service, together with oil, hot water and other pipes for general distribution to the various buildings of the plant. None of these features of the equipment will be carried above ground at any outdoor point.

The New York Automobile Show.

This is Automobile week in New York City, and the fact is as palpable and evident as Horse Show week is. Uptown, particularly in the vicinity of Madison Square Garden, the automobile is conspicuously numerous, while in every hotel, restaurant and café of the fashionable quarter well-known automobilists are to be seen aplenty. As for the Garden itself, the show given there under the auspices of the Automobile Club of America and the National Association of Automobile Manufacturers, is a brilliant success. The fourth annual show is an advance over all its predecessors in the shape of exhibits, attendance, sales and general public interest, although it cannot be said that any particular novelty is to be encountered. In fact, the art would appear to have become rapidly standardized in regard to many of its essentials, and freak ideas or machines are disappearing. The present show closing to-night, Saturday, has had on view, aside from innumerable specialties and supplies ranging from sprocket chains to goggles, no fewer than 250 automobiles, including 181 gasoline, 46 electrics, 11 steam and 12 motor cycles. These figures represent very closely the relative magnitude and importance of the three motive powers, as thus far developed, though it is probable that no one would predict very boldly as to their ratio in the years to come. A great many of the electric automobiles shown are of the commercial type, an encouraging fact for the builders and for the manufacturers of storage batteries. We illustrate herewith some of the leading groups of electrics.

The Edison Storage Battery Company had a very interesting exhibit of a set of 20 of its cells in a Baker Electric Stanhope, which was exhibited under the competent charge of Mr. Bee, who stated in connection with this set that owing to recent improvements Mr. Edison has again greatly increased the capacity of the cell, adding to its desirability for automobile work.

The Electric Storage Battery Company of America had a small but adequate and interesting exhibit in the space of the Electric Vehicle Company. It showed three types of cell, chief of which was the express cell intended specially for heavy work, such as drays, trucks, etc. This battery was opened up so that the interior construction and the nature of the basswood and rubber separators, etc., could be observed. The lugs on the plates are extremely substantial and heavy. The second type shown was the latest form with heavy lugs for ordinary automobile work, and the third type was a very compact little set devised for sparking purposes on gasoline and other hydrocarbon vehicles. All of these are in extensive use to-day. Other sets of Electric Storage Battery Company's cells were to be found around the exhibition, notably one in the space of the General Electric Company, being charged by means of alternating current taken through a mercury arc rectifier.

The General Electric Company had a most interesting and comprehensive exhibit at the Fourth Avenue end of the hall, comprising its new motors, controller, panelboard, etc., details of which are given elsewhere in this issue, and particularly its novel form of mercury arc rectifier. Under the care of Mr. A. Churchward a set

Fig. 2.—Exhibit of National Electric Automobiles.

was shown of apparatus including a rotary reversed, taking the direct current of the house and delivering single-phase current to the mercury arc rectifier, whose operation could be witnessed through glass. This rectifier straightened out the current and delivered it to a set of Exide cells and the quantity of current going into the battery could be noted from the indicating instruments on the board. This attracted a great deal of attention, especially as experiments were made to show flexibility under a range of frequency and under other varying conditions. Mr. Churchward stated that he had been charging storage batteries for practical work in this way for six months past.

Fig. 1.—General View of the Automobile Show, Madison Square Garden, New York.

THE BAKER ELECTRIC VEHICLE COMPANY had a very interesting display, containing possibly the greatest novelty in the direction of electric vehicles, one with the Elwell-Parker motor placed in the front hood usually occupied by the gasoline engine and driving at right angles on the axle shaft by means of beveled gearing. The vehicle was a surrey equipped with a $2\frac{1}{2}$-hp motor and 24 cells of storage battery.

THE ELECTRIC CONTRACT COMPANY showed a line of its dry batteries and sparking outfits. The exhibit was in charge of Mr. Skinner.

FIG. 3.—BAKER ELECTRIC VEHICLE EXHIBIT.

MEYROWITZ MANUFACTURING COMPANY had an exhibit of eye glasses and shades for automobilists.

DAYTON ELECTRIC MANUFACTURING COMPANY showed the Apple Igniter, which has become so deservedly popular for sparking purposes on gasoline vehicles.

NATIONAL CARBON COMPANY batteries, etc., were shown in a handsome booth.

FIG. 4.—EXHIBIT OF ELECTRIC VEHICLE COMPANY.

DOW PORTABLE ELECTRIC COMPANY, Boston, had dry batteries and sparking outfits on exhibition.

C. F. SPLITDORF showed his well-known coils in a well-arranged exhibit.

MR. F. A. LA ROCHE, the well-known electrical manufacturer, showed a full line of French Darracq automobiles for which he is American representative.

EMIL GROSSMAN showed a line of jacks. He was admirably represented by Harry M. Shaw, well known in electrical circles.

MESSRS. A. G. HYDE AND WALLACE L. HOWARD represented the Whitlock Coil Pipe Company, of Hartford, Conn.

THE UNITED ELECTRICAL MANUFACTURING COMPANY had dry batteries on exhibition.

MESSRS. RUSHMORE AND POINER, of the Rushmore Dynamo Works, exhibited their searchlights, which are finding extensive use on automobiles.

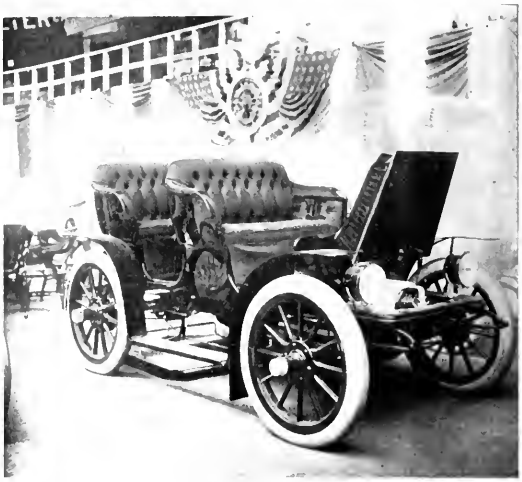
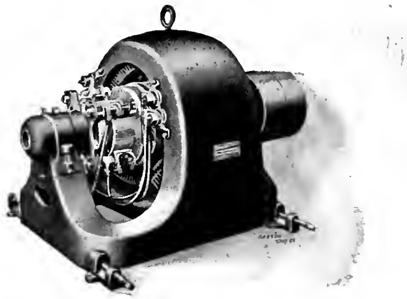


FIG. 5.—NEW TYPE OF ELECTRIC AUTOMOBILE.

Direct Current Dynamos and Motors.

A line of direct-current machines, of bipolar and multipolar design, is being introduced by the Hertner Electric Company, of Cleveland, Ohio. These machines range in sizes from ¼ to 15 hp and are adapted for lighting, power and elevator work. Electrically the intention of the designers seems to have been directed towards making the magnetic circuit of the field as stiff as possible, resulting in a decrease in the speed or armature turns, or both, to the great advantage of the overload capacity of the machines. In most respects the design is similar to that of standard machines now on the market, particular attention being paid to the production of a mechanically symmetrical construction. Several novel devices are resorted to in order to insure perfect freedom from oil on the inside of the commutator. The company is making a specialty of furnishing motors for extraordinary service.



DIRECT-CURRENT MACHINE.

These machines, it is stated, have been used with marked success in certain classes of printing press work where the speed variations are wide. The brush-holder is of a somewhat novel type. It is claimed that it overcomes the chattering of the brushes and the sticking to the face of the holder. The only moving parts are the brush and a very light finger, so that the motion of the commutator will be readily followed.

General Electric Exhibits at the New York Automobile Show.

The exhibit at the show of the General Electric Company were electric motors of new and improved design, a motor-generator charging set, a large and small Lemp steering check, a controller for electric vehicles using one motor, a standard controller for electric vehicles using two-motor equipments, a charging panel, a switchboard, a single-phase rotary converter and a mercury rectifier. The exhibit occupied a space at the right-hand corner of the south aisle at the Fourth Avenue end of the Garden and was handsomely decorated.

It is obvious that where the power to run the motor is derived from batteries carried in the vehicle and not from practically an unlimited source of power, such as the overhead trolley supplies, that the electrical qualities of such a motor should receive very careful attention. The qualities are of low cost and light weight, of course, desirable but not at the expense of high torque efficiency and proper speed characteristics at all loads. If the motor be too light it lacks proper structural strength, and its life is consequently short. If a motor is to have the proper electrical efficiency a certain amount of iron and copper must be provided in order to obtain increase of torque for the given current input and decreased heating effected.

The new six-pole General Electric automobile motor known as the G.E.-1010 and G.E.-1011, now exhibited for the first time, approaches very nearly to theoretical possibilities in its speed, torque and efficiency characteristics and the relationship between them. The torque for a given current is relatively high and increases in correct proportion as the current increases. It also keeps up its efficiency when a large torque is required, such as starting, hill climbing or running on bad or muddy roads. The field rings of this new class of motors are made of cast steel. The pole pieces are of laminated iron and the coils are machine wound and thoroughly water-proof. The commutator segments of the armatures are deep and wide, giving high conductivity and perfect radiation of heat at overloads as well as insuring long life and freedom from sparking.

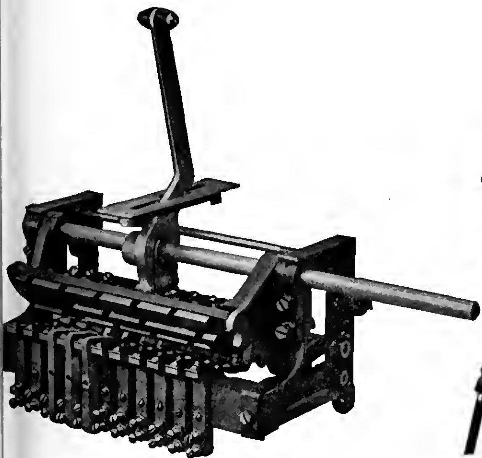


FIG. 1.—CONTROLLER.

FIG. 2.—CHARGING PANEL.

FIG. 3.—MOTOR.

In order to decrease the cost of repairs, the armatures of these motors have been built on quills so as to facilitate removal. The oil ring bearings have been standardized in a form similar to those so successfully employed in street railway service. The shafts have been made of a specially high grade of steel, and the journals are large, insuring minimum attention, and are protected from dirt and grit by a perfected form of dust-proof packing.

As many parts as possible of these new motors have been standardized and are, therefore, interchangeable. Any size of motor may be fitted with or without axle arms, according to the desire of the customer as to the method of suspension.

The charging panel shown in the General Electric Company's exhibit is fitted for one 2-hp, three-phase, 60-cycle induction motor connected to 1-kw, 110-volt generator. The equipment of this panel consists of a four-pole circuit-breaker, two lamps with bases to be used as polarity indicators, one pocket voltmeter, 10-amp. capacity; one pocket voltmeter, with 120-volts capacity; one starting rheostat, two fuses, one plug switch and one resistance for low-voltage coil.

To supply the demand for a small charging set for automobiles,

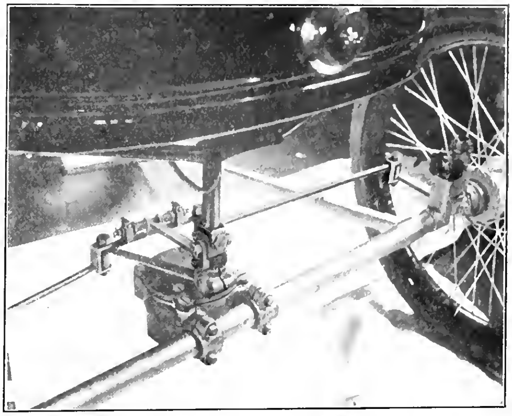


FIG. 4.—STEERING CHECK.

that can be operated by any standard single-phase circuit, the General Electric Company has placed on the market a single-phase self-starting rotary transformer that can be operated successfully on both 60 and 133-cycle circuits. This type of single-phase rotary is self-starting, with less than full-load current, and the starting mechanism is automatically changed from the starting to the synchronous running position.

Up to the present time it has not been possible to build an efficient and satisfactory single-phase rotary transformer without the use of some dampening or anti-hunting device. The Churchward anti-hunting device has been in successful operation for a number of years, both 60 and 133-cycle rotaries operating on single, two and three-phase currents. All these new single-phase rotaries are equipped with the latest improvements on this device. The present standard outfit will give the following range of e.m.f. without the use of resistance: 90-120 volts, 45-60 volts at full load.

For localities where the owner of a small electric automobile has great difficulty in arranging charging facilities, or the expense and care of a gas engine or motor-generator is too great to be considered the General Electric Company has developed a mercury arc rectifier suitable for charging the common runabout of 20 to 30 cells under all ordinary conditions of usage. The two principal features of the rectifier outfit are, first, a vacuum tube in which the conversion takes place, and, second, a reactance, the function of which is to secure stability of operation and to give a ready means of varying the load. The operation of the rectifier is most simple. On inserting the battery plug and closing the line switch, the vacuum tube automatically lights, and as soon as lighted the battery begins to receive its charge, the amount of current being regulated by the dial switch on the face of the compensating reactance mounted on the top of the panel. The capacity of this rectifier is 10 amp., this being a rate of charge at which an automobile, in case it is fully run down, may safely be left charging all night. Inasmuch as the rectifier is so simple to operate and requires no attention, there should be little excuse for vehicle owners ever being caught with an empty battery. If, during the time of charging, the power should go off, charging ceases, to automatically recommence as soon as the circuit becomes alive again.

Resistances in Telephone and Telegraph Practice.

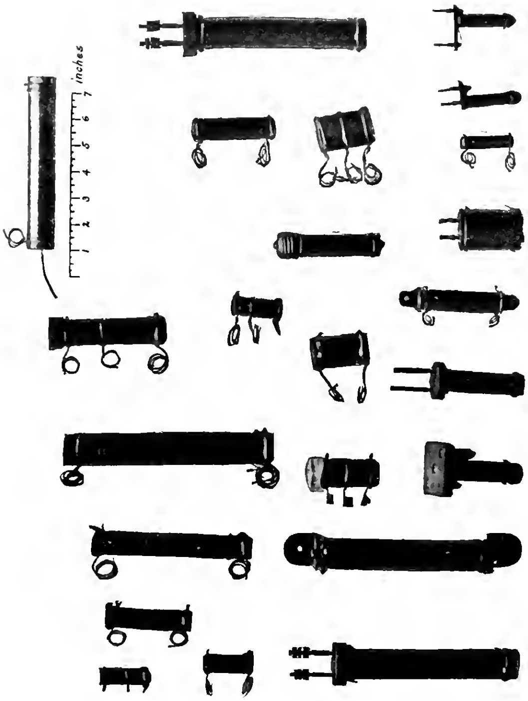
As the telephone and telegraph service is of vital importance in quick modern business transactions, anything which promises increased efficiency in this service is worthy of being given the closest investigation and of having the best engineering talent devoted to the solution of the questions involved. The Ward Leonard Electric Company has devoted its attention to the specific task of producing a compact unit, of high resistance and moderate current-carrying capacity, combining in a small space the salient features of a strong, durable telephone or telegraph resistance unit.

The cuts show units made of wire enameled on porcelain tubes, possessing the following advantageous features: The resistance wire is imbedded in a material which will expand and contract at the same rate as the resistance itself within the limits of usage, thus preventing the adjacent coils from closing together and short-circuiting, preventing, therefore, a change in the resistance of the unit which might cause a burn-out in the circuit. The enamel in which the wire is imbedded and by which it is entirely covered, protects the wire from the atmosphere. As the entire wire is hermetically sealed, it cannot deteriorate owing to the action of moisture or other corrosive elements. The coating of enamel over the wire is so thin and the enamel so good a conductor of heat that the heat generated is dissipated very rapidly because the radiating surface is practically increased from that of the fine wire to that of the porcelain tube. The resistance wire has a zero temperature coefficient, that is, its resistance, does not alter with change of temperature, the importance of which is well known.

These units are very strong mechanically, are small, compact, non-abrasive, rust-proof, water-proof, fire-proof and dust-proof. The terminals are very strong and the connection between the resistance wire and the terminal head is embedded in the enamel, which preserves the joint against any depreciation. The shape is the best possible for mounting in practice, as will be evident from the cut, which shows units designed for mounting in cord circuits in telephone exchanges. They are 2 in. long by ½ in. diameter and can be wound for any resistance from five ohms to three-hundred.

The cut also shows units designed for ringing circuits in telephone exchanges. The resistances are 3¼ in. long by ¾ in. diameter. They can be wound for any resistance from five ohms to seven hundred ohms. The cut shows 650-ohm units arranged for mounting in Edison sockets, mounting against the wall of a section or for mounting on a slate panel.

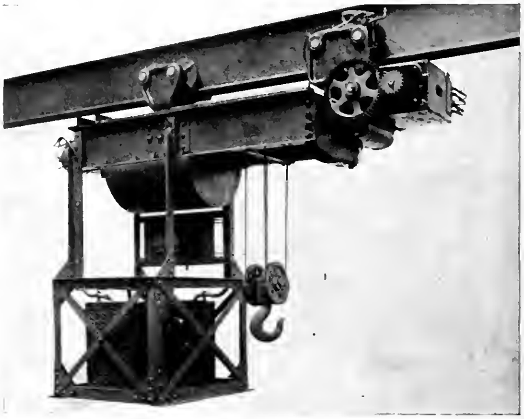
Ward Leonard Electric Company's engineers solicit the opinion of telephone and telegraph men and would gladly take up any problems of design, mountings, etc., which they may suggest. The Postal Telegraph Company, always progressive, has adopted these units of a larger size for their circuits and in the construction of their rheostats.



RESISTANCE COILS.

Electric Traveling Hoist.

The engraving herewith illustrates the new electric traveling hoist built by the Niles-Bement-Pond Company, of New York, at its Philadelphia crane department. These hoists may be equipped with a cage as shown, or may be arranged to be operated from the floor by means of pendant controllers. The hoisting mechanism is placed between the channel framing of the trolley and is direct-geared to the drum, a standard load and motor brake being provided. Power for hoisting, in all cases, is furnished by electric motors, while the trolley travel may be arranged for by motor or hand racking. This type of hoist is built in three sizes of three, four and ten-tons capacity. Swivel trucks will be furnished for use on curved tracks.


ELECTRIC TRAVELING HOIST.

New Engineering Firm.

The Beardsworth Engineering & Machinery Company, Cleveland, Ohio, has been formed to act as electrical engineer and selling agent for electrical equipment. The company will make a specialty of selling and re-installing complete second-hand power plants that are fully guaranteed by those who wish to dispose of the same. It has a number of complete plants for sale in various parts of the country. Parties having steam and electrical equipment too small for their present requirements can make advantageous exchanges through this company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was irregular in its tendencies, being influenced largely by the conflicting reports of the situation in the Far East, and the nervousness of the European markets. United States Steel issues were stronger, and Brooklyn Rapid Transit and similar stocks were rather heavy. The firmness in Steel preferred and sinking fund bonds was due to absorption from many sources, the West being again a liberal buyer. Tractions and Electrics were neglected, and weakness characterized the market for this class of securities. General Electric was almost entirely neglected, only 80 shares having been reported sold during the week. The price, however, kept quite steady, ranging from 173 to 175, and closing at 174. Westinghouse common closed at 168, being a loss of 4½ points net. Western Union closed at 87¾, which is ¼ point off. Commercial Cable, on sales of 546 shares, closed at 183½, this being a net gain of 15½ points. American Telegraph & Cable gained 3⅞, closing at 85⅞. Among the tractions Brooklyn Rapid Transit closed at 48½, a net loss of 2¼ points, the sales aggregating 73,100 shares. Metropolitan Street Railway closed at 121, a net loss of 1 point. In Boston notable strength was displayed at the end of the week in Massachusetts Electric, Edison Electric Illuminating and the copper shares, while the general market was steady. Following are the closing quotations at New York of January 19:

NEW YORK.

	Jan. 12	Jan. 19		Jan. 12	Jan. 19
American Tel. & Cable	85½	85	General Electric	173	174¼
American Tel. & Tel	124	126	Hudson River Tel	..	
American Diat. Tel	25	22	Metropolitan St. Ry	120½	122½
Brooklyn Rapid Tranait	49⅛	50⅛	N. E. Elec. Veh. Trna	..	..
Commercial Cable	176¼	..	N. Y. & N. J. Tel	..	..
Electric Boal	17	18	Marconi Tel	..	..
Electric Boat pfd	45	45	Western Union Tel	87½	87⅞
Electric Lead Reduction	1	1	Westinghouse com	165	170½
Electric Vehicle	9¼	8¾	Westinghouse pfd	185	190
Electric Vehicle pfd	13	14			

BOSTON.

	Jan. 12	Jan. 19		Jan. 12	Jan. 19
American Tet. & Tel	125	125¾	Weatern Tel. & Tel. pfd	79	79½
Cumberland Telephone	*110¾	*114½	Mexican Telephone	1¾	1¼
Edison Elec. Illum	233	230	New England Telephoue	120	*122
General Electric	173	174	Mass. Elec. Ry	21	22
Western Tel. & Tel	..	8	Mass. Elec Ry. pfd	75¾	79

PHILADELPHIA.

	Jan. 12	Jan. 19		Jan. 12	Jan. 19
American Railwaya	*44	43	Phila. Traction	97⅝	..
Elec. Storage Battery	56	56	Phila. Electric	6⅜	6⅜
Elec. Storage Battery pfd.	56	56	Phila. Rapid Trans	8¾	8⅞
Elec. Co. of America	8⅜	8½			

CHICAGO.

	Jan. 12	Jan. 19		Jan. 12	Jan. 19
Central Union Tel.	..	..	National Carbon pfd	92	93¼
Chicago Ediaon	148½	..	Metropolitan Elev. com	17	16
Chicago City Ry	162	160	Union Traction	6	6¼
Chicago Tel. Co	125	..	Union Traction pfd	30½	30
National Carbon	24	26			

*Asked

DIVIDENDS.—The directors of the American Light & Traction Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable February 1. The directors of Allis-Chalmers have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock. National Steel & Wire Company directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 3. The Chicago Edison Company has declared a quarterly dividend of 2 per cent., payable February 1, to holders of record January 23. The Central District & Printing Telegraph (Bell Telephone) Company has declared the regular quarterly dividend of 2 per cent., payable January 30. Electric Company of America directors have declared a dividend of 3 per cent. (30 cents per share), payable January 30. The Columbus (Ohio) Gaslight & Heating Company has declared a dividend of 4 per cent. on its common stock. The Minneapolis General Electric Company has declared a dividend of $3 per share.

THE "SOO" EDISON COMPANY.—Some important changes are to be noted in the personnel of the Edison Sault Electric Company, of Sault Ste. Marie, Mich. At the adjourned annual meeting held January 15, 1904, the following directors were elected: William Chandler, Sault Ste. Marie, Mich.; Henry W. Darling, Schenectady, N. Y.; Alex. Dow, Detroit, Mich.; Alfred Jeretzki, New York; Frank P. Sullivan, Sault Ste. Marie, Mich. The directors elected Mr. Alex. Dow as president and Mr. William Chandler as vice-president. Messrs. Dow, Jeretzki and Sullivan are new names on the board and represent a change of control of the property. Mr. Dow is to be the active representative of the new interests. Mr. Dow is widely known as a manager of other successful illuminating properties, more particularly the Edison system in Detroit. The stockholders at the same meeting authorized the increase of the capital stock of the company from $57,000 to $150,000.

CLARK WIRELESS TELEGRAPH.—At the meeting held last week, the following officers were elected for the coming year of the Thomas E. Clark Wireless Telegraph-Telephone Company: Thomas E. Clark, president, Detroit; Frank Ford, vice-president, Birmingham, Mich.; J. E. Sawyer, secretary, Pontiac, Mich.; Joshua Hill, treasurer, Pontiac; Wm. Barringer, assistant secretary, Pontiac; John Z. Hayes, director, Detroit; A. Stiling, director, Detroit. The further sale of treasury stock was voted upon, and it was agreed that $20,000 worth of the treasury stock should be sold, to increase working capital in order to care for the larger business which was coming to the company in the various lines of wireless telegraph instruments, as well as other electrical specialties.

STORAGE BATTERY OUTLOOK.—Advices from Philadelphia say: "An Electric Storage Battery director says the 1903 year's earnings ran about $4,000,000, the largest business the company ever did. Easily 10 per cent. can be shown earned on the stock. While, as a matter of fact, the company could have paid spot cash for the factory real estate it recently purchased, it was deemed best to accept other terms, because of easy payments with low interest rates."

AMERICAN GRAPHOPHONE.—The American Graphophone Company reports total income for the year of $659,513, and net of $270,266, out of which the preferred dividend takes $78,677, leaving a surplus of $191,589. Assets are put at $3,798,215 and liabilities offsetting, with surplus of $522,403.

SOUTHERN NEW ENGLAND BELL.—It is stated in New Haven dispatches that the directors of the Southern New England Telephone Company have voted to increase the capital stock from $3,500,000 to $4,000,000.

BOSTON EDISON EXTENSION.—The Edison Electric Illuminating Company, it is stated in Boston dispatches, has acquired the Somerville (Mass.) Electric Light Company, the consideration being $577,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Spring trade shows signs of activity, and this, coupled with a large volume of clearance sales by retailers, gives evidence of brisk mid-winter operations. There is also an evident improvement in the industrial situation, particularly in iron and steel mill resumptions, and an active spring is looked for in this line. Reports from all sections of the country are favorable, and trade in all lines of commodities and products is cheerful and satisfactory. Foreign trade returns are gratifying. Export trade in 1903 swelled largely by the record-breaking value of cotton shipments, and aided also by large exports of beef cattle and expansion in exports of manufactured goods, broke all records, exceeding those of 1900 by a small percentage. Imports, too, were the largest on record, the result being a total foreign trade of $2,500,000,000, a sum exceeding all previous totals. The iron trade was irregular, but the outlook and conditions are regarded with favor. Production was the lowest for the past five years, although current resumptions will soon swell the output slightly. Finished products are also irregular. A sale of 20,000 tons of rails for Turkey is reported. Copper, lead and tin are all higher on reported good demand. In copper there was a strong effort to lift the market which resulted in higher quotations. There was little business, however. The closing quotations were 12¾c. for Lake, 12⅝c. for electrolytic and 12½c. for casting stock. There were 315 business failures during the week ending January 14, according to *Bradstreet's*, against 262 the week previous, and 234 the corresponding week last year.

ENGINE OUTLOOK.—An official of the Allis-Chalmers Company is quoted in Chicago as follows: "There has been a great deal of keen competition among builders of machinery during the last five or six months, and the new year has by no means eliminated the condition. Compared with a year ago prices are very much lower, and the volume of business available shows marked shrinkage in many lines, particularly that of heavy power engines such as are used by the public service companies of municipal corporations. These projects are very nearly all dependent upon the flotation of bonds and at the prevailing high rates for money it is practically impossible to carry out such plans. There are many projects planned, but held in abeyance because of these conditions. This company is getting its share of the business offering and our principal orders now are coming from the southwest, where milling and mining machinery is in fair demand. Old Mexico is also taking more modern machinery than usual. Outside of Mexico, and some work in the Canadian border country, export business is slack. In continental Europe there is very little demand for American machinery at this time, the disposition being inclined to discriminate against it, especially in Great Britain and Germany. South Africa is a good field, but it does not seem to recuperate as rapidly as it should since the Boer war. The great complaint there is the scarcity of labor. Capital is not doing much in the South American republics on account of the almost incessant political uprisings in those countries."

ELECTRIC LIGHT ENGINE WANTED.—The electric light company of Teneriffe, Canary Islands, is desirous of purchasing an American electric light engine of at least 500 hp, as with the machinery they now have they find it impossible to meet the large and constantly-increasing demand for electric light. The engine required must be of the latest pattern, of first-class material, and up-to-date in all respects. Price should be quoted c.i.f. Teneriffe. The following firms issue through bills of lading at Teneriffe: Elder, Dempster & Co., Produce Exchange, New York, and J. M. Ceballos & Co., Wall Street, New York. Quotations and all communications should be addressed to Senor Don Nicolas Marti, presidente Compania Electrica e Industrial, Teneriffe. The above information is from Mr. Sol. Berliner, United States Consul at Teneriffe, Canary Islands, South Atlantic.

SOME BUFFALO FORGE COMPANY ORDERS.—The Buffalo Forge Company reports through its New York offices in the Taylor Building that business in their lines is picking up considerably and that several interesting engines are on hand. The De Witt Wire Cloth Company, De Witt, N. J., is extending its factory and has ordered a horizontal center-crank Buffalo engine of 40-hp capacity for direct connection to a 25-kw Crocker-Wheeler generator. The Newberger Electric Company, of Brooklyn, has ordered a 100-hp horizontal center-crank Buffalo engine for direct connection to a 60-kw Elwell-Parker motor. This outfit is intended for lighting purposes. The Mackay Engineering Company, Singer Building, New York, has requisitioned for a 25-hp vertical engine for direct connection to a 15-kw Akron generator for lighting the Mutual Chemical Company's plant.

FOREIGN TRADE FIGURES.—The month of December shows up well with imports of $77,750,284 and exports of $174,734,368, giving an excess of exports of $96,984,084, the largest excess for any month last year. The total exports excess for the year was $489,122,029, which has only been exceeded in three years since 1892, while the total of exports, $1,484,854,694, is the largest for any year in that long period, and the total import and export trade is also nearly $150,000,000 more than the previous largest year, 1901, being not less than the magnificent figure of $2,480,587,359. This does not look very much like adversity, and there is in it no justification for the shallow pessimism of last year. Moreover, against the highest exports of the year in December, the imports for the same month were the lowest, which does not look like extravagant indulgence in foreign luxuries.

EQUIPMENT FOR NEW LEHIGH VALLEY RAILROAD SHOPS.—Contracts have been let for the equipment of the locomotive shops now under construction at Sayre, Pa., by the Lehigh Valley Railroad Company. The capacity of the power plant will be 8,000 hp. The Westinghouse Electric & Manufacturing Company secured the contract for the generating equipment. McIntosh, Seymour & Co. will build the engines. Wickes Brothers, Saginaw, Mich., have taken the contract for the boilers. The crane equipment will be installed by the Shaw Electric Crane Company, of Muskegon, Mich. There will be twelve cranes. The contract for the ventilating equipment has been let to the Buffalo Forge Company. Ten 10-ft. fans will be installed in the main locomotive shops, each fan driven by 20-hp motors, which have yet to be ordered.

HOLTZER-CABOT PRESS MOTORS.—The American Type Founders Company, of Jersey City, has awarded a contract to the Holtzer-Cabot Electric Company, New York offices 43 Liberty Street, for a number of special designed motors which are to be used for driving the company's catalogue printing presses. Thirteen motors have already been ordered. They will have varying speeds and will be of from ¼ hp to 5 hp capacity. The motors will be fitted with either Carpenter or Cutler-Hammer control. They will be placed under the step of the printing presses. The presses will be built by the Whitlock Company, Derby, Conn. Motors will also drive the servers and cutters.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, reports a steady demand for its various types of switchboards and telephones, its new type mechanical self-restoring drop board meeting with special favor. Among recent shipments might be mentioned the following: Nappanee, Ind., 300 capacity; Bevier, Mo., a 100-capacity addition to the first section installed within the past thirty days; Bunker Hill, Mo., 100-capacity; South Wayne, Wis., 100-capacity; Gratiot, Wis., 100-capacity; Chatham, Ill., 150-capacity; Divernon, Ill., 150-capacity; Winslow, Ill., 100-capacity. A number of the above orders included complete telephone equipment as well.

BROOKLYN HARDWARE FACTORY.—Percival Robert Moses, 35 Nassau Street, New York, has let contracts for the equipment of the large hardware factory which is being built at Kent Avenue and South Eighth Street, Brooklyn, for Charles R. Ring. The power equipment will have a capacity of 150 hp. The engine, a belted one, will be of Fitchburg build. The boilers, two units, have been ordered from the Bigelow Company, 15 Cortlandt Street, New York. The generator will be of C. & C. make. Its capacity will be 65 kw. A combination passenger and freight elevator will be put in by the A. B. See Elevator Company. Several motors have yet to be ordered.

THE PROMETHEUS ELECTRIC COMPANY, 39 Cortlandt Street, New York, manufacturers of electric heating and cooking apparatus, elected the following officers at its annual meeting: President, David T. Davis; vice-president, Dr. S. S. Wheeler; treasurer, William B. Symmes, Jr.; secretary, Max Loewenthal. The above gentlemen, in conjunction with Mr. Max Osterberg and Mr. William Ballin, constitute the board of directors. The outlook for the sale of the apparatus is reported as excellent, and the sales during the past year have been very encouraging.

TRAIN LIGHTING.—At a meeting of the board of directors of the Consolidated Railway Electric Lighting & Equipment Company, held January 13, Col. John T. Dickinson, heretofore general agent, was elected second vice-president in charge of negotiations with railway companies for the use of the Consolidated "Axle Light" system of electric car lighting. The company's general offices were recently moved from 100 Broadway to the Hanover Bank Building, corner Pine and Nassau Streets, New York City.

THE WESTERN ELECTRIC COMPANY reports having received orders for 250 fire alarm boxes and complete central station equipment for the World's Fair at St. Louis. The apparatus will be similar to that used in the city of Chicago. As a result of the recent fire in the latter city, all the theatres and many of the large business houses are being supplied with Western Electric fire alarm boxes, which will be connected direct with the city system.

EQUIPMENT FOR ARGENTINA FORTIFICATIONS.—The government of the Argentine Republic is to purchase considerable electrical equipment for installation in the fortification works of the Puerto Militar. About $25,000 gold will be expended. The equipments will include machinery for the manipulation of disappearing guns, ammunition hoists, deck winches, portable stationary blowers, etc.

3,000 HP MORE FOR SAO PAULO COMPANY.—The additional equipment to be installed in the Rio Tiete hydraulic plant operated by the Sao Paulo Tramway, Light & Power Company, of Sao Paulo, Brazil, will be of 3,000-hp capacity. The existing plant is of 7,000 hp. The contracts for the new installation will be let through the New York offices of the concern, 29 Broadway, early next month.

STEEL TOWERS FOR MEXICAN TRANSMISSION LINES.—The Mexican Light & Power Company, New York offices 29 Broadway, is in the market for about 2,000 steel towers of special design which are to be used for carrying the transmission lines which are to run between the Necaxa plant of the company to Mexico City, and to El Oro mining district, a total distance of about 150 miles.

THE HERTNER ELECTRIC COMPANY, of Cleveland, Ohio, has just completed the installation of 30 motors in the large printing establishment of Martin & Lamb, of that city. Every press, cutter, folder and stitcher, as well as all the separate tools used in the binding and electrotyping departments, are operated by individual motors specially designed.

PUMPS FOR WORLD'S FAIR.—The Warren Steam Pump Works, of Warren, Mass., have secured the contract for the pumping equipment to be installed in the 5,000-hp plant which is to operate the Intramural Electric Railway in the St. Louis World's Fair grounds.

THE MANSFIELD ENGINEERING COMPANY, of Mansfield, Ohio, is building three 200-hp engines, which will be used in driving part of the electrical equipment at the St. Louis World's Fair.

BALL ENGINE ORDER.—The Union Ice Company, of Bakersfield, Cal., has recently purchased a 300-hp Ball automatic engine from the Ball Engine Company, Erie, Pa.

THE OSBORN ENGINEERING COMPANY is preparing plans for a large plant to be erected at Clarksburg, W. Va., for the National Carbon Company, of Cleveland.

General News.

THE TELEPHONE.

EVENING SHADE, ARK.—The Sharpe County Telephone Company has been incorporated with a capital stock of $1000. C. J. Wilson is president.

LOS ANGELES, CAL.—The Monrovia Telephone & Telegraph Company has created a bonded indebtedness of $25,000.

LOS ANGELES, CAL.—The Imperial Telephone Company is making an extension of its line from Imperial to Holton.

LOS ANGELES, CAL.—The Home Telephone Company has petitioned the City Trustees of Fullerton to advertise for sale a telephone franchise in that city, promising to begin work at once and spend $4000 in two years.

LOS ANGELES, CAL.—Increase in business has made it necessary for the Sunset Telephone Company to construct a new line from San Diego to Corona, a distance of about 100 miles. The new line has been completed to Pala, 45 miles south of Corona.

LOS ANGELES, CAL.—The rumor to the effect that there is to be a merger of the Home Telephone Company with the Sunset Company is denied. At the present time the Home concern has about 11,000 telephones working and nearly as many contracts yet to fill, according to General Manager Van Liew. Furthermore, there are about twenty-five long-distance toll lines connected through, and, in addition to this, all towns in Southern California of 5000 population and over have been connected-up locally. Mr. Van Liew says that he has not had a solicitor out for almost a year, and that contracts are being signed faster than is possible to meet them.

BOISE, IDAHO.—Articles of incorporation of the Independent Long Distance Telephone Company have been filed here. The capital stock is $250,000 and the principal office of the company is to be in this city. The directors are H. E. Neal, E. H. Beggs and A. J. Swain, of Boise; James McDevitt, R. E. Shaw, Harry L. Fisher, C. J. Sinsel and M. B. Zimmer.

DANVILLE, ILL.—The Vermillion County Telephone Company has increased its capital stock from $150,000 to $400,000.

ADRIAN, ILL.—The Carthage & Coluca Telephone Company has been incorporated with a capital stock of $2500. The directors are William Black, J. L. Haines and others.

JACKSONVILLE, ILL.—Representatives of thirteen independent telephone companies in central and western Illinois met at this place Jan. 5, for the purpose of organizing an independent telephone association and of arranging matters so that it will be clearly understood what part of the gross charge each company is to receive for the transmission of a long-distance message, or of messages other than local. It is expected that during the present year they will establish copper metallic circuits between Hannibal, Springfield, Alton, Louisiana, Jacksonville and other cities of importance in the district embraced by the following counties, which were represented in the meeting: Calhoun, Jersey, Macoupin, Green, Scott, Morgan, Cass, Sangamon, Pike, Adams, Browne, Hancock and Hannibal and several counties in Missouri.

SOUTH BEND, IND.—The Central Union Telephone Company will rebuild its plant during the spring, placing the wires underground.

OAKLANDON, IND.—The Rural Telephone Company, of this place, has been organized with a capital of $300. The directors are Michael Mock, Henry Mock and John W. Apple.

MUNCIE, IND.—The Delaware & Madison Counties Telephone Company reports having had a very successful year. The company is now operating over a large territory and has 3100 telephones in service. The company has expended over $80,000 in extensions during the past year.

DANVILLE, IND.—One hundred and thirty-eight farmer patrons of the Consolidated Telephone Company of this city and community are at outs with the management and threaten to organize a company and establish a system of their own. The company has recently consolidated the exchanges in Danville, Plainfield, New Salem and Pittsboro and put in new metallic service greatly improving and extending the service. The management announced that after Dec. 31, the rate for residence and country telephones would be $1 a month, an increase of 25 cents. The farmer patrons rebelled and held a mass meeting and passed resolutions to the effect that they would retain their telephones at the old price, but in case service was denied them they would establish their own system. However, after investigating the cost of a new plant and realizing its limitation, some of the more conservative farmers are inclined to remain with the company. It is asserted that Bell people are backing the farmers and have looked with favor on this territory for some time. The Bell Company has only a pay station in Danville.

EXLINE, IA.—The Exline Telephone Company has ordered 1300 lbs. of wire to build a new line.

VALLEY JUNCTION, IA.—The Grimes Mutual Telephone Company has been granted a local franchise.

REINBECK, IA.—The Reinbeck Mutual Telephone Company has been organized to establish a local mutual exchange.

BUFFALO CENTER, IA.—Another rural telephone line will be built south and east of Buffalo Center by the Great Northern Telephone Company.

JEFFERSON, IA.—The Citizens' Mutual Telephone Company, of Jefferson, has been incorporated. Capital stock, $9990. Incorporators: J. E. Shaw and several others.

VALLEY JUNCTION, IA.—The Valley Junction & Orilla Telephone Company has been organized and will build a line in the spring. F. L. Bailey, of Bloomfield township, is secretary.

DETROIT, KAN.—A farmers' mutual telephone company is being organized by farmers south of Detroit.

MONTGOMERY, MASS.—The New England Telephone & Telegraph Company will build a line from Russell to Montgomery.

ESCANABA, MICH.—The Finch Telephone Company will extend its line to Menominee.

HILLSDALE, MICH.—Extensive improvements to cost in the neighborhood of $8000, are about to be made by the Bell Telephone Company in its Hillsdale plant. The cables are to be extended, the switchboard and operating room enlarged and provision made to accommodate 200 additional subscribers.

PILLAGER, MINN.—E. P. Bacon proposes to establish a telephone exchange in this place.

DASSELL, MINN.—A telephone line is to be constructed to Lake Jennie. Work will be started in the early spring.

COMFREY, MINN.—The North Star Telephone Company contemplates building a line from Comfrey to Springfield.

BLACKDUCK, MINN.—The Blackduck Electric & Telephone Company will be incorporated with $25,000 to $50,000 capital stock.

ST. PAUL, MINN.—The Nicollet County Telephone & Telegraph Company has increased its capital stock from $20,000 to $50,000.

COMSTOCK, MINN.—The Neightborhood State Telephone Company has been incorporated with a capital stock of $25,000. The directors are H. H. Harvey, Sam Gilbert and others.

ABBOTTSFORD, MISS.—The Abbottsford Electric Light & Telephone Company, Abbottsford, Clarke County, has been incorporated; capital stock $25,000. A. J. Young, E. C. Schilling and G. H. Schilling are the incorporators.

SEDALIA, MO.—The Missouri and Kansas Telephone linemen here struck Jan. 2, because their wages had not been increased from $2.25 to $2.50 a day, with one and one-half pay for overtime and double pay for Sundays. The men went to work on the promise that the matter would be considered upon the return of President Burt from Boston, but nothing having been done, they struck again Jan. 6.

BASSETT, NEB.—The Bassett-Springview Telephone Company has increased its capital to $25,000.

VINELAND, N. J.—The United Telephone & Telegraph Company, of Vineland, has been incorporated with a capital stock of $25,000, by Joseph H. Dowler, Jr., Walter D. Wilson, Wm. E. Wilson, J. Homer Lewis and Henry Taylor.

PLAINFIELD, N. J.—The public services committee of the Common Council has recommended that the application for a franchise by the Central New Jersey Telephone Company be refused. In the committee's opinion the time is not ripe for the granting of another license.

SENECA FALLS, N. Y.—The Home Telephone Company is about to extend its line from Waterloo to Geneva.

WHITESBORO, N. Y.—The Central New York Telephone & Telegraph Company and the Utica Home Telephone Company have made application for franchises in the village.

NORTH WALCOTT, N. Y.—The North Walcott Telephone Company has been incorporated with a capital stock of $5500, by D. J. Kyle, N. F. Fields, and George W. Van Note.

PLATTSBURGH, N. Y.—The Beekmantown Telephone Company, of Plattsburgh, N. Y., has been incorporated; capital, $1000. Incorporators: Chellis Brothers, Addison Ladd, Nathan R. Mason, all of Plattsburgh, N. Y.

RICHFIELD SPRINGS, N. Y.—The Winfield Home Telephone Company, Richfield Springs, has been incorporated; capital, $5000. Incorporators: Frederick C. Ward, Cooperstown; Willard Bullion, George Cany, Richfield Springs.

JAMAICA, L. I., N. Y.—The New York & Long Island Telephone Company is strongly competing with the New York & New Jersey Telephone Company in this section. The new company is offering all sorts of inducements to subscribers. The New York & New Jersey Company has as yet made no effort to meet the competition.

QUAKER CITY, OHIO.—The Yoker Valley Telephone Company has been incorporated with a capital stock of $550. Directors: W. W. James, N. P. Hartley and others.

CHATTANOOGA, TENN.—After a long fight over the question of a charter for an independent telephone company in Chattanooga, the matter has been settled by the signing of a contract by the East Tennessee and Hamilton Telephone Companies, fixing the charges in the city and suburbs by specifying the rates to be charged within prescribed limits.

MIDLAND, TEX.—The Automatic Telephone Company has been incorporated with a capital stock of $10,000. Directors: E. H. Estes, J. T. Blair and others.

BEAUMONT, TEX.—The Southwestern Telegraph & Telephone Company will erect an office and exchange building here. J. E. Farnsworth, general manager, Dallas, Texas, can give information.

SMITHVILLE, TEX.—The Smithville Telephone Company, of this place, has purchased the telephone line of the Smithville & Red Rock Telephone Company and will extend it to Lockhart.

PETERSBURG, VA.—The Petersburg Telephone Company is extending its line from DeWitt to McKenney Station in Dinwiddie County.

PORT ROYAL, VA.—The Royal Telephone Company, of this place, has been chartered with a capital stock of $3000 to $5000. Mr. George W. Forsyth is secretary and treasurer.

CHEHALIS, WASH.—A telephone company is projected to build a line to Aberdeen.

CENTRALIA, WASH.—The Sunset Telephone Company will build a line from this city to Elma, 30 miles.

EVERETT, WASH.—The Skagit Farmers' Mutual Telephone Company will ask for a franchise for an independent telephone system.

READSTOWN, WIS.—The Readstown Telephone Company of the village of Readstown, Vernon County; capital $5000, has been incorporated by F. M. Groves, G. W. Heinka, C. A. Reeve and G. A. Ewers.

Electric Light and Power.

TEMPE, ARIZ.—The Tempe Canal Company will probably construct a power plant to cost $170,000. G. Jones, J. Woolf and Carl Hayden, all of Tempe, are among the stockholders.

ALHAMBRA, CAL.—Bids are wanted Feb. 9 for a franchise for furnishing electricity for light, heat and power. A. A. Clapp, Sr., is City Clerk.

LOS ANGELES, CAL.—A company has been organized at Downey to build an electric light plant. The incorporators are Dr. Q. J. Rowley, A. L. Ball, T. R. Crawford, Joseph Smith and S. S. Skidmore.

LOS ANGELES, CAL.—John B. Miller, president of the Edison Electric Company, speaking of the company's plans, says: "The first power line in the vicinity of Santa Barbara will be a branch line from the 60,000-volt transmission line, to connect with the 28,000-hp plant we are building at the mouth of Kern River, but this plant will not be completed for about 18 months. We expect, however, to complete a 1000-hp plant on Lytle Creek some time in February or March, and another plant of 2000-hp capacity on the Santa Ana River, immediately below our 4000-hp plant on that river, some time next summer. Both of these plants will be connected with our main transmission line running from Santa Ana River and Mill Creek, back of Redlands, to Los Angeles, and will represent an expenditure of about $350,000."

SOUTH GLASTONBURY, CONN.—Engineers Daboll & Crandall, of New London, are preparing an estimate of the available power and cost of development of Roaring Brook.

SANDERSVILLE, GA.—Bids are wanted Jan. 27 for constructing water works and an electric light plant.

ALBANY, GA.—The city of Albany has agreed to take 300 electrical horsepower for lighting the city and supplying power at the water plant, from the Florida capitalists who have in hand the proposed development of Big Shoals on Muckafoonee creek. It is proposed to develop from 15,000 to 25,000 horsepower.

ATLANTA, GA.—Park Woodward, general manager Water Works Department, in his annual message recommends an electric light plant for No. 2 pumping station, the filter house and the old and new reservoirs, at a cost of $5000.

HAILEY, IDA.—R. J. Allen, of this city, is promoter of an enterprise to build a power plant here at a cost of about $50,000.

MOLINE, ILL.—The People's Power Company will purchase two watertube boilers and one 250-hp engine.

PEORIA, ILL.—The Peoria Gas Light & Coke Company has been bought by the Peoria Gas & Electric Company. The capital stock has been increased from $2,000,000 to $2,500,000.

TAMMS, ILL.—The Illinois Milling & Elevating Company has been incorporated, with a capital of $50,000. It will furnish electric light and power. The incorporators are Oscar T. Tamm, Joseph Mayer, Jr., David S. Lansden.

MONTPELIER, IND.—The city is considering the question of constructing an electric light plant.

NORWAY, IND.—A. A. McKain, of this place, and others, of Indianapolis, have purchased the power dam in Tippecanoe River, and will at once establish an electric power plant.

SOUTH BEND, IND.—The South Bend Electric Company is preparing to place its wires underground, and arranging for the new lighting system, which will require about 450 enclosed arc lights. F. A. Bryan is general manager.

VINCENNES, IND.—The City Council has granted P. K. Tyng an extended franchise of 25 years for his electric light plant and service. Mr. Tyng is to furnish free lights to the city hall, the city to pay for all fixtures and breakages after once placed.

MONTICELLO, IND.—A. A. McKam and others, of Indianapolis, have purchased the water power dams at Norway and Tioga, on the Tippecanoe River near here and will at once improve them for the purpose of erecting electrical power plants. The promoters propose furnishing electricity to the surrounding towns and cities.

CRESTON, IA.—M. E. Springer, of Des Moines, is interested in the construction of an electric light and gas plant for Creston.

BAXTER SPRINGS, KAN.—It is stated that the deal for the transfer of water rights at Baxter Springs from the city to W. G. Sergeant, of Joplin, Mo., has been closed. He proposes commencing work in the spring. The power house will be constructed at Lowell.

PORTLAND, ME.—The North Shore Power Company has been incorporated to supply electricity for light, heat and power; capital, $500,000. C. C. Le Grow and E. E. Stone, both of Portland, and H. E. Stevens, Boston, Mass., are among the directors.

WARE, MASS.—The Ware Electric Company has petitioned the State Board of Gas and Electric Light Commissioners at Boston for authority to issue additional capital to the amount of $10,000 for the purpose of extending the plant.

HOLYOKE, MASS.—According to the annual report of the Gas and Electric Department of Holyoke, the equipment of the electric light station which was transferred to the city less than one year ago was at that time obsolete and overloaded. The poles were decayed and the wire insulation badly impaired, and all overloaded. It has been decided to discard all of the present electrical machinery and substitute for the small units two large ones that will develop electrically and economically all of the power furnished by the water wheels. It is also planned to change the entire street lighting service to enclosed arcs and add 236 lights to the 263 at present in use, making a total of 499 street lamps.

BUFFALO, N. Y.—The electrical workers of this city are on a strike because the contractors decided to keep "open shop."

SCHENECTADY, N. Y.—The Schenectady Railway Company secured the contract for lighting the city for three years at 22½ cts. per lamp per night.

CAMDEN, N. Y.—The citizens voted Dec. 29 to issue $40,000 bonds for the establishment of a municipal electric light plant. H. B. Sweet, of Utica, is engineer. H. G. DuBois is president of the Council.

ONEIDA, N. Y.—It is stated that arrangements have been made by the Madison County Gas & Electric Company to acquire the Lime Kiln Falls electric water power plant. Mr. DeWitt C. Haddock will complete the Falls plant and have it ready by July 1 next. The plant will have a capacity of 1500 horsepower and will cost about $130,000.

WINSTON, N. C.—W. T. Brown and others have been appointed a committee to investigate the feasibility of an electric lighting plant in this city.

ATTICA, OHIO.—An election has resulted in favor of issuing $6250 in bonds for the purpose of building a municipal lighting plant.

TOLEDO, OHIO.—The Hocking Valley Railway Company will spend $50,000 in installing a power plant and equipping all its machinery on its coal and ore docks here with electricity in place of steam.

XENIA, OHIO.—Charles Darlington, M. D. Stewart and others are planning to organize a co-operate electric light company. The capital stock will be $30,000. The company will erect a lighting plant and furnish current for commercial and private use.

KENTON, OHIO.—The Kenton Ice Company will erect an artificial ice plant and install considerable electrical equipment. The York Manufacturing Company, of York, Pa., is supplying plans for the plant. W. P. Bowman is manager of the Kenton Company.

ELYRIA, OHIO.—The Ely Realty Company is erecting an addition to its power plant and will install a 300-hp gas engine direct-connected to a Westinghouse alternating current generator. A rotary converter will be installed for supplying direct current to a portion of the system.

MASSILLON, OHIO.—At the recent meeting of stock holders of the Massillon Light, Heat & Power Company, directors were elected and they, in turn, elected officers as follows: President and treasurer, Warren E. Russell; vice-president, Joseph K. Russell; secretary, Maurice R. Bissell.

SHERIDAN, ORE.—The Yamhill Milling Company, of Sheridan, is considering the installation of an electric light plant for its mill, and also for lighting the town.

ROSEBURG, ORE.—The plants of the Douglas Electric and Water Company, of this city, and the Roseburg Water & Light Company, of Winchester, have been purchased by the Oregon Boom & Timber Company, the consideration being $125,000 for the Winchester plant and $50,000 for the Roseburg holdings.

BRADDOCK, PA.—An ordinance has been submitted to Council providing for an issue of $20,000 bonds for a municipal electric light plant.

GETTYSBURG, PA.—The Council has authorized the Light Commission to procure an estimate of cost of constructing and operating a municipal electric light plant.

HARRISBURG, PA.—According to a report made by Prof. Jackson, of the State College, the Harrisburg Light, Heat & Power Company is supplying not more than one-half the light required by the contract with the city. The investigation was made at the instance of Mayor McCormick.

SARATOGA, TEX.—The Sour Lake Electric Light & Power Company, of Sour Lake, will install an electric light and power plant at this place.

SALT LAKE CITY, UTAH.—A deal which creates an electrical monopoly in the state was consummated in the merger of the Utah Light & Power Company and Consolidated Railway & Power Company under the name of the Utah Light & Railway Company. The new corporation is capitalized for $10,000,000. Joseph F. Smith was selected president of the company and the former manager of the Utah Light & Power Company, R. S. Campbell, will be secretary and general manager. Extensive improvements will be commenced at once, and the directors have in view the outlay of about $1,000,000 in the next few years in repairs and improvements. Of the total capitalization $4,000,000 will be held for sale for the improvement of the plant and system.

WISE, VA.—The Cumberland Light & Transportation Company has been organized at Wise, by E. M. Fulton, H. M. Smyth, G. A. Esser and others to build an electric railway from Wise, connecting the mining towns of Norton, Glamorgan, Dorchester, Coeburn, Big Stone Gap and Stonega. Bids for construction will be received till Jan. 15. Address, E. M. Fulton, of Wise.

EVERETT, WASH.—It is reported that J. T. McChesney will expend about $500,000 in developing the falls near Wallace on May Creek.

SHELTON, WASH.—W. H. Kneeland has purchased the Shelton electric light plant and proposed increasing it and improving the service.

MOUNDSVILLE, W. VA.—The Council has granted a franchise to the Moundsville Electrical Company.

SHAWANO, WIS.—The citizens have voted to issue bonds for enlarging the electric light plant.

ANTIGO, WIS.—A charter has been granted to the Antigo Light, Heat & Power Company, of Antigo; capital, $50,000. Incorporators: W. L. Elliott, C. T. Mortensen and F. C. Duchac.

OTTAWA, ONT.—The ratepayers of the city of Ottawa have voted by a large majority to adopt a by-law providing $50,000 for the establishment and operation by the municipality of an electric lighting plant for street lighting purposes.

MONTREAL, QUE.—Engineer J. Phelps, of Baltimore, Md., has submitted his report to Council on the cost to the city of a modern conduit system. There is an estimate on four classes of conduits to be known as Classes A, B, C and D. According to Class C, which he recommends for Montreal, the cost per duct foot is 37.24 cts.; the main conduit to cost $1,005,750, and the distributing system $199,100. According to Class A, the cost per duct foot is 45.9 cts.; Class B, 43.34 cts., and Class D, 34.68 cts.

THE ELECTRIC RAILWAY.

OPELIKA, ALA.—Rush Taylor has secured a franchise to build an electric railway from Opelika to Auburn. The road will be known as the Opelika Electric Street and Interurabn Electric Railway.

SAN FRANCISCO, CAL.—The shareholders of the Petaluma & Santa Rosa (Electric) Railway will meet in San Francisco, on Feb. 9, to authorize a mortgage to the Mercantile Trust Company, of San Francisco, to secure an issue of $1,000,000 of 5 per cent 20-year gold bonds, to be dated March 1, 1903, and to be subject to call on six months' notice at 110. Of the bonds, $500,000 will be reserved for extensions. E. H. Rollins & Sons, the bankers, have arranged to finance the enterprise. The company was incorporated on June 20, 1903, with $1,000,000 authorized capital stock, to build 32 miles of electric railway between Petaluma, Sebastapool, Santa Rosa and Forestville. There will be steamer connection between San Francisco and Petaluma. The officers and directors are John A. McNear, president; W. F. Kelly, vice-president; Burke Corbet, treasurer; Thomas Archer, secretary; Francis Cutting, of the Cutting Company; W. F. Kelly, of the Oakland Transit Company; Thomas Archer, of the E. H. Rollins & Sons, of Boston; John A. McNear, Burke Corbet, W. H. Pope and F. A. Brush, of the Santa Rosa National Bank, directors.

CHICAGO, ILL.—The Metropolitan West Side Elevated Railroad Company has made application to list $7,500,000 common stock on the New York Stock Exchange.

TAYLORVILLE, ILL.—David M. Sharp, of Taylorville, has applied to the Secretary of State for articles of incorporation for an interurban railway system in this county. The company will be capitalized at $205,000.

CHICAGO, ILL.—The Springfield & Peoria Railway has been incorporated with a capital of $50,000. Incorporators and first board of directors: Francis S. Peabody, John J. Hart, Arthur W. Underwood, Frederick W. Upham, all of Chicago, Ill.

PEORIA, ILL.—The Peoria & Rock Island Traction Company has been incorporated; capital $100,000. Incorporators and first board of directors: W. B. McKinley, Charles Zilly, B. R. Stephens, B. E. Cartwright and J. E. Barry, all of Champaign, Ill.

MENDOTA, ILL.—The Northern Illinois Traction Company has been incorporated with a capital of $25,000. The incorporators and first board of directors are Hal B. Allen, Erie, Ill.; W. A. Burkley, Mendota, Ill.; George W. Hamilton, Means A. Booth and W. E. Booth, New Bedford, Ill.

NATICK, MASS.—The Natick & Needham Street Railway has gone into the hands of N. Summer Myrick as receiver on the petition of its stockholders. The petition for the appointment of a receiver was the outcome of the refusal of the receiver appointed for the South Middlesex Street Railway, to which the Natick & Needham Street Railway was leased, to operate the latter line. It is said that the Natick & Needham will now surrender its charter; that the road will be dug up, and that the rails and rolling stock will be disposed of at the best price they will bring.

BROOKLYN, N. Y.—The Appellate Division of the Supreme Court, in Brooklyn, has handed down a decision sustaining the city's ordinance requiring street railroad companies to carry passengers from any part of the railroad to their destination at any other part of the same railroad without a change of cars.

GLOVERSVILLE, N. Y.—The Fonda, Johnstown & Gloversville Railroad Company has purchased the property of the Adirondacks Lakes Traction Company, consisting of the electric railway leading from Gloversville to Mountain Lake, and all the hotels, pavilions and other property at the lake. The road will be run independently of the Fonda, Johnstown & Gloversville system. The following officers have been elected: John Shanahan, president; Lyman K. Brown, vice-president; E. H. Steckel, secretary.

NEW YORK, N. Y.—Supreme Court Justice Fitzgerald, of White Plains, has granted an order allowing the Interurban Street Railway Company to assume the new name of "New York City Railway Company" on and after Feb. 10 next. The petition of the company asking for the change says: "At the present time there are several corporations operating in the same district, which results in confusion tending to prejudice its interests, and the name it desires to adopt will better indicate the nature and extent of its system, which comprises practically the entire surface street railway system in New York City."

CHARLOTTE, N. C.—The Goldsboro and Seven Springs Securities Company is a new North Carolina concern which, among other rights, has the privilege of building street car and trolley lines, hotels, roads, etc., capital $150,000.

YORK, PA.—The York County Traction Company, which has been negotiating for the purchase of the Hanover & McSherrystown Street Railway Company and the Hanover Light & Power Company, has consummated the deal, and the two companies will now be merged in one and form one county system covering almost every important point in York County. The consideration was $100,000. The officers of the Hanover & McSherrytown Street Railway Company resigned their positions Dec. 31, and the new officers were elected to take their place as follows: Captain W. H. Lanius, of York, president; Ellis S. Lewis, of York, treasurer; George S. Billmeyer, John W. Steacy, of York; William A. Himes, of New Oxford, Harry N. Gitt, Charles Ehrhart and Thomas J. O'Neall, of Hanover, directors.

WAUWATOSA, WIS.—Mayor E. D. Hoyt and the Common Council of Wauwatosa have filed an answer to the petition of the residents for a writ of mandamus to compel the city authorities to submit the question of railway franchise ordinance to a vote of the people, in which they state that the latter had no right to vote upon the subject. They assert that the ordinance is not a new one and that it seeks to extend existing railway lines and is simply an extension or an amendment of the present ordinance, and therefore does not come within the law enacted by the legislature last spring.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN CAR TELEPHONE COMPANY has been incorporated at Grand Rapids, Mich., with a capital stock of $2,500,000.

THE VACUO-STATIC CARBON COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $60,000. The directors are P. A. Clum, C. M. Lane and F. J. Cross, Rochester.

THE ECONOMIC ELECTRIC COMPANY, of New York, has been incorporated; capital, $200,000. Directors: L. L. Roberts and Edmund Tweedy, of New York, and William Newcomb, of Tenafly, N. J.

THE ELECTRIC DEVELOPMENT & SECURITIES COMPANY, with a capital stock of $100,000, has been incorporated in New York City. The directors are W. C. Goodale, J. M. O'Laughlin and M. R. O'Laughlin, of New York City.

THE CUMBERLAND ENGINEERING COMPANY has been incorporated at Cleveland, Ohio, with $25,000 capital stock, by W. H. Pelton, A. E. Thompson, E. Shoemaker, E. L. Dulz and N. B. Daerr. The company will do a general contracting business.

THE PRISMATIC ELECTRIC MFG. COMPANY, of New York City, has been incorporated to manufacture prismatic and electrical novelties. The capital stock is $200,000, and the incorporators and directors for the first year are M. E. Wooster, C. E. Bleyer and L. Wallach, of New York City.

THE MOLINE INCANDESCENT LAMP COMPANY has been incorporated at Moline, Ill., by Albert H. Kreitler, C. F. Gantz and E. E. Morgan. The purpose of the company is to manufacture incandescent lamps and other electrical apparatus. The capital stock is $30,000, and the first board of directors is composed of the following-named gentlemen: C. H. Deere, E. E. Morgan, H. W. Cooper, C. P. Skinner, C. R. Wood, Edward Coryn and A. H. Kreitler.

OBITUARY.

MR. W. W. SKILES.—We regret to learn the death on Jan. 9, of Mr. W. W. Skiles, the president of the Shelby Electric Company, of Shelby, Ohio. The funeral took place on Jan. 13.

MR. A. G. NICHOLS.—Mr. Amos G. Nichols, president of the New York Safety Steam Power Company and president of the Langworthy Machine Company, died at Hope Valley, R. I., on Wednesday, Jan. 13, after a short illness. Funeral services were held at Hope Valley on Jan. 16.

MR. A. G. GARRISON.—We learn with deep regret, just at the moment of going to press, the news of the death of Mr. W. O. Garrison, president of the Columbia Incandescent Lamp Company, of St. Louis. This young and talented man has been ill for some time, but this news will come as a severe blow to a wide circle of friends and admirers all over the country.

PERSONAL.


W. T. GENTRY.

MR. W. T. GENTRY.—Vice-president and general manager W. T. Gentry, of the Southern Bell Telephone and Telegraph Company, was given a dinner at the Capital City Club, Atlanta, Ga., on Thursday, January 14, by the officials of the company in commemoration of the twenty-fifth anniversary of his continuous service. Among other prominent officials invited or attending were Mr. Edward J. Hall, president of the company, and vice-president of the American Telephone and Telegraph Company, and Mr. Charles H. Wilson, general superintendent of the latter company and formerly general manager of the Southern Bell Company. The territory under the management of Mr. Gentry embraces seven southern states and the company operates upwards of 40,000 telephones. Mr. Gentry is a man of much energy—democratic in his ways and personally known to almost every employe—and to thousands of business men and officials throughout the seven southern states within the jurisdiction of his company. He is gentle of speech and beneficent of mind—wise to resolve and patient to perform—of the mildest manner and gentlest heart. Mr. Gentry entered business life as a telegraph operator for the Southern Atlantic Telegraph Company in 1870, at Charlottesville, Va., serving the company later at Lynchburg and Richmond, Va., finally receiving the appointment of circuit manager with headquarters at Gormondsville, Va. The Southern Atlantic Company being absorbed in 1876 by the Western Union Telegraph Company, Mr. Gentry was transferred to Wilmington, N. C., at which place in 1879 he built the first telephone exchange, using the Edison patents and apparatus. After three years' service, he was again transferred to the management of the Western Union office at Alexandria, Va., constructing at that place a telephone exchange in the interest of the Southern Bell Telephone and Telegraph Company and managing it in conjunction with the Western Union office until the latter part of 1883 when he accepted the appointment of manager of the same company's telephone exchange at Atlanta, Ga., and later was appointed assistant superintendent, which position he held until 1896, when he was again promoted to the position of general superintendent of construction for the entire territory of the company, which included seven southern states. In 1901 Mr. Gentry became general manager, and in 1903 was elected vice-president and general manager, which position he now holds with headquarters at Atlanta.


GEORGE W. DAVENPORT.

MR. GEORGE W. DAVENPORT, whose portrait is presented herewith, has, as noted in these columns, been elected recently third vice-president of the Niagara Falls Power Company, that office having been created quite recently. The appointment took effect on Jan. 1 and Mr. Davenport is now in residence at Niagara Falls, where he will perform the duties assigned to him by the second vice-president, whom he will assist, Mr. Rankine, finding that the constantly increasing business of the Niagara Falls Power Company and its allied concerns demands attention from a man of Mr. Davenport's scope of experience, energy and ability. Mr. Davenport, after a course in the Massachusetts Institute of Technology, and factory experience with the Thomson-Houston Electric Company at Lynn, Mass., became general manager of the Thomson-Houston International Company, and for eight years was connected with that company and the General Electric Company. When the General Electric Company, in 1893, turned over to a board of trustees, known as the trustees of Street Railway and Illuminating Properties, over ten millions of securities of various electric lighting and railway companies situated in different parts of the United States, Mr. Davenport became assistant to the trustees, and had a varied experience in the examination, operation, and management of many of the 136 properties in which the trustees were interested. He has recently been second vice-president of the Planters' Compress Company, whose head office is in Boston. As an associate of Mr. C. A. Coffin in the old Thomson-Houston days, and latterly as an expert and manager in connection with electric light and power properties, Mr. Davenport has made a great success, being also one of the most widely known men in the central station field. He is a man of marked personality, charming manners and is not only conversant with affairs but a deeply read student, one of his hobbies being the collection of old books and early electrical literature. His new appointment gives much pleasure to a host of friends who have watched his career with interest.

DR. LEE DE FOREST has returned from England where his wireless telegraph system has been attracting considerable attention.

MADAME CURIE, of radium fame, has been awarded $12,000 as part of the Osiris prize by the Institute of France, and M. Branly has been awarded the remaining $8000.

MR. W. T. JACKSON, western representative, was recently in Chicago on an extended trip throughout the west, in the interests of G. M. Gest, the contractor of Cincinnati, New York and Boston.

MR. ERNEST H. DAVIS, secretary of the National Electric Light Association, has advised members that the transactions for last year will soon be out, but has been delayed by the unusual bulk of its contents.

MR. GUY E. PAINE, formerly superintendent of the Postal Telegraph-Cable Company, at St. Louis, has been appointed general superintendent of the southern division of the same system, with headquarters at Atlanta, Ga.

MR. H. F. PARSHALL, the well-known consulting electrical engineer who has so long been domiciled in England and engaged there on important electric railway work is visiting this country for a brief stay of two or three weeks.

MR. F. M. ASHLEY has become associated with Philip K. Stern and will conduct business under the firm name of Ashley & Stern at 130 Fulton Street, New York, as consulting electrical and mechanical engineers and solicitors of patents.

MR. GUSTAVO LOBO, an electrical and mechanical engineer, well known at one time in this city, announces his wedding at the Church of Our Lady of Lourdes, City of Mexico, to Miss Maria de los Dolores, daughter of Mr. and Mrs. Agustin Pradillo, of that city.

MR. AUGUSTUS D. WALLER, a well-known English educator and member of the Senate of London University, is about to publish in this country through E. P. Dutton & Company a small volume entitled "Eight Lectures on the Signs of Life from Their Electrical Aspect."

MR. B. F. ALLEN, chief engineer of the Harrisburg, Pa., Foundry Company Machine Works, was in town for a few days this week. He reports that business is very promising and that the works have contracts in hand which will keep them busy night and day for at least four months.

MR. G. H. PIERCE.—The International Telephone Mfg. Company, of Chicago, has secured the services of Mr. Geo. H. Pierce, who formerly represented the Stromberg-Carlson Company in New York and New Jersey. Mr. Pierce will cover the state of Iowa with headquarters at Des Moines.

MESSRS. RUEBEL & SCHULTE, engineers of the Anheuser-Busch Brewing Company, of St. Louis, Mo., are now in New York for the purpose of securing estimates for equipment to be installed in an extension to the company's plant. It is proposed to install 800-hp of additional electrical machinery.

MR. ANATOL FOMILIANT, student at the Imperial Technical College of Moscow, Russia, is on a visit to this country to make arrangements for an excursion to the World's Fair of a body of students from the Moscow College. The excursion has been authorized by, and will be under the auspices of, the college authorities.

MR. MAX LOWENTHAL, secretary and engineer of the Prometheus Electric Company, of New York, has started on a trip through the eastern and middle states to establish agencies for the electric heating apparatus of that concern. A number of interesting technical problems await his attention. The company has already established several agencies.

MR. A. FREDERICK COLLINS has recently prepared three contributions for the Encyclopedia Americana of the *Scientific American* on telegraphy, wireless telegraphy and wireless telephony. He has also been a contributor to the International Encyclopedia on wireless telegraphy. Some of his recent "popular" work for the *New York Herald* has been excellent.

MR. FRANK WISNER has been appointed chief electrician of the electrical equipment in the various power houses of the Cleveland Electric Railway Company. He succeeds Mr. George Bacon who has become identified with the Willard Storage Battery Company of Cleveland. Mr. Wisner was formerly chief electrician of the Cleveland City Railway Company.

MR. ANDREW KEISER, superintendent of telegraphs of the Pennsylvania Railroad, and Mr. R. H. Rudd, assistant engineer of signals, are going abroad to study features of transportation work in Europe, including England, France and Germany. Mr. R. E. McCarty, assistant superintendent of the Pittsburg division of the Pan Handle system, is to accompany them.

MR. W. E. L. GAINES, general manager of the National Telephone Company, London, and Mr. Frank Gill, engineer-in-chief of the same company, are making a tour of telephone and electrical plants of this country and Canada. They recently visited the exchange of the Buffalo Telephone Company and then went to Niagara Falls to inspect the power plants there.

MR. J. E. WOODBRIDGE, of the railway engineering department of the General Electric Company at Schenectady has been transferred to the British Thomson-Houston Company, at Rugby, England, where he should now be addressed. Mr. Woodbridge was at one time editor of *The Electrical World* and left its staff a few years ago to devote himself more particularly to direct engineering work.

MR. E. G. LONG, who was for several years associated with the Brush and General Electric companies, and who, during the past five years, has acted as vice-president and general sales agent of the Peckham Mfg. Company, has opened offices at 95 Liberty Street, for the purpose of doing business in electric railway materials. Mr. Long will make a specialty of catering to the export trade and is figuring on some substantial contracts.

MR. SAMUEL INSULL, president Chicago Edison Company, has been in New York City this week, taking among other things an active share in the Edison Medal Association of which he is chairman and which intends to present its fund to the Institute at the annual dinner at the Waldorf on February 11. Mr. Insull is also very much interested in the historical exhibit of the Edison companies to be made at St. Louis this year.

MR. W. J. JOHNSTON has sold to Mr. H. M. Swetland his stock interest in the Johnston Publishing Company, the corporation which owns *The Engineering and Mining Journal*, and has severed his connection with that publication. Mr. Johnston will now devote his entire time and energies to the development of the *Pacific Coast Miner*, which he has owned personally for the past year, but to which heretofore he has only been able to give "absent treatment."

MR. H. M. DEAVITT, analytical and consulting chemist and assayer, with a large practice in Chicago, has taken the management of the Chicago office of the Engineering Company of America, 159 LaSalle St. Mr. Ellis C. Spoker, the expert in cement plants, has also become associated with the Engineering Company of America with headquarters at its Chicago office. Mr. Edward Everett, civil engineer, who has specialized in railroad work, and who made the survey for one of the Hudson River tunnels, has become associated with the company at its New York office, 74 Broadway.

MR. M. G. HUBBARD who has been recently elected secretary and treasurer of C. E. Hewitt & Company, engineers and contractors, Park Row Building, New York, was for 13 years engineer and general superintendent of the McGuire Manufacturing Company, of Chicago. For the last three years he has been engaged in exporting railway supplies at No. 114 Liberty St., New York. While with the McGuire Manufacturing Company he spent considerable time on the road and became well known in electrical railway circles. By experience and training he is well fitted for his new business, and his many friends will wish him every success.

MR. N. S. BRADEN, formerly manager of the Westinghouse Electric & Manufacturing Company's district office at Cleveland, Ohio, has been appointed sales manager of the new Canadian Westinghouse Company, Ltd., and assumed the duties of that office on Jan. 1, 1904. Mr. Braden succeeds the late Mr. Thomas C. Frenyear, who died on Dec. 10. Mr. Frenyear's office was at Toronto, but Mr. Braden will make his headquarters at Hamilton, Ont. Mr. Braden was born at Indianapolis, Ind., thirty-four years ago. He finished his schooling in 1892, and went with the Jenney Electric Motor Company in his native city. He remained with that company until 1899, when he joined the Cleveland district sales office of the Westinghouse Company, as a salesman, where he later became manager.

PROF. S. P. LANGLEY, head of the Smithsonian Institution, was guest of honor at a dinner given by Mr. John Brisben Walker at the Waldorf-Astoria, New York, on January 19. There were many well-known men present. Mr. Walker said that he believed the Langley flying machine would be a commercial possibility within twelve months, and that within twenty-five years it would be the safest means of travel. Santos-Dumont received a rousing welcome. He simply addressed two words to Prof. Langley, these being "Be constant." Edwin Markham, the poet, indulged in a bit of imaginative picturing of the aerial highways of the future. Charles Francis Adams spoke in a similar vein, and went into detail regarding a plan of campaign against neighboring planets. Arthur Brisbane, Gen. Davis, Murat Halstead and others also spoke.

Trade Notes.

THE TRENTON PORCELAIN COMPANY, Trenton, N. J., is manufacturing a high grade of porcelain for all electrical purposes. Its goods have given satisfaction wherever used and the company is increasing its business rapidly. It makes a specialty of all porcelain made for particular uses.

THE HORTON-MASSNICK COMPANY, 11-23 Raynor St., Detroit, Mich., is now putting on the market the "Arkless" fuse formerly manufactured by another concern. This fuse may be placed in any position between terminals any distance apart. This affords a variety of adaptability not usually found.

THE ELECTRICAL POWER STORAGE COMPANY, Limited, 4 Great Winchester Street, London, E. C., England, is distributing its usual annual combination pad, consisting of a desk blotting pad, with a monthly calendar running across the top, and a diary attached to the side. It is a very useful adjunct to any desk. Inside of the diary is an insurance policy covering railroad accidents in the United Kingdom.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports an exceedingly good business on Columbia incandescent lamps for which it is sales agent. Up to this time the Columbia lamp has been manufactured in only the ordinary incandescent and series burning types. The Central Electric Co. is authority for the statement that it will now be able to supply miniature lamps of the Columbia brand which will doubtless meet with a large demand.

THE STUART-HOWLAND COMPANY, of Boston, Mass., is proud of its growth. Starting in a modest way four years ago, it has developed one of the largest supply businesses in New England. In order to impress upon the users of electrical supplies the present size and importance of the concern it has issued a tasteful calendar, with a half-tone illustration on it of its present quarters. The stock which this enterprising company carries of all kinds of supplies makes it a most convenient house to do business with in its section of the country.

THE LUNKENHEIMER COMPANY, Cincinnati, maker of superior brass and iron steam specialties, reports that owing to the unprecedented and growing demand for its specialties, it has again greatly increased its facilities and is now in position to guarantee reasonably prompt shipments. It also reports through its foreign branches an increasing export demand for its specialties and informs us that it will shortly place some new specialties upon the market, which will be contained in a very complete catalogue to be issued in the course of a few months.

FLASH LIGHTS.—Electric portable flash lights are growing more and more popular. The American Endoscopic Company, Providence, R. I., makes a flash and search light that is stated to be up-to-date and complete in every particular. An advantage in the construction of this device is that it can be easily taken apart and examined. On a card recently sent out by the company one of these lamps is shown dissected. The size of the lamp is 1½ by 9 inches and the life of the battery is stated in terms of flashes, being good for 8000 to 10,000 flashes, an equivalent of 7 to 8 hours continuous use. The battery is said to be good for three months' service.

HART & COMPANY, 256 Dearborn St., Chicago, have issued a four-page circular describing their bronze woven-wire gauze brushes, manufactured of the finest bronze woven wire gauze. It is claimed that they need no trimming and very little adjusting and that they will not cut or scratch the commutator. Another production of the concern is their Red Cross commutator compound which lubricates the commutator and prevents cutting. A six-page circular issued by the same people describes their carbon brushes, contains illustrations of six different shapes and styles and gives price on nearly 250 different sizes of brush.

THE TRUMBULL ELECTRIC MFG. COMPANY, Plainville, Conn., has issued a 48-page catalogue bound in an attractive cover which contains illustrations and descriptions of the various knife switches which it makes. In addition to that there are shown illustrations of its rheostats, sockets, cut-outs and the various specialties which it has put on the work recently, including its new flush receptacle taking the Edison base attachment plug. The pendant push button switch on which a patent was allowed in the early part of 1903 is also contained in this catalogue and a sectional view shows the operation very clearly. One push button is used both for opening and closing the circuit.

TAKING CARE OF ORDERS.—At the annual banquet of the Electric Appliance Company, Chicago, on Jan. 9, a series of papers were read by the salesmen and heads of departments dealing with the origin, care and shipment of an order. The taking and shipping of an order would seem to be but a simple matter. Those who listened to this series of papers, however, were impressed with the care and knowledge and thought necessary to properly handle an order to the satisfaction of an up-to-date supply house and of the wide awake customers of to-day. The Electric Appliance Company is to be congratulated upon its admirable organization and on the bright set of men with which it has surrounded itself.

THE CENTRAL STATION ENGINEERING COMPANY has been organized for the purpose of remodeling and placing on a paying basis electric light, street railway, gas and heating properties, which may wish to avail themselves of the experience of engineers who have had broad experience in those lines. They are prepared to investigate properties as to whether improvement is possible, what improvements should be made, and how and where to buy the necessary machinery for such improvements. They are also prepared to furnish plans for complete systems of office book-keeping, both cash and material accounts, so that the conditions of a plant can be ascertained with ease at any time. Mr. R. M. Kimball, vice-president of the Kenosha Gas & Electric Company, is the president in charge of the company. The offices are located at 1430 Old Colony Building, Chicago.

"NIAGRITE."—A material for preventing loss by fire and danger to life from the short-circuiting of high voltage electrical wires, for which the trade mark "Niagrite" has been adopted, is being placed on the market by the H. W. Johns-Manville Company. "Niagrite" is furnished in strips of several widths from 3 inches to 36 inches, suitable for wrapping spirally on electrical cables, and is held in place with asbestos fireproof glue, thus protecting the cables from external fire and confining any internal fire. The material presents a very neat and permanent finish and is not affected by atmospheric conditions. It has been adopted by the Niagara Falls Power Company, International Power Company, Buffalo Street Railroad Company, New York Edison Company, and other important electrical plants. Full particulars may be obtained from the asbestos department of the H. W. Johns-Manville Company, 100 William St., New York.

WATERBURY & COMPANY, of 69 South Street, New York City, Mr. George W. Nock, manager and electrical engineer, have issued the following notice to the trade: "On Jan. 1, 1904, we shall be completely equipped and prepared to fill orders promptly for all classes and kinds of electrical materials, special or standard. We shall be pleased to quote you on armature coils, field coils, or other windings, and to wind armatures complete for generators, motors, converters, etc.; also the designing and building of switchboards and special instruments, together with all special apparatus and materials required in electrical lines, and the laying out of complete installations for light and power purposes. Our plant is entirely new, and is planned with the idea of facilitating all orders, so as to give prompt and efficient service to all our customers at minimum prices. We guarantee all our goods to be the very best that knowledge and skill can produce."

OLD NEW YORK.—The Robins Conveying Belt Company, which has offices in the Park Row Building in this city, has just issued a very handsome broadsheet which is worth framing. It is two feet long by one foot wide, and shows New York as it was 250 years ago and as it is to-day, the contrast between the original old Dutch buildings and the sky scrapers of the present century being very remarkable. The oldest city was certainly as picturesque as the new, but in most other respects the new seems to have the advantage. Flanking the central pictures of old and new New York are two of buildings typical of the modern city. One shows the Flatiron Building and the other the Park Row Building, which is the highest in the world. We are sorry that the Robins Company cannot associate with this a picture of New York 250 years hence. The contrast between the city of that day and that of to-day would doubtless be as great as that between the two pictures now before us, and in the interim the Robins conveying belt has a lot of work cut out for it.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 12, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

748,911. MACHINE FOR COVERING FLAT WIRE; James C. Anderson, Jersey City, N. J. App. filed April 30, 1903. The machine folds the edges of paper tape and then opens the folds and inserts ribbon wire therein.

749,160. ELECTRICALLY OPERATED RAILWAY SWITCH; Claude W. Breedlove and Rudolph R. Grant, Berkley, Va. App. filed Jan. 12, 1904. Details.

749,175. AUTOMATIC AND MANUAL FIRE ALARM; William Livingston Denio, Rochester, N. Y. App. filed May 14, 1903. Details.

749,178. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed March 5, 1903. A Morse key having a curved arm projecting into a body of oil where the contacts are located.

749,185. ELECTRODE; Rudolf Hager, Halensee, Germany. App. filed Jan. 31, 1901. (See page 176.)

749,191. ELECTRIC SIGNALING APPARATUS; Felix B. Herzog, New York, N. Y. App. filed May 17, 1886. The principal feature consists in employing apparatus at a central station and the sub-stations whereby when the central operator manipulates the receiving apparatus, this will automatically indicate which of the sub-stations has signalled and will give in addition to this indication the signal which the transmitter has been prepared to transmit.

749,193. ELEVATOR; Nelson Hiss, New York, N. Y. App. filed Nov. 11, 1903. An endless cable arranged in two bights and moving always in the same direction, is caused to move the car one way or the other, or not at all, by varying the relative degrees of effort which the motor is permitted to exert upon the two bights of the cable, without changing the speed of the motor.

749,200. HIGH POTENTIAL SWITCH; John F. Kelly, Pittsfield, Mass. App. filed May 23, 1903. A circuit breaker, a device affording an easy path for abnormal frequency currents and a difficult path for normal frequency currents in series with a circuit breaker and means for cutting said device in and out of circuit.

749,204. ELECTRIC HEATING APPARATUS; Richard Kuch, Hanau, Germany. App. filed Nov. 7, 1902. The body to be heated has a strip of platinum foil applied to its surface for carrying the current, this material being of such a nature as to permit of close contact with the body.

749,213. ELECTROMAGNETIC DEVICE FOR VIBRATORY MASSAGE; Eugen K. Muller, Zurich, Switzerland. App. filed Sept. 20, 1902. An alternating current magnet actuating an oscillating knob through which the current passes when it is in operation.

749,224. COMPOUND APPLICABLE FOR INSULATING MATERIAL OR OTHER PURPOSES; Leonard M. Randolph, Newark, N. J. App. filed April 25, 1902. Varnish residue deprived of its liquid constituents.

749,225. TELEPHONE SYSTEM; Hope Redmon, Rufus L. Hall and Robert H. Conway, Cynthiana, Ky. App. filed Nov. 10, 1902. (See page 179.)

749,252. SYNCHRONIZER; Leonard Andrews, Manchester, England. App. filed June 25, 1903. For coupling alternating generators to the same circuit, a lamp indicator is operated without moving parts but through transformers having two primary windings and two secondary windings so connected to the generators, bus-bars and the indicator that one of the secondaries is excited when the current of both primaries are in phase and the other when the currents are in opposition.

749,255. ELECTRIC INTERLOCKING SWITCH AND SIGNAL SYSTEM; Gustave Bleynie and Theophile Ducousso, Paris, France. App. filed March 6, 1902. Details.

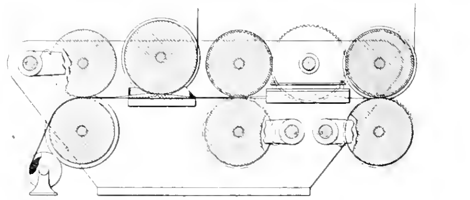
749,261. SWITCH; Troy Cope, New Waterford, Ohio. App. filed Aug. 20, 1903. Details.

749,268. ELECTRIC ARC LAMP; George R. Davison, Pittsfield, Mass. App. filed May 8, 1903. Such air as enters the globe through the carbon passage, must pass through a thin passage, the walls of which are heated, before it mingles with the gases in the globe.

749,271. ELECTRIC MOTOR CONTROL; Samuel T. Dodd, Pittsfield, Mass. App. filed June 4, 1903. A plurality of motors are controlled by shifting them from series to parallel while maintaining the connection of each armature to the corresponding field and using that armature and half of its field as an element in all combinations.

749,272. MOTOR CONTROL; Samule T. Dodd, Pittsfield, Mass. App. filed June 13, 1903. See preceding patent.

749,301. TROLLEY STAND; Washington H. Kilbourn, Greenfield, Mass. App. filed Aug. 14, 1902. Embodying among other details means for preventing the trolley pole from flying upward when the wheel leaves the wire.



748,911.—Machine for Covering Flat Wire.

749,306. TELEPHONE SYSTEM; Albion T. Libby, Chicago, Ill. App. filed Dec. 3, 1902. (See page 179.)

749,308. TELEPHONE-EXCHANGE; Frank A. Lundquist and John K. Norstrom, Chicago, Ill. App. filed Nov. 19, 1900. (See page 179.)

749,335. INSULATOR; Louis Steinberger, Brooklyn, N. Y. App. filed Sept. 18, 1902. A metallic sleeve is inserted in a porcelain insulator for strength, the sleeve then being filled with an insulating material and having a seat in its rear portion for the conductor.

749,336. INSULATED SUPPORT FOR WIRES; Louis Steinberger, New York, N. Y. App. filed Nov. 12, 1902. A clip for trolley wires in which a block of insulating material is inserted between the wire clamp and the supporting nipple.

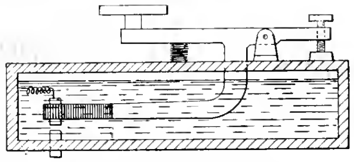
749,365. ELECTRIC BELL; Harry E. Dey, New York, N. Y. App. filed Aug. 15, 1901. A magnet having a reciprocating core projecting at both ends, is placed obliquely inside of two gongs, so that the core will strike one gong when moving in one direction and the other when moving in the opposite direction.

749,370. WIRELESS SIGNALING SYSTEM; Cornelius D. Ehret, Ardmore, Pa. App. filed Nov. 15, 1902. Consists in increasing the current of the received energy after having been transformed into the energy of currents in the receiving circuit.

749,371. WIRELESS TELEGRAPH RECEIVER; Lee De Forest, New York, N. Y. App. filed June 4, 1903. A magnetic detector for use with a duplex system whereby waves of other character than those for which the apparatus is designed, will not injuriously affect the receiving apparatus.

749,372. ART OF WIRELESS TELEGRAPHY; Lee De Forest, New York, N. Y. App. filed June 4, 1903. The method of sending a warning signal consisting in emitting a recurring series of high frequency waves varying both in their spark frequencies and in their continuity in accordance with a predetermned cycle, and in translating the waves into audible sound.

749,387. AUTOMATIC NON-INTERFERING REPEATER FOR FIRE ALARM CIRCUITS; Wm. H. Kirnan, Bayonne, N. J. App. filed Oct. 4, 1902. Non-interference magnets corresponding with the street-box magnets, prevent the operation of the repeater by any one of the street magnets while under the control of any other of them.



749,178.—Wireless Signaling Apparatus.

749,391. BOND FOR CONDUITS FOR ELECTRIC WIRES; George A. Lutz, New York, N. Y. App. filed May 7, 1901. A corrugated metal strap embracing the joint of conduit sections.

749,392. ELBOW FOR CONDUITS FOR ELECTRIC WIRES; George A. Lutz, New York, N. Y. App. filed May 7, 1901. The cover of the elbow is confined by lugs located at intervals around the curve and bent over the edge of the cover.

749,399. ALTERNATING CURRENT RELAY; Greenleaf W. Pickard, Amesbury, Mass. App. filed Aug. 21, 1903. A novel electro-magnetic movement actuated by alternating currents and employing three pole pieces, one of which is movable between the other two, and a coil embracing the movable pole and one of the other two pole pieces, the object being to provide a call receiving apparatus promptly responsive to alternating currents of high frequency and equally responsive reversely to the cessations of such current.

749,401. ELECTRIC RAILWAY; Leon W. Pullen, Philadelphia, Pa. App. filed April 18, 1903. Details of a system wherein magnets carried by the car actuate circuit controllers in the road bed to energize contact studs fixed at suitable intervals along the way.

749,409. IGNITING DEVICE FOR ACETYLENE GAS BURNERS; Henry C. Thomson, Boston, Mass. App. filed Nov. 6, 1902. Details.

749,416. SAFETY APPLIANCE SYSTEM FOR ELECTRICALLY ACTUATED ELEVATORS; Harry G. Wright, Providence, R. I. App. filed May 9, 1903. Relates to that class of machine adapted to automatically prevent the car from moving in case any of the landing doors are not fully closed.

749,418. METHOD OF MAKING CARBON ARTICLES; Edward Goodrich Acheson, Niagara Falls, N. Y. App. filed Sept. 4, 1902. (See page 176.)

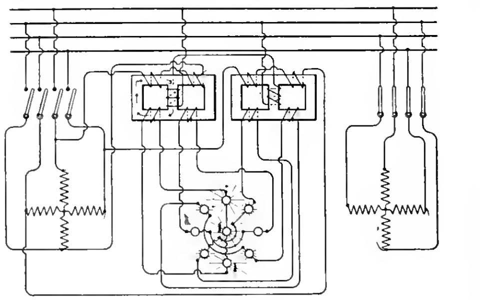
749,426. LIGHTNING ARRESTER; William E. Cone, Memphis, Mo. App. filed May 28, 1903. Details.

749,434. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed June 4, 1903. The spark determining member of the transmitting apparatus cuts the indicating member of the repeating apparatus out of the circuit during the time of each spark in the transmitting apparatus.

749,435. GENERATING SET FOR WIRELESS TELEGRAPHY; Lee De Forest, New York, N. Y. App. filed June 17, 1903. The set comprises an explosive engine, a dynamo, a choke-transformer, step-up transformer, a sparking circuit and a radiating conductor.

749,436. WIRELESS TELEGRAPH RANGE FINDER; Lee De Forest, New York, N. Y. App. filed June 17, 1903. A distance indicator comprising a variable resistance adapted to be inserted in the circuit with the indicating device in quantities having values proportioned to different distances.

749,439. ELECTRICAL CONTROLLING APPARATUS; John D. Ihlder, Yonkers, N. Y. App. filed March 22, 1902. The speed of an alternating current motor can be automatically changed while it is in operation.



749,252.—Synchronizer.

749,442. OUTLET BOX; Hubert Krantz, Brooklyn, N. Y. App. filed May 25, 1903. The openings are covered by removable disks which are held in place by radially projecting ears.

749,448. TELEPHONE-TRANSMITTER; Philip G. Randall, Boston, Mass. App. filed Feb. 9, 1903. (See page 179.)

749,460. ELECTRIC FURNACE; LeRoy W. Stevens and Bernard Timmerman, Chicago, Ill. App. filed Aug. 8, 1902. (See page 176.)

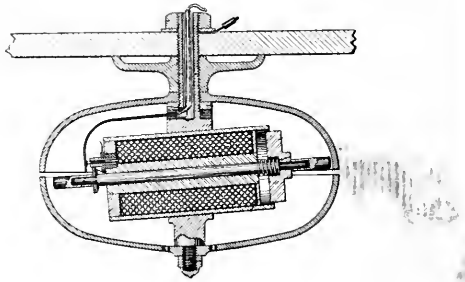
749,461. ELECTRIC FURNACE; LeRoy W. Stevens and Bernard Timmerman, Chicago, Ill. App. filed Oct. 29, 1902. (See page 176.)

749,462. FURNACE; LeRoy W. Stevens and Bernard Timmerman, Chicago, Ill. App. filed Oct. 30, 1902. (See page 176.)

749,481. TELEPHONE REPEATER; Merritt Gally, Brooklyn, N. Y. App. filed April 18, 1903. (See page 179.)

749,495. ELECTRIC STRIKING CLOCK; William Olson, Jersey City, N. J. App. filed Dec. 31, 1902. Details.

749,500. MINER'S ELECTRIC LAMP; Henry G. Prested, Camden Town, England. App. filed Feb. 7, 1903. The combustible gas diffusing through a porous diaphragm at a rate different from that at which air diffuses, is utilized to move a contact controlling the circuit of a glow lamp.



749,365.—Electric Bell.

749,509. TROLLEY; Willis D. Williams, Kirkland, Arizona Ter. App. filed Aug. 19, 1903. The flanges of the wheel are flanked by spiders, the arms of which project to retain the wheel on the wire.

749,584. WIRELESS SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed Oct. 3, 1902. A plurality of local circuits controlled by the wave-responsive device, each circuit containing means for selecting a certain message to the exclusion of other messages which may be simultaneously received.

749,597. ELECTRIC RAILWAY SWITCH; Johann G. Weniger, New York, N. Y. App. filed June 9, 1903. Details.

749,601. TROLLEY HARP DEVICE; Frederick H. Allen, Dunkirk, N. Y. App. filed Nov. 2, 1903. A construction enabling the wheel to be quickly removed and replaced.

749,628. ELECTRIC HEATER; George J. Peacock, Pittsburg, Pa. App. filed April 19, 1902. An electric heater embedded in protective material surrounding a water plug.

749,633. ELECTRICAL HOSE SIGNALING APPARATUS; William G. Seeley, Brookline, Mass. App. filed May 25, 1903. Details of the joint for maintaining the continuity of the circuit

749,657. AMUSEMENT AND ADVERTISING DEVICE; Miles W. Beemer, New York, N. Y. App. filed Jan. 5, 1903. A miniature lighthouse with a battery and motor in the base whereby the light shows alternately white or red.

749,694. MEANS FOR DETERMINING THE NAUTICAL BEARING OF NAVIGABLE VESSELS; Hermon W. Ladd, Boston, Mass. App. filed May 15, 1899. A conductor for catching Hertzian waves is shielded on all side except one, the shield being mounted to rotate and to carry with it an index that plays over a compass dial. When a signal is received, the position of the index indicates the bearing whence it came.

749,705. REGULATOR FOR INCANDESCENT LAMPS; Frederick C. Schofield, Washington, D. C. App. filed May 7, 1903. Details of a rheostat placed in the socket of the lamp.

749,710. ELECTRIC BLOCK SIGNAL SYSTEM; Louis C. Werner, Broadbrook, Conn. App. filed Dec. 12, 1901. A four-position semaphore and means for locking it at each position.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JANUARY 30, 1904. No. 5.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE . . . . . . 1139 Monadnock Block.
PHILADELPHIA OFFICE . . . . . . 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, JANUARY 30, 1904.

CONTENTS.

THE UNION ENGINEERING BUILDING.

Stage by stage the great Union Engineering Building project, due to Mr. Andrew Carnegie's munificence, advances to successful issue. The American Society of Civil Engineers, at its meeting last week, decided to canvass its members, and although many objections to union were raised, it is hardly to be believed that the civil engineers of the country will want to reject their share of the gift or imperil that of the sister societies, especially after Mr. Carnegie has just added $500,000 to the original $1,000,000 in order to take full care of the necessities of all the societies, if the Civils should "come in." However, in its broadest aspect, the matter is now "up to" the Civils; and we do not hesitate to say, knowing whereof we speak, that the Electricals count confidently upon their co-operation. In the early days of struggle, the Electrical Engineers were fostered by the Civils and always made at home at the old house in East Twenty-third Street; and it is sanguinely hoped thus to cultivate again at no distant date, in a grander, more splendid, more comfortable, place, the close fellowship of the past.

The Civils have been told that if they do not come in the project thereby falls to the ground. Should this be true, their responsibility would, indeed, be great, and we have no objection to their understanding it in that manner. But it is not true, and it is best that at each stage there should be the fullest light and understanding on the scheme. President Noble last week quoted apparently a remark of Mr. Carnegie, that he was likely to have five lots on his hands; but that Mr. Noble gravely misunderstood him seems at once evidenced, by the fact that last week also Mr. Carnegie acquired another lot, making, we believe, six in all, and bringing his generous investment in land which he is carrying for the societies—over and above the million and a half—to more than $600,000. It will be seen that this fact and Mr. Noble's theory, anxiously put forward by him to help bring his fellows into line, are not consistent or harmonious.

The various bodies can rest assured that Mr. Carnegie does not propose to see his magnificent ideas and purposes frustrated; it would be the first time in his history. Moreover, it would present the spectacle of a strong and wealthy society deliberately reaching forth its hand to prevent other societies less well off, but able to apply the endowment very beneficially, from receiving a single cent. That aspect of the case has only to be mentioned to show its improbability not less than the sinister interpretation the wide, outside world would bestow on such an action. The renewed and extended primacy in engineering matters which belongs to the Civils and has been deservedly won, will, by acceptance of the gift, be one of the brightest of auguries alike for the wider influence of the society and for the future of the profession.

NORTHWESTERN ELECTRICAL CONVENTION.

Elsewhere we print that part of the proceedings of the convention of the Northwestern Electrical Association not convered in the telegraphic report which appeared in our pages last week. As will be seen, the character of the papers read and the interest manifested in the proceedings show no falling off from the previous meetings of this flourishing association. As has almost invariably been the case in recent years when it came up, the topic which appeared to appeal most directly to the audience was that of central station auxiliary heating service. Indeed, at the meetings of all the associations representing the smaller central stations, this subject, when on the programme, arouses, judging from its lively discussion, even more interest than the most timely electrical topic. From the experiences related in such discussions it appears that the distribution of heat in connection with a lighting service can, without doubt, be made a profitable business in smaller towns and cities if a proper plant is installed and intelligently managed, and adequate rates are charged. Another advantage of such an appendage to a central station plant pointed out at the convention is that the combination offers a safeguard against the intrusion of a competitor in the lighting field, and the establishment of a municipal electric plant. In view of this situation the interest taken is well justified, and smaller central stations everywhere should not neglect to examine into the advisability of adopting heat distribution in connection with their lighting business.

Alternating-Current Power Curves.

It is known that when an alternating e.m.f. drives an alternating-current in a circuit, the power pulsates between a maximum and zero in the non-inductive condition, or between a maximum positive and lesser maximum negative quantity, when the load is inductive. The pulsation of power has twice the frequency of either alternating pressure or of the alternating current. Mathematical proofs of this proposition by several writers are to be found scattered through the polyglot literature of alternating-current technology. An additional demonstration is given in an article on page 215 by Mr. W. J. Berry. It follows that if a wattmeter mechanism could be constructed of sufficiently small periodic time, it would pulsate with twice the frequency of the generator assumed as bipolar. If this wattmeter mechanism drove a new bipolar generator, the frequency in its circuit would be double that of the first generator. By successive concatenations of wattmeter mechanisms to generators, the frequency might be redoubled indefinitely. Such an arrangement is probably quite impracticable, but it forms an interesting ideal method of frequency multiplication. The late F. Jarvis Patten at one time took up the investigation of the subject and devised some ingenious means for arriving at practical results.

Electrical Foucault Pendulum Systems.

The name of Foucault is not only associated with eddy currents, or electric whirls, in metallic masses, but also with the demonstration of the variation of the plane of vibration of a pendulum. The public demonstration which he made in 1851 at the Paris Pantheon, by swinging a pendulum from the dome, dominated popular fancy, and perhaps first made clear to the ordinary conception the rotation of the earth about its axis. His pendulum consisted of a 28-kilogram bob suspended by a steel pianoforte wire from the dome ceiling. The length of the pendulum is recorded as 67.21+ meters, so that the time of a single swing was 8.2 seconds, or 16.4 seconds for the complete period. There were thus less than four complete swings per minute. The angle of initial displacement was about 10°, and the pendulum was started from this displacement by burning the deviating thread. At a radius of four meters a ring of sand was raised, which was chiseled by a point on the bottom of the swinging bob. If the pendulum had been erected at the North Pole it would, naturally, tend to swing in its original plane, while the earth moved around beneath it, thus bringing the entire ring of sand through one complete revolution in 24 hours. This would mean an apparent advance of the bob along the sand at the rate of 25.13 meters in 24 hours, or 1.047 meters per hour, or 1.744 centimeters per minute; or 4.77 millimeters per complete swing. But the Pantheon at Paris, instead of being at the North Pole, or in latitude 90°, was in 48° 50′ 49″ north latitude, according to the record, and the deviation of the plane of vibration would be less than that at the Pole in the ratio of the sine of this latitude, or 0.7529. This would reduce the cut into the sand at each successive swing from 4.77 millimeters to 3.59 millimeters (about one-seventh of an inch), and the observed rate of cutting is said to have agreed with this result.

The trouble with this beautiful experiment was naturally the continual diminution of the successive swings. The rate of decrement is not stated; but the original stock of energy being limited to about 2,800 megergs at 10° original deviation, the continual frittering away of this energy in air friction and wire bending would soon greatly enfeeble the swings. Consequently, charming and instructive as the demonstration must have been, it was necessarily but short-lived. Real luxury in such a case would be to restore energy to the swinging bob without perplexing it, or affecting its plane of vibration, and thus to keep it going at full amplitude indefinitely. At the end of 24 hours the bob should have cut down the little sand bank to the extent representing the sine of the latitude, or 75.29 per cent. of a complete rotation in relative space. Probably elaborate precautions against tremors and air currents would become necessary in making the measurement under such ideally luxurious conditions. But after due care had been expended in safeguarding the plane of vibration from accidental disturbance, the perennially-reinforced pendulum ought to work out its own latitude very nicely in this way.

Another form of the mechanical system capable of revealing persistence of motion is the gyrostat, or rapidly-revolving small fly-wheel, whose axis tends to remain in the original direction, and to permit all terrestrial things to move around according to the earth's rotation. In fact, the pendulum may be looked upon as a particular form of the gyrostat, in which the rotation is incomplete and oscillatory. Of course, the gyrostat also suffers from the decay of initial energy, and only scorns the earth's movement for but a brief interval. The problem of reinforcing a gyrostat or pendulum, without disturbing its plane of vibration, has been considered by various writers, and electrical means have been favorites. It seems almost impossible to restore energy by mechanical force, through the medium of any contact with the moving parts, without at the same time exerting a bias or disturbing force on the plane of vibration. For example, the ordinary pendulum clock restores enough energy at each beat of the pendulum, from the mainspring or driving weight, to make up for the loss during the preceding beat; but in this case the plane of the pendulum is kept definite and moves around with the earth.

In the article on page 211 Mr. E. K. Adams considers various electromagnetic pendulums, and suggests a variety of ingenious electric expedients for maintaining the amplitude of vibration. It is, of course, hard to foresee the minor difficulties that may arise in the operation of such devices, but it would be very interesting to develop a working apparatus of this kind. At least one of the forms described should be capable of operating successfully. Such an apparatus, actually maintaining itself at full amplitude of vibration for a day at a time, would be both interesting and instructive; but its utility would be seemingly confined to interest and instruction. Any apparatus, however, which could be devised to operate automatically in spite of jars, or swings of its support, would, if not too expensive, be of great practical value. Possibly it would be hopeless to control the pendulum on board a rolling ship at sea; but it might be within the range of possibility to work a gyrostat electrically at a very high speed, so as to retain its direction of motion in gimbals, regardless of the behavior of the ship. If this could be done, the navigator, by running the apparatus during a measured time, might be able to compute the latitude, from the deviation of the plane of motion, by compass, during that period. Such a plan, if it could be made effective, would be available for latitude observations at sea, in fog, or darkness, or near the land.

ELECTRIC CONVECTION.

The December number of the *Physical Review* contains an important report by Messrs. Cremieu and Pender on the magnetic effect of electric convection, the conclusions of which we printed last week, and to which, owing to the unusual interest of the subject, we now return. The fundamental theory of electromagnetism declares that there are two kinds of electric currents, namely, currents of conduction, such as are guided by a wire forming a closed conducting circuit, and currents of displacement, such as are formed by electrostatic displacement in a dielectric. The conduction current is typically presented in a direct-current circuit, while a displacement current is presented in a condenser connected to an alternating e.m.f. The characteristic requirement of a conduction current is a wire or conductor. The characteristic requirement of a displacement current is an insulator subjected to a variation of electric force. It is also fundamental that whatever the nature of a current of given strength, by conduction, or by displacement, the magnetic effect is the same. An ampere of displacement current entering a condenser will have the same magnetic behavior as an ampere of conduction current in an overhead wire, allowance being made for the different geometrical distribution in the two cases.

In fact, we may be said to know that a conduction current is of the same nature as a displacement current, for the latter is a production of electric flux in a dielectric by electric charge, or electric potential difference; and the former is a movement of electric flux in a dielectric surrounding a guiding conductor. In a condenser, the varying electric flux which constitutes a current, is due to the variation of potential between the two opposed surfaces. In a direct-current circuit, the electric flux changes by running along the wire. Magnetic action accompanies change or motion of electric flux, and it should not matter how the change in electric flux is produced. The magnetism merely depends upon the change. If we take a charged body, say an electrified gilded billiard ball suspended by a silk thread, we know that electric flux emanates from the ball radially in free space, and very nearly radially in the middle of an ordinary room. When we move the electrified ball, as by swinging it, the electric charge moves also, and the electric flux moves conformably. That is, flux permeates the air in regions that were not previously permeated to the same degree, and vacates other regions that were previously more thoroughly permeated. This means, according to accepted theory, the establishment of displacement currents. It also means, by the same theory, the production of magnetic action in the neighborhood, during the motion. Consequently, when the electrified ball is stationary, there will be electric flux at rest, but no current and no magnetic action. When the ball is moving, there will be both current and magnetism. Moreover, the current and magnetism should increase in intensity with the speed of movement.

Maxwell predicted this result in 1873. The late Prof. Henry Rowland published experimental results in 1878, showing that the magnetic effect of a moving charge existed. It was commonly called the Rowland effect. Rowland rotated a disc with a charged conducting surface inside a box, and delicately supported a magnetic needle over the rotating disc outside the box. When the rotating disc was charged, or grounded, or reversed in electrification, the magnetic needle behaved in reasonable accordance with theory. It would be a serious matter for the present electrical theory if the effect could not be found. In fact, it may be said that if persistent effort showed that the magnetic effect of electric convection did not exist, it would kill the theory, and the death of the theory would upheave all our notions concerning electricity, which have been slowly and steadily put together by more than a century of the world's electrical labors. In 1884, however, Lecher tried the experiment in a somewhat different way, and failed to detect the effect. The magnetic effect to be expected is, however, very feeble at any speed and electrification that can be conveniently employed in a laboratory; so that the fact that a single observer did not obtain the effect, did not make electricians feel very uncomfortable, seeing that one good observer said he had found the effect. Negative evidence is not nearly so definite as negative electrification. Röntgen tried the experiment in 1885 and reported that he obtained the effect. Prof. Rowland and Dr. Cary T. Hutchinson repeated Rowland's original experiment in 1889, on an enlarged scale. They employed a pair of discs running in condenser boxes at high speeds, and with delicate magnetic needles outside. The effect was obtained within about 6 per cent. of its theoretical amount, the maximum variation being about 25 per cent. above or below. Prof. Himstedt took up the experiment about the same time and obtained the effect in a substantially similar manner.

So far only one observer of known ability had failed to obtain the effect. But in 1897 M. Victor Crémieu, of Paris, took up the experiment, or rather a whole series of experiments, and failed to get the effect. He went so far as to say, in 1901, that the effect was a myth. Theory showed that the effect was very minute under laboratory conditions; but positively declared that it must be there. So when Crémieu declared that the effect was certainly not there, consternation awoke. Crémieu worked for several years on the question and kept publishing papers to show that his experiments were all negative. In 1901 Pender, under Rowland's directions, repeated Rowland's experiments and made a long research into the matter, using a pair of discs revolving at high speeds. He obtained the effect within 2 per cent. of the theoretical amount, and within a maximum variation of 8 per cent. Pender kept repeating his experiments and getting the effect on this side of the Atlantic, while Crémieu kept repeating his experiments and not getting the effect on the other side of the Atlantic. Eichenwald, in Europe, recently repeated Rowland's experiment, with certain modifications, and got the effect, while Adams, in England, rotated electrified spheres, fastened to the spokes of a pair of wheels, and also obtained the effect.

In 1902 Poincaré suggested that Pender, who always got the effect, should meet and collaborate with Crémieu, who always did not get it, so as to arrive at a joint result. Lord Kelvin suggested that the joint research should be made in Paris. Johns Hopkins University placed the apparatus used by Pender at his disposal for transportation, and the Carnegie Institute defrayed the expense of his journey. M. Bouty placed his laboratory in the Sorbonne at the disposal of the two investigators, while the expense of their experiments was met by the Institute de France. The two men worked together for about three months. They finally report jointly that the effect is found. Incidentally, they trace the negative results previously obtained by Crémieu to the influence of certain thin layers of solid insulating material fastened to the surfaces of the revolving electric conductor. Just how these insulating covers prevented the effect is not clear, but it will probably be investigated. The real value of the joint report of Crémieu and Pender, recently published, lies not only in the final establishment of the magnetic effect of a moving electric flux, as required by theory, but also, and more particularly, in the international co-operation of scientific organizations to bring about this result. This international scientific co-operation is of enormous potential importance, and every effort should be made to foster it. Electrical science owes much to both of these joint observers for their collaboration.

Institute Annual Dinner.

Notices have been issued this week to members of the American Institute of Electrical Engineers, with regard to the annual dinner at the Waldorf-Astoria on February 11. As already stated, the price of tickets for gentlemen, without wine, is $7, and for ladies, $5. In addition to this, provision is also being made for admission to the boxes in the galleries of the ballroom at $1 per ticket. Mr. Calvin W. Rice, chairman of the committee, believes that a large number of persons will be glad to avail themselves of the opportunity thus to be present at a function which takes on a rather more historical and memorial character than the ordinary banquet, and it is not unlikely that the galleries may be filled with quite a large audience in addition to the guests at dinner on the main floor. It may be noted as an item of news that the menu being prepared will include a fine portrait in colors of Mr. Edison, being the gift to the Institute for that purpose by the New York Edison Company.

The Edison Medal Association is, of course, co-operating actively in the plans for the dinner, and many subscribers to the Fund, not members of the Institute, will be present. A large number of subscriptions to the Institute Edison Medal have been received, and the fund is already an assured success; but it is desired that it shall reach the full sum set forth in the circulars, in order that liberal provision for the foundation may be made in every respect. The suggestion has reached the Association that many of those who derive their living from the industries created by inventions in the lighting field would like to contribute also to the Fund, and the Association has prepared lists which are obtainable by companies desiring thus to contribute to the Edison Medal, the first, it is said, which has ever been offered in the field of electricity as an encouragement for studious and ambitious young men. Amounts of $1 and less will be received, and the lists of names will be bound into the album which it is proposed to give Mr. Edison containing the autographs of all the contributors.

Equipping the Erie Canal Electrically.

The question of equipping the Erie Canal electrically is just now attracting a great deal of attention, especially as a result of the tests described recently in these pages. Mr. Charles S. Boyd, superintendent of public works, believes that he can grant an indeterminate right to the International Towing & Power Company to install a similar electric towing plant the entire length of Champlain Canal. But in the first place, the law of 1893 permits him to allow only the temporary erection of a towing plant for testing the "efficiency, economy and practicability" of such device. It conveys no power which would enable any experimenters to do business and charge tolls. In the second place, the law restricts the experiments to corporations "authorized to transact business within this State," and this authorization, it is said at the Secretary of State's office, the towing company mentioned has not received. In the third place, the State Constitution forbids the lease, sale or other disposition of the canals. This is construed to mean that the canal banks, beds, towpaths, etc., are to be kept in the possession and management of the State forever, and that no exclusive privilege to do towing could be granted.

It is contended on behalf of Mr. Boyd's position that Section 38, Article 3, Chapter 338, Laws of 1894, gives warrant for his point of view. This provides that "the Superintendent of Public Works may authorize from time to time any person or corporation to construct, maintain and operate electric conductors for light, heat or power upon or along any canal, on such terms and conditions, not inconsistent with the public use of such canal, as he approves; in like manner contract for or permit the use of such light, heat or power upon any such canal, but not to create a charge against the State except against appropriations lawfully applicable thereto."

Justice Herrick's recent decision, enjoining a man from cutting ice on the canal without a permit from the Superintendent of Public Works, seems also to recognize the large power of that officer over the canals. He may grant or refuse permission to cut ice wherever he wills.

Precedent for the giving of a permit to an electrical towing company is indicated in the case of the Cataract Electric Company. In 1894 Superintendent Hannan issued a permit to that company to put up pole lines, etc., along the canal.

The Automobile Club Annual Dinner.

The Automobile Show in New York City came to a most successful close last week, the attendance being estimated at 50,000 and upwards, while the sales are also reported to have been very large. A fitting finale was given by the annual dinner at the Waldorf-Astoria on Saturday night, attended by over 300 guests, with about 100 ladies in the boxes, in addition. A notably large number of electrical men were present, and Mr. T. A. Edison occupied a prominent seat at the speakers' table. The decorations and electrical effects were admirable. The speaking also, under the skillful guidance of President Scarritt, was excellent. The keynote of the evening, as usual, was "good roads," and hearty endorsement was given by speakers and audience alike to the Brownlow measure now before Congress to spend $20,000,000 on the betterment of the main roads of the United States. Among those present were Messrs. L. R. Alberger, W. H. Baker, W. G. Bee, Hart O. Berg, E. T. Birdsall, N. F. Brady, A. H. Chadbourne, G. H. Day, C. J. Glidden, W. C. Gotshall, J. M. Hill, John A. Hill, Walter H. Johnson, W. C. L. Eglin, F. A. La Roche, T. C. Martin, Lewis Nixon, P. T. Dodge, A. R. Pardington, A. L. Riker, Henry Sanderson, J. Seligman, Angus Sinclair, E. L. Powers, H. M. Swetland, R. A. C. Smith, A. H. Whiting, C. C. Worthington and others in the electrical and allied fields.

World's Fair Electric Railway Test Commission.

A second meeting of the Electric Railway Test Commission of the Universal Exposition, St. Louis, 1904, convened in New York on January 27, 1904. All of the commissioners, namely, Mr. J. G. White, chairman; Mr. H. H. Vreeland, Mr. James H. McGraw, Mr. George F. McCulloch, Mr. W. J. Wilgus, were present, and a great deal of work was accomplished in furthering the plans for an elaborate series of tests of electric railway equipment at the Exposition. Much interest has been manifested by electrical engineers in the proposed tests, and the value of the engineering data which in all probability can be accumulated in this way, is not to be overestimated. The tests will undoubtedly have the effect of greatly stimulating interest in electric railway undertakings and promoting development along the lines best adapted to meet effectively the conditions most prominent in different classes of service.

The work has been divided into four main divisions, and special committees of engineers, who are specialists in the several divisions of electric railway work, have been appointed to prepare a schedule of the tests which will be made of the equipment offered in each class. These special engineering committees on the scope of the tests will take cognizance of the following branches of work: City and suburban equipments, interurban equipments, heavy traction equipments, new systems of electric traction. The committees are expected to prepare and submit preliminary reports to the commission on or before February 22, and the next meeting of the commission will take place in New York City, on Monday, February 29, at which time the reports of the special committees will be reviewed and passed upon.

High Speed in Germany.

A special cable dispatch from Berlin, of January 26, says: "Before the budget committee of the Prussian Diet to-day, Minister of Public Works Budde, discussing the recent electrical rapid transit experiments, said:

"The studies are still in their preliminary stages. We cannot undertake the transportation of the general passenger public electrically. It is still uncertain whether such roads can be economically profitable. The experiments will be continued with necessary precautions. The operation of the suburban road from Berlin to Grosslichterfelde gives the most favorable results, and we shall soon see the practical introduction of electricity on the Hamburg Elevated Railroad. The Prussian Railroad Administration will utilize the results of all these experiments."

The Siskiyou Power Transmission.

THE power house of the Siskiyou Electric Power Company is situated on Fall Creek, a tributary of Klamath River, eight miles from the well-known Klamath Hot Springs, two miles south of the Oregon line, in California, and twelve miles from Lairds, on the main line of the Southern Pacific Railway traversing California and Oregon. The power house is situated within 300 ft. of the Klamath Lake Railway, which made it very convenient for getting supplies on to the ground for the construction of the power house, pipe line and other work. The water for the operation of the plant is delivered from two creeks; one, Fall Creek, so named from the beautiful water falls along its course, supplies 1,500 miners' inches; and the other, Spring Creek, so named from the fact that its source of supply is in a great spring, supplies 700 inches. These creeks might have been named from the two respective seasons to denote that their water supply is continuous through spring and fall, as the flow of 2,000 miners' inches is uniform the year around. The supply appears to come from the drainage of a large area of tableland extending over thirty miles, where no water courses are to be found outside of these two creeks, which are evidently the drainage of this territory. Their chief peculiarity, however, is the fact that they do not freeze in winter because of their origin in and transit through a volcanic country.

A small wingdam has been built across Spring Creek for diverting the water into a 3,000-ft. ditch, which carries it first through a backbone of a mountain and thence to the main channel of Fall Creek. This ditch is 3 ft wide at the bottom, 6 ft. at the top, 3½ ft. deep and is built on a grade of 5 ft. to 100 ft. The course of Fall Creek ditch lies almost entirely through rock of volcanic formation, and it begins one mile above the upper falls of Fall Creek, from which it takes water by means of a diverting dam 115 ft. long and 4 ft. high. Very little work was necessary to put in this dam, as all natural conditions were favorable to it. The Fall Creek ditch is 4,650 ft. long, being 6 ft. wide at the bottom, 5 ft. deep and 12 ft. wide at the top, built on a 5 per cent. grade. The velocity is 3¾ ft. per second, which gives the ditch a capacity of 2,000 miners' inches. The only piece of flume in the work is a stretch of 96 ft. leading from the ditch to the penstock, it being 6 ft. wide by 4 ft. high and laid on solid rock. The penstock is solidly built on a cement foundation, laid on 12 by 12 timbers; that is, 14 ft. square by 16 ft. deep, and its walls are made up of 2-in. plank 6 in. wide, piled up flat one above the other. This wall is lined with a ⅛-in. coating of P. & B. roofing material, after which it is surfaced with 2-in. tongue and groove flooring. The whole penstock is braced with rods and turn-buckles extending diagonally across its section; finally it is painted inside and out with P. & B. paint and roofed over.

FIG. 1.—POLE LINE CONSTRUCTION.

FIG. 2.—VIEW OF MAIN DITCH.

FIG. 3.—GATE VALVE.

The pipe line is made of double-riveted steel pipe in the following lengths, the enumeration beginning at the penstock and extending downward: 37 ft. of pipe, 40 in. tapering to 30 in., of No. 10 gauge steel; 800 ft. of pipe, 30 in. No. 10 gauge steel; 700 ft. of pipe, 30 in. No. 6 gauge steel; 800 ft. of pipe, 30 in. ¼-in. steel; 500 ft. of pipe, 30 in. ⅝-in. steel.

The receiver is 60 ft. long, 30 in. in diameter, and made of 7/16 steel. From it there are taken three 12-in. taps for the respective three water wheels. From penstock to nozzle the head is 715 ft., giving a static pressure of 310 pounds to the square inch. A 30-in. hand-operated gate, which weighs 12,000 pounds, and which is provided with a 4-in. bypass gate, is inserted in the pipe line in the manner shown in the accompanying illustration, before the pipe line enters the receiver.

FIG. 4.—DIVERTING DAM.

The power house is constructed of a light steel frame, covered with corrugated iron. The main building is 30 ft. by 57 ft. in ground area, and the transformer room, which is separate from it—a similar building—measures 14 by 20 ft. in size. A 7-ton traveling crane runs the entire length of the main building, the latter being designed to contain three generator sets, one of a capacity of 500 kw and the other two to be of a capacity of 750 kw each.

At present there is installed one 2,300-volt General Electric generator, direct-connected to a 62-in. Pelton water wheel of two bearings and with a flexible coupling. This water wheel has a capacity of 1,000 hp. The whole is set on a concrete foundation built up of one part cement, two parts of sand and three of gravel, extending 8 ft. below the surface of the ground, which is of the ordinary lava formation mixed with a sort of cemented clay. A Lombard governor controls the generator, the exciter for which is a 125-volt General Electric generator, run by an 18-in. Pelton water wheel that overhangs on the exciter bearing. The switchboard consists of one main generator panel, one exciter panel, and one low-tension panel, all being provided with oil switches and everything in connection with the switchboard being of latest General Electric design.

The transformer house contains three General Electric water-

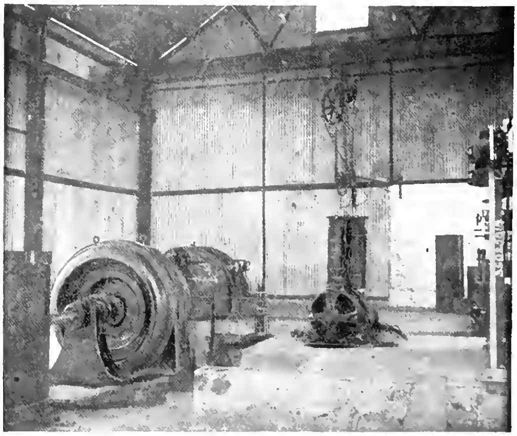


FIG. 5.—FIRST GENERATOR INSTALLED.

cooled transformers having a capacity of 167 kw each, the primary voltage being 22,500 and the second voltage being 2,300. There are also installed in the transformer house three lightning arresters and one high-tension oil switch panel.

The circuit extends in a direct line running southwest from the power house on Fall Creek to Yreka, a distance of 22 miles, whence it continues on in another direct line tending west by southwest, passing the base of Humbug Mountain to New York Mine, 14 miles beyond Yreka. Almost due south of the New York Mine and separated 7 miles from it by way of the pole line is Fort Jones, whither the line also reaches, thus making the total length of the main line

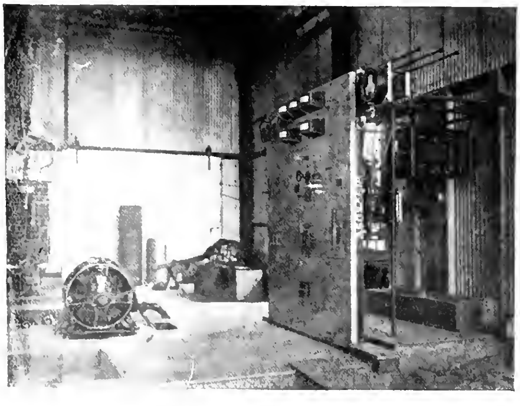


FIG. 6.—POWER HOUSE SWITCHBOARD.

to be 43 miles. The Hornbrook line is tapped from the main line at its crossing over Bogus Creek, which is a little less than one-half the distance from the power house to Yreka, and just before entering Yreka another branch line, which runs to Montague, a station on the Southern Pacific line to Oregon, is tapped off the main line. From Montague this extension is continued on across the base of Mount Shasta in a direct line to Little Shasta Mill. The length of the Hornbrook branch is six miles, while that of the Montague branch is close to 14 miles. All the line is of aluminum three-strand No. 4 cable, using Locke insulators with glass top and petticoat, and designed for a working pressure of 40,000 volts. The pins are eucalyptus, 1½ in. x 12 in. in size and are boiled in oil. The cross arms are of Washington fir, boiled in oil and painted. The poles are round, of red fir, 30 ft. long, with 7-in. iron-shod tops, creosoted at the butt and in some places tarred.

Current was turned on September 12th, and the business consists of both lights and power service. The towns of Montague, Yreka, Fort Jones and Aetna in California are already supplied, while Ashland, Medford, Jacksonville and Phœnix in Oregon will be supplied with electric service. The plant was started with 300 lights at Montague, 400 lights at Fort Jones, 75 hp at the New York Mine, and 125 hp at Punch Creek, near Yreka. Besides lighting and general industrial power service, a large power field will be found in the mines now operating, and which hitherto have been only prospective,

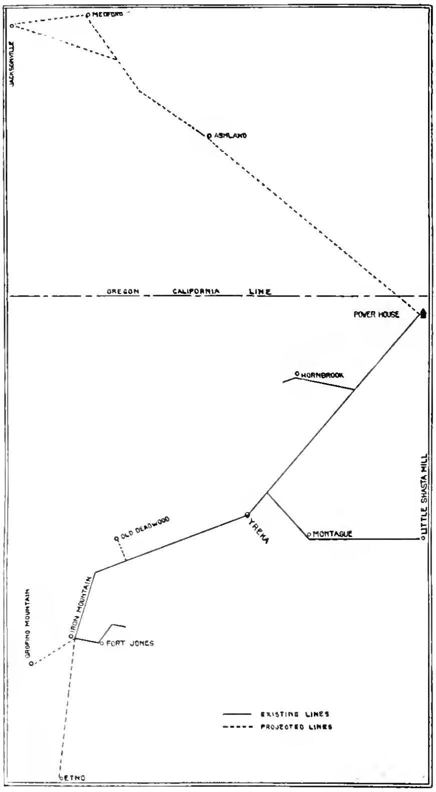


FIG. 7.—MAP OF ROUTE OF LINES.

due to the lack of economical and convenient power. Another field which will take up a large amount of power, although in small units, will be pumping for irrigation. Large tracts of land, that are not now under cultivation, have an abundant supply of water within 10 or 12 ft. of the surface and with electric power these lands will be brought into commission through pumping. Considering the reliability of the water supply and the rich country that is reached by the pole lines both present and prospective, a large and prosperous business is undoubtedly in store for the company.

Telephone Distress Signal.

A correspondent at Indianapolis states that at Anderson, Ind., the Farmers' Telephone Company has adopted a general signal of distress for its patrons on party lines. Following the general alarm the exchange operator will give the number of rings indicating the house from which the alarm came so that the neighbors may go direct to the place where assistance is needed.

Electrical Foucault Pendulum Systems.

By ERNEST K. ADAMS.

FOUCAULT'S pendulum demonstration of the rotation of the earth, which was first carried out on a large scale in the Pantheon at Paris in 1851, is perhaps one of the most interesting experiments that physics affords, for it demonstrates to the observer the absolute revolution in space of the earth; not that relative motion which one sees when looking at the firmament on a clear night, but a positive turning of the earth in a certain direction with respect to the celestial sphere. The repetition of Foucault's pendulum demonstration in the Pantheon by M. Camille Flammarion, approximately fifty years after the original, has renewed the interest in the same, and has influenced physicists about the world to again carry out the experiment. The pendulum, however, is limited by the fact that in the course of a short time, depending upon the length of the vibrating system, the oscillations cease.

To overcome this disadvantage and thereby provide a means of prolonging the motion of the pendulum, or maintaining the same in constant vibration, are the purposes of the accompanying designs. The sensitiveness of a Foucault pendulum is well known, but it is

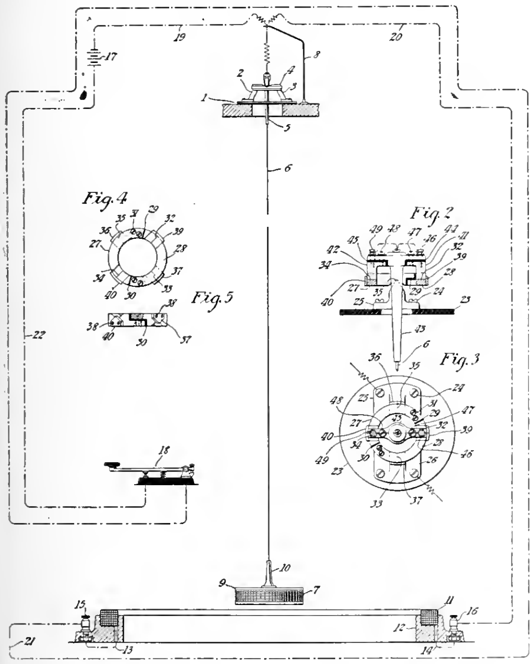


FIG. 1.—KEY-CONTROLLED TYPE OF FOUCAULT PENDULUM.

believed that, under suitable conditions, the acceleration may be satisfactorily accomplished, the present designs being herewith presented, both as suggestions for a line of laboratory investigation in this subject, and as convenient adjuncts in physical lectures or other demonstrations. The accelerating principle of the systems is based upon the electrodynamic action of two coils of different diameters, the smaller of which is incorporated in the bob of the pendulum, while the larger is mounted beneath and symmetrically with respect to the aforesaid pendulum. When direct or alternating currents are allowed to simultaneously flow in the two coils in the same direction, it has been found by experiment that the pendulum coil is urged toward the center of the large coil. This action takes place in whatever plane of oscillation the pendulum coil vibrates, and is strongest when the said coil is directly over a portion of the large coil. In the following designs this principle, which allows of accelerating Foucault pendulums without any material contact therewith, has been incorporated, and a number of methods developed for controlling the accelerating action.

KEY-CONTROLLED TYPE.

In this form of electrical Foucault pendulum, the circuit of the accelerating coils is intended to be manually controlled at a key, which is closed when the pendulum bob is traveling toward the center of the large coil. The frequency with which the key should be closed depends upon the length and weight of the pendulum system, the amplitude of the same, the dimensions of the accelerating coils and the strength of the current employed.

By reference to the drawing, Fig. 1, is a diagram of the system, while Figs. 2 to 5, inclusive, show the details of a modified suspension.

The pendulum system primarily consists of a sensitive knife-edge suspension, which is made up of a base plate, 1, two fixed knife-edges, 2 and 3, rocking ring, 4, and central oscillating member, 5. The base, 1, of the suspension is secured to any support, which is both free from vibration and gives the desired height for swinging the pendulum. Passing through the central member, 5, is a flexible twin concentric conductor, 6, which, secured in the aforesaid member, 5, by tying a knot in it, proceeds downward to the pendulum coil, 7. In order to introduce current into the suspension and yet allow it to vibrate without friction, the twin conductor, 6, is coiled before entering the aforesaid suspension, and, furthermore, suspended above by a small wire standard, 8. The coil, 7, is wound upon a wooden spool, 9. A metal post, 10, bolted to the center of the spool, 9, receives the twin conductor, 6. This conductor, 6, is fastened in the post, 10, by tying a knot in it, or by the employment of some other suitable fastening device. The two wires of the twin conductor, 6, are connected with the terminals of the coil, 7, through suitable openings, which are cut in the spool, 9. Located upon any suitable horizontal surface beneath the pendulum is the stationary coil, 11, which is supported in a wooden mounting, 12. The terminals, 13 and 14, of the coil, 11, are respectively connected to two binding posts, 15 and 16, secured to the mounting, 12. The large coil, 11, is accurately adjusted with respect to the pendulum system, so that the center of the said coil, 11, will be directly under the geometric point of suspension of the pendulum. The adjustment is furthermore so made that the clearance between the spool 9 and coil 11 will be a minimum and constant amount in whatever plane of oscillation the pendulum may vibrate.

The wiring of the system consists in placing the two coils, 7 and 11, in series with a source of current, 17, and controlling key, 18, the circuit being made up, from the aforesaid source, 17, of a wire, 19, one of the members of the twin conductor, 6, pendulum coil, 7, other member of the conductor, 6, wire 20, post 16, conductor 14, stationary coil 11, wire 13, post 15, conductor 21, key 18 and wire 22. As already stated, the current should simultaneously flow in the same direction in the two coils, 7 and 11. Having set the pendulum in vibration in the plane of the meridian by burning a thread in the usual manner, the said thread being tied to any suitable support and the pendulum spool, 9, the pendulum may be maintained in constant vibration, throughout its changing plane of oscillation, by pressing the key, 18, when the pendulum coil, 7, is traveling toward the center of the large coil, 11. In this manner an acceleration may be given to the pendulum without materially interfering with the earth's action upon the same. It will be found that a continual pressing of the key, 18, will hardly be required. On account of the arrangement of the accelerating coils, 7 and 11, of the system, alternating current may be employed for operating the pendulum in place of direct current. It may be found that by suitably proportioning and making the spool, 9, and mounting, 12, of iron, the dynamic action will be increased. In that case, if alternating current is employed, the spool, 9, and mounting, 12, should be divided in one or more places for preventing the induction of heating currents therein.

A modification in the suspension is shown in Figs. 2 to 5, inclusive, whereby current may be introduced to the pendulum coil, 7, without the employment of a coiled wire at the suspension. This device embodies a circular fibre plate, 23, to which is fastened, by a number of screws, 24, two steel knife-edge supports, 25 and 26. Resting upon these knife-edges, 25 and 26, is a rocking ring, made up of two segments, 27 and 28, secured together, but insulated from each other, by two fibre pieces, 29 and 30, screens, 31, together with a number of insulating bushings. Four V-shaped cuts, 32 to 35, inclusive, are made at 90° to each other in the segments, 27 and 28. The two supports, 25 and 26, rest in the cuts, 35 and 33, respectively, and are prevented from sliding therein by two steel stops, 36 and 37, held in position by a number of screws, 38. Resting in the other cuts, 32 and 34, and restricted from longitudinal motion therein by two stops, 39 and 40, are two steel knife-edges, 41 and 42, respectively. The stops, 39 and 40, are held in place, as are the other ones, numbered 36 and 37, by several screws, 38. The knife-edges, 41 and

42, are insulated upon a central rocking member, 43, by two pieces of fibre, 44 and 45, four screws, 46 and 49, inclusive, together with a number of insulating bushings. The twin concentric conductor, 6, which supports the pendulum spool, 9, is knotted in the central member, 43, and the wires of the said conductor, 6, are electrically connected, through the screws, 46 and 49, with the knife-edges, 41 and 42, respectively. It will thus be evident from the construction that current may be led to the pendulum coil, 7, by connecting the controlling circuit with the knife-edge supports, 25 and 26.

HIGH-POTENTIAL TYPE.

The present arrangement is designed to enable a Foucault pendulum organization to be frictionlessly and automatically maintained in vibration throughout its changing plane of oscillation. The accelerating coils of the system possess the same construction and dynamic action as those described in the preceding apparatus. The means, however, of introducing current to the pendulum and stationary coils at the moment that the former is just over the latter, takes advantage of the fact, that, when the secondary circuit of an

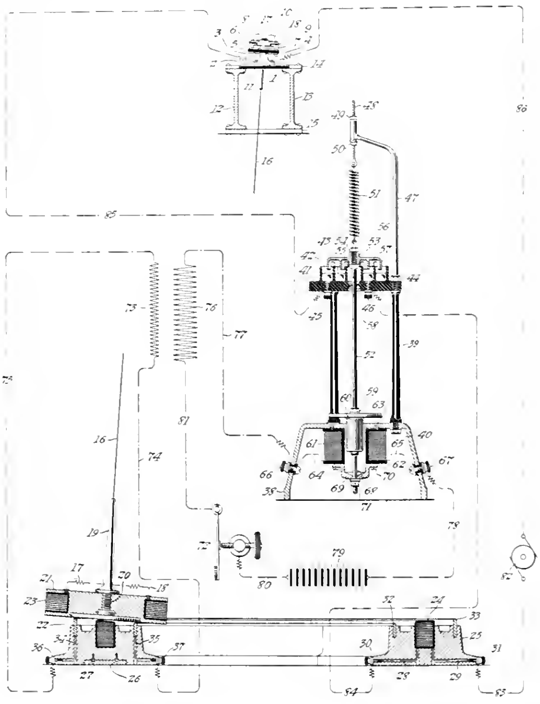


FIG. 2.—HIGH-POTENTIAL TYPE OF FOUCAULT PENDULUM.

induction coil is closed, the current in the primary is immediately augmented. If, now, the primary of the induction coil includes a make-and-break device, suitable battery and sensitive relay, the last of which independently commands the accelerating coils of the pendulum system and a source of current, and, furthermore, the secondary circuit of the induction coil is arranged to be closed by the pendulum with small air-gaps, when the said pendulum is terminating its swing over the stationary coil, the vibrating system will be constantly accelerated in whatever plane of oscillation it may be vibrating, for the temporary closing of the secondary circuit will immediately increase the strength of the primary current, which then instantaneously operates the relay, thereby sending current to the two pendulum coils and giving the system an acceleration. When the pendulum arrives at the other extremity of its amplitude, the same cycle of operations will again take place. The automatic principle of the system is capable of a number of modifications. In the illustration, a diagrammatic view of the organization is shown.

The pendulum system springs from an insulated knife-edge suspension, which, primarily made up of the members 1 to 10, inclusive, and detailed in the preceding description, is rigidly mounted upon a fibre plate, 11, riveted to two iron beams, 12 and 13. These beams, 12 and 13, which are secured together at each end by two metal plates, 14 and 15, may rest upon masonry supports when convenient. A twin concentric conductor, 16, is secured to the central portion, 10, of the suspension, and the two wires, 17 and 18, of the aforesaid conductor, 16, are electrically connected with the knife-edges, 6 and 7, respectively. The lower extremity of the twin conductor, 16, is fastened in a metal post, 19. This post, 19, has an extension, 20, which passes through a wooden spool, 21, and is threaded into a metal disc, 22, let into the under side of the aforesaid spool, 21. The lower ends of the two wires, 17 and 18, of the twin conductor, 16, are electrically joined with the terminals of a coil, 23, which is wound upon the pendulum spool, 21. The stationary accelerating coil, 24, is laid in a circular mounting, 25, which is constructed of wood and made in three sections, fastened together by a number of plates, 26 and screws, 27. The terminals, 28 and 29, of the stationary coil, 24, are, respectively, connected to two binding posts, 30 and 31, which are screwed into the mounting, 25. Incorporated in the mounting, 25, are two split copper rings, 32 and 33, which are employed, in connection with the pendulum disc, 22, for closing the secondary circuit of the induction coil. The rings, 32 and 33, are, respectively, joined by two wires, 34 and 35, with an equal number of binding posts, 36 and 37, secured to the mounting, 25. The reason for dividing the rings, 32 and 33, is so that currents will not be induced therein by the stationary coil, 24. The mounting, 25, is so adjusted with respect to the pendulum system that the center of the said mounting, 25, will be directly beneath the geometric point of suspension of the pendulum conductor, 16. The mounting, 25, is, furthermore, so arranged that it will have a minimum and constant clearance between its upper surface and the under side of the pendulum spool, 21.

The relay for controlling the accelerating circuit of the pendulum system consists of a brass base, 38, to the top of which three hard rubber columns, 39, are secured by an equal number of hexagonal nuts, 40. An ebonite receptacle, 41, having two annular mercury baths, 42 and 43, incorporated in the same, is fastened to the top of the columns, 39, by several hexagonal nuts, 44. Two binding posts, 45 and 46, secured to the receptacle, 41, electrically communicate with the mercury baths, 42 and 43, respectively. Threaded upon one of the columns, 39, is an extension, 47, which has an eye bolt, 48, adjustably secured therein by two hexagonal nuts, 49 and 50. Supported from the eye bolt, 48, by a retractile spring, 51, is a hard rubber rod, 52, having a contact member, 53, fastened thereto by two hexagonal nuts, 54 and 55. This contact member, 53, is provided with two annular projections, 56 and 57, which are adapted to short-circuit the mercury baths, 42 and 43. For enabling the contact to be a multiple one, the projections, 56 and 57, of the member, 53, are toothed. The binding posts, 45 and 46, are placed in series with the accelerating circuit of the pendulum. The rod, 52, is guided at the top by a circular knife-edge, 58, which is turned in the receptacle, 41. At the lower end the rod, 52, is locked by a hexagonal nut, 59, in an iron core, 60, which is adapted to be acted upon by a coil, 61. The spool, 62, upon which the coil, 61, is wound, is fastened to the base, 38, by two screws, 63. The terminals, 64 and 65, of the coil, 61, are, respectively, connected to two binding posts, 66 and 67, which are insulated upon the base, 38, and placed in series with the primary circuit of the already-mentioned induction coil. A spindle, 68, driven into the lower end of the core, 60, is guided by a circular knife-edge, 69, which is fastened to the under side of the spool, 62, by several screws, 70. A nut, 71, is threaded upon the spindle, 68, for limiting the upward motion of the core, 60, due to the retractile spring, 51. The retractile spring, 51, is so chosen and the eye bolt, 48, so adjusted, that the weight of the vertically-moving members will be taken up and the nut, 71, normally maintained against the under side of the knife-edge, 69. When, however, the current in the coil, 61, increases sufficiently to attract the core, 60, the toothed annular projections, 56 and 57, of the contact member, 53, will short-circuit the mercury contacts, 42 and 43.

The operation of the system, presupposing both that the pendulum has been started vibrating in the plane of the meridian, by burning a thread in the customary manner, and the vibrator, 72, of the induction coil, already referred to, has been set in motion, consists, when the pendulum spool, 21, is directly over the stationary coil, 24, of the passage of a number of sparks between the rings, 32 and 33, by way of the copper disc, 22. The secondary circuit of the induction coil is now closed. This circuit is composed of the secondary winding, 73, wire 74, binding post 37, conductor 35, ring 32, disc 22, ring 33, wire 34, binding post 36 and conductor 75. Simultaneously with this flow of current through the secondary, the current in the primary circuit, which is made up of the primary winding, 76, wire 77, binding post 66, conductor 64, relay coil 61, wire 65, binding post 67, conductor 78, battery 79, wire 80, vibrator 72, and conductor 81, will be immediately increased and the relay coil, 61, energized sufficiently to attract its armature, 60. At this moment the projections, 56 and 57, of the contact member, 53, having been moved down into contact with the mercury baths, 42 and 43, a direct or alternating current from a dynamo, 82, is allowed to flow through the accelerating circuit, thereby producing a repulsion between the pendulum and stationary coils, 23 and 24, respectively, and accelerating the pendulum system. This accelerating circuit consists from the dynamo, 82, of a wire, 83, binding post 31, conductor 29, stationary coil 24, wire 28, binding post 30, conductor 84, binding post 46, mercury bath 43, annular projections 56 and 57 of contact member 53, mercury bath 42, binding post 45, wire 85, knife-edge support 2, segment 3 of rocking ring, knife-edge 6, conductor 17, pendulum coil 23, wire 18, knife-edge 7, segment 4, knife-edge support 1 and conductor 86. As soon as the pendulum coil, 23, has swung toward the center sufficiently for the secondary circuit to be broken, the current in the primary will drop to a minimum, and the contact member, 53, of the relay now being allowed to return to its normal position, the circuit of the accelerating coils, 23 and 24, will be interrupted. When the pendulum spool, 21, arrives at the other extremity of its vibration, the same action will again occur, thereby accelerating the pendulum system once more.

The high-potential principle above employed may possibly be further extended in conjunction with the laws of induction, in such a way that the pendulum will consist of a single steel wire. Such a pendulum system may embody a high-potential transformer, the primary of which, together with a large circular stationary accelerating winding, is in series with a source of alternating current. The secondary of the transformer is placed in series with a spark-gap device, which will allow the said secondary to be closed when the pendulum bob is over a portion of the stationary winding, the spark-gap arrangement being such as to render the primary and secondary circuits absolutely independent. The pendulum bob is provided with a short-circuited winding, and the stationary winding is so constructed that, when alternating currents flow in the same, similar alternating currents will be induced in the pendulum winding, when the said winding is directly over a portion of the stationary winding. The pendulum and stationary windings are furthermore so arranged that the directions of the induced currents in the pendulum winding will cause the pendulum to be accelerated toward the center. This method of connecting up the transformer is such that there will be little or no current in the primary coil and stationary winding, until the secondary is closed through the spark-gap device by the pendulum terminating its swing over the aforesaid stationary winding. When this takes place the current in the primary will instantaneously reach a maximum, thereby inducing repulsion currents in the pendulum winding, with a consequent acceleration of the vibrating system. When the secondary is broken the accelerating current will drop to a minimum again until the pendulum arrives at the other side of the stationary winding, at which time the same cycle of operations will be once more performed.

The method of inducing currents in the pendulum coil, with the advantage that a fine steel wire may support the bob of the vibrating pendulum system, may be perhaps arranged in such a way that the stationary winding will be of approximately the same dimensions as the pendulum winding, and located directly under the pendulum suspension. The wiring of the transformer is the same as above outlined, and the action of the spark-gap device, together with the inducing and induced currents, is so planned that a repulsion will occur between the pendulum and stationary windings after the vibrating system has passed the vertical.

SYNCHRONOUS TYPE.

A further method is herewith shown for automatically accelerating Foucault pendulums of any size, however their planes of oscillation may change, there being no material contact with their vibrating systems. The magnetic coils of the system are analogous in their construction and dynamic action to those employed in the preceding studies. The automatic means of operating the pendulum system, however, consists in providing a controlling contact mechanism, which, adjusted in synchronism with the Foucault pendulum, or the latter regulated with respect to the former, sends impulses of current to the pendulum and stationary coils of the organization, when the pendulum of the same is moving toward the center of the stationary coil. In this manner the Foucault pendulum is constantly accelerated. There is, furthermore, herein illustrated a magnetic starting device for the pendulum, thereby obviating the necessity of employing the customary arrangement, where a thread, which holds the pendulum at one of the extremities of its swing, is burned.

By reference to the drawings, Fig. 1, is a diagrammatic scheme of the pendulum system, Fig. 2, a front elevation of the mechanism for controlling the pendulum, and Fig. 3 a detail of the differential gear adjustment for the contact wheel.

The Foucault pendulum primarily embodies a suspension system, which consists of two iron beams, 1 and 2, metal plate 3, fibre base 4, posts 5 and 6, cone-shaped capstan screws, 7 and 8, insulated rocking ring, made up of the two portions 9 and 10, insulated capstan screws 11 and 12, bridge member 13, tube 14, hexagonal nut 15

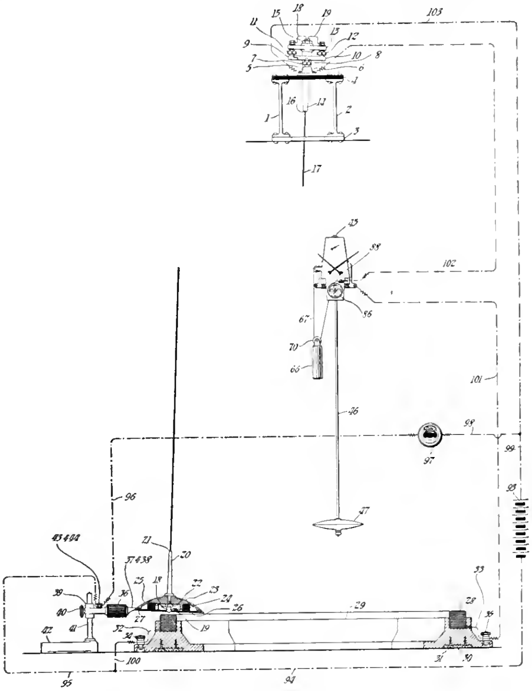


FIG. 3.—SYNCHRONOUS TYPE OF FOUCAULT PENDULUM.

and fibre lining 16. A small twin concentric pendulum conductor, 17, passes through the fibre lining, 16, of the suspension tube, 14, and is held in place by tying a knot in it. The wire, 18 and 19, of the twin conductor, 17, are connected with the insulated capstan screws, 11 and 12, respectively. The lower end of the conductor, 17, is fastened in a pendulum bob, which is made up of a metal post, 20, fibre lining 21, hexagonal nut 22, wooden spool 23, pendulum coil 24, iron rim 25, fibre disc 26 and a number of screws 27. The wires, 18 and 19, of the twin conductor, 17, are electrically joined with the terminals of the pendulum coil, 24. The iron ring, 25, the purpose of which will be described hereafter, is radially slotted in a number of places, in order that currents will not be induced therein by the periodic energization of the pendulum coil, 24. This is particularly necessary if alternating current is employed in the pendulum accelerating circuit. The shape of the pendulum bob is such as to displace as little air as possible in its vibration and changing plane of oscillation. This construction also enables the pendulum coil, 24, to swing directly over the stationary coil, 28. This coil, 28, is designed to be laid in a wooden mounting, 29, which, for the sake of convenience, is made in sections and fastened together by a number of plates, 30, and screws, 31. The terminals, 32 and 33, of the stationary coil, 28, are, respectively, connected to two posts, 34 and 35, which are secured to the mounting, 29. The device for starting the pendulum vibrating consists of a magnet, 36, the poles, 37 and 38, of which are adapted to fit the circular iron ring, 25, of the pendulum bob. The cores of the magnet, 36, are provided with a yoke, 39, which is adjustably secured by a knurled screw, 40, upon a vertical rod, 41, driven into the corner of a heavy triangular base, 42. The terminals of the magnet, 36, are connected to two posts, 43 and 44, insulated upon the yoke, 39. By energizing the magnet, 36, which may be adjusted in any desired position, both vertically and horizontally, the pendulum may be held stationary, preparatory to setting it in vibration in the plane of the meridian. To start the pendulum all that is required is to interrupt the current in the magnet, 36.

The controlling contact mechanism, for providing periodic currents for accelerating the pendulum system, is shown in Fig. 1 and detailed in Figs. 2 and 3. This device consists of a second's pendulum movement, primarily embodying a cast-iron bracket, 45, pendulum 46, elliptical bob 47, frame plates 48 and 49, separating posts 50, together with the fastening members 51 and 52. Mounted between the frame plates 48 and 49 is an escapement train, having a ratio of 1 : 720, and made up of a barrel, 53, ratchets, 54 and 55, pawls 56 and 57, gears 58, 59 and 60, pinions 61, 62 and 63, thirty-toothed escapement wheel 64, and anchor 65. The barrel, 53, is operated by a weight, 66, through the medium of a cord, 67, which is wound about the aforesaid barrel, 53, and secured to a post, 68, driven into the front frame plate, 49. A pulley, 69, journaled upon the frame plate, 49, guides the cord, 67, from the barrel, 53, to a second pulley, 70, mounted upon the weight, 66. With an ordinary drop for the weight, 66, the ratios are such as to drive the pendulum, 46, for eight days. A second gear train, having a ratio of 1 : 720, is also driven by the barrel, 53, the members of the said train being numbered 71 to 75, inclusive. The terminating spindle, 76, of this

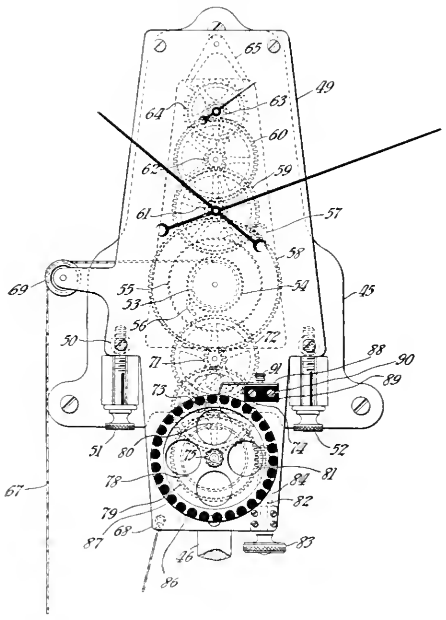


FIG. 4.—CONTACT MECHANISM OF SYNCHRONOUS TYPE.

second train has mounted thereon a differential gear adjustment, which consists of two crown gears, 77 and 78, intermediate worm gear 79, plantetary pinion 80, worm 81, spindle 82, knurled adjustment member 83, and journaling portion 84. The crown gear, 78, is secured to a sleeve, 85, which, mounted loosely upon the spindle, 76, passes through the frame plate, 49, and has secured thereto a contact wheel, 86, having a number of fibre rods, 87, let into its periphery. The circumference of the contact wheel, 86, is turned down sufficiently to make the insulating and metallic spaces equal in width. Bearing upon the contact wheel, 86, which, on account of the gearing, makes one turn per minute in an anti-clockwise direction from the front, is a platinum-pointed spring, 88, mounted upon the frame plate, 49, by a fibre block, 89, together with several screws, 90 and 91. From the property of the differential adjustment, when the worm, 81, is revolved by turning the knurled member, 83, the contact wheel, 86, may be adjusted, while running, until the impulses of current, which are sent to the pendulum accelerating coils, 24 and 28, are in proper step with the vibrations of the Foucault pendulum system. When desired a dial, 92, may be mounted upon the frame plate, 49, of the movement, an opening being provided in the said dial, 92, for the contact spring, 88, to pass therethrough.

For enabling the mechanism to control pendulums of different lengths, it is intended that a number of contact wheels, similar to that numbered 86, but having varying numbers of insulated rods driven into their peripheries, shall be employed. Thus, if the Foucault pendulum makes one beat per second, the electrical contact, while the pendulum coil, 24, is traveling toward the center of the

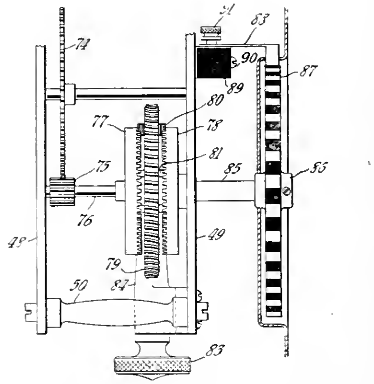


FIG. 5.—CONTACT ADJUSTMENT OF SYNCHRONOUS TYPE.

stationary coil, 28, should last .5 second, and there will be sixty contacts, together with an equal number of insulating spaces upon the periphery of the contact wheel. For a pendulum having a beat of 1.5 seconds, the contact should last .75 second, and there will be forty fibre rods in the contact wheel. If the pendulum makes a vibration in two seconds, the electrical contact will have a duration of one second, and there will be thirty fibre rods in the contact wheel. With a beat of 2.5 seconds for the pendulum, the contact will last 1.25 second, and there will be twenty-four fibre rods in the contact wheel. For a pendulum making as oscillation in 5 seconds, the contact will last 2.5 seconds, and the contact wheel should have twelve fibre segments. With a pendulum making a vibration in 7.5 seconds, the contact should last 3.75 seconds, and there will be eight insulating rods in the periphery of the contact wheel. By being able to substitute different contact wheels, the controlling mechanism may be adapted to a Foucault pendulum of any given length.

Having set up the pendulum system in an enclosure, if possible similar to the dome of the Pantheon in Paris or other like structure, the pendulum bob is held at one of the extremities of its amplitude by energizing the magnet, 36, of the starting device, the circuit consisting from a battery, 93, or other suitable source of current, of two conductors, 94 and 95, binding post, 43, coils of magnet, 36, post 44, wire 96, switch 97, together with the conductors 98 and 99. When it is desired to start the Foucault pendulum, the switch, 97, is opened, and, the magnet, 36, being now without attractive force, the pendulum will begin to vibrate. The knurled member, 83, of the controlling mechanism is then adjusted until the impulses of current, sent out therefrom to the pendulum coils, 24 and 28, always occur while the pendulum is traveling toward the center of the large coil, 28. The circuit for producing this constant acceleration embodies the battery, 93, conductors, 94 and 100, post 34, wire 32, stationary coil 28, conductor 33, post 35, wire 101, frame 45 of controlling movement, contact wheel 86, spring 88, conductor 102, post 5, capstan screw 7, portion 10 of rocking ring, capstan screw 12, wire 19 of pendulum twin conductor 17, coil 24, wire 18, capstan screw 11, portion 9 of rocking ring, capstan screw 8, post 6, together with the conductors 103 and 99. In setting up the system, the length of the Foucault and current-controlling pendulums, together with the contact wheel, should be so chosen and adjusted that the occurrences of the accelerating current will be in synchronism with the oscillations of the aforesaid Foucault pendulum. The general principle of the organization is also applicable to time service systems.

In the above series of electrically-operated Foucault pendulums, current has been simultaneously sent through the pendulum accelerating coils in the same direction, thereby causing the pendulum coil to be accelerated toward the center of the stationary coil. It is believed that the reverse action may be also employed for operating Foucault pendulums. In this case, current is allowed to flow at the same instant in opposite directions in the two accelerating coils, the pendulum being radially accelerated away from the center of the stationary coil.

For measuring the angular change of the plane of oscillation of Foucault pendulums, other devices may be employed, irrespective of the customary method where a fine needle, which is affixed to the bottom of the pendulum bob, is allowed to travel over a graduated circle or make small furrows through the top of a pointed heap of sand. When the length of the pendulum is suitable, and the facilities are favorable therefor, the angular variation may be observed from a point just below the suspension. The arrangement for this purpose may consist of a graduated ring, which is rotatively secured to a suitable horizontal mounting, the pendulum occupying the center of the aforesaid ring. A fine wire is attached to opposite points of the ring, and passes within a short distance of the pendulum. An index is provided upon the mounting adjacent to the graduations upon the ring. Having turned the ring until the wire is coincident with the plane of oscillation of the pendulum bob below, the angular change may be observed, at the end of any given period of measurement, by again revolving the ring until the wire is in coincidence with the pendulum's path. This operation may be facilitated by suitably mounting a telescope upon the graduated ring, and providing a highly polished point in the center of the pendulum bob to sight upon. Another method may embody a carriage which is adapted to slide around a graduated ring, mounted symmetrically at the bottom of the pendulum system. Passing radially through the carriage is a pointed rod, which may be moved up to the pendulum wire, when the same is resting in its normal vertical position or at the end of its maximum amplitude. Having once set the rod in the plane of vibration of the pendulum, the angular change may be noted at any time by circumferentially moving the carriage until the rod is again in coincidence with the pendulum's plane. When desired, the mounting of the stationary accelerating winding of the pendulum system may be arranged to receive the above-mentioned sliding carriage.

The Theoretical Determination of Power Curves.

By WILLIAM J. BERRY.

THE close relation existing between practical electrical engineering and the higher mathematics is daily receiving wider and wider recognition from engineers of established reputation, while the fact that many mathematical theorems find their best illustrations in electrical phenomena is well known to all who have pursued mathematical investigations to any considerable extent. The time has passed when the practical rule-of-thumb electrician could afford to sneer at the mathematical engineer, because of the latter's theorising; empiricism has carried the profession as far as it can, henceforth the advance must be along the strictest scientific and theoretic lines. Many facts, revealed by experimental investigation, and made familiar through long-continued practice, are demonstrable from the standpoint of the mathematician.

One such subject is that of power curves. Every alternating-current engineer knows that with an impressed harmonic e.m.f. of sine-wave shape, the resultant power curve is a sine curve of double frequency, but so far as the present writer knows there exists no rigid mathematical demonstration of this fact. Messrs. Ryan, Norris and Hoxie, in their recently-published book, have proved it for certain special values of the angle of lag, but the demonstration which follows is valid for any amount of phase difference, whether the current leads or lags behind the e.m.f.

Let the curve, E, in Fig. 1, represent a pressure curve of sine-wave shape, and suppose its equation to be $y = A \sin x$, where A is a constant; let I, in the same figure, be the current curve, differing in phase from E by the angle ϕ, and let $y' = B \sin [x \pm \phi]$ represent its equation, in which B is a constant, and the plus or minus sign is to be used, according as ϕ is the amount of lag or lead of the current. Since the instantaneous power is equal to the product of the instantaneous pressure by the instantaneous current, the ordinates of the power curve, P, must be the product of the correspond-

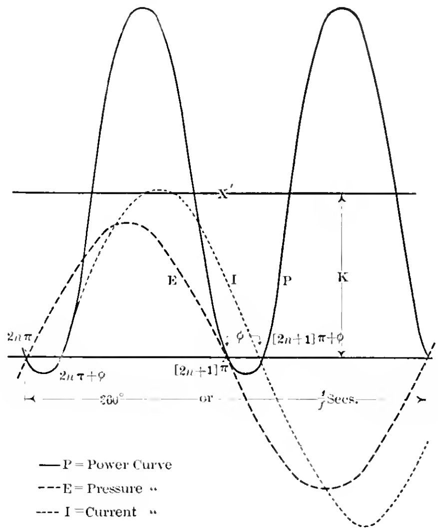


FIG. 1.—PRESSURE CURVE.

ing ordinates of E and I, and the equation of P is $y'' = y\,y' = A\,B \sin x \sin [x \pm \phi]$.

Expanding this expression, and replacing $A\,B$ by C,

$$y'' = C\,[\sin^2 x \cos \phi \pm \sin x \cos x \cos \phi].$$

Now, in any given case ϕ, and, therefore, $\sin \phi$ and $\cos \phi$ are constant throughout, hence

$$y'' = C\,[\alpha \sin^2 x \pm \beta \sin x \cos x],$$

where

$$\alpha = \cos \phi \text{ and } \beta = \sin \phi.$$

This may be further simplified,

$$y'' = \alpha' \sin^2 x \pm \beta' \sin x \cos x,$$

where

$$\alpha' = C\,\alpha, \text{ and } \beta' = C\,\beta.$$

$$y'' = \alpha' \sin^2 x \pm \frac{\beta'}{2}\, 2 \sin x \cos x,$$

$$y'' = \alpha' \sin^2 x \pm \frac{\beta'}{2} \sin 2x.$$

Differentiating with respect to x,

$$D_x\, y'' = 2\,\alpha' \sin x \cos x\, d\,x \pm \frac{\beta'}{2} \cos 2\,x\,.\,2\,d\,x,$$

$$D_x\, y'' = \frac{\alpha'}{2} \sin 2\,x\,.\,2\,d\,x \pm \frac{\beta'}{2} \cos 2\,x\,.\,2\,d\,x.$$

Integrating,

$y'' = -\frac{\alpha'}{2} \cos 2\,x \pm \frac{\beta'}{2} \sin 2\,x + K$, where K is the constant of integration. If, now, we replace $\frac{\alpha'}{2}$ by $C' \cos \phi$, and $\frac{\beta'}{2}$ by $C' \sin \phi$, where $C' = -\frac{C}{2}$, the equation reduces to

$$y'' = C'\,[\cos' 2\,x \cos \phi \mp \sin 2\,x \sin \phi] + K.$$

To eliminate the constant, K, we may transform the equation to a parallel X-axis, such that y''', the new ordinate of P, is equal to $y'' - K$, whence

$$y''' = C' \,[\, \cos' 2x \cos \phi \mp \sin 2x \sin \phi].$$

The significance of this transformation of co-ordinates will be explained later. But

$$y''' = \frac{C'}{2}\,[2 \cos 2x \cos \phi] \pm \frac{C'}{2}\,[-2 \sin 2x \sin \phi].$$

$$2 \cos 2x \cos \phi = \cos\,[2x + \phi] + \cos\,[2x - \phi],$$

and

$$-2 \sin 2x \sin \phi = \cos\,[2x + \phi] - \cos\,[2x - \phi].$$

(See Wentworth's Trig., § 31, or Murray's Trig., § 52.) Hence,

$$y''' = C' \cos\,[2x \pm \phi] = C' \sin\,[\frac{\pi}{2} - (2x \pm \phi)],$$

which proves that under the given conditions, the power curve is a sine curve.

Now, the number of lobes of the curve per cycle is equal to the number of roots per cycle; that is, to the number of times the curve cuts the X-axis. The pressure curve, E, or $y = A \sin x$, has roots, that is, $y = 0$, whenever $\sin x = 0$, since by hypothesis A cannot be zero; but $\sin x = 0$ for $x = 2n\pi$, or $[2n + 1]\pi$; that is, twice in one cycle, or twice during the interval $1/f$ secs., where f is the number of cycles per second.

Similarly, $y' = B \sin\,[x \pm \phi]$, the current curve, has roots whenever $[x \pm \phi] = 2n\pi$, or $[2n + 1]\pi$, and this occurs twice during the interval $1/f$ seconds.

But the power curve, P, being of the form $A B \sin x \sin\,[x \pm \phi]$, will have roots whenever either $\sin x = 0$, or $\sin\,[x \pm \phi] = 0$. P, therefore, cuts the X-axis at $x = 2n\pi$, $x = [2n + 1]\pi$, $x = \mp \phi 2n\pi$, $x = [2n + 1]\pi \mp \phi$, or four times during the interval $1/f$ seconds; which shows that the power curve has double the frequency of either the e.m.f. or current curves, and that this is totally independent of phase difference.

By referring to Fig. 1, it will be noticed that X, the axis of symmetry of E and I, is not the axis of symmetry for P, but that X', parallel to X, is such an axis. When in the foregoing discussion we transformed the equation from one set of co-ordinates to another

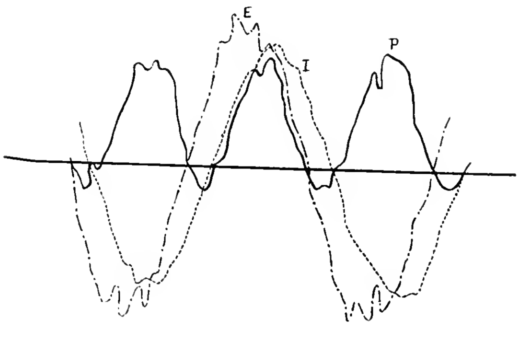


FIG. 2.—CURVES.

in such manner as to eliminate the constant, K, we were really transferring from X to X', the constant of integration, K representing the distance between X and X'.

In Fig. 2 is given a set of curves obtained by the writer and his associates, from a ½-kw Westinghouse alternator in the laboratory of the Polytechnic Institute of Brooklyn, the alternator carrying an inductive load. Though only approximating the sine shape, this power curve illustrates the main points discussed in this article. The ordinates of the power curve in Fig. 2 have been multiplied by a reduction factor, to bring the curve within the limits of the cross-section paper employed in the original, of which this figure is a tracing.

Sports in Aid of Spanish War Veterans.

The Spanish War Veterans' organization, which is about to conduct athletic sports in this city, is composed of veterans of the Spanish war who were honorably discharged or mustered out. The association is similar to and modeled upon the Grand Army of the Republic. Many comrades are at times in needy circumstances and require financial assistance. The widows and children of deceased comrades frequently require help and funds are needed to defray the burial expenses of comrades who die in poverty. These are worthy charities which appeal to all who honor these men who fought for their country in the Spanish war. The treasuries of the corps and individual commands, replenished only by per capita taxes, are insufficient. Funds disbursed by the Spanish War Veterans' Associations for such purposes are disbursed under scrupulous supervision and only in the most worthy cases.

General Eugene Griffin is corps commander of the State of New York Spanish War Veterans, which comprises about thirty-five commands and nearly 5,000 enrolled comrades. The commands in the vicinity of New York City (about twenty) have arranged to hold a military athletic tournament in the armory of the Twenty-second Regiment, N. G. S. N. Y., on March 5, 1904, the net proceeds to go to the treasuries of the corps and commands concerned. In order that the tournament may be held under the auspices and with the sanction of the Amateur Athletic Union, it has been necessary for the commands to organize the Spanish War Veterans' Athletic Association, and the tournament will be held in the name of such association.

Great interest has been manifested in the project. The use of the armory has been donated, and the services of all concerned in the tournament (other than the professionals, such as starter, handicapper, etc.) have been and will be given free. The tournament will be the athletic event of the winter.

The prizes will have sentimental as well as intrinsic value. President Roosevelt has donated funds for the purchase of a prize. Admiral Dewey has donated a cup with a personal letter, suggesting that the cup be offered as the "Dewey Cup." Cups have also been donated by Hon. Elihu Root, Secretary of War; Gen. Robert Shaw Oliver, Assistant Secretary of War; Gen. Geo. L. Gillespie, Chief of Engineers; Gen. Wm. Crozier, Chief of Ordnance; Col. John Jacob Astor, Senator Depew, Senator Platt, Senator Proctor, Senator Hanna, Senator Alger, Senator Lodge, Hon. Geo. B. McClellan, Hon. Wm. Randolph Hearst.

It is expected that other prizes will be offered by prominent officials of the Army and Navy, by Senators and Representatives of the United States Congress and by governors of States. The interest in the tournament, the number of athletic entries and the attendance will be greatly increased by the desire to win cups presented by such donors. Subscriptions from those interested should be paid to Gen. Eugene Griffin, at 44 Broad Street, New York City, for the prize fund of the tournament to be held for the benefit of the Spanish war veterans, as above described.

Philadelphia A. I. E. E. Meeting.

The regular meeting of the Philadelphia Branch of the American Institute of Electrical Engineers was held January 11 at the Engineers' Club. Mr. W. C. L. Eglin discussed the paper presented by Mr. George H. Lukes at the New York meeting on "Overhead High-Tension Distributing Systems in Suburban Districts." He also presented his own paper on "Safeguards and Regulations in Operation of Overhead Distributing System," with considerable amplification. Mr. J. T. Hutchings, of the Philadelphia Electric Company, presented a paper, using Mr. E. J. Bechtel's paper on "Automatic Apparatus for Regulating Generator and Feeder Potentials" as a basis, and going somewhat further into the matter than Mr. Bechtel did. Mr. J. B. Klumpp, of the United Gas Improvement Company, of Philadelphia, presented a paper, discussing and criticising the paper on "Gas Power for Central Stations," read by Mr. J. R. Bibbins at New York. The discussion of these papers was participated in by Messrs. Paul Spencer, W. C. L. Eglin, C. W. Pike, Charles Hewitt, H. A. Foster, J. B. Klumpp and Carl Hering.

The Gilbert Tercentenary Picture.

Some details were recently given in these pages of the presentation of a picture to the corporation of Colchester, England, by the Institution of Electrical Engineers, to celebrate the three-hundredth anniversary of the death of Dr. Gilbert, December 10. We are now glad to be able to publish herewith a reproduction of the historical painting in question. The artist is Mr. A. Ackland Hunt, and the original picture measures about 6 ft. x 4 ft. Its cost was defrayed by private subscription and the picture, it appears, was exhibited originally at the Manchester Exhibition in 1876. Prof. Silvanus P. Thompson and Mr. Conrad W. Cooke acted as honorary secretaries of the fund and the contributions were given by past and present members of the council of the Institution. As will be seen, it is an interesting and vigorous piece of work, and it is considered by students of the period, such as Prof. Thompson, a faithful piece of portraiture as well as a happy piece of imagination as to just what might have occurred when Gilbert made an exhibition before Queen Elizabeth of some of his experiments and investigations.

THE ACKLAND HUNT PICTURE OF DR. GILBERT MAKING EXPERIMENTS BEFORE QUEEN ELIZABETH.

Gilbert was born in the town in which he died and spent the best part of his life there, aside from the time given to the practice of his profession in London. It may be noted that Gilbert was born at Colchester on May 25, 1544, in a house which is still standing, and to which he returned in his later years. It may be added that Dr. Gilbert, as physician to Queen Elizabeth and president of the Royal College of Physicians, was one who would naturally stand high in her favor and whose demonstrations as thus depicted would be witnessed by the Virgin Queen with unusual interest.

There are not many historical pictures on electrical subjects and this makes a worthy addition to that which is doubtless well known to our readers, of Volta explaining his voltaic pile to young Napoleon, and the other one, perhaps better known in this country than abroad, of the gathering of the pioneers of the first Atlantic cable, now hanging in the New York Chamber of Commerce. Some day, perhaps, in the new Union Engineering Building, the American Institute of Electrical Engineers may become the recipient of other works of this character from generous friends and members. To-day the Institute is even without a picture or a bust of Franklin.

Electrification of an English Steam Railway.

The Lancashire & Yorkshire Railway Company, one of the most important of the shorter steam railroads in England, has substituted electricity for steam as motive power, and the electrical operation of a portion of the line was recently inaugurated. The 600-volt direct-current rotary-converter system is used, with alternating-current transmission to the converter sub-stations at 7,500 volts. The line is 23 miles long and double-tracked.

The trains generally are composed of two first and two third-class cars, the third-class cars of which are equipped with four motors of 150 hp each, making a total of 1,200 hp per train. To operate these motors current is obtained from a third rail, which is fed with direct current at about 600 volts from four sub-stations, three of which are situated at Birkdale, Seaforth and Sandhills, respectively, and another in the main power house building at Formby.

The power station adjoins the railway, on the banks of the River Alt, at Formby, and is a building 290 feet long by 130 feet wide, consisting of an independent steel structure, the steel stanchions of which, in addition to carrying the roof, support traveling cranes over the engine room, the spaces between the stanchions being filled with brickwork. It has two spans, one containing sixteen Lancashire boilers, 8 feet 6 inches in diameter, by 32 feet long, for a working pressure of 160 pounds per square inch, together with superheaters, feed pumps, induced draught plant, etc.; the other and larger span contains four horizontal cross-compound condensing engines of 1,500-kw capacity, also one subsidiary vertical compound condensing engine of 750-kw capacity, capable of taking large overload for short periods.

The generators in connection with these engines are of the three-phase type, with a periodicity of 25, and a voltage of 7,500. The engine room also contains steam-driven exciters, sub-station plant and a main switchboard.

Three-core paper-insulated metallic-sheathed cables convey the high-tension current to the sub-stations, and are laid on what is known as the "solid system," at a suitable depth along the company's right of way.

The sub-station equipments, similar in character, consist of transformers, which step-down the three-phase alternating current of 7,500 volts to low-tension alternating current, from which it is converted in rotary converters to direct current at 600 volts. The rotary converters are nominally of 600-kw capacity, four being provided in each sub-station, and three static transformers, cooled by means of air blast, are provided in connection with each rotary. The connections from these sub-stations to the third rail are made by insulated copper cables, run underground in troughing.

The third rail is carried outside the track rails, and is supported

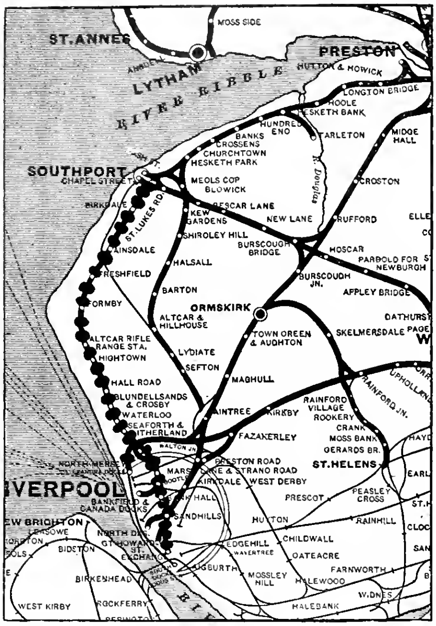


FIG. 1.—MAP OF ROUTE.

at intervals of 10 feet on insulators. The center of the rail is 3 feet $11\frac{1}{2}$ inches from the center line of the track, and the top of the rail 3 inches above the surface of the track rails, these being limensions agreed upon between all the British railway companies.

The third rail, which is of special composition to secure conductivity, weighs 70 pounds per yard, and is protected by a timber guard rail at points where there might be danger of accidental contact. To insure a good return circuit a fourth rail, supported on wooden blocks, has been placed in the 4-foot way, and bonded to each running rail; this method of return, it was thought, would interfere least with the running tracks, and would permit the easy removal of any running rail at any time.

FIG. 2.—ELECTRIC TRAIN ON LANCASHIRE & YORKSHIRE RAILWAY.

The cars differ from those used on the steam lines of the company, and were built especially for the service. They are 60 feet long and 10 feet wide, being the widest cars in Great Britain. This width was adopted because it was found before any operations were begun that it was possible on the Southport line, as distinguished from other parts of the main line, to have wider stock, some slight alterations to the track and some trifling ones to the platforms along this length alone being necessary. The carriages have center aisles throughout, with vestibules to allow passage from one carriage to the next, this arrangement being borrowed from American practice.

The motor cars are at the ends of the train, and are the third-class cars, and, as previously described, are equipped with two 150-hp motors on each truck, and with multiple-unit control. The front end has a small compartment for the motorman, containing all the apparatus for controlling the train; and near this is a baggage compartment, the remainder of the car being devoted to passengers. Most of the seats are cross-seats, and seat three on one side of the passage and two on the other, but at the ends are longitudinal, to allow more room for passengers entering or leaving the cars. The trailers or first-class cars have seats arranged after the same design, but only two on each side of the passage. A four-car train will carry 270 passengers, the third class seating 69 and the first-class 66 people. The delay at stations will be reduced to the smallest possible amount. Notice boards are hung on the platforms showing passengers where to stand to await their class, and in order to ensure quick loading and unloading of passengers, strict regulations are made that every passenger is to enter the cars at the end door and leave by the front door, thus ensuring a continuous circulation.

In view of the alarm caused within recent months by fires on electric trains, the company has taken all possible precaution against such an occurrence. The motor compartments have, with the exception of the roof, which is covered with sheet-steel plates, been lined with uralite, a well-known fireproof material, the floor also being fireproof. In addition, the cable conduits are lined with uralite, and the whole of the floor over the motors is covered with the same material and thin steel plates. All the trains also carry fire appliances.

The vacuum brake used on the trains is, with some slight differences, the same as that used all over the Lancashire & Yorkshire Railway. It is fitted with quick-acting valves, but is provided with an electrical exhauster in place of the steam ejector on the locomotive.

The service will start with a 10 minutes headway in both directions between Liverpool and Hall Road, and every second train will run through to Southport. In addition an hourly express will run in each direction between Liverpool and Southport, and at certain times the trains arriving at Southport from Liverpool will go on to Crossens. The accommodation trains between Liverpool and Hall Road and those between Liverpool and Southport will be run in less time than at present, but it is not intended that the expresses to Southport shall do the journey in less time than the fastest steam trains now running.

The whole of the work with the exception of the rolling stock, which is being made at the Horwich and Newton Heath Works of the railway company, is being carried out by Dick, Kerr & Company, Ltd., of London and Preston, who are now completing at their Preston works the main and auxiliary generators, the sub-station equipment, the control equipments of the trains and the rest of the electrical plant.

Automobile School.

The Boston Y. M. C. A. inaugurated an automobile school last fall. The course embraces practical as well as theoretical study and instruction as to automobiles. This is claimed to be the first automobile school established in the world, and, according to a recent report, it has been very successful so far.

International Electrical Congress of St. Louis.

According to the present indications, the International Electrical Congress, to be in session at St. Louis, September 12-17, 1904, will be one of the most successful that has yet been held, both with respect to the number of adhesions and to the value of the transactions.

Up to date about 3,550 circular letters of invitations to join the Congress have been issued to persons or associations in North America. From these 875 postcard acceptances of membership have been received. About 350 similar circular letters of invitation have been recently sent to other countries. It is intended to issue in all about 5,000 invitation circular letters in America and about 6,000 in foreign countries. It is expected that many persons will join the Congress, both in America and abroad, who do not expect to attend the sessions in St. Louis, in order to secure a copy of the Transactions, which will form one and perhaps two large octavo volumes. Collection of fees has commenced, and upon receipt of a fee the member will be forwarded a certificate of membership. The certificate is 8½ in. by 11 in. in size (21.5 cm. x 28 cm.) and printed on heavy paper of excellent quality. A miniature replica of this certificate, without the signatures, is appended.

Recently 280 special letters of invitation have been issued on behalf of the committee of organization to prominent electricians and electrical engineers, signed by the president and the general secretary of the committee, requesting papers for the Congress in th various sections. Of these 146 have been sent to foreign authors, and 134 to American authors. There has not been time to receive replies from more than a few foreign authors, but 21 acceptances have, up to date, been received from abroad, and 46 acceptances from North America. Sixty-seven papers are thus already promised for the Congress, and the number is steadily increasing. A considerable number of invitations to contribute papers have yet to be issued. It is hoped that the Congress will convene with a full programme in each section, and that at least half of the papers may be from foreign countries. According to the plans of the committee, papers for the Congress programme are specially invited, but papers voluntarily offered will be submitted to the officers of the sections to which the papers belong, and may be included in the programme by invitation at their request, if the subjects are desirable, and if the schedule allotted to each section will permit, it being the desire of the section officers to secure and offer the best possible programme and presentation.


International Electrical Congress

St. Louis. 1904

Henry J. Caldwell

having been invited to participate in the International Electrical Congress of St. Louis, 1904, and having duly paid the fees is hereby enrolled a member with the privilege of attending all general and sectional meetings, and of receiving the printed transactions of the Congress

For Committee of Organization

President Treasurer General Secretary

ELECTRICAL CONGRESS MEMBERSHIP CERTIFICATE.

Petitions from the Congress Committee of Organization, and from the president of the American Institute of Electrical Engineers, have been filed with the Department of State at Washington, through the Department of Commerce and Labor, and the National Bureau of Standards, urging that the various foreign governments should be invited to appoint official delegates to the Congress. The lists of such delegates to be invited is, in accordance with the lists, allotted to the various countries at the Paris Congress of 1900, and the Chicago Congress of 1893. Including the United States, the lists comprise 56 official delegates. Information has been received that these petitions have been granted, and that the State Department on the 17th of December, 1903, instructed the diplomatic officers of the United States abroad to extend an invitation to foreign countries to be represented at the Congress by delegates.

Arrangements are being made with a view to perfecting plans of co-operation between the Congress and electrical societies and associations in various parts of the world. Invitations have already been extended to the Congress members to visit places of electrical interest on the journey to or from St. Louis.

The Committee of Organization of the Congress consists of Elihu Thomson, president; A. E. Kennelly, general secretary; W. D. Weaver, treasurer; Bion J. Arnold, vice-president and chairman of Executive Committee; C. F. Scott, Dr. S. W. Stratton, Prof. H. S. Carhart and Prof. W. E. Goldsborough, vice-presidents.

The following section officers (chairmen and secretaries) have been appointed by the president, and have already done much work in organizing their sections:

Sec. A General Theory,	Prof. E. L. Nichols, Cornell University.	Prof. H. T. Barnes, McGill University.
Sec. B General Applications,	C. P. Steinmetz, Schenectady.	Prof. Samuel Sheldon, Brooklyn.
Sec. C Electrochemistry,	Prof. H. S. Carhart, Univ. of Michigan.	Carl Hering, Philadelphia.
Sec. D Elec. Power Transmission,	Mr. C. F. Scott, Pittsburg.	Dr. Louis Bell, Boston.
Sec. E Electric Light and Distribution,	Mr. J. W. Lieb, Jr., New York.	Mr. G. S. Dunn, New York.
Sec. F Electric Transportation,	Dr. Louis Duncan, Mass. Inst. of Technology.	Mr. A. H. Armstrong, Schenectady.
Sec. G Electric Communication,	Mr. F. W. Jones, New York.	Mr. Bancroft Gherardi, N. Y.
Sec. H Electrotherapeutics,	Dr. W. J. Morton, New York.	Mr. W. J. Jenks, New York.

All communications should be addressed to the General Secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass. He reports general and widespread interest in the subject as indicated by the correspondence, the bulk of which may be faintly inferred from the figures that have been quoted above. Indeed, the interest attaching to the work of the Congress is one of the best of auguries as to its abounding success.

An Automobile Engineers' Society.

Automobile engineers held a meeting last week in the club rooms of the New York Automobile Trade Club and organized the Society of Automobile Engineers, with E. T. Birdsall, of the Standard Automobile Company, in the chair. Those present favored the formation of a body similar to the American Society of Mechanical Engineers in objects and work. The chief mission of the society will be the interchange of technical automobile knowledge among the members. Quarterly meetings will be held and papers will be read on mechanical topics.

These officers were elected: President, A. L. Riker, Locomobile Company of America; first vice-president, Henry Ford, Ford Motor Car Company; second vice-president, John Wilkinson, Franklin Motor Car Company; secretary and treasurer, E. T. Birdsall, Standard Automobile Company. Membership Committee—A. H. Whiting, Edison Battery Company (chairman); A. L. Riker, L. I. Gibbs and E. T. Birdsall.

Nearly fifty applications for membership are in hand. There will be two classes of members, viz., an active class, for registered engineers, and an associate class, for members interested in automobile sale or construction who are not engineers. It is interesting to note the prominence of men of electrical training and connections.

Convention of the Northwestern Electrical Association.

IN our issue of last week a telegraphic report was given of the opening sessions of the convention of the Northwestern Electrical Association. Below we present a fuller account of the proceedings up to the time of adjournment.

Secretary-Treasurer Mercein's report called attention to the resolution adopted last January to hold a summer meeting at St. Louis, in the present year, in connection with the National Electric Light Association. He recommended that the association take action in regard to this. The balance in the treasury, as further reported, showed the finances of the association to be in good condition. Adjournment was then taken until 1.45 the same afternoon.

In the presidential address, Mr. F. W. Bowen called attention to the "Question Box" and "Wrinkle" department, which he had hoped to make a feature of the present convention, but had been prevented from so doing because of much additional work which had been thrown upon him incident to the destruction of his station by fire twice. The programme, however, was prepared with a view to presenting matters which would be of interest to the members, both active and associate. The question of pre-arranged discussion of papers was not considered advisable, as it would not afford the opportunity which otherwise would present itself, and because the ranks of the association include such men and minds as are competent enough to discuss any paper offered in the programme.

Mr. Bowen called attention to the fact that the commercial side of every proposition is the one which most appeals to the central station man. Continuing, he considered that the general principles of the business seem to be better settled and more fully grounded and the lines of machine building seems to have reached an ultimate standard, for a considerable time at least, and, therefore, the central station man is very much nearer a standard than ever before. The twin subjects of "Taxation" and "Municipal Ownership" were touched upon, as well as several other phases of the central station business, which are of vital interest to all.

Letters were then read from various sub-committees of the legislative committee, reporting the progress made in their particular States. The committee on membership then recommended a number of applications. It was deemed advisable to continue the committee on uniform advertising, and Mr. H. Almert was added to the same.

After some discussion a motion was carried that the summer meeting be held in September at St. Louis to meet with the other electrical associations and electrical people, the date to be left to the executive committee. It was also decided to send a representative in the person of the secretary, to the convention of the National Electric Light Association, to be held at Boston in May.

The Northwestern Electrical Association is to be congratulated upon the fortunate selection it has made in the person of its new president, T. F. Grover. Progressive, liberal and well versed in his chosen field, he will prove a most worthy successor to the retiring president, F. W. Bowen. Identified with electrical interests since the electric current was first introduced on a commercial scale, Mr. Grover is at home in the lighting and street railway field. Being vice-president and general manager of the Eastern Wisconsin Railway & Light Company, he is a member not only of the Northwestern Electrical Association, but of the National Electric Light Association, the American Street Railway Association and the American Gas Light Association as well. Although born and brought up in New Jersey and the East, he has been in the Northwest since 1892. He was the superintendent of the former Milwaukee & Wauwatosa Electric Company, which he left in 1896 to go to Fond du Lac, Wis. He acquired an interest in and was vice-president and superintendent of the then Fond du Lac Electric Company, which, under Mr. Grover's guidance, has steadily advanced. Having secured a new electric light, street railway and gas franchise, he then formed the Fond du Lac Railway & Light Company, which later acquired the property of the Gas Light Company. In 1899 he built the street railway system in Fond du Lac, which in the following year was extended to North Fond du Lac. In 1902 the Fond du Lac & Oshkosh Electric Railway Company was incorporated, of which he was the general manager and later its president. This company was subsequently absorbed by the Eastern Wisconsin Railway & Light Company. Mr. Grover takes an active part in the affairs of his city and is identified with various commercial enterprises.

T. F. GROVER,
PRESIDENT NORTHWESTERN ELECTRICAL ASSOCIATION.

HEATING FROM CENTRAL STATIONS.

The first paper presented in the afternoon session was one on "Central Station Heating," by W. H. Schott. To judge by the discussion of which this paper was productive, it was a subject which is of great interest to many of the central station men. Mr. Schott considered various features common to all systems, but the question to be decided upon when a central station plant is considered is, "Which shall We Use, Water or Steam?"

Hot water heating is in operation in a great many cities, some using a single pipe circuit system, others a two-pipe static head system, and still others a two-pipe balance column system. The single-pipe system is adaptable only where there is a limited territory to serve; for large areas a two-pipe system becomes necessary in order to give the system the necessary amount of flexibility required and to furnish a positive circulation. Where the district to be served is compact with large buildings, ranging in height from six to sixteen stories, the situation then becomes a steam-heating one, the steam being supplied at low pressure, which may be obtained either from engines or furnished direct from boilers.

Heating plants utilizing either water or steam are found to be a better investment where exhaust steam is used in furnishing the heat, or at least part of it. Where exhaust steam exists and it is desirable to use it, this can be done more economically in a hot water system than in a steam system, due to the fact that it may be used at atmospheric pressure, and at a pressure represented by a 20-in. vacuum during the milder periods, the circulation being made positive by using a pump as the circulating medium.

In a well-designed water system there is only required from ten to thirty pounds pressure to overcome the pressure due to circulation and friction of mains, the power utilized by the circulation being absorbed in the circulating water, so that it is not lost. With a steam system sufficient pressure must be maintained upon the mains to overcome the friction in the street work and to furnish the necessary circulation to the surface which is to be heated, this pressure ranging from 2 to 20 pounds and even higher, but ordinarily at from 5 to 10 pounds pressure.

In taking up the question of a central station heating plant, the territory to be heated should be carefully examined by some one familiar with its needs and then a plant designed that will give an economical operation, together with a superior service to meet the needs as found. Many franchises granted in the past are accepted by companies that should never have been accepted, due to the fact that the rates prescribed were entirely too low, resulting in disaster to the company. The street work should be installed in the best possible manner known, great care being taken to see that the main is of ample capacity, and the expansion taken care of in a proper manner so as not to throw undue strain on any fitting in the system; the insulation should be of the best so as to reduce street losses to a minimum, the pipe lines should be properly under-drained so as to eliminate the possibility of water logging, and in a steam system great care should be taken in the maintaining of drains.

The radiation required for a building should be based upon the minimum temperature, or say 20° below zero. If sufficient radiation is set to maintain the standard temperature, a company is only called upon to operate 40 per cent. of its maximum as an average during the entire heating season. It is an absolute necessity to adopt some form of regulation, as otherwise a large amount of heat is wasted. Tests made show that a regulator system will save to the central station 40 per cent. of its fuel requirements, which implies that 40 per cent. more business can be carried on a given plant with regulation.

In a well-designed water system during the average temperature of the heating season six to eight pounds of water per square foot of radiation per hour is ample to furnish all the heat required, but when the temperature is 20° below zero twelve to eighteen pounds of water per square foot per hour are necessary, and the plant must have a corresponding capacity. The same conditions practically apply to a steam as to a water plant.

Mr. Schott said that in tests made recently he has found a wider range in a steam than in a water plant. Comparing the tests taken in a building where the radiation set up was up to requirements against one where the radiation was set on a 52 per cent. basis, he found that a change of 34 per cent. in outside temperature varied condensation in the building where radiation was properly set 13.72 per cent. below in the building underset, the same change in outside temperature varying condensation 24.24 per cent.

As to charges for heating a given space, certainly a rate based on cubical contents is entirely wrong. A building, due to its construction and exposures, may vary from two to eight or ten changes of air per hour. These changes govern the amount of heat required to heat the space in question. Necessarily, to heat properly, the radiation must be based upon the maximum number of changes of air that will take place per hour, and as the number of square feet of radiation set governs the operating expenses of a central station, it must in that case be the basis of charge, either on a square foot or on a meter basis.

With the radiation furnished on a square foot basis and without regulation, a price that would justify the company in operating without any restrictions would seem prohibitive, but the application of regulation is practically like a meter service, in not permitting the building to be overheated, but furnishing the necessary heat to maintain 70 or 72°, the temperature usually agreed upon; with consumers securing their heat upon this basis, they are usually much better satisfied than upon a meter basis, and the income of the company per square foot per season should average higher than with a meter basis.

Probably the ideal method of furnishing heat to the consumer from the station standpoint would be through a meter and at the same time give the consumer automatic regulation. The regulator would prevent the building being overheated and insure an even temperature, and at the same time the company would be paid for all heat so supplied.

Mr. Schott presented several charts, showing the regulation obtained in a building without any manipulation of valves. The regulator closes off the circulation from ten to 70 per cent. of the time in each twenty-four hours, depending entirely on the outside temperature and as an average during the heating season will keep the circulation closed off over 40 per cent. of the time.

If a lighting and power company is in a position to furnish heat, in addition to its light and power, it can eliminate a large percentage of the isolated plants, with which they have always to contend. Moreover, a heating plant enables it to fortify its business against municipal ownership and competition. Consequently, in considering the establishment of a plant of this character, there should be considered the advantages to be gained by the operation of a consolidated property, and due credit should be given the heating department for the assistance it renders the lighting department in securing profitable lighting and power business that a company otherwise could not obtain.

In the discussion of Mr. Schott's paper, Mr. Almert asked the yearly cost of coal in a system with a fairly tight boiler and heating plant, heating say 200 or 210 days a year and using coal containing 11,500 to 12,000 B.T.U., costing say $2.25 per ton. Mr. Schott replied that in a test made recently at Purdue University Prof. Goss showed that the cost was 3.8 cents per square foot per season for hot water; the coal tested 10,500 B.T.U., which would put it on a $2.00 per ton basis. "Assuming the same value for the coal, it would cost a fraction under 8 cents per square foot per season. The actual test was 77 pounds of coal per square foot of radiation per season." With a steam proposition, which runs actually 130 pounds per square foot, an estimate can easily be arrived at to determine the cost with regulation. Without regulation, it will run as high as 180 pounds per square foot.

Mr. Kimball said that in Kenosha great difficulty has been met in differentiating between what is properly chargeable to the electric light plant and that chargeable to the heating plant. About 77 pounds of coal are used per square foot of radiation, in addition to the exhaust steam put into the heating system. Mr. Schott added that in the Purdue test everything was not charged against the heating plant. The engines in that case absorbed 7 per cent. of the heat transmitted to them and the pump absorbed 4 per cent. When it came to condensation, the engines tested at 28½ pounds and the pumps 95½ pounds per indicated horse-power per hour, and everything was charged against the heating plant except the actual heat units absorbed by the engines and pumps. The test proved that the difference in favor of regulation is just about 40 per cent. One should get at least 40 per cent. more for heating without regulation than with it. He said that the amount of heat given off governs the amount of coal burned, and the number of degrees drop in water depends upon how the plant is being worked. Some plants will work on as little as 10° or 12° difference, some 15° to 20°, and we have them as high as 30°. The heavier the load on the plant, the greater the drop will be in the water, on an average.

Mr. Kimball added that in some tests that were recently made the return temperature where regulators were not working was greater; more water was being pumped than where the regulators were operating; but as far as 40 per cent. difference in operating is concerned, he did not figure that the gain in economy would be as much. As to distribution losses, Mr. Schott said he had undertaken to arrive at the street losses, but was not quite satisfied; the tests should continue for a week or ten days and an average taken. In reply to a query, Mr. Schott said if at a temperature of 200° not less than 246 heat units will be given off for each square foot of radiating surface. At 170° there will be 170 units and at 160° 155 units; 160° is the average temperature carried throughout the heating season, providing the radiation is figured on that basis. It is another proposition to fix the radiation on a 210° basis so as to take care of the space at 20° below zero. It takes more radiating surface with the circulating water at 160° than at 210°. The drop in temperature, on the ordinary average distance, which is about half a mile, should not exceed two to three degrees as a maximum. The question of drop in the supply is usually figured on the basis that when the pipe line is handling 60 per cent. of its capacity, a change of water should take place within an hour's time. This might be increased, but when a line is working above 60 per cent. capacity, this should not exceed 2°, and it is being done on less than one. For average conditions 30° difference between supply and return at the power house is an average for standard practice. The difference in the temperature between the supply and return going in and out of a house should not exceed 12°.

Mr. Harding said that in the operation of his plant, which is one of the oldest in the country, it has been found very much better results are obtained by adjusting the houses to a drop of 40° than where running with a drop of from 25° to 30°. Mr. Schott said in the case of consumers taking water for domestic purposes, a boiler is placed in the return end of the line, and a meter connected. He did not consider it a good proposition to sell hot water.

In reply to a question as to how many average feet of radiation can be taken care of per horse-power of exhaust steam from the engine in the case of hot water heating, Mr. Schott said the average during the season will be 17,500 and on the basis of a temperature of 10° below zero, it will take care of a fraction under 10,000. "Assuming radiation as figured from a proper standpoint, and not throwing onto it a double condensation, this figure is more like 6,800 square feet. This is on the basis of 100 hp." As to the relative amount of horse-power required in a building for heating and for lighting, that depends entirely upon the character of the building. Assuming a store there will be a surplus of steam at all times required for lighting over and above that which is required for heating. In the case of a certain building of sufficient size to require 17,000 ft. of radiation to heat it with steam under normal conditions, 170 hp are required. The load on the electrc end runs as high as 350° and averages about 200 hp. so that the exhaust steam will more than heat the building. In this particular case the owners have agreed to take their heat and power from a central station company, with a minimum guarantee that it will not run over $15,000 a year.

COIL WINDINGS FOR ELECTRICAL PURPOSES.

The next paper to be presented was one on "Coil Windings for Electrical Purposes," by Messrs. Richard Varley and Charles R. Underhill. As there is very little data on the subject and the requirements are so exacting the practical method of obtaining data has been to construct electromagnets of different forms and sizes and make actual tests. Having once found the pull which may be produced through various distances with different magnetizing forces, it is then comparatively easy to determine what size of wire should be used for any given voltage to produce the desired results. The paper then took up various points concerning the manufacture of electromagnets and developed formulæ whereby it is possible to quickly determine the proper size of wire for any purpose.

ELECTROLYTIC RECTIFIERS.

In the absence of the author, a paper on "Rectifiers," by W. Scheidel, was read by the secretary. This dealt more in particular with the construction of an aluminum rectifier which has recently been placed in the market for the charging of storage batteries from alternating-current lines. The main feature is the use of an inactive electrode between the two active electrodes; the former is connected to the middle point of a transformer secondary, and the two latter to the secondary terminals.

INCANDESCENT LAMPS AND THEIR SMASHING POINT.

The last paper to be read at the afternoon session was one on "Incandescent Lamps in General, their Smashing Point in Particular," by George C. Keech. From the very birth of the "smashing point" expression came the thought that the next step toward the ideal lamp was to make one which would automatically die when it had lived out its usefulness. After pointing out the desirability of keeping the illumination up to the standard, the paper then outlined improvements in the process of manufacture whereby, although exactness is not possible, lamps are made which will burn out very close to such a point, and the important result is practically obtained. Such lamps will smash automatically and must be renewed. In the discussion Mr. Keech, in answering to a question as to what he considered a proper "smashing point," said that this is when the candle-power falls to 80 per cent. of normal, or 12.8 candle-power. In reply to a question he said the candle-power are for 3.1 and 3.5 watt-lamps; about 7,200 and 13,800 hours, respectively. Mr. Schott said that the frequent changing of lamps is a good thing to maintain candle-power, but the tendency of cities is to force companies into lower rates, and it is an open question whether they can go to too great expense to maintain it. In reply Mr. Keech said that the average burning of a lamp is, say, two hours per night, and one lamp at half a cent would bring in a revenue of one cent per night; fifty lamps, fifty cents; and in 365 nights those fifty lamps would bring in about $180. In that way fifty dead lamps on the line, if they had been burning, would have meant the sale of $180 worth of current: and, of course, the central station man expects to make his money out of the sale of current. Mr. Schott reported his experience that the average renewals are about a lamp per year for the connected load. For instance, with about 7,000 lamps connected with a station, about 7,000 would be the average number of renewals, which statement applies particularly to a residence territory; if a commercial plant, the percentage of renewals will materially increase. In the ordinary country plant, where anywhere from 30 to 60 per cent. of the connected load is for residence use, about one lamp per year for each lamp connected would be a fair average to consider. In a town of ten to 12,000 inhabitants, 7,000 lamp renewals would cost about $1,400. He uses a 52 to 57-watt lamp (55 on an average). An increase in voltage of 1 per cent. means an increase in candle-power of 6.2 per cent. and an increase in life of 25 per cent. Mr. Keech said that by burning a lamp 3 per cent. high its life will be cut in two, no matter what the efficiency is. A 3.5 watt lamp, burning 3 per cent. high, will last about 54 per cent. and a 3.1-watt lamp on the same circuit will last about 50 per cent. of its life, on the average, because the 3.1-watt lamp is more delicate. In the case of a 110-volt lamp run 3 per cent. high, it would make a 16-cp lamp give 19 cp. The wattage would be forced up about one watt to a volt and the lamp would practically give out 19 candles at 60 watts, which is just about 3.1. As a consequence, a 16-cp lamp burned 3 per cent. high will result in increasing the watts a little, so that when you divide 19 into 59 watts you have a 3.5-watt lamp, which brings it back to where it was in the first place, and the efficiency remains the same.

Mr. Schott considered that one of the worst features to contend with in plants in small towns is the fact that the consumer expects to take one lamp and make it do the work of two. If a filament is white, the average consumer will think it is giving more light than a red one. In large cities where they are educated in this manner and put in the proper number of lights, you can run your lamp under voltage a little bit, and give satisfaction, but in a typical country plant you have to vary from good practice to satisfy your customer and yourself.

DOUBLE-CURRENT GENERATORS.

On Thursday morning Mr. W. L. Waters presented a paper entitled "Double-Current Generators in their Connection with Double-Current Supply," in which he pointed out that the double-current generator offers the best solution in cases where a station supplies both alternating and direct current, owing to the saving both in the first cost and operating expenses. The efficiency is also higher than when rotary converters or motor generator sets are used. The main objection is that the voltage of the alternating-current side of the machine bears a different ratio to that on the direct-current side; that one cannot be varied without the other, and variation of the load on one side affects to a slight extent the voltage on the other side. The relative weight of these objections must be decided in each individual case. From the manufacturer's point of view the great objection to double-current generators is that they are special machines, usually requiring new designs and special patterns and dies.

It was pointed out that some standard direct-current generators can be very conveniently used as double-current generators with only a very slight change in the speed. For example, a standard 2,500-kw, 250-volt engine type machine can make a very good 25-cycle double-current generator, the only change being to provide the machine with collector rings, increase the air-gap, and put more copper on the field magnets in order to make the machine regulate properly when running as an alternating-current generator. These changes would not increase the cost of the machine more than 20 per cent. On the other hand, if a 500-kw, 500-volt engine type machine were taken, it would mean very radical changes to make this into a 25-cycle, double-current generator; 25 or 40-cycle machines are not in any way difficult to design, but in the case of 60-cycle generators difficulties are encountered with the commutator on account of the high peripheral speed; 60-cycle, 600-volt, double-current generator and rotary converters can be made to work, but they are not as reliable as those for lower frequencies, and there is no brush gear at present on the market which is quite satisfactory for the commutator peripheral speeds necessary in a 60-cycle, 600-volt machine. It appears that the most satisfactory 60-cycle, double-current generators will be those driven by steam turbines, and it looks as though this prime-mover would solve this problem.

In summing up Mr. Waters says that, generally speaking, 25-cycle, double-current generators, if of large size, can be direct-connected to the engine, while for sizes smaller than 500 kw they are better belt-driven; 40-cycle machines should always be belt-driven if the cost is to be reasonable, while for 60-cycle, double-current generators, apparently the only reasonable solution is to have steam turbine sets. Of course, double-current generators can be made for any frequency and voltage up to 60 cycles, 600 volts, and for any speed desired; it is simply a question of dollars and cents whether one wishes the most reasonable prices and the quickest deliveries and to have machines which, when second-hand, will be something more than scrap. They should consider the matter of frequencies and outputs when laying out a station for double-current supply.

The discussion of Mr. Waters' paper more particularly related to the construction of double-current generators, and not with the practical application of these to central station work. The president remarked that the use of double-current generators was one of expediency with each individual station. As it is seldom good practice to run an engine underloaded below, say, 50 per cent., it is such a condition to which the double-current generator is especially applicable.

RECTIFICATION OF ALTERNATING CURRENTS.

The convention then listened to the reading of a paper on "Rectifiers," by C. F. Burgess, assistant professor of electrical engineering at the University of Wisconsin. This paper more particularly dealt with the theoretical aspect of the subject, and indicated the direction in which practical results may be expected. Rectifiers were divided into three general types: mechanical, vapor and electrolytic. Omitting the rotary converter, which is essentially a direct-current dynamo driven by an alternating-current motor, and is not a rectifier in the commonly accepted meaning of the term, the mechanical rectifiers include the synchronously-driven rotating reversing switch, and the vibrating reverser in which the contact-maker is maintained in synchronous vibrations by energy derived from the alternating circuit. Various inherent defects have prevented these devices from being extensively adopted in spite of their low cost, as compared with the rotary converter.

A class of electrolytic rectifier only recently placed upon the market in this country is sometimes designated an electrolytic valve, and, as such, has an analogy in the hydraulic check valve, which automatically allows water to flow freely through a pipe in one direction, but prevents its passage in the opposite direction. With the commercial frequencies now employed, of from 25 to over 100 cycles per second, it is evident that this valve must act with great rapidity. As the result of laboratory investigation, it has been shown that an aluminum plate immersed in a sodium nitrate electrolyte required about 1/1100 second for closing the electrical valve at each reversal of pressure.

Among the advantages of such a rectifier are that it possesses no moving parts; it is a close approximation to the static alternating-current transformer, requiring little or no attention during operation. The materials of which it is constructed are cheap, and the total cost should be lower than that of the ordinary transformer of equivalent outputs. The electrolytic rectifier has a high power factor. It requires little or no abnormal rush of starting current. In its present condition, it has an efficiency in the neighborhood of 50 per cent. In small sizes this form of rectifier is especially advantageous for the charging of small storage batteries from alternating-current circuits.

With aluminum electrodes 2 x 1 x 1½ in., a normal load of 10 amp. can be obtained at a rectified pressure of 25 to 50 volts. The current may be several hundred times higher than this value for a short time, without detriment, and a 50 per cent. overload causes excessive heating and vaporization of the salt, only after several hours' run. The total weight of an output of this capacity is about 30 pounds, most of which is in the transformer. The greatest use which the electrolytic rectifier finds at present is in the charging of storage batteries for various purposes, and its commercial introduction will afford an additional market for the central station product.

The discussion served to show that the future of the rectifier in smaller sizes is a promising one, and that although the efficiency may not be as high as may be desired, it nevertheless will fill a want for the charging of storage batteries for automobile and other purposes.

STANDARD ALTERNATING-CURRENT PRACTICE.

The first paper to be read at the Wednesday afternoon session was on "Standard Practice in the Use of Alternating-Current Electrical Apparatus," by J. J. Gibson. In the absence of the author, Mr. J. R. Kimball read the paper. Referring to the revolving armature generator, it was stated it still retains some advantages for both belted and direct-connected units in the smaller sizes; but the revolving field generator has become a fixture for all others. The question of direct-connected versus belted units is one which has been quite definitely decided in practice. The question of synchronism in throwing alternators together in parallel, is most frequently determined by the lighting up of the synchronizing lamps when the machines are in parallel. The most satisfactory method, however, has proved to be the one employing a synchrnoscope, as it has the advantage of the lamp method because it shows the slightest difference in phase or frequency, whereas lamps do not. As to frequency, for a pure and simple power proposition, 25 cycles has come to be standard. It gives low speed for motors, and although rotaries are successfully built and operated on 60-cycle systems, still the design of the 25-cycle rotary is less difficult and expensive. For lighting and power 60 cycles per second has come to be the accepted standard, as this frequency is not too high for power, either in motors or rotary converters, and it is about the lowest allowable frequency for successful operation of arcs and incandescents.

As to choice of number of phases, stations carrying an incandescent lighting load alone, with no prospect of ever having a power load, should use single-phase apparatus. A single-phase distribution is not suitable for the operation of motors. It is necessary in a station carrying a mixed load to use polyphase generators, which supply different systems of feeders—polyphase feeders for power circuits, and single-phase feeders for lighting circuits. Three-phase distribution for power calls for about three-quarters of the copper which would be used in two-phase distribution. On the other hand, it is easier, on a lighting load, to keep two than three phases balanced, and the lowering transformer equipment is more expensive in three-phase distribution. For a station, therefore, operating a mixed load, where lighting predominates, two-phase is far better than three-phase. When the power load increases to a point where 25 per cent. of the copper in that branch of the service becomes a considerable item and amounts to more than the saving in transformers, then three-phase distribution is the proper thing to use.

For transmission lines three-phase is universally adopted, although in stepping down for distribution from transmission lines, the current is very often changed to two-phase, in order to obtain the benefits of such regulation. As to choice of voltage in the case of central stations operating lights and motors, 1,100 and 2,200 volts are at present standard. Where necessary alternators can be wound to deliver 6,600 to 11,000 volts. For industrial plants, where the current must not be sent a very long distance, 220 or 440 volts are used, thus doing away with the necessity of lowering transformers. Mr. Gibson considers that the single-phase transformer is best, and that the three-phase transformer will never be more than a specialty. The induction motor, although essentially a constant-speed motor, like the shunt-wound, direct-current motor, is being applied to variable-speed work. Synchronous motors are the exception, and not the rule, and in very many cases are being discarded for the induction motor. Double-current generators are specialties, and not standard practice. Alternating-current arc lamps are finding extensive application as they enable the central station man to use one system for all classes of service.

STORAGE BATTERIES IN SMALL CENTRAL STATIONS.

Mr. J. H. S. Waring then read a paper in which he took up the specific cases of a lighting station in a typical small village and showed the benefit of installing a storage battery in connection therewith. In this case it usually proves unprofitable to furnish continuous service throughout 24 hours, owing to the small demand during the early morning hours and during the greater portion of the day. On the other hand, a central station operating only on the night schedule is greatly handicapped since the owners of residences naturally demand lighting during all hours of the night, and would probably desire fan service throughout the day during the summer months.

The plant considered consists of one 60-hp and one 120-hp non-condensing engines, which, in addition to driving certain machinery, operate two 220-volt geerators, one of 20 and the other of 25 kw, connected to a three-wire system with 220 volts across the outers. The maximum peak load of 150 amp. was on the station for about an hour and a half in the evening; that is, from 6.30 to 8 P.M. It then gradually decreased to about 10 amp. at 11 P.M. and at midnight the plant was shut down. A storage battery was then put in; the machinery operated the same number of hours as previously, and current supplied from the storage battery for the remainder of the day. A 110-volt battery was installed, and the two outer wires connected together at the station, the system thus operating as a two-wire, 110-volt system with a considerably less drop than when operated as a three-wire system with maximum load. There was an increase in load after the installation of the battery of about 60 per cent. and an increased fuel consumption of only about 25 per cent., showing that the cost of fuel per kilowatt-hour was decreased about 37 per cent., which decrease was due to the fact that the generator set while operating with the battery was run at a considerably higher percentage of full load than previously.

Another case was cited of a plant which supplied current to outlying districts. While the alternating load was extremely heavy during the peak, it was very light during the day, consisting only of a small amount of fan service in the summer months. A battery was installed in this plant which furnished current directly to the direct-current motors and at the same time operated a direct-current motor running a small alternator, so that the fans on the alternating-current system could be used.

Another application of the storage battery referred to and irrespective to the size of the plant, is in connection with a water power plant. There are many cases where there is sufficient water power to supply considerably more than the load existing during the greater part of 24 hours, but not sufficient for the peak load. In this case the generators, while carrying the day load, can charge a battery, the same being discharged at the time of the peak load.

Another application of the storage battery referred to is that of placing it at the center of the load of a direct-current system of distribution. When the volume of business in a congested locality reaches a certain volume (and the more remote the sooner is this point reached), the amount of copper required to care for the power from the station tends to render this system of distribution impracticable. By the installation of a battery of sufficient capacity to care for a certain portion of the peak, the amount of copper between the central station and the center of the load is decreased to such an extent that the battery investments is decidedly a good one from the commercial standpoint. A recent adaptation mentioned of the storage battery is its use with direct-current exciters in alternating-current power and lighting plants. With a storage battery floating at all times on the exciter, power interruptions of current in the exciter circuit are practically obviated, fluctuations on the exciter voltage are reduced with corresponding reductions in the alternating-current voltage fluctuations. Where alternating-current motors are used to drive the exciters, the battery also serves to supply field current when starting up the plant after a shut-down.

At the conclusion of his paper, the author showed a number of lantern slides, which served to illustrate some points of interest in lighting work and storage batteries. Among others was shown the new type of negative plates of the Electric Storage Battery Company, known as the box negative. In this plate the active material is held in place by perforated lead sheets on each side of the plate, which thus prevents the loss of the active material. In a laboratory test, after 8,000 complete discharges of the plate, a depreciation of less than 1 per cent. was noticeable.

In answer to a question, Mr. Waring stated that the latest practice of his company was to place wooden separators in the battery after they had been in operation for about a year. Mr. Lukes cited the advantages of the storage battery on railway circuits in order to prevent the abrupt fluctuation. These fluctuations are very severe, the load changing from almost zero to perhaps 50, or even as high as 150 kw. Mr. Waring said the use of a storage battery in conjunction with a street railway plant is perhaps the most common application of storage battery work in large stations. One application is to take off the fluctuations of the railway load, so that all machines may be belted to one shaft, thus avoiding trouble with regulation on lighting circuit. In a recent case a firm of consulting engineers made a test on an interurban system where there were three sub-stations with a storage battery in each. They made a test of a sub-station, running with the rotaries alone, the batteries being out of service; the next test was made with the battery running without a booster, the battery merely floating; and the third test was made with the battery operating with booster in conjunction with rotaries. In that case the fluctuations either side of the average voltage were 3 per cent. on a 600-volt system, when the battery was operating with booster; when the battery and booster were off the voltage fluctuation was 16 per cent. under just about the same load variations. In that case they were not aiming at voltage regulation, because it made no difference whether the rotaries did vary somewhat, but that may serve as an illustration of what it will do. In reply to a question, Mr. Waring said that in most interurban practice he figures on certainly not over 100 watt-hours per ton-mile for cars, and the starting current will vary from two to three times the average current. That does not mean necessarily a large-sized battery, because the battery only has to take care of the fluctuation momentarily, and not for any length of time.

THE CURTIS STEAM TURBINE.

Mr. James Lyman presented a paper with this title, which opened with an account of the fundamental principles of the steam turbine, and compared the Curtis type with those of Parsons and De Laval. The former was then described in detail and its advantages over the reciprocating steam engine pointed out. With respect to regulation, it was stated that in the case of a 1,500-kw Curtis turbine with a mixed load of lighting, induction motors and railway power with momentary fluctuations of 200 kw, the load ranging from 500 to 800 kw, the speed varied less than 2 per cent., with the boiler pressure varying all the way from 75 to 150 pounds. It was added that no reciprocating engine could give such regulation. Experience with Curtis turbines in operation and deductions from their form of construction, show that the repair account will be exceedingly low, making a large saving as compared with the operation of reciprocating engines. One of the advantages adduced in favor of the Curtis turbine is that, when used in connection with steam heating plants, it can be changed from condensing to non-condensing without shutting down. The heating system can be connected with the first stage or free exhaust and regulated for several pounds back pressure by adjustment of the second stage valves; thus, where all the exhaust system is not required for heating, it can be efficiently used by the turbine. Another advantage noted is that the Curtis turbine in running is almost noiseless. Following is a list giving the sizes of Curtis turbo-alternators now made by the General Electric Company: For 60 cycles; 500 kw at 1,800 r.p.m.; 1,500 kw at 900 r.p.m.; 3,000 kw at 600 r.p.m., and 5,000 kw at 514 r.p.m. For 25 cycles: 2,000 kw at 750 r.p.m., and 5,000 kw at 500 r.p.m. It was stated that the General Electric Company has sold 122 turbo-alternators aggregating 206,500 kw; 25 of the units have already been shipped and about half of them are now in regular commercial operation.

RADIUM AND RADIOACTIVITY.

The last number on the programme was an illustrated lecture on "Radium," by Prof. R. A. Millikan, of the University of Chicago. This was a pleasing diversion from the technical papers discussed at the convention, and, furthermore, was a very instructive lecture on a subject which is arousing the greatest interest, not only among scientists, but among laymen as well. The lecturer treated the subjects under the following heads: Discovery of X-rays; discovery of radioactivity; discovery of radium; nature of cathode rays; new theory as to the constitution of matter; nature of X-rays; radioactive substances emit cathode rays; other radiations from radioactive substance; nature of alpha-rays; the Crookes spinthariscope; continuous emission of light and heat by radioactive substances; radioactivity a manifestation of subatomic energy; production of uranium rays; the emanations from radium; induced radioactivity; the birth of helium; the life of radium; the transmutation of the elements; sub-atomic energies.

As will be seen from the above enumeration, the lecture covered a great extent of ground. The historical development was considered in each case and the views by different authorities as to the nature of the various radioactive phenomena given. In conclusion, Prof. Milliken says that the studies of the last eight years upon radiation seem to indicate that in the atomic world at least some of the heaviest and most complex atomic structures are tending to disintegrate into simple atoms. The profoundly interesting question is thus suggested whether there is any natural process which does, among the atoms, what the life process does among the molecules, namely, which takes the simpler forms and builds them up again into more complex forms. Prof. Milliken thinks that it would be rash to attempt to give any positive answer to such a query, yet the fact that radium now exists on the earth, taken in connection with the fact that the life of radium is short in comparison that the ages the earth has been in existence, certainly seems to point to an affirmative answer. The experiments of the last eight years have marked a remarkable advance in science in that they have proven the existence of an immense store of sub-atomic energy. It seems highly improbable, however, that this energy can ever be utilized on the earth to serve man's economic needs, for thus far we know of but three substances which are disengaging this sub-atomic energy and these are changing so quickly that the rate of evolution of energy is almost infinitesimal. Radium may possibly prove to be of some practical value in the cure of diseases, although it is too early yet to ascertain this with certainty. But even if no practical application of this discovery should be found, radioactivity will, nevertheless, have served the most useful of all ends, namely, that of enlarging man's knowledge of the ways of nature and of deepening his insight into the constitution of matter.

The report of the nominating committee, which submitted the following names for officers and directors for the following year, was adopted, and the following declared elected: For president, T. F. Grover, Fond du Lac, Wis.; first vice-president, George H. Lukes, Evanston, Ill.; second vice-president, E. A. Daniell, Menominee, Mich.; secretary-treasurer, Thomas R. Mercein, Milwaukee. Directors—W. H. Schott, Chicago; D. C. Jackson, Madison, and H. Almert, Oak Park, Ill.

Thursday evening the annual banquet was held at Hotel Pfister, as usual.

The following members were in attendance at the convention: T. F. Grover, vice-president and general manager Eastern Wisconsin Railway & Light Company, Fond du Lac, Wis.; C. F. Burgess, assistant professor of electrical engineering, University of Wisconsin, Madison, Wis.; L. Owen, assistant superintendent Peoria Gas & Electric Company, Peoria, Ill.; J. H. Harding, treasurer and superintendent La Porte Electric Company, La Porte, Ind.; George H. Lukes, general superintendent North Shore Electric Company, Evanston, Ill.; Harold Almert, manager Cicero Light, Heat & Power Company, Oak Park, Ill.; R. Kimball, vice-president and superintendent Kenosha Gas & Electric Company, Kenosha, Wis.; H. W. Frund, secretary and manager the Vincennes Electric Light & Power Company, Vincennes, Ind.; F. W. Bowen, president; Thomas R.

Mercein, secretary; J. S. Allen, Beloit Electric Company, Beloit, Wis.; Irving P. Lord, Waupaca, Wis.; H. F. Pearce, Negaunee, Mich.; G. R. Lindsay, Manawa, Wis.; P. H. Korst, Janesville Electric Company, Janesville, Wis.; Edward Danfield, manager and secretary, Menominee & Marinette Light & Traction Company, Menominee, Mich.; P. L. Utley, manager Watertown Electric Company, Watertown, Wis.; Fred W. Insull, secretary North Shore Electric Company, Evanston, Ill.; William B. Jackson, Madison, Wis.; Mr. Rau, the Milwaukee Electric Railway & Light Company, Milwaukee, Wis.; D. B. Bronson, Chicago Edison Company, Chicago, Ill.; G. N. Eastman, Chicago Edison Company, Chicago, Ill.

The Lamme Single-Phase Series Motor.

The first issue of the *Electric Club Journal*, published by the Wilkinsburg Electric Club, contains an article by Mr. Charles F. Scott, entitled, "The Single-Phase Series Motor in Its Relation to Existing Railway Systems." After sketching the development of the electric railway and its present status, and pointing out how the advent of the series alternating-current motor has created a radical new situation in the electric railway field, it is stated that at first a frequency of 16⅔ cycles was employed for the Lamme single-phase motor, but experience gained in the construction and tests of a number of motors have led to the design of motors for 25 cycles equal in performance to the earlier motors at the lower frequency. The adoption of this frequency, moreover, makes present alternators available for the operation of the alternating-current motor, and, in fact, they may be used for supplying current to the cars equipped with the new motor and for supplying direct current through rotary converters to old cars.

It is stated that an unique feature of the alternating-current motor which is now being considered is its conformity to the standard type of direct-current motor. The former is also a first-class direct-current motor, being a type that can be operated indifferently on alternating current or on direct current. While this characteristic will be of little or no consequence with respect to new installations, there are many cases where it is necessary or at least desirable to operate from a direct-current trolley. Lamme single-phase series motors are normally wound for 250 volts, so that if two are connected in series they can operate on a 500-volt direct-current circuit. Two single-phase motors connected in series can take the place of one direct-current motor, and a four-motor equipment motor, therefore, may be operated with the ordinary direct-current type of series parallel control. A two-motor alternating-current equipment, if operated by direct current, would make it necessary that the whole control be by means of a rheostat in the same way that a single direct-current motor would be operated.

An equipment of single-phase motors with rheostatic control may be operated either on a 500-volt, direct-current circuit or on a 500-volt alternating-current wound circuit, or on a high-voltage trolley circuit of, say, 1,000 to 3,000 volts, the voltage being reduced by transformers on the car. A given car, therefore, may start in a city which has a 500-volt system, running along with local cars from the same direct-current trolley; it may then go across country with alternating current at high voltage and then through a village taking alternating current at 500 volts, and then take high voltage again, as may be convenient. It is true that this arrangement will prevent the use of variable voltage control. The advantage in voltage control, however, is greatest in those cases where stops are frequent, or where the motor is run at low speed during a considerable portion of the time, as it is in these cases with rheostatic control that the rheostat is in service a considerable part of the time with corresponding loss; but the loss in the rheostat of an ordinary suburban car will be relatively small if stops are infrequent. It is, theoretically, possible to install both the rheostatic and the voltage control on the same car, but in general this is not advisable on account of the weight, cost and complication of the double system of control.

More Radium.

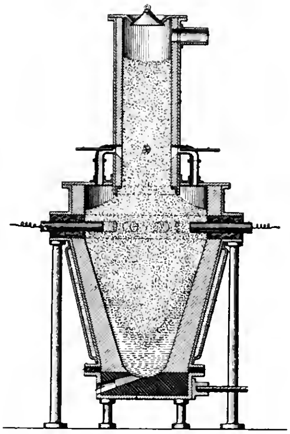
The State of Texas is the latest aspirant to the honor of being a radium-producing region. According to a press dispatch from Austin, vast quantities of earth containing radium compounds have been discovered in the Llano mineral region near that city. It is further asserted that scientists claim that these earths will yield more radium than any other known deposits in the world.

Recent Electrochemical Developments.

RESISTANCE FURNACE FOR THE MANUFACTURE OF CALCIUM CARBIDE.

Three patents were granted on January 19 to Mr. Alfred H. Cowles, of Cleveland, Ohio, all referring to the manufacture of calcium carbide in an electric resistance furnace. He proposes to pre-heat the charge, for example a mixture of lime and carbon, by withdrawing the waste carbon mon-oxide from the furnace and burning it in the pre-heating chamber. The resonance furnace itself is so designed that the current density increases towards the bottom of the furnace so that the temperature is highest at the bottom, thus giving a sufficient fluidity to the calcium carbide to permit it to be tapped.

The adjoining illustration shows one of the various furnaces for this purpose. It is an annular stack of refractory non-conducting material, enclosed by a casing of iron. The major portion of the body is a downwardly-converging bosh surrounded by a water jacket. The hearth of the furnace consists of a solid mass of carbon set in an iron casing which is insulated from the upper casing of the furnace. A



CALCIUM CARBIDE FURNACE.

tap-hole for the molten product extends through the hearth. The hearth serves as one electrode, while the other electrode consists of a number of radial carbon rods passing horizontally through the side walls of the furnace near its top.

Supported upon an opening into the upper end of the furnace is the pre-heating chamber, consisting of a shell of iron with a lining of refractory material. The upper end of the pre-heating chamber has a *bell-and-hopper* charging mechanism. Pipes for withdrawing the combustible gases from the electric furnace extend upwards through its top and are connected to burners with air-blast pipes, which enter openings in the sides of the pre-heating chamber.

BATTERY INVENTION.

A patent granted to Mr. Oskar Frank, of Detroit, Michigan, refers to the mechanical construction of a grid for pasted storage battery plates. Another patent granted to Mr. F. A. Feldkamp relates to a method of producing a storage battery plate. A perforated metal plate is wrapped in layers of an open-mesh fabric such as mull, linen, mosquito netting, etc., and the active material in a plastic state is pressed into the layers of fabric.

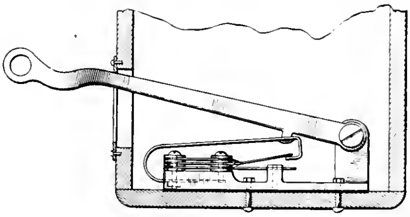
ELECTROLYTIC EXTRACTION OF GOLD.

Two recent patents granted to Mr. H. R. Cassel, of New York City, refer to a method and apparatus for extracting precious metals by electrolysis. In the electrolytic vat the anodes and cathodes are vertically arranged, and the pulverized ore, after having been converted into a pulp mixed with cyanide of potassium, is introduced into the vessel. The stream of constantly flowing pulp is diverted to the anodes, the particles of gold being thus brought into intimate contact with the same and rapidly dissolved. The cathodes are continually covered with mercury so that the gold is precipitated upon the cathodes as an amalgam. Means are provided by which the pulp is constantly circulated through the vat from the top to the bottom and then through a pipe back to the top. Means are also provided for continually amalgamating the cathode by a circulation of mercury, the cathodes being blanked by a number of slats or deflectors which are inclined from top to bottom toward the cathodes and serve to continoually throw the mercury as it rebounds from the cathode back upon the same, and effect the rapid accumulation of amalgam. The mercury which collects in the bottom of the cell is returned by means of a pipe to an acid chamber at the top where any alkali in the mercury is neutralized.

New Telephone Patents.

NEW FORM OF HOOK SWITCH.

The telephone hook switch has undergone a very considerable change in the last few years, the older type in which the hook itself sufficed for a switch blade having been almost entirely superseded. Of the superseding types, that in which the hook serves as a switch lever operating upon a key composed of flat springs is the most prevalent. Many admirable varieties of such a hook-switch have been developed, the latest being that described in a patent recently issued to E. E. Yaxley, of Chicago. A side view of this switch is shown in the figure. As will be noted, the spring controlling the hook is so formed as to engage the extremities of all of a nest of springs assembled in the manner customary for switchboard keys. The uppermost spring is bent so that its extremity lies in the same horizontal plane as the middle spring, both springs normally resting upon an insulating bridge underneath which the movement of the lowest or bell spring takes place. The American Electric Telephone Company, of Chicago, has obtained the patent for this excellent switch.



YAXLEY HOOK SWITCH.

NEW SIGNALING CIRCUITS FOR TWO-WIRE SWITCHBOARD.

A modified system of circuits for signaling in connection with two-wire central energy switchboards forms the subject of a patent granted to K. B. Miller, of Chicago, and assigned by him to the Kellogg Switchboard and Supply Company. The novelty lies in the supervisory circuits in which a plug socket switch is so associated with the lamp circuit that this circuit is opened whenever the plug is in the seat. By the use of such means one relay in the cord circuit is sufficient to properly control each signal, instead of the two usually required. The ultimate economy of such an arrangement is, of course, extremely questionable because of the uncertain habits which experience has shown plug socket switches to possess.

PARTY-LINE DEVICE.

It is, of course, a well-known fact that with party-line working any subscriber may ordinarily hold up a whole line by allowing his receiver to remain off the hook. Undoubtedly here and there considerable difficulty is found from this cause especially on lines where there is a particularly irritable subscriber. Therefore, the idea of Mr. N. E. Noistrom of overcoming this difficulty by bringing the control of the connection between each station and the line into the hands of the central office operator would be an admirable one, provided it could be obtained with less cumbersome apparatus. Unfortunately, he has worked out the problem for a step-by-step party line system and his solution is, therefore, subject to all the limitations of such a system.

Use of the Electrophone.

In connection with a recent tariff speech by Mr. Joseph Chamberlain at the Guildhall, London, the *Evening News* issued an electrophone edition, containing a verbatim report on sale fifteen minutes after the delivery of the speech.

CURRENT NEWS AND NOTES.

TELEPHONING FIRE ALARMS.—It has been the practice of the Wisconsin Telephone Company in Milwaukee to suggest in its telephone directory that patrons send in fire alarms by telephone. The chief of police has requested the manager of the telephone company to omit this suggestion from the book hereafter, for the reason that it frequently takes too long a time to notify the fire headquarters by telephone. This delay gives the fire a chance to gain a good headway before the department is able to respond to the telephone fire call.

HARVARD UNIVERSITY AND MASS. INST. OF TECHNOLOGY.—A press dispatch from Boston states that an alliance of Harvard University and the Massachusetts Institute of Technology is a future possibility. It is pointed out in the dispatch that such an arrangement would be merely an alliance, and not an absorption of one institution by the other. The result would be the limitation of the Lawrence school at Harvard to pure science and the transfer of all Harvard engineering instruction to the Institute of Technology. What is drawing the attention of the Harvard overseers and the technology corporation to the suggestion, the dispatch adds, is the economy and the idea of stopping the actual waste of money and energy involved in the upbuilding and maintenance of two rival technical institutes three miles apart. The project is yet in an embryotic state, and no direct negotiations have yet been undertaken.

CINCINNATI MEETING OF A. I. E. E.—The Cincinnati local branch of the American Institute of Electrical Engineers held its first annual meeting at the Grand Hotel on the evening of January 18. The business meeting was preceded by a dinner in which forty members, associates and guests, participated. The following officers were appointed: Chairman, Mr. B. A. Behrend, chief engineer Bullock Electric Manufacturing Company; vice-chairman, Mr. J. Hendrick Hallberg, general superintendent Cincinnati Gas & Electric Company; secretary and treasurer, Mr. Louis E. Bogen, civil and electrical engineer Bullock Electric Manufacturing Company, late professor of Electrical Engineering at the University of Cincinnati. After the business meeting the chairman introduced Louis Trenchard More, professor of Physics at the University of Cincinnati, who delivered an instructive, interesting talk on radium, exhibiting several photographs taken with radium and also a specimen of radium chloride. The lecture was followed by a general discussion on the new ideas in molecular physics and the great scientific importance of radium in such questions as the age of the earth and the revision of our views of the molecular theory of matter. The local branch has been started with energy and enthusiasm, and the management is arranging with able and representative engineers to lecture before its members.

INDIANA ENGINEERS' SOCIETY.—The 24th annual convention of the Indiana Engineers' Society was held in Indianapolis on January 14, 15 and 16. In his annual address, President R. L. Sackett dwelt upon the evolution of the engineer. Several papers relating to electrical subjects and development were read. The report of the committee on electrical engineering stated that progress was so great that it was difficult for the most diligent engineers and students to keep up with it. Among the many papers read were the following: "Smoke Prevention," by R. P. King; "A Description of the New Centralized Power and Heating Plant at Purdue University," Prof. J. D. Hoffman; "Power Chains and Their Uses," by C. H. Hills; "The Railway Profile Considered with Reference to the Propelling Power of Locomotives or Electric Railway Motor," by Prof. W. D. Pence; "The De Laval Steam Turbine," by G. A. Young; "Interurban Railways in Small Cities," by J. W. Fulwider; "Special Street Railway Work," T. B. McMath, and "Surveys for Electric Railway Construction," by C. L. Sellers. As to electric railway engineering it was claimed that a level track was by no means necessary; that an undulating track, otherwise properly constructed, was not detrimental to successful operation. Mr. Sackett was re-elected president and J. B. Nelson vice-president. The next convention will be held in Indianapolis on January 13, 14 and 15, 1905.

DISSATISFIED TELEGRAPHERS.—It is stated that the 1,500 telegraphers employed by the Baltimore & Ohio Railroad have placed a demand with the company for shorter hours and an increase in wages. The main complaint is to the effect that the operators are kept at work in the towers longer hours than they are paid for.

INTERNATIONAL SUPPLIES.—The *World's Work* for February notes the fact that in the large power plant installed in the Mysore country in Southern India, the timber came from Australia, insulators from Italy, the hydraulic plant from Switzerland, the penstock pipes from Scotland, and the entire electric plant from America.

AN APOLOGETIC CORPORATION.—By way of making apology to the public for the bad trolley service in northeast New Jersey, the Public Service Corporation carried two columns of advertising matter in the columns of several of the local newspapers in the form of a statement signed by President Thomas N. McCarter. He admits that the service is bad, but says this is caused in part by changes necessary when the competing lines of North Jersey were merged, but more especially from the fact that the rolling stock acquired was in such a miserable condition that in the recent cold snap there was hardly a car that did not give out in some essential part after one or two trips. No relief is promised until spring, when open cars can be used and new cars being built will be delivered. After advising patience, the address concludes with a paragraph that has caused considerable adverse comment. It is as follows: "The Public Service Corporation has every disposition to comply with all reasonable demands of the public and regulations of municipal bodies. It cannot, however, thoroughly reorganize and largely re-equip an extensive street railroad system in a few months. Unreasonable and vexatious ordinances and impositions can only result in additional delay in the efforts of the company to improve its system, and will, of course, be contested if enacted. The strike of last summer followed by the flood and the severity of the present winter, have added considerably to the strain upon the facilities of this company to discharge its duties to the public. Besides, harsh and intemperate criticism tends to demoralize discipline and weaken the efficacy of the service."

ELECTRIC TRUCKS.—The following from the New York *Herald* looks like a partial or prejudiced statement: "After a thorough trial of self-propelled trucks for delivery work, several of the leading brewers of New York have decided to discontinue the service and replace with horse-drawn vehicles all automobiles now in use. Purchased primarily for advertising purposes, the electric brewery trucks have proved to be too expensive and unreliable to warrant their retention even for this purpose. One brewer who paid $4,500 apiece for eight of them about two years ago has offered, it is said, to throw off the $4,000 and take $500 around for the lot that he has on hand. Failing to find buyers for the second-hand motor trucks, he says, he will consign them to the scrap heap in preference to using them longer. The constant replacing of batteries, which cost about $750 each, and of tires, which cost $250 a set, makes the machines enormously expensive to maintain, and, notwithstanding the high cost of operating them, they are always breaking down on the road, preventing prompt deliveries and thereby hurting trade. Scarcely a day passes, it is said, without having to send out a pair of horses to drag one or more of the disabled motor trucks back to the repair shops. The brewer referred to announced when he purchased the first automobiles that he intended to use them altogether as soon as he could get rid of his horses and obtain enough machines to do the work. The shoe is now on the other foot. The machines having been tried and found wanting, he has decided to discard them altogether and use horses exclusively in the future. To this end he has just placed with Fiss, Doerr & Carroll a larger order than ever before for fancy draught horses of the brewery weight and quality to take the places of the discredited machines. Business houses that have experimented with the motor vehicles for light delivery work are in some instances no better satisfied than the brewers and are either discarding the costly toys outright or endeavoring to exchange them for horses and horse-drawn wagons. Fiss, Doerr & Carroll say they have been flooded with requests to take motor vehicles in part payment for horses, but, knowing of no way to dispose of the second-hand machines, have declined all such offers."

LETTER TO THE EDITORS.

Theories in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

SIRS:—Owing to absence in Europe my attention has only now been called to the letter of Mr. J. E. Taylor in your issue of December 26, and that of Prof. Blondel in the following issue. To discuss first M. Blondel's letter, I would say that the positions taken by M. Blondel and myself are really identical in regard to every single point discussed, and that where M. Blondel assumes a difference this is due to a misunderstanding. For example, M. Blondel states in his letter, paragraph 3, "If Prof. Fessenden has found this height very limited it is, I believe, simply because the energy decreases rapidly as the distance from the earth increases." Now there is no statement in any article or letter by me that I found the height very limited. As a matter of fact, as will be seen by a perusal of some of my articles, my method was to find the height at which the intensity decreases to 1/E th of the initial value. For example, in a previous article, I point out that waves 500 feet long penetrated about 8 inches into salt water, and about 2 feet into ordinary soil, before falling off to 1/E th of their intensity. That the height is, however, actually limited is true, as is shown by my measurements, and in this M. Blondel agrees with me for he states in his article, last two lines, "And present a maximum effect toward the horizon and *no* effect toward the zenith."

With reference to M. Blondel's statement that I have not taken account of the very great sensitiveness of the gold coherer, I would say that a reference to my article will show that I *have* done this, for in my article in these columns, October 31, page 728, I gave a table showing that the gold coherer is four times as sensitive as the regular coherer.

In addition, I would say that I was perfectly aware of the fact that the gold coherer can be made to have great sensitiveness, but as mentioned in my article, "In making this comparison the coherers were adjusted to be as sensitive as possible *without giving false signals*," and an experience of five years in working with coherers of gold and silver and their alloys has shown me that when gold coherers are adjusted so as to be more than four times as sensitive as the ordinary coherer they become unreliable and are influenced by vibration, etc.

With reference to the question of syntonization by group frequency, I would point out that this is undoubtedly a case of simultaneous invention, as though M. Blondel's patent was filed May 3, 1900, mine was filed June 2, 1900, and the specification itself was actually drawn up in October or November, 1899.

The same would appear to be the case with reference to the method for the continuous production of waves, as though M. Blondel's patent was granted July 11, 1902, my patent was filed June 6, 1902, and granted August 12, while the experiments on which it is based were made more than a year earlier.

Personally, I would say that putting the commercial question to one side, it has given me considerable pleasure to find that my own ideas have been running concurrently with those of so eminent an electrician as M. Blondel, and this coincidence may possibly be taken as indicating that the theory of the subject rests upon a sound foundation.

The above will show, I believe, that the supposed points of difference between M. Blondel and myself do not exist and that our opinions are really identical. With reference to other points, I am happy to say that my measurements entirely corroborate the theory as given in his last paper by M. Blondel.

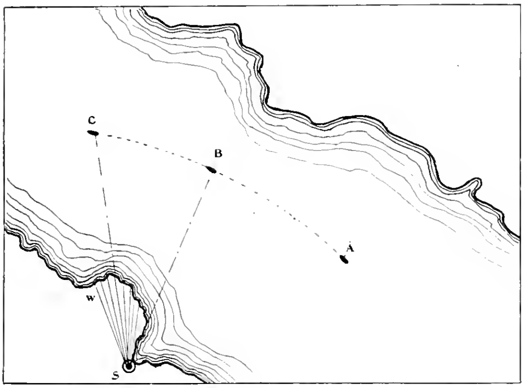
First, they prove absolutely that the energy falls off as the square of the distance, and hence that the waves are "Space propagated," i. e., they are spread over approximately spherical (hemispherical) surfaces, and not along a simple circular belt, which latter theory is held by Mr. Taylor. M. Blondel agrees with me, paragraph 3, in stating that Mr. Taylor is incorrect in attributing to the half waves a constant height. This was as I pointed out and is proved conclusively by my actual measurements of the height.

M. Blondel states that the energy decreases rapidly as the distance from the earth increases, as indicated by an energy curve which figures in his paper. This fact was, I believe, first indicated by me, and referred to in my article mentioned above, page 728, last paragraph from bottom, "The intensity was strongest near the ground and diminished upwards, instead of the reverse, as would have been the case if the effect had been due to diffraction."

On re-reading M. Blondel's paper I see, however, that there is one point in which our ideas possibly do differ, *i. e.*, on the effect of the earth.

This question is rather complicated and I intend discussing it in a separate article. For the present I will give an actual practical illustration of its use which I think will indicate that there is something more required besides actually grounding the conductor. In the experiments above referred to a station was erected on the shore of an island at the point *S*, the island having roughly the shape shown in the accompanying figure. The island was formed of a mass of rock with slight patches of grass but without any soil upon it. The antennæ was grounded by a plate inserted in the water so that the resistance as actually measured between the antennæ and ground was only a few ohms.

A second set of apparatus was placed upon a tug boat having a 50-foot mast. When the tug boat was in the position *A* signals



WIRELESS TELEGRAPH EXPERIMENTS.

were received as far as the boat could go on the opposite side of the bay, *i. e.*, about 15 miles. On the tug boat passing around to the point *B*, while a message was being received on the boat the message was cut off in the middle of a word, absolutely, sharply and decisively, and communication was established equally as sharply on the boat reaching the same position when moving in the opposite direction. At all points beyond *B* in the direction of *C* it was impossible to obtain any communication. A wave chute was then laid over the surface of the island, consisting of a galvanized iron wire spread out in a fan shape and grounded in the water as shown at *W*.

As soon as this wave chute was constructed, communication was immediately established when the tug boat was in the position *C*, and on the tug boat moving off in that direction, a distance of 14 miles, the intensity appeared to be, if anything, stronger than in the direction *A*.

Bearing in mind, as mentioned, that the antennæ was grounded both before and after the construction of the wave chute, to a large plate of copper immersed in the sea and having a ground resistance of only a few ohms, it will be realized that *merely grounding the conductor is not the essential thing*. In fact, as M. Blondel has pointed out, the actual *metallic* grounding of the conductor is not necessary, as it may be grounded through a condenser. Of course, to insure any good results the condenser must have very large capacity, and merely terminating the lower end of the antennæ with a knob or Léyden jar is not sufficient, unless the outer coating of the Léyden jar is at the same time directly connected to earth. I am prepared to say positively that the real essential thing is not a metallic ground connection, but the existence of a natural or artificial wave chute.

It is quite possible that even in this there is no real difference of opinion between M. Blondel and myself, and that my statement as to the necessity of either a *natural* or artificial wave chute has been overlooked.

With reference to the sensitiveness of the liquid barretter, I am giving myself the pleasure of forwarding one of these receivers to M. Blondel, and I am convinced that he will find that I have understated rather than overstated its sensibility. From our last tests, this receiver appears capable of working a distance of 250 miles over land with the expenditure of one-quarter of a horse-power and verticals 140 feet high.

With reference to Mr. Taylor's communication, the whole point may be summarized by an extract from his letter of December 26: "How he (Prof. Fessenden) can possibly argue that the intensity can vary with the square of the distance on any 'sliding wave' theory under perfect conditions of transmission, is quite beyond me. When this is the case the waves are space propagated. That is, they are spread over a spherical or roughly spherical surface and not along a simple circular belt." In other words, Mr. Taylor still believes that the waves are propagated in the way he described them in his paper, *i. e.*, in an approximately circular belt, the waves being of constant height as is shown in the figure in his paper, reproduced in M. Blondel's article January 2, 1904, and he considers the idea that they are propagated in an approximately spherical surface as a *reductio ad absurdum*.

Now the mathematical theory of electricity as developed by M. Blondel and myself shows that these waves actually *are* propagated in the way he considers impossible, *i. e.*, are propagated in an approximately spherical (hemispherical on account of the presence of the earth's surface). In addition, actual quantitative measurements repeated again and again over a period of four or five years, in which all intensities were carefully plotted, show that the mathematical theory as developed by M. Blondel and myself is correct.

What has Mr. Taylor to present against the mathematical theory of M. Blondel and myself and my own quantitative measurements? Nothing but his own bare statements deduced from "logical considerations" and unsupported by the slightest particle of experimental evidence.

I think that any further discussion of Mr. Taylor's theory is unnecessary, until he produces some mathematical foundation for, or experimental confirmation of, his ideas. There are one or two statements, however, in Mr. Taylor's letter which I may touch upon. He states in his letter, second paragraph, that I have accused him of being a "lucky guesser." No such statement occurs in my communication. On the contrary, my communication shows, I believe conclusively, that Mr. Taylor is not a "lucky" but an "unlucky guesser," inasmuch as he assumes that the waves are propagated in an entirely different manner from what theory and experiment shows to be the fact.

He states that I have assumed that he made no experiments. I made no such statement. The assumption I did make was that he had made no *quantitative* measurements. If Mr. Taylor has made any quantitative measurements, he has done himself an injustice in concealing the fact. So far as I know, at the present time there is only one form of receiver in existence which is capable of giving accurate quantitative measurements, and that is the hot-wire barretter. If Mr. Taylor knows of any other piece of apparatus, he should certainly disclose it.

With reference to Mr. Taylor's statements that the curvature of the earth would have little or no effect on transmission, I would say that this is incorrect, as it can be mathematically demonstrated that a wave transmitted from England to the antipodes will lose exactly 50 per cent. in intensity. Mr. McDonald has, I believe, made two calculations on the loss across the Atlantic, and I understand gets somewhat different results from the above, but I believe that my results will be found correct.

With reference to Mr. Taylor's statement, "Ionized air would and does absorb much of the energy from the waves, according to the degree of ionization present," I would say that this is another instance of the inadvisability of attempting to apply "logic" instead of quantitative measurements to natural phenomena. I have a set of accurate quantitative measurements extending over half a year, including thunder storms, droughts, zero and freezing weather, snow storms, rain and fog, and I am prepared to say now that up to date there is no evidence of any such ionization effect. I do not mean that no change in intensity has been observed, but that in every case where change in intensity has been observed it has been found to be *mainly* due to other causes, one being the type of receiver used. I would point out that up to the present time absolutely no evidence has been given that, even if this effect does exist to the extent mentioned, it is due to the effect of ironized air and not to other causes.

With reference to Mr. Taylor's definition of waves, that in all waves the electrical and magnetic energies are equal, I would refer him to Dr. Pupin's paper in the *Transactions* of the American Institute of Electrical Engineers, February, 1901, entitled "Wave Transmission over Cables and Long Lines." I am prepared to believe that Dr. Pupin's definition of a wave is as permissible as that given by Mr. Taylor.

With reference to the question of the phase of the energy in Lodge's waves, I would point out that since the term Lodge waves was introduced by me and defined in the manner stated, any wave which does not have this property cannot be called a Lodge wave.

As regards correctness of this definition Prof. Lodge's own statements may be quoted. For example, on page 5 of his work entitled "Signalling Through Space Without Wires," Third Edition, Sir Oliver Lodge says: "Furthermore, any conductor electrically charged or discharged with sufficient suddenness must emit electrical waves into the ether, because the charge given to it will not settle down instantly, but will surge to and fro several times first; and those surgings or electric oscillations must, according to Maxwell, start waves in the other, because at the end of each half swing they cause electromagnetic effects, and the rapid alternation from one of these modes of energy to the other constitutes etherial waves. If a wire is handy they will run along it, and may be felt a long way off.

"Strictly speaking, in the waves themselves there is no lag or difference of phase between the electric and the magnetic vibrations; the difference exists in emitter or absorber, but not in the transmitting medium. True radiation of energy does not begin till about a quarter wave length from the source and within that distance the initial quarter period difference of phase is obliterated."

In the conductor, therefore, the energy alternates between the electrostatic and the electromagnetic. We know from the mathematical theory of electricity as set forth, for example, by Prof. J. J. Thomson in his "Recent Developments," and also from direct experiments made by myself and others, that if we have a long straight vertical antennæ, the wave length produced by its discharge will be four times the height. In other words, that the disturbance will approximate the velocity of light.

Waves of the type imagined by Mr. Taylor, having a constant height and spreading out in a "circular belt," have no existence and are at variance with the mathematical theory of electricity.

It was on waves of this character, oscillating backward and forward in conductors, that Sir Oliver Lodge made his brilliant investigations.

We have, therefore, three separate and distinct classes of waves, differing fundamentally from one another.

First. The waves investigated by Hertz. These travel in straight lines, and their electromagnetic and electrostatic energies are a maximum at the same instant.

Second. The waves investigated by Lodge. These differ from Hertzian waves in that they do not travel in straight lines, but follow the conductor. They also differ in that, as pointed out by Lodge (Ibid.), the electrostatic energy is a maximum at the time when the electromagnetic energy is a minimum.

Third. The waves investigated by me. These differ from Hertzian waves in that they do not travel in straight lines, but are guided by the surface of the conductor. They differ from Lodge waves in that the electrostatic and electromagnetic energies are a maximum at the same instant.

All these waves travel with approximately the velocity of light, and have their electromagnetic and electrostatic eneergies equal.

It is hoped that the above brief definition of the three broad classes of electromagnetic waves which have up to date been investigated will prove useful in distinguishing between the different types.

A fourth kind of wave observed in some of our experiments may be described as a closed or anchor ring wave. I hope to describe this at some time in the future.

With reference to Mr. Taylor's assumption that my barretter was incapable of detecting currents in the earth, I would point out that in the first place this is pure assumption, unsupported by any evidence, and secondly, that if Mr. Taylor had read Mr. Collins' paper carefully he would have found that as a matter of fact currents *were* observed in the earth. For example, in the fifth paragraph of Mr. Collins' paper he states that "At the point where the direction of the waves changed from along the water to up the slope of the bank currents were generated." Now, in going up the slope of the bank, the detector was shunting a circular belt of the earth's surface in exactly the same way as when the ground was horizontal. Therefore, the statement that the detector was not sensitive enough to show currents when shunting a circular belt of the earth is incorrect, since currents in the earth were actually observed and quantitatively measured.

In addition to the actual fact that currents were actually measured under these conditions, I would point out that if Mr. Taylor will calculate the resistance of the earth he will find that not only was the detector, which responds to 1/50 of an erg. sufficiently sensitive, but also that in practice it is necessary to shunt the hot-wire barretter with a metallic conductor in order to prevent its being destroyed. This matter I will discuss in a separate article, as my statement is to a certain extent conditioned by what is meant by a "current." An effect was produced on this barretter in all cases.

I note that Mr. Taylor states that his measurements on the relative sensitiveness of coherers and magnetic receivers do not agree with mine, and that he finds that there is "a surprising small difference between them."

I might point out that Mr. Taylor has not indicated, as I have done, the method in which he made these measurements, but it will suffice if I quote the following from experiments made by the Marconi engineers, and published in the *Scientific American* on November 28, about a month after my paper appeared:

"The result was that, under such conditions, over a distance of 76 km (47 miles), which is that from San Vito to Leghorn, the Morse apparatus required a 9 mm. (.354-in.) spark in order to receive properly, while with the magnetic detector, receiving was possible and satisfactory with sparks of but 2 mm. (.078 in.)."

Since the energy varies approximately as the square of the spark length, it will be seen that the magnetic hysteresis receiver was approximately 25 times as sensitive as the coherer.

Now, my measurements, given in my letter of October 31, made it about 40 times as sensitive, and in this connection it may be mentioned that I have been informed that the Marconi engineers have not yet been able to design a transformer so as to obtain the best results with the magnetic receiver, while I have.

The fact that the Marconi engineers found that the magnetic receiver is 25 times as sensitive as the coherer and I find it 40 times as sensitive, while Mr. Taylor finds "a surprising small difference," may be taken as an indication of the relative reliability of Mr. Taylor's measurements and those made by us.

It must not be inferred from what I have said above that I have failed to recognize the admirable work done by Mr. Taylor in wireless telegraphy. No one appreciates the value of his labors more than I. But engineers in general do not, I believe, understand the present status of wireless telegraphy, and the fact that it is now upon a strictly quantitative basis. The design of a wireless telegraph plant is now just as much a matter of strict calculation as a design of a dynamo, and in fact it is possible to design a wireless telegraph plant much more accurately than one can design a wire line.

Electrical engineers in general would probably be astonished to know that it would be possible at the present time to fill three or four volumes of the size of S. P. Thompson's "Dynamo Machinery" with nothing but a discussion of the principles governing the design of wireless stations and apparatus. Some day I hope to be able to take up this question, but the amount of labor involved in merely transcribing the results is enormous. The experiments alone are numbered by tens of thousands, and a large safety deposit compartment in Pittsburg is at present occupied by record books filled from brim to brim with the quantitative and qualitative measurements which have been necessary for developing this line of work.

Aside entirely from the question of the point above discussed, is the broad one of whether these waves are a new form of wave. It is true that, as Mr. Taylor points out, in my paper before the American Institute of Electrical Engineers I attribute the broad theory to Heaviside, because, as a matter of course, since these are a particular type of electromagnetic waves, their theory must be a particular case of the general electromagnetic theory. Consider, however, the case of the Hertz waves. The theory of these waves was given by Maxwell. The means of producing these waves was given by Fitzgerald. Maxwell's theory and Fitzgerald's method have been shown to be absolutely correct. Hertz was the first to invent a receiver which would be capable of measuring them, and he was the first to *actually make* such measurements. So far as I am aware nobody has, up to date, found fault with Hertz for describing these waves as a new type. My own case is exactly analogous. The general theory of these waves has been given by Heaviside, the idea of images has been suggested by Delaricci and Blondel. The method of generation was to a certain extent known. I was the first to devise a type of receiver capable of quantitatively measuring these waves and also the first to plot their shape and show the way in which they were propagated.

Until this was done there was no certainty as to the nature of these waves, as is shown, for example, by the fact that Mr. Taylor is still of the opinion that the energy does not fall off as the square of the distance.

I believe, therefore, that I am justified in calling these waves a new type of wave, because they are a new type of wave in exactly the same sense that Hertz waves were a new form of wave at the time that Hertz investigated them.

I would here correct a typographical error in my letter of November 13 on the "Relative Reliability of Wireless and Wire Telegraph Systems." As originally written the statement was made: "A number of interfering stations both in New York and Philadelphia." In setting up the article the compositor substituted for the words "A number" the figures giving the height of the verticals at the stations, and made the article read "There are 135 interfering stations." Though the mistake is, of course, self-evident, I take the opportunity to mention the fact that during the yacht races there were sometimes as many as 12 stations simultaneously operating in the vicinity of New York.

WASHINGTON, D. C. REGINALD A. FESSENDEN.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Single-Phase Commutator Motors.—OSNOS.—The first part of a long article in which he gives a review of the development and method of working of single-phase commutator motors. He says that to Lamme is due the credit of having brought single-phase traction successfully before the public and for having shown that the single-phase commutator motor can be successfully used in practice. The Lamme motor does not represent a novel type of alternating-current motor, but an important improvement in the design of the old series motor. To Thomson is due the invention of the repulsion motor. The author then calls attention to the work of Atkinson, who invented from 1895 to 1898 several commutator motors and had recognized at that time the possibility of regulating the speed in this wide limits without an essential loss of energy. The author then gives a critical and comparative analysis of the various types of commutator motors which have been invented. In each case a diagram is given, together with a reference to the first description of this type and a statement whether this type is patented in Germany or not. He first deals with the series motor in original form, which involves difficulties, first in so far as the oscillating exciting field induces an e.m.f. in the coils which are short-circuited through the brushes, and second, on account of the phase difference. The e.m.f. of commutation is not greater than with direct-current motors. Since the e.m.f. induced by the alternating field in the short-circuited coils is proportional to the number of turns, a decrease of the number of turns per segment also diminishes the short-circuited currents which are due to this alternating field. The phase difference of the series motor is due to the self-induction of the stator and of the armature. The latter can be compensated for by the use of a compensating winding, either in series with the armature (Steinmetz) or short-circuited on itself (Heubach). The shunt motor does not seem to be promising since its power is in general very small. He then discusses various forms of repulsion motors and points out that the frame of the repulsion motor should be formed of uniformly distributed iron masses. For the stator winding a uniformly distributed winding is preferable. In comparing the repulsion motor and the series motor he says that the former has a greater phase difference for the same weight. On the other hand, the repulsion motor has the good quality that the commutator is always short-circuited and has not to transmit any electric energy, so that the commutation will be in this case just as easy as with slip rings. The author then discusses various types of the repulsion motor invented by Atkinson, and shows how some other combinations may be derived from the same. The article is to be concluded.—*Elek. Zeit.*, Jan. 7.

Single-Phase Motors.—LATOUR.—His reply to Eichberg's communication, recently noticed in the Digest, on the priority of invention of the Eichberg-Wintner single-phase traction motor. The claims that Wintner and Eichberg, in their German patent specification, first proposed to return the energy usually dissipated in the rotor circuits of polyphase motors (external resistances) to the supply network, by the use of a commutator on the rotor and a recuperating transformer with a variable ratio of transformation. To obtain the same results in single-phase motors, they adopted the following arrangement: In Fig. 1 the stator is connected by the main terminals *e f* to the single-phase network *AB*, the instantaneous voltage of which is *V sin wt*. The brushes *c d*, placed in line with terminals *e f*, are connected to the recuperating transformer *T*, the transformation ratio of which is varied with the speed of the rotor. The rotor torque is obtained by connecting the auxiliary stator terminals *a b*, placed at 90 degrees to the main terminals, *e f*, to an auxiliary source of current, the voltage of which is in quadrature with the voltage of *AB*. Because Wintner and Eichberg have stated that, as an alternative, the auxiliary source of current may be applied to the rotor by brushes, *a′ b′*, placed in line

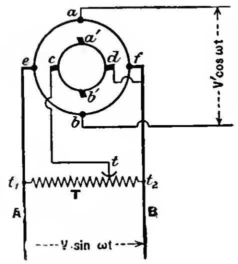


FIG. 1.—SINGLE-PHASE MOTOR CIRCUITS.

with *a b*, the present writer claims that they have failed to understand the essential phenomena of compensation. This argument is that if at, or nearly at, synchronous speed of rotor the brushes *c d* are short-circuited by bringing the contact *t* to the terminal t_2 of the recuperating transformer *T*, while the brushes *a b* are connected to the auxiliary source, the rotor and the stator windings will be burned out and the torque of the motor will completely disappear. This will take place owing to the suppression of self-induction in the rotor. The writer claims that since Winter and Eichberg have become acquainted with his compensated motor they have modified their original ideas and now point out the advantage of zero-phase displacement between the instantaneous voltages of the network *AB* and the auxiliary source.—Lond. *Elec.*, Jan. 8.

REFERENCES.

Electric Motors.—HOBART.—A continuation of his long serial on electric motors, their theory and construction. The present installment deals with the slip and torque of induction motors. Only elementary mathematics is used, but the explanation is very specific, the author giving much numerical data. A table of diagrams gives data of various induction motors.—*Traction and Transmission*, January.

Eddy-Current Losses in Machines.—See the abstract on Eddy Currents under Electrophysics.

LIGHTS AND LIGHTING.

REFERENCE.

Train Lighting.—MARTENS.—The conclusion of his illustrated serial on different methods of electric train lighting. The present insallment gives an illustrated description of a system devised by Kull and employed by Brown, Boveri & Company, in which use is made of a shunt dynamo of special construction, a small storage battery and various controlling apparatus. The system of Vicarino is also described.—*Dingler's Polytechn. Journal*, January 9.

Power.

Pumping Station.—A fully illustrated article on Philadelphia's new fire-fighting service, covering the congested business portion. There is provided a central pumping station and independent pipe system whereby high pressures are obtained directly at the hydrants. The pumping station will contain ten pumps each capable of delivering 1,200 gallons per minute at 40 revolutions, against a pressure of 300 lbs. per sq. in. There are also two pumps of 350 gallons capacity per minute. Each of the large pumps will be driven by a 280-hp, three-cylinder, single-acting gas engine, and the small pumps by gas engines of 125-hp each, which will also drive ignition generators of 7.5-kw each and the air compressors supplying air at 200 lbs. pressure for starting the main engines. There are three sources of current for ignition, connections with the city lighting mains and a storage battery being provided in addition to the ignition generators. The lighting current is reduced from 220 to 110 volts by a rotary converter. The engines are started with compressed air in one cylinder with the relief valves on the pumps open. These valves are controlled by electric motors operated from the engine platform, one motor being on each valve. The entire work of operating the engines, pumps and valves is under the immediate control of one person, who, from the gallery of the engine, without moving from his position, can open and close all valves by means of electric devices.—*Iron Age*, January 21.

Power Absorbed in Drilling.—Norris.—An account of an extended investigation of the power absorbed in drilling in various metals at various speeds and feeds. The results are given in tables and the following general conclusions are arrived at: When the speed and feed are constant, the power required to drill cast steel is about 1.10 times, wrought iron about 1.65 times and machinery steel about 1.90 times, that required to drill cast iron. When the speeds and feeds remain constant, the power required is approximately proportionate to the diameter of the drill. When the diameter of the drill and rate of feed are constant, the power required is approximately proportional to the speed. When the speed and diameter of drill are constant, the power required is approximately proportional to the feed.—*Am. Mach.*, January 14. The numerical data given by the author are represented in form of five diagrams in *Am. Mach.*, January 21.

References.

Milling Machine.—A detailed illustrated description of a universal milling machine of the Brown & Sharpe Manufacturing Company, an essential point of which is that the power-receiving shaft runs at a constant speed and variations of the spindle speed are obtained by means of change gearing. Thus the machine, when motor-driven, enables the use of a constant-speed motor.—*Iron Age*, January 14.

Turbine Tests.—An account of tests of turbines for the Cleveland, Elyria & Western Railway. These turbines are of 1,000 kw, direct-connected to a two-pole, three-phase alternator of 50 cycles. The turbine ran at about 1,500 r.p.m. and had an average overload of 50 per cent. Data from the test are given.—*St. R'y Jour.*, December 19.

Turbo-generators versus Reciprocating Engines.—See the abstract on Eddy Currents under Electrophysics.

Traction.

Alternating-Current Traction.—An abstract of the discussion at the Manchester local section of the (British) Institute of Electrical Engineers on Eborall's paper recently abstracted in the Digest. Portheim read extracts from a letter from Blathy (of Ganz & Co.), comparing three-phase and single-phase motors for economy and efficiency, to the advantage of three-phase. The losses are greater in single-phase, more expensive gear is required for regulation, and they are restricted to a low-pressure system. Regulation with three-phase is effected by the half-speed cascade arrangement. The capital outlay for three-phase and single-phase is the same. He considers it no disadvantage that three-phase motors have to take the worst grades at full speed, and the sub-stations ought to stand the overload. To obtain the same acceleration the cost of three-phase is only equal to direct-current equipment. Regeneration of three-phase on the down grades is an advantage. He remembered making arrangements to supply three-phase traction current to a colliery and when the line came to be operated, with empty trains going up and full ones coming down from the colliery, they found that instead of supplying current to the colliery they were furnishing current to the supply company. Comparing the double trolley with the single, he drew attention to the fact that the same power can be transmitted through the double trolley at a lower voltage, and, any way, the cost of the line can be only 7 per cent. of the cost of the locomotive equipment. He believes it is only 1½ per cent. on the Valtellina Railway. The three-phase motor is as simple as any other motor, and in heavy main-line work the pressure would have to be greater for single-phase than for the two-wire, three-phase line. Rhodes expressed his disbelief in single-phase motors with commutators. The great point about alternating-current motors would have to be the absence of a commutator and freedom from repairs to minor details. Eborall said that there was no hope for single-phase motors starting with phase-splitting arrangements beyond ordinary industrial application. He defended commutators in low-frequency, single-phase motors, but said that in any case a series motor is hopeless over 25 cycles.—Lond. *Elec.*, January 1.

Alternating-Current Traction.—Some editorial notes on Arnold's electropneumatic system. Its success is thought to depend upon the controlling valve mechanism for securing the proper relative action of the electric and compressed air devices. Assuming that this arrangement is perfectly successful—that is, that by its means the air engines geared to the motor may be made to equalize the varying load, torque and speed requirements at all times, without sacrifice of reliability or material drop of efficiency—then the system is believed to promise the best combination of the advantages of the direct-current system and high-tension alternating-current transmission that has yet been proposed. The weight of car equipment is rather high, but applied to a locomotive it will not be a disadvantage. Concerning the use of high voltage it is doubtful whether the public and the responsible authorities will permit high-voltage trolley lines to be installed, if at all, without better guarantee of safety than is afforded by present practice in car wiring and operation. The same contains a communication by Lincoln in which he replies to some criticisms in a former issue on his paper on alternating-current traction. Concerning the use of high voltage he says that practically all of the apparatus on the car may be placed in the low-tension side of the car transformer. The only high tension on the car, therefore, consists of the high-tension winding of the transformer, the current from the trolley to the transformer and a circuit-breaker. These can be protected so as to make the escape of current practically impossible. The part of the apparatus from which the current is most liable to escape, namely, the motors and controlling apparatus, are at voltages which are lower than present direct-current practices. It is a question, therefore, whether or not the alternating-current equipment is not really safer than the present direct-current equipment. Moreover, the trolley voltage can be reduced at will by increasing the number of transformers along the line. The cost of this would not be prohibitive.—*Eng. News*, January 7.

Three-Wire System for Traction.—McMahon.—A long paper read before the (British) Inst. Elec. Eng. on the City & South London Railway, in which he gives the working results of the three-wire system used on this road. Fig. 2 shows the system in its simplest form; that is, all the independent cables for supplying the lifts and lighting circuits being omitted for the sake of clearness. The up and down working conductors, with the running rails as the middle wire, form the three-wire system pure and simple, the 500-volt generators being on either side of the system. To supply the sub-station, another generator, either steam or motor-driven, adds an additional 500 volts to an additional set of high-tension bus-bars, from which the two sub-stations are fed at 1,000 volts above the rail potential, or 2,000 volts across the outers. The pressure is reduced at the sub-station by special reducers, in which only half the energy is transformed and the cable drop compensated for. In the engine house at Stockwell seven direct-connected sets are installed varying in output from 125 kw to 800 kw. The author gives details of an all-day test, discusses electric versus hydraulic lifts in favor of the former, and gives detailed accounts of results obtained in continuous working. The coal per ton-mile at the switchboard amounts to 0.237 pounds, which figure includes all boiler house losses, such as lighting up boilers, etc. If compared with main line locomotives the result is in favor of the latter, but the author calls attention to the fact that the energy spent upon accelerating main line trains is only a fraction of that spent upon a line of short sections, and the traction resistance per ton is at least double that obtained in main line practice. "The published results obtained with steam locomotives are usually taken over short periods and refer to special tests from which all standing losses are excluded. When the time arrives at which electric locomotives can be tried under conditions similar to those of steam locomotives, there is every reason to believe that the coal per ton-mile will be in favor of the electric locomotive." The latest type of powerful locomotives used on this road has been very successful, and it has been found that the slot-wound armature is vastly more satisfactory than the smooth-core armature. In an editorial discussion of the paper special attention is called to the following points: Using direct-current generation with only 2,000 volts maximum pressure (1,000 volts either side from earth), the Angel sub-station, at a distance of 5½ miles, delivers 83 per cent. of the power delivered at the bus-bars. The result is not materially different from the all-day efficiency of a three-

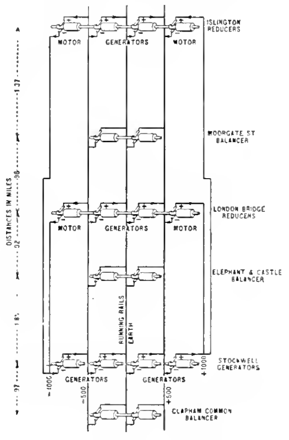


FIG. 2.—THREE-WIRE TRACTION SYSTEM.

phase rotary converter working on a similar load factor, but is attained with a lower working pressure and very much less expensive converting apparatus. The main reason for this is that the current has not to be transformed in kind, consequently the high-tension mains and the transforming apparatus have to deal only with a portion of the current, and transformation losses are incurred upon that portion only. The total result over the whole line is that from generating station switchboard to locomotive, the net efficiency is 90 per cent. This figure is decidedly higher than the all-day efficiency of a rotary converter on a traction road, and the capital expenditure is obviously on the side of the direct current. For such lines as that of the City & South London Railway, a direct-current generating station has an economical radius of at least 6 or 7 miles.—Lond. *Elec.*, December 18, 25.

Electric Traction on Canals.—An illustrated description of the system used in the trials of electric traction on the Teltow Canal in Germany. For most part a locomotive running on the tow path is used, while at special points a vessel provided with a storage battery of 220 cells is used for dragging the boats through the canal. This vessel can also get current from a double overhead wire, either by contact rods of 12 m. length of the kind used for tramways without rails or the Lombard-Gerin system may be used, in which a small motor runs along the trolley wire and is connected with the wires supplying the current to the vessel. For the locomotive also two overhead wires are used, because the return of the current through the rails would have disturbed the magnetic observatory in Potsdam. Otherwise a single trolley would have been sufficient. Some details are given of mechanical arrangements of the locomotive. In a test in which four vessels, representing an aggregate load of 1,450 tons, were dragged with an average speed of 4.35 km. per hour, the tractive force was 2,000 kg. during starting and otherwise, 1,000 kg. in the average. The voltage between the two overhead wires was 445 volts and the average current consumed was 35 amp. The average efficiency was 61.5 per cent. The electric boat is provided with three screws, each being driven by a 20-hp motor running at 600 r.p.m. normal speed. If current is supplied from overhead wires a voltage of 500 to 600 volts is used. If storage batteries are used the voltage impressed on the motors is 400 to 450. For regulating the speed within wide limits the connections of the motors are changed, eight different arrangements being possible. In a test in which the boat had no trailer boats, the speed was 12.5 km. per hour and the current consumed was 85 amp. at 400 volts. If the boat drags two vessels with a total weight of 454 tons, it attains a speed of 5.2 kw per hour and consumes 43 kw. This shows that the efficiency of the boat is not nearly so high as that of the locomotive. The main reason is that the efficiency of a ship's screw with a small diameter is very low. Since only for short stretches of the canal the electric vessel is used, and the locomotive on by far the greatest part, the low efficiency of the electric vessel has only a small influence on the economy of the whole service.—*Elek. Zeit.*, December 31.

REFERENCES.

Running Trolley Wire.—Harvey.—Since a properly constructed wagon for carrying trolley wire drums and running out the wire is sometimes too expensive in smaller cities, the author has devised a cheap reel frame for this purpose which can be placed and worked on the top of an ordinary two-wheel stiff cart and has most of the advantages of a proper reel wagon. The apparatus is described together with drawings.—Lond. *Elec. Rev.*, January 8.

Insulation of Trolley Wire.—Moerk.—A brief mathematical article illustrated by diagrams in which the author gives an account of insulation measurements of the trolley wire with electric tramways.—*Elek. Zeit.*, January 7.

Installations, Systems and Appliances.

Cut-Outs.—Andrews.—A communication referring to the opinions expressed by various other writers in a discussion on this subject, as was recently noticed in the Digest. The present writer has for 10 years experimented on a great many different types of cut-outs and has reached the following general conclusions: Zero cut-outs are useless. Maximum cut-outs in generator circuits are equally useless. Polarized cut-outs will work satisfactorily on a small or moderate reverse current, but will almost invariably fail on a short circuit, because the heavy series current entirely wipes out the effect of the permanent magnets. The releasing pull of a reverse-current cut-out should increase as the reverse current increases, as it does in an excess current cut-out. This result can only be obtained by employing the series current to directly operate the cut-out. In many types of cut-outs the release pull increases with the reverse current up to a certain point. The curve then doubles back and, with a further increase of current, falls to a zero and reverses to a holding-in pull, thus causing the cut-out to fail. Compound-wound devices will fail if the e.m.f. winding is coupled directly across the terminals of the generator controlled, as a short across the brushes will cause this e.m.f. to fall to zero. If the shunt winding of the cut-out is connected across a battery in parallel with the generator, the resistance of the battery and generator leads will often serve to maintain sufficient e.m.f. across the shunt to operate the cut-out. This, however, cannot be relied upon. To obtain absolute reliability the shunt windings of the cut-outs should be excited off a small independent battery, that will be unaffected by any disturbance on the supply system. Reverse-current cut-outs should not operate with a reverse current of less than 25 per cent. of the full-load current. Cut-outs can quite well be made to operate on a reverse current of less than 5 per cent. of the full-load current, but such cut-outs require fine adjustments and are more liable to give trouble.—Lond. *Elec.*, January 8.

Graphite Rheostat.—Klein.—An illustrated communication referring to the graphite rheostat of Hopfelt mentioned in the Digest October 31. He also has found that graphite powder has special advantages for use in rheostats since the resistance of such powder decreases gradually while current passes through it. This property seems to make such a rheostat suitable for starting motors. However, such a rheostat changes with the time, having a different initial resistance when freshly filled than after having been used for some time. After such a resistance has been used for a while its resistance when current begins to flow is much smaller than when it is freshly filled, so that the valuable property of a considerable decrease of resistance while the current passes is finally lost. This is due to the fact that the powdered graphite has conglomerated into globules, which are better conductors than the powder.—*Elek. Zeit.*, November 26.

Hopfelt.—A reply to Klein. He confirms the observations of the latter, but has found that the conglomeration in globules is due to impurities which are either in the graphite powder or are due to evaporation of the insulating layers and the contact plates with the rheostat. For this reason he now uses specially prepared pure graphite and provides for good radiation of the heat developed in the rheostat. A freshly-filled graphite powder rheostat changes with the time, although unused, slightly compressed powders decreasing in resistance and strongly compressed powders increasing. It is, therefore, necessary to choose such a pressure that there is no change of resistance with the time. He states that several hundred of these rheostats have been used for months and some for a year and a half and none of them has shown a change of resistance.—*Elek. Zeit.*, December 31.

WIRES, WIRING AND CONDUITS.

Perforation Voltage.—BAUR.—An article in which the author gives the results of experimental investigations which confirm the imperical law given by him before. It states that the voltage at which a dielectric is perforated equals a constant multiplied by the ⅔ power of the thickness of the dielectric plate in millimeters. The constant, therefore, represents the e.m.f. in volts which is required to perforate one millimeter of the substance. It is, however, not entirely constant, since it slightly increases with increasing thickness of the dielectric. For air with a sinusoidal current and plate electrodes the constant is about 3,000 volts, while for air with sinusoidal current and needle point electrodes the constant is 2,400 volts. Pointed electrodes, therefore, require a smaller perforation voltage than plate electrodes, as has long been known. He uses this formula to determine the voltage of a lightning flash. If the length of air perforated by the lightning flash is one kilometer, then the voltage is 30,000,000, if the constant is 3,000; but since the constant is greater for a greater distance, the voltage of the flash is estimated as about 40,000,000. For mica the constant is 58,000, for paraffine 20,000.—*Elek. Zeit.*, January 7.

Power Transmission Cables.—SCHMIDT.—A continuation of his illustrated serial on the construction and manufacture of cables. In the present installment some details are given on the construction of cables of Cassirer. Impregnated paper and jute is used either alone or combined. For the high-tension cables with fibre insulation, paper is used, although on the basis of good results in practice, paper is already used in cables with 500-volt pressure. The cables insulated with paper or jute are mainly used for underground power transmission, while the lead-covered cables, insulated with vulcanized rubber, are mostly used in mines and on shipboard. Some details are given as to cables between 250 and 2,000 volts.—*Elek. Anz.*, January 3.

ELECTRO-PHYSICS AND MAGNETISM.

Eddy Currents.—THORNTON.—The conclusion of his illustrated paper. He discusses the influence of periodic irregularity of armature rotation and of unequal turning moment in prime-movers on the magnitude of the eddy currents, and gives the results of some experiments made by him which show that the efficiency of a transmission system supplied from turbo-generators may be several per cent. higher than from reciprocating engines. Two converters in his laboratory were connected single-phase, then driven by direct current, first from a turbo-generator and afterwards from a single-cylinder, double-acting engine with a heavy fly-wheel. Measuring the input and output by carefully calibrated wattmeters, the curves shown in Fig. 3 were determined. The author remarks that the case no doubt represents the two extremes of engine regularity, "but many large gas engine plants show much more fluctuation on load than does a 75-hp, single-cylinder engine." In an appendix the author deals with the separation of eddy current and hysteresis loss in armatures.—Lond. *Elec.*, January 8.

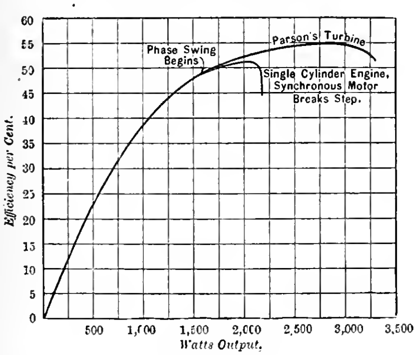


FIG. 3.—CURVES OF TESTS.

Damping of Oscillations.—KOWALSKI.—An abstract of a paper read before the French Society for the Advancement of Science, in which he discusses the reasons of the disagreement between the theoretical formula of Lord Kelvin for the damping of electric oscillations and the experimental results of various physicists. He finds that Kelvin's formula is correct and that the disagreement formerly found is due to the fact that the theoretical conditions of the experiments were not rigorously maintained. Poor insulation of the self-induction coils is the main fault. In fact, the measurement of the damping which can be made with great accuracy, may be used as a good indication of the quality of the insulation. He emphasizes the importance of good insulation for the various applications of electric oscillations.—*L'Eclairage Elec.*, December 12.

REFERENCES.

Dielectric Hysteresis.—BEAULARD.—A paper read before the French Association for the Advancement of Sciences. Schaufelberger has formerly indicated a method for studying dielectric hysteresis, but an error in the calculations has rendered his numerical values inexact. The present author has recalculated the results of these experiments. One of the interesting results at which he arrives is that of the two hypotheses on ether—one assuming the ether at rest and the other assuming the ether to be carried together with moving matter—the latter is the more probable one. It is the fundamental hypothesis of the theory of the electrodynamics of Hertz.—*L'Eclairage Elec.*, December 12.

Quaternions in Electrical Calculations.—FERGUSON.—A brief paper on the use of quaternions in the theory of alternating-current phenomena.—*Phys. Rev.*, November.

Terrestrial Magnetism.—MATHIAS.—An abstract of a paper read before the French Association for the Advancement of Science on the law of regular distribution of the total force of terrestrial magnetism in France on January 1, 1896.—*L'Eclairage Elec.*, December 12.

Nature of Radioactivity.—LODGE.—An abstract of a lecture in which he considers that the phenomenon of radioactivity is intelligible and simple on the theory that it is due to atomic disintegration. The important consequences of the theory are the belief in the mutability of matter and the transmutation of the elements.—Lond. *Elec.*, January 8.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrical Losses in an Electrolytic Copper Refinery.—HUTCHINSON.—An account of the results obtained in the course of an investigation made in 1897 on the cost of producing and using steam power throughout the Anaconda works, and also of determining the cost of electrolytic refining at these works. The energy loss in contacts in the tanks, obviously great, was considered in detail. For one "system," comprising 200 tanks in series, the current was 3,800 amp., the pressure at the generator 67 volts; the losses in switchboard, 0.31 volt; in feeders, 2.00 volts; in mains, 6.00 volts; in all contacts, 7.36 volts; hence, the total volts lost, 15.67, i. e., 23.5 per cent. Thus the electrical efficiency from generator terminals to the solutions was 76.5 per cent. and the total loss from generator to solution was divided as follows: In switchboards, 2.0 per cent.; in feeders, 12.8 per cent.; in mains, 38.4 per cent.; in contacts, 46.8 per cent. For one tank system of 200 tanks the loss thus amounts to 60 kw; this makes the total annual cost of wasted energy for one tank system $9,400, and for six, $56,400. As the capacity of the refinery was approximately 30,000 tons per year, this gives a cost of $1.88 per ton for lost energy. While this amount seems small, it is very approximately equal to the interest on the total investment in the refinery plant; hence, a saving of one-half of this loss would justify an increase of 50 per cent. in the total investment. "As a matter of fact, one-half of this loss can be saved for a very much smaller sum." The author thinks that the fondness of refinery managers for secrecy is absurd, "since there is nothing to conceal," and that undue secrecy and refusal to compare results with others leads to poor results.—*Electrochem. Ind.*, January.

REFERENCES.

Edison Accumulator.—BAINVILLE.—An article criticising some claims made by Hibbert and relating to his tests of the Edison accumulator. He objects to Hibbert's claim that the property of the

Edison accumulator to stand a heavy rate of discharge, although already half discharged, is a characteristic feature of the cell for traction purposes. He claims that a lead accumulator in good condition is equally capable of fulfilling the requirements of electric traction. As the essential features of the Edison battery, he considers its great durability and its rapid recovery of the original e.m.f. after discharges at a high rate. He does not believe, however, that the latter property is as important as it is claimed to be.—*L'Elec.*, January 2.

Electric Discharges Through Gases.—Kowalski.—An abstract of a paper read before the French Association for the Advancement of Science. He describes his experiments on chemical action of high-frequency discharges through mixtures of gases. At a certain frequency the discharge obtains a special character, which depends upon the quantity of electrical energy. He has especially investigated the production of nitrous vapors by means of discharges through air, and the subsequent production of nitric acid. He states that it is possible to get up to 44 grams of nitric acid per kw-hour, and that the price of the kilogram of calcium nitrate would not be more than 13 centimes (about 2½ cents).—*L'Eclairage Elec.*, December 12.

Rare Elements.—Lenher.—The first part of a summary of our present knowledge of what are called the rare elements. The present installment deals with the radioactive elements; the new atmospheric gases, helium, neon, argon, krypton and xenon; lithium, rubidium and calsium; beryllium; gallium, indium, thallium; germanium and titanium.—*Electrochem. Ind.*, January.

Units, Measurements and Instruments.

Flicker Photometer.—Simmance and Abady.—A (British) Phys. Soc'y paper in which the authors describe a flicker photometer, which is capable of balancing and comparing the most violently contrasted tints and which is based on the following principles: The light effects must be in juxtaposition without any apparent division line, and must move, oscillate or rotate so that the point of juncture of the rays of the two lights passes and returns entirely across the vision field. Any hiatus or longer exhibition of one light than the other biases the result. The observation surface or surfaces upon which the light rays fall must be at exactly the same distance from the eye, at exactly the same angle in relation to the line of sight, and must be of pure white, such as is afforded, for example, by clean chalk, plaster of paris, magnesium carbonate or barium sulphate, since any tint affects the accuracy of the results. The photometer itself consists of a wheel of a white material with a specially shaped periphery, which is caused to revolve before an eye-piece by means of a suitable motor. At right angles to the line of sight and parallel with the axis of the revolving wheel, are the two lights undergoing examination, the rays of which fall upon the shaped periphery of the wheel, enabling the effect of such light to be seen in turn through the eye-piece. The discussion which followed the reading of the paper turned mainly on two points: first, whether the instrument measures candle-power, and second, whether it is independent of the Purkinje effect. In his reply, Abady said that if a Bunsen disc is taken and used to compare the candle-powers of two lights of the same color, the grease spot vanishes at a certain point. If a flicker photometer is substituted for the Bunsen disc the flicker disappears at the same point. In both cases candle-power has been measured. Results obtained from the photometer by different observers agree among themselves and also with results obtained from the Bunsen disc photometer. He does not think the Purkinje effect affects the readings of a flicker photometer, because the same values for the ratio between the intensities of two different colored lights are obtained by varying the distances of the light from the instrument within wide limits.—Lond. *Elec.*, December 25.

References.

Direct-Reading Scales for Slide-Wire Bridge.—Buckingham.—A brief article. When a large number of rough measurements are to be made on the slide-wire Wheatstone bridge, it is very convenient to have the scale so divided as to read directly the ratio of the two segments of the wire, thus obviating the necessity of calculating it or looking it up in Obach's table. While such scales are in common use, the author describes a simple geometrical construction for making them.—*Phys. Rev.*, November.

Comparing Low Resistances.—Wenner.—A brief description of a convenient method of comparing low resistances by means of the Wheatstone bridge.—*Phys. Rev.*, November.

Differential Duplex Telegraph System.—An illustrated description of a method devised 20 years ago by McGaurin and recently revived and improved by Janvey of the Australian telegraphic administration. Batteries are used at one end only. The method of producing the changes of line resistance which actuates the relays at the receiving end is described and illustrated in a diagram. It is thought that for short, well-insulated lines or for underground conductors this system may be perfectly reliable. The system was tried with success on a loop of 175 miles in length commencing and terminating in Melbourne.—Lond. *Elec.*, January 1.

Miscellaneous.

Metal and Mineral Productions.—The annual statistical number, giving statistical data on metal and mineral production in 1903, reviews of the markets, etc. The production of aluminum in the United States in 1903 was 7,500,000 pounds, valued at $2,325,000, as compared with 7,300,000 pounds, valued at $2,284,590 in 1901. The production of copper was 670,880,000 pounds, valued at $88,334,770 (against 610,815,384 pounds and $71,072,586 in 1902). The production of gold in the United States in 1903 was 3,600,645 troy ounces, valued at $74,425,340; besides the output of gold from domestic ores, a large quantity of gold is recovered by the refineries each year from foreign ores and bullion, the output from these sources in 1902 being valued at $34,932,211. The total output of desilverized, soft and antimonial lead produced in the United States in 1903, was 289,030 short tons, valued at $24,492,402, and in addition a production of 84,771 tons of lead from foreign ores and bullion. The output of silver from domestic ores was 56,519,793 trop ounces, valued at $30,520,688. The production of zinc was 156,318 short tons, valued at $16,882,344. There was a large increase in the output of banxite, which amounted to 40,700 short tons ($179,080), against 27,322 tons ($121,465), in 1902. The output of carborundum was 4,724,000 pounds ($472,400), against 3,741,500 pounds ($374,150), in 1902.—*Eng. & Min. Jour.*, January 7.

Reference.

American Trade.—Dredge.—The first part of a long statistical article on the development of American trade, with a great many diagrams. The article is more of a general character dealing with the export trade of the United States and referring to electrical engineering only incidentally. A diagram of the exports from the United States of electrical machinery shows a rapidly ascending and nearly straight line from 1898 to 1901 and a slight dropping off from 1901 to 1902. The article is to be concluded.—*Traction and Transmission*, January.

New Books.

Distribution de L'Energie par Courants Polyphases. Par J. Rodet. 2 ieme Edition. Paris: Gauthier-Villars. 562 pages, 213 illustrations. Price, 15 francs.

The volume is one of the best text-books on alternating-current power transmission systems, printed in the French language. It is essentially intended for the use of electrical engineers and electrical enginering students.

The work is divided into nine chapters. The first chapter is preliminary. The second concerns polyphase generators, both synchronous and asynchronous. The third deals with polyphase conductors and conducting systems. The fourth chapter is devoted to the design, construction and principles of operation of transformers and frequency changers. The fifth chapter considers converters. The sixth deals with polyphase motors. The seventh with meters and measuring instruments. The eighth relates to the applications of polyphase currents to electric traction. The ninth and last chapter describes a number of typical polyphase plants and transmission systems in various parts of the world.

The treatment is clear and logical, employing algebra and engineering mathematics. The author has taken pains to deal with the subject broadly, and does not confine himself to French alternating-current practice. In fact, an American student can learn more about American transmission systems in their salient engineering features than he can find in a number of American books on the same subject.

The book would be improved by a subject-index and an author-index at the end. There is only a chapter-index. The work can be strongly recommended to students of electric power transmission.

Electric Heating Equipment of a Modern Hat Factory.

By Max Loewenthal, E.E.

REGARDLESS of many adverse conditions, the electric heating industry has been making history during the last decade at a pace which is a surprise even to those who have witnessed the remarkable rise of other branches of electrical engineering. Largely responsible for this encouraging situation to-day are, first, a better understanding on the part of the manufacturers as to the needs of the consumer and the limitations of his products; secondly, the tendency of central station managers to make rate concessions to consumers using current for domestic or industrial heating, and finally the public's gradual but inevitable recognition of the advantages of electric heating for specific purposes. To the engineer, the application of electric heat to industrial operations is of particular interest, and a number of instances might be cited in support of the statement that cerain industries have been almost revolutionized and their products cheapened and improved after the introduction of electric heat.

Perhaps the most striking example of this is the use of electric heat in modern hat manufacture, where electric irons and other electrically-heated machines are not only rapidly replacing gas-heated devices, but have become almost indispensable factors, and where price competition must be met while the high standard of quality of product must be maintained. One of the first hat concerns in this country to recognize the advantages of electric heat, and back up their faith by a complete installation was the well-known firm of F. Berg & Co., of Orange Valley, N. J., manufacturers of soft felt hats. This firm, established in 1864, equipped their entire plant with electrically-heated apparatus as far back as September 1, 1898, and when their old plant burned down in 1902, they started at once to rebuild the works, rearing on the site of the old buildings the most up-to-date hat factory in this country, while manufacturing was temporarily carried on in the company's Newark establishment.

FIG. 1.—CORNER OF TRIMMING ROOM, SHOWING ELECTRIC CURLING MACHINES.

The new buildings, completed in the past summer, occupy a plot comprising several acres and represent an outlay of more than a quarter of a million dollars. It is claimed to be the only hat factory built according to a definitely conceived plan, housing within three splendid buildings the necessary machinery and men for an output of about 300 dozen hats per day. The two factory buildings are known in the trade as the "back shop," the smaller of the two, where the initial work is done and the "front shop," where the hats are finished. Although we are particularly interested in the "front shop," which contains the electric heating appliances, it might be well, in order to more fully comprehend the exact mission of the devices, to briefly describe the processes gone through in the manufacture of soft felt hats.

The first building to enter, then, is the "back shop," which runs parallel to the "front shop" or main building. It is built of brick, is two stories in height, 150 ft. long, 100 ft. wide and of the mill type of construction. On the first floor is the stock room for the raw fur as it is received from the fur cutters. This fur is first taken to the blowing room on the same floor, where the hair is separated from the fur by means of four blowers. The fur is then taken into the mixing room, where the various grades are mixed by an automatic machine. In the forming department, a definite quantity of this mixture is then placed around a perforated copper cone, which is dipped into hot water and taken to the sizing department on the second floor. Here the hats are "felted" by being soaked in boiling water and kneaded by hand and machines until the embryo hat has shrunk to its normal size. It is then dried and put through a stiffening machine, clear shellac being introduced into the brim of the hat. Thence the hat is sent into the dyeing department on the same floor, where it receives its proper shade, which varies largely with

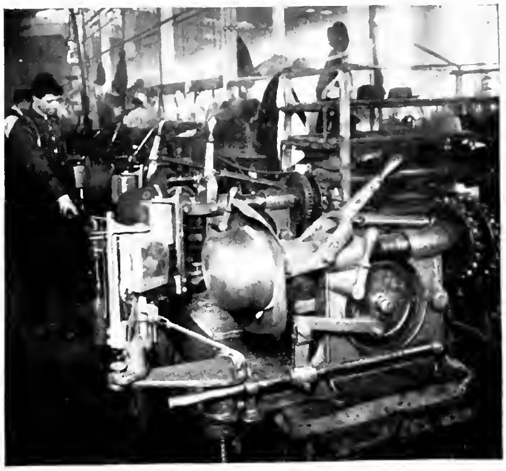


FIG. 2.—PORTION OF MAIN FINISHING ROOM, SHOWING ELECTRIC MACHINE HAT IRONS.

the demand of the market. The shape and size are next given to the hat in the blocking and stretching departments, after which it is thoroughly dried by steam driers and passed down to the pouncing department on the first floor, where it is machine sand papered internally and externally. The hat is then sent to the stock room, from where it is delivered in due time to the finishing department on the top floor of the "front shop." This building, constructed of brick, is three stories in height and has a basement, each floor being 14 ft. high. Its dimensions are 175 x 50 ft. Its roof is a series of skylights, giving the best possible light to the finishing departments on the third floor. The main room on this floor is 100 ft. long by 45 ft. wide, and at the other end of the building is another finishing room measuring 65 x 45 feet. In these two rooms 200 men are employed "finishing," or as it might be more commonly called, "ironing" the hats.

This is done with electrically-heated hand shells, each weighing about 15 pounds and consuming between 400 and 450 watts. The shells are of a uniform shape, which has resulted from many years' use by journeyman hatters. The shells, 200 in number, are equipped with Prometheus electric heating units. The conducting layer of these units consists of a thin metallic film on mica, another piece of mica being used as a cover plate. The two pieces of mica are enclosed in a sheet metal casing and suitable terminals are brought out. A unit of this description is slipped into the hollow shell and pressed against the bottom surface by means of a heavy iron pressure plate, which is forced against the unit by a bolt operating two sliding wedge blocks. A smaller unit is fastened to a projection on the pressure plate and serves to heat the one side of the shell, used for "veluring." For this purpose the shell is inclined on projections on the iron stand and the operator heats a cloth pad held in his hand on this side of the shell. These heating units not alone insure uniformity of temperature, but may be replaced in case of necessity by the workman himself. An idea of the flexibility of this system may be gained from the fact that all the old shells which had gone through the fire were in a very short space of time equipped with the heating units.

Fig. 3 shows one of the hand shell operators at work and, as will be seen, each shell is connected to a separate small knife switch on the wall. The operator's work consists in stretching the hat over a wooden block of the right shape and size, first making it pliable over steam and removing superfluous hair by holding the hat in a singeing stove, and then finishing or ironing the same and trimming the brim to the proper width by means of a gauged knife.

At the further end of this floor twenty-eight ironing machines are located, divided into four gangs of seven each, belted to a countershaft driven by a motor. A gang of these machines, shown in Fig. 2, is looked after by a boy and all his work consists of is to "feed" the blocks with hats and start and stop the shell which travels around the hat, regardless of the shape, the tension being maintained by means of its suspended weight. These machine shells differ from the hand shells in that their faces are slightly curved, while the hand shell faces are perfectly flat, and instead of a handle they are supplied with a shaft at one end, which fits into and revolves in a bearing fastened to an arm, which carries the shell around the surface of the hat. The working face of these shells only is heated and a Prometheus heating unit is held against the easily-removable bottom by means of a heavy pressure plate fastened down by screws. A flexible connecting cord leads from two terminals at the lower end of the shell to a cut-out block at the side of each machine. The watt consumption of these shelves is the same as that of the hand shells.

The many advantages of electrically-heated shells over gas-heated shells, namely safety, cleanliness, better sanitary conditions, reduced operating expenses and lower insurance rates are supplemented in the case of machine shells by the fact that no matter how much the electrically-heated shell may be jarred, the heat supplied is constant and steady, which greatly enhances the efficiency of the operator tending a group of these machines.

From the finishing departments the hats are sent to the floor below where they are passed upon by an inspector and then to the curling machines shown in Fig. 1. In these an electrically-heated revolving disc curls the edge of the brim, the heaters almost entirely surrounding the disc. It needs no argument to show the decided advantage

FIG. 3.—CORNER IN MAIN FINISHING ROOM, SHOWING MANNER OF USING ELECTRIC HAND IRON.

of this method of heating the disc over the old method of projecting against it, and almost into the face of the operator, a jet of gas.

In a large room at the other end of this floor 200 girl operatives sew the various trimmings on the hats, all the sewing machines being electrically driven. In the flanging room on the first floor twenty flanging bags are used for giving the brim its final shape. These bags, which are filled with sand, are at present heated externally on steam tables, but they will probably be heated internally by means of electric heaters in the near future. Fifteen additional electric hand irons are used by the flanging bag operators, shown at work in Fig. 4.

The power house, a pretentious brick structure, occupying a plot 50 ft. by 95 ft., on the company's spacious site, is divided by a heavy fire wall in two sections. In the one are located four Coatesville horizontal tubular boilers, 200 hp each, equipped with the Parsons patent forced draught system, in which superheated steam mixes with the air in the ash pit. Natural draft is obtained from a steel stack 100 ft. high and 6 ft. in diameter. Green economizers and Berryman heaters are used for the heating of the boiler feed water. Three Worthington pumps furnish the water for the boiler and house supply. In the spacious engine room two Fitchburg horizontal, tandem compound, 300-hp engines are direct-connected to two Stanley 200-kw inductor type 60-cycle, 7,200 alternations, two-phase generators, delivering current at 220 volts, and being supplied with automatic phase regulator windings.

One 12-kw and one 24-kw Northern exciter are belted, respectively, to the two generators. The switchboard, consisting of five blue Vermont marble panels, is 17 ft. long and 9 ft. high and is so located that it may be easily seen from any part of the engine room. One of the end panels is used as the exciter panel and is equipped with two ammeters and one voltmeter, of the Stanley type and exciter switches. Adjoining this panel are two generator panels with the usual equipment, the next is the light and heat panel and finally the power panel. In a separate building adjoining the power plant a 100,000-gallon pump is housed which furnishes the water supply for the extensive

FIG. 4.—FLANGING ROOM, SHOWING FLANGING BAGS AND ELECTRIC HAND IRONS.

sprinkler system installed throughout the buildings, there being a total of 1,200 sprinkler heads. The average load on the system is 900 amp. at 220 volts, which is the pressure employed for the operation of the motors, of which there are 30, ranging in capacity from 3 to 30 hp; 800 lights are scattered throughout the buildings and they, as well as the heating appliances, are operated on 110-volt circuits. That these devices are important factors in the operation of a modern hat factory may be gathered from the fact that one-half of the entire average output of the plant described above is consumed by electrically-heated devices, approximating 100 kw.

The designers and owners of this establishment, where steam and gas have been so largely supplanted by electricity, must certainly have been convinced of the truth of the statement, made recently by a well-known engineer, that "An electrically-driven, electrically-heated and electrically-lighted tool is as perfect a combination for good work as it is possible to make." The entire plant was designed and erected under the personal supervision of Mr. Luther D. Martin, of the Taylor-Martin Engineering Co., Newark, N. J., who was retained as consulting engineer by F. Berg & Co., in view of his experience in the design of hat factories. The electric heating equipment was supplied by the Prometheus Electric Company, of New York.

Heavy Traction in England.

A contract for the equipment of a large three-phase electrical generating station to be erected by the Great Western Railway Company at Park Royal, near London, has been secured by the Electric Construction Co., of London and Wolverhampton. The station will require about 10,000 hp of plant, available for either lighting or traction. The North Eastern Railway Company has recently carried out extended and satisfactory trials of the newly electrified branch of their line between Newcastle and Monk Seaton Station, on the other side of Tynemouth. The distance is about 10 miles, with a double track, making the length of rails traversed rather over 20 miles. Mr. Philip Dawson is understood to have been at work for some time on electric traction projects for the London, Brighton & South Coast system.

Central Station Feeder Regulators.

The accompanying illustrations show a type of central station feeder regulator made by the General Electric Company for alternating-current circuits, which is free from the objection of introducing lagging currents. The regulator is of the transformer type, having its primary connected across the bus-bar and its secondary wound in several sections controlled by a dial switch. The amount by which

FIG. I.—REGULATOR

the generator voltage is raised or depressed on the feeder is determined by the amount of secondary winding included in the feeder circuit. The windings of the regulator, being arranged similarly to those of the usual transformer, are free from all appreciable reactance, and the regulator does not, therefore, introduce a lagging current into the system, as is the case with apparatus which contain a large amount of reactance, the presence of which is a necessary consequence of the principle of regulation.

The control of the feeder by means of this regulator is of the simplest nature. Starting with the regulator in position of maximum boost, that is, with the dial switch turned to the extreme left as far as it will go, a continuous right-handed movement of the dial switch

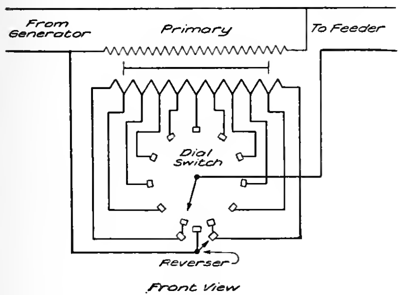


FIG. 2.—DIAGRAM OF SWITCH CONNECTIONS.

for two complete revolutions is obtained. During the first revolution the switch cuts out, step by step, the ten sections of secondary winding. When the first revolution has been completed, the voltage on the feeder is the same as that of the generator, no secondary winding being included. A further movement of the switch in the same direction automatically throws a reversing switch on the back of the panel, and continuing the movement of the dial switch, still in the same direction, the secondary windings are again switched in, step by step, this time with reversed polarity; so that when the second revolution is complete the whole secondary winding is again included in the feeder, but now opposing the voltage of the generator.

Thus by one continuous movement of the switch, covering two revolutions in one direction, the complete range between maximum boost and maximum depression of the feeder voltage is covered. At either end of this range the switch is automatically arrested, so that it is impossible to turn it too far.

The dial switch embodies a number of improvements, designed to overcome objections in other forms of apparatus intended for a similar purpose. In the dial switch, the awkward combination of split contact fingers and reactive shunt is avoided and the switch operates with a positive "snap" movement from step to step, regardless of the manner in which the operating handle is manipulated. This is accomplished by means of compression springs interposed between operating handle and the traveling blade.

An automatic bolt holds the switch on its contact point until the bolt is withdrawn by a self-acting cam, when the spring has received

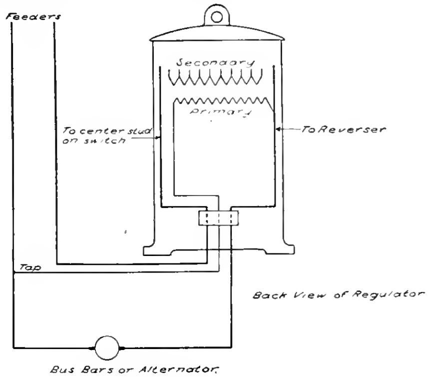


FIG. 3.—REGULATOR CONNECTIONS.

sufficient compression to carry the blade with a quick movement onto the next contact, on which it is instantly locked again by the bolt. Owing to the quickness of movement obtained, together with the special shaping of the contact blades, no flicker on the lamps is observed when the switch is moved from step to step.

The contact blades are of heavy copper with turned edges arranged to chill, by their mass, the momentary arc which occurs when passing from point to point; thus avoiding damage from arcing. If after prolonged service it should become desirable to renew these contact blades, they can be readily removed and replaced.

Fig. 1 shows the appearance of the standard regulator as usually installed at the station and in some special cases at the center of distribution. The core is of the cylindrical type and with its winding stands vertically within a well ventilated frame with sheet iron panels.

Fig. 2 shows the general arrangement for connecting the various sections of the secondary winding to the dial switch; also the electrical connection of the reversing switch. This latter is operated by an arm attached to the main shaft.

Fig. 3 shows the connection of the regulator to the generator and feeders. It will be seen that three leads only have to be connected in order to place the regulator in service.

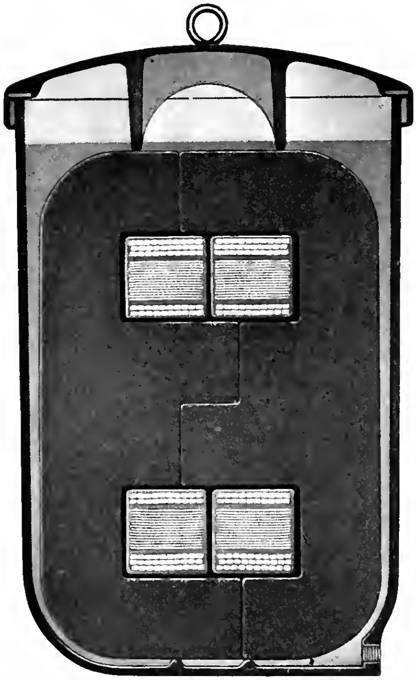
Fire Losses.

It is of much interest to electrical people to note that the property losses in the United States and Canada through fires the past year are estimated to have reached an aggregate of about $152,000,000, allowing for a probable loss of $13,000,000 in the month of December, whose figures are yet to be tabulated. On this showing there was a decline of fully $9,000,000 in the total fire waste as compared with 1902, which showed losses of $161,000,000. The real extent of the gain to underwriters becomes more evident when 1901, with its aggregate of $169,500,000 in losses, and 1900, with its loss record of about $178,000,000, are recalled. Thus 1903 has yielded a fire waste of about $26,000,000 less than that of 1900. There does not appear, however, to be any abatement in the demands of Fire Underwriters for increased precaution at the expense of the insured, nor any sign of reduction of rates.

Practical Study of Transformer Design.

The fact that technical literature used in our colleges can be effectively supplemented by the assistance of manufacturing concerns was strikingly illustrated recently in a transaction between the University of Iowa and the Fort Wayne Electric Works, Fort Wayne, Ind. In class room work an instructor is often handicapped in lecturing on electrical design by lack of suitable illustrating matter on the subject under discussion. This applies particularly to modern standard practice, which is often lacking in up-to-date technical text-books. To supply this omission at the University of Iowa, correspondence was opened by Prof. Spinney with the Fort Wayne Electric Works, regarding the possibility of effectively illustrating transformer construction. The type A oil-insulated Wood transformer was selected as a suitable preferred design for illustrating shell type construction as applied to lighting transformers.

In order to obtain the most satisfactory results in class room work, a full-sized model of the cross-section of the transformer was constructed and mounted in a suitable glass-covered case for suspending on the class room walls. An illustration of this cross-section model is shown herewith. It will be noticed that nearly all of the points of construction which would be considered in economical commercial design are effectively shown in this illustration.


CROSS-SECTION OF MODEL TRANSFORMER.

The cross-section was taken across the coils through the center of the core. In constructing this model a thin section of coils and core was mounted on a board cut to conform with the outlines of such transformers. Around the edge of this board was built up a reproduction of the section of the transformer case the same thickness as the section of core and coils. Felt gaskets under the cover, oil within the case and other features hard to reproduce were represented by the proper color paint. The dimensions of all parts and proportion of different parts were made exactly the same as in a transformer of this size, to show the high insulation between primary and secondary coils and core. In this way also was shown the close proximity of the core to the case and the short conducting path through oil, which is interposed between the core and case on all sides.

Another feature shown is the method adopted in the design of the transformer to make it suitable for operation on three-wire circuits, by dividing the primary and secondary coils into several sections separated from each other by insulating materials and oil space and occupying different positions with respect to the magnetic circuit. The protection to the primary from both moisture and injury is also illustrated, the coarse wire of the secondary surrounding the fine primary conductors on the two sides most liable to injury. The core construction is also plainly seen to consist of a single punching, which is used in pairs to make a single complete lamination in the core.

The magnetic circuits are short and of low reluctance, because of the large area of contact between the two sides of the gaps in the magnetic path. The transformer requires a minimum amount of oil for insulation and conduction, because of the close conformity of the shape of the case to that of the assembled core and coils and the most efficient use made of the relatively small amount. Mechanical construction of the case furnishes means for holding the core rigidly in the proper position in the case without the use of angle irons or bracket construction of frame.

The use of the vacuum drying and substitution process employed in the construction of the coils is shown by the uniform spacing and straight regular arrangement of the conductors in different layers of the primary and secondary.

Telephone Card Index Bracket.

Mr. M. Holtz, the secretary of the *Dry Goods Economist,* a well-known trade paper, has recently, by reason of the constant annoyance and delay incurred in looking up names and numbers in the New York telephone directory, invented a very practical attachment for the purpose of giving the subscriber means of instant reference to a name and number. It consists of a nickel bracket attached to the post of the portable telephone above the receiver hook with a slotted bracket containing cards arranged as in a card index permitting any classification by business, alphabetically or any other way that suits the convenience of the user. A card may be withdrawn and any number of names of the same general classification up to the capacity of the card may be seen at a glance and the card will drop back in its place by its own weight. The projecting tabs on the top of the cards give an instant guide to the contents and permit of ready withdrawal of any card or cards.


TELEPHONE CARD INDEX BRACKET.

One great advantage of this attachment is in its permanent attachment to a portable desk telephone which is being constantly shifted around from one place to another, where wall card index books or other separate devices lose their value by reason of not being handy when wanted. This is entirely obviated in the case of this attachment. This invention should also make possible a great saving on the part of telephone companies. The cost of revising and publishing directories is a very large item. With the general use of this attachment by a local company the average subscriber would have little occasion to look in the telephone book.

It will be readily seen that the first card is instantly visible to the user of the telephone—this card being reserved for most frequent calls. Furthermore, its use will permit an exchange operator to repeat back a wrong or changed number call and requesting it be changed on the card, avoiding a recurrence of the same error.

Electricity in Typesetting and Printing.

A considerable amount of space has been given lately to illustrating and describing in the pages of Electrical World and Engineer the various processes dependent upon electricity in some form and employed in the Government Printing Office at Washington. The multiplicity of such processes was bewildering and many readers in commenting upon them have expressed the belief that the list was exhausted. This, however, is not likely to be the

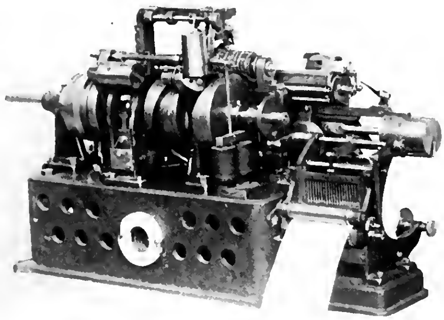


FIG. 1.—PART OF TRANSFER PRINTING MECHANISM.

case for a long time to come; and we are now able to signalize a further departure, to which we have in fact already directed attention. The device is known as the "lithotype" and provides not only for typesetting electrically, but for printing with smooth aluminum plates on rotary presses; so that, in a broad sense the principles of lithography may be said to be applied. The invention is striking also for what it eliminates from the ordinary printing office mechanism and equipment, since it proposes not only to do away with the setting and distribution of type, whether by hand or machine, but does away also at one sweep with matrix making, stereotyping or electrotyping. The inventor is Mr. Walter S. Timmis, consulting engineer of the Sackett & Wilhelms Company, to whom several

Fig. 2.—General View of the "Lithotype" Punching Mechanism.

patents are issuing; while the introduction of the aluminum plate is to the credit of Mr. John Mullaly, president of the United States Aluminum Printing Plate Company.

The apparatus was seen in full operation in New York last week by a member of the staff of this journal. As then studied, the lithotype consists of two parts or devices operating separately. Arrangements, however, have been made to co-ordinate these parts. The first, shown in Fig. 2, and seen operated by a young woman, consists of a small machine comprising an electrical keyboard similar to that of the ordinary typewriter, a perforating device to perforate a stout manila paper ribbon or strip of any required length, and a counting device. The perforating device is operated electrically by electromagnets grouped back and under the mechanism so as to give control by armature pull of the punches making the perforations, and controlled by the depression of the keys through the circuit-closing devices associated therewith. The machine automatically takes care of the spaces between the words. The holes in the strip when it is put on the next machine in the process are translated duly into the letters actuated originally on the typewriter keyboard. The magnets can be run on an ordinary light or power circuit, preferably with a condenser in circuit to avoid "arcing."

The perforated strip goes directly into the second part of the combination, shown in Fig. 1, which operates to bring the printing member into position, so that the selected character is directly opposite the printing point. The character is then inked, the paper is moved up to the character and the impression is taken therefrom. This action is repeated for each character until the line is completed, when the paper-carrying device returns and moves for the new line. Power is furnished conveniently to keep the machine running by a small electric motor. The transfer thus obtained is now ready to be impressed on the surface of the prepared aluminum plate.

The plate, with the imposed transfer, is put under pressure, the paper is washed off, the impression thus made is "rolled up," and then, with a few finishing touches, is ready for the press.

High Pressure Gas Distribution by Gas Power.

A gas-power installation of exceptional interest is now under construction by the Laclede Gas Light Company, of St. Louis, Mo. The system has for its object more efficient distribution of gas over larger areas than may be economically covered by the simple method of running large low-pressure mains from a centrally-located gas-generating plant to supply all parts of the city. The system under construction is intended to supply the entire city of St. Louis, embracing an area of approximately 65 square miles. In order to serve the outlying districts of such an area, one of three methods must be employed: First, large low-pressure feeder from central holder to center of district to be covered; second, medium-sized feeders from main holder to auxiliary holder in center of district, and third, high-pressure feeder to distributing center, using pressure-reducing valves at this point for obtaining proper pressure upon the service lines. The enormous expense for construction entailed by the first two methods has practically prohibited their use in St. Louis, and the high-pressure system is being installed. With this system, the size of feeder pipes is greatly reduced, and the necessity of auxiliary district holders is entirely done away with.

For serving suburban communities, lying far beyond the city limits, this method may be extended and the pressure of the gas raised to any desirable extent for transmission through small pipes, this pressure being reduced at the suburban distributing center by pressure regulators, as in the medium-pressure system above mentioned. This gas-distribution system as a whole presents a striking similarity to the ordinary alternating-current distribution system with primary high-pressure feeders, reducing transformers and secondary low-pressure distributing lines, the theory of high-pressure transmission being in both cases identical.

The pressures to be employed in the system under construction at St. Louis are approximately 5 lbs. per square inch for the medium-pressure feeders and from 20 to 80 lbs. per square inch for the high-pressure suburban feeders. On account of the use of cast-iron mains, the 5-lb. limit was chosen for the medium-pressure system, but for the high-pressure system iron pipe with screwed fittings will be used. With this construction any desirable pressure may be carried with entire safety, and the radius of distribution extended to 100 miles, if necessary.

The gas pressure will be supplied by a blowing unit, consisting of a standard Connersville blower direct-driven by a 300-hp Westinghouse horizontal gas engine of the type recently brought out for high-power work. The engine has two double-acting cylinders, 16½ in. in diameter and 24 in. stroke, arranged in tandem with a single crank, and uses for fuel the ordinary illuminating gas drawn directly from the gas mains. The engine operates upon the four-stroke cycle, and the method of governing secures a constant quality of explosive mixture at all loads, the quantity of the mixture being proportioned by the governor to the load of the engine. Electric ignition is employed. In this particular installation the engine is controlled by an automatic pressure-governor which adjusts the speed of the unit in direct proportion to the demand for gas, the speed thus being in inverse proportion to the pressure in the distribution main. So sensitive is this control that the variation in pressure will not exceed 8 oz. for a 50 per cent. range in gas output. The regular centrifugal speed-governor is, however, also used in order to prevent, under any conditions, the engine running at excessive speed.

The St. Louis installation is one of the first of its kind in the illuminating-gas field and presents many interesting features which will be subsequently brought out in special articles at the completion of the work. The system has, however, long been in successful use in the distribution of natural gas over large districts adjacent to natural gas fields. The St. Louis system is in charge of Mr. W. A. Baehr, engineer of the Laclede Gas Light Company.

Northwestern Electrical Convention Notes.

The exhibits at the Northwestern Electrical Association's winter convention at Milwaukee this year, although not extensive, included some apparatus of much interest to central station men. Nearly all the parlors on the second floor of Hotel Pfister were occupied by the supply men as exhibition and reception rooms.

THE GENERAL ELECTRIC COMPANY made no attempt at a display, but had headquarters in one of the parlors. Its interests were well looked after by Mr. F. N. Boyer, manager of the supply department; Mr. J. Scribner, manager of the lighting department; Thomas Ferris, Wisconsin representative; S. F. Dibble, manager small motor department; W. J. Ferris, of the Chicago office, and James Lyman, engineer Chicago office, who read a most interesting paper on steam turbines before the convention.

THE HOLOPHANE GLASS COMPANY was well represented by its Western distributors, the V. R. Lansingh Co., of Chicago. With its well-known generosity the company presented to its visitors two samples of its Holophane globes and Pagoda reflectors, which retail for $1.15. The news of this, the most expensive souvenirs presented at the convention, soon spread and the already crowded rooms of the company were soon filled to overflowing. The crowd, however, was well handled by V. R. Lansingh and H. M. Lauritzen and each man, after seeing the dark room tests, was presented with the globes. One of the most interesting of the tests in the dark room was that of a 50-cp power lamp on one side and a 6-cp lamp covered with a reflector on the other, the latter showing at least double downward illumination. Another of this company's exhibits was a large board over the doorway fitted with colored lamps with Holophanes and Pagodas, which was connected with a Reynolds flasher. This gave beautiful and startling effects, as the colors were rapidly shifted. The room was beautifully lighted by a new six-light cluster, using a special Benjamin body and six pagodas. Every corner of the room was so evenly lighted that the management of the hotel at once placed an order for 60 of the clusters to light its sample rooms. The best display of this company, however, was the Pfister Hotel itself. The entire lobby, first floor and banquet hall, were equipped with Holophanes over a year ago, every 16-cp lamp being replaced by 10-cp lamps, giving at the same time a marked increase in illumination with the well-known softening and diffusing effect of the Holophane system. So satisfactory has this proved that the management placed their order during the convention for equipping the dining-rooms, corridors, etc.

JULIUS ANDRAE & SONS CO., of Milwaukee, had an extensive display of the various electrical supplies for which it is agent, looked after by J. C. Schmidtbauer, sales manager; F. T. Andrae, vice-president and A. E. Stadlbauer, salesman.

THE CROUSE-HINDS ELECTRIC COMPANY, represented by F. F. Skeel, Western sales manager, of Chicago, exhibited a line of its switches, tablet boards and Norbitt specialties. Their new Imperial car headlight attracted especial attention.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY, of Lafayette, Ind., exhibited a number of its latest type of direct-current meters. Particular attention was drawn to the new method of compensating for friction which consists of a very neat and small multipoint switch placed within the meter and having its contacts connected with various turns of the compensating coil. By the mere movement of the switch lever any desired compensation for friction or vibration can be obtained in an instant. This new feature eliminates entirely the old and clumsy method of moving the compensating coil bodily to effect the compensation. It is also free from the objection of having the compensating coil disturbed or changed by the action of the series coils on short circuit. Another commendable feature is the new visual bearing, which permits of an inspection of the bearings while the meter is in operation, besides allowing the spindle point to be removed for renewals or examination with a special tool. A marked improvement is noticeable in the threadless jewel post by virtue of its simplicity and the quickness with which it can be taken out and replaced again. The binding posts are made both dust and fire-proof, and the spindle is constructed from nickel-steel tubing. The company was represented by Mr. Thomas Duncan and William Cothrell, of the engineering staff.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY received visitors and distributed bulletins in one of the parlors. A number of its well-known meters were arranged for the inspection of the members attending the convention. Messrs. A. L. Millard, W. E. McDonald and Norman Stewart were in attendance and extolled the virtues of the Westinghouse apparatus.

THE SAWYER-MAN ELECTRIC COMPANY did not make any exhibit, but was represented in the person of Mr. C. A. Ross, of its sales staff.

THE NATIONAL ELECTRIC COMPANY sent a cordial invitation to all the members of the Northwestern Electrical Association to visit its plant at Park Place and the river and inspect the manufacture of National Electric machinery and Christensen air brakes. A trip to the factory disclosed the various types of direct and alternating-current machines of the most modern type, in course of construction. A guide accompanied the visitors throughout the shops and explained the various processes of manufacture. The invitation also contained several car tickets of the Milwaukee Electric Railway & Light Company, and directions for readily reaching the plant. At the Pfister Hotel the company occupied a parlor in which several small motors, armatures, coils and apparatus were shown. Several large photographs served to show the larger apparatus which the company has turned out in the past. The interests of the company were taken care of by H. M. Klingenfeld, advertising agent; C. G. Burton, Chicago manager electrical sales; A. P. Peck, salesman; C. P. Tolman, A. E. Knight, engineers, and W. L. Waters, chief engineer, who read a paper before the convention on "Double-Current Generators."

THE BRYAN-MARSH COMPANY had George C. Keech, general manager of Chicago; L. P. Sawyer, manager the Minneapolis branch; J. L. Barnard, Wisconsin representative, and J. S. Corby, Illinois representative, receiving delegates at its headquarters.

THE PHELPS COMPANY had its interests in charge of W. E. Phelps, who exhibited a line of the Phelps specialties.

THE PARDRIDGE REFLECTOR was very much in evidence in the Convention Hall and in the corridors of the hotel. Cards about the hotels called attention to the fact that they increase the light 500 per cent. in a given direction and fit in places where others will not get. They need no shade holder and fit on any lamp from 2 to 50 cp in sizes. Mr. A. J. Pardridge did not fail to acquaint the various delegates with the merits of his invention.

THE WAGNER ELECTRIC MANUFACTURING COMPANY and the BULLOCK ELECTRIC MANUFACTURING COMPANY showed a line of their alternating and direct-current motors in one of the parlors. Mr. E. S. Bissell, assistant manager of sales at St. Louis, represented the former, while L. G. Bassett and H. J. Meyer represented the latter.

THE STANDARD UNDERGROUND CABLE COMPANY, although not represented, as usual, by Mr. Wiley, nevertheless was well taken care of by Mr. E. J. Pietzcker.

THE KUHLMAN ELECTRIC COMPANY, of Elkhardt, Ind., although not making an exhibit, nevertheless was very much in evidence in the person of Mr. E. Kuhlman.

MR. F. L. MERRILL, of the Standard Railway Materials Company, of Chicago, renewed old acquaintances at the convention.

THE BROWNING COMPANY, of Milwaukee, made an exhibit of its new line of motors, which range in size from 3 to 30 hp. They were represented by Mr. William Stark Smith, sales manager; Franklin Sweet, mechanical engineer, and F. W. Ells, electrical engineer.

THE CENTRAL ELECTRIC COMPANY, of Chicago, although occupying one of the larger parlors, contented itself with renewing acquaintances and keeping in evidence in the persons of J. W. Mason, sales manager, and W. W. Geisse, their Wisconsin salesman.

MR. WILLIAM M. PORTER, as Western sales manager, represented the Alphaduct Manufacturing Company. Pipe souvenirs, made of alphaduct, were distributed to the visitors.

THE KESTER ELECTRIC MANUFACTURING COMPANY showed a line of their self-fluxing solder. Mr. F. G. Dickerson, secretary; A. J. Witherall, president, and J. E. Goodwin, salesman, extolled the merits of the company's products.

MR. W. H. SCHOTT, the well-known heating engineer of Chicago, received his many friends in one of the parlors.

THE FORT WAYNE ELECTRIC WORKS made an exhibit of its direct and alternating-current arc lamps and the type "K" meters. Their standard bulletins and literature were distributed among visitors at their parlors. The latter were received by W. S. Goll, the Chicago manager; C. E. Sedgwick and J. S. Raymond, of the Chicago office.

THE NERNST LAMP and its excellent qualities, although not requiring specially to be brought to the attention of the delegates, nevertheless were explained in an interesting manner by Mr. G. E. Bennett, the assistant manager of the Chicago office. A new throw-away holder, which is practically fool-proof, was brought to the attention of the visitors at the parlors. This overcomes any objections which may have been raised in the past against the former method of renewing both the glowers and heaters.

THE WALKER ELECTRIC COMPANY, of Philadelphia, showed a line of its well-known type of switches. The exhibit was in charge of Mr. J. R. Kimball.

THE MILWAUKEE ELECTRIC COMPANY had an exhibit of its well-known line of motors in one of the parlors. Mr. W. Cary, the vice-president of the company and manager of sales, was ably assisted by Mr. I. B. Cary, of the sales department, and T. G. Whaling, the secretary and assistant treasurer.

THE TRIUMPH ELECTRIC COMPANY was represented at the convention by Mr. Jacobs.

THE AMERICAN CIRCULAR LOOM COMPANY exhibited its well-known product and was represented by Mr. Thomas G. Grier, its Western manager.

THE THOMAS G. GRIER COMPANY, of Chicago, made an extensive display of the various specialties which it sells. These included the Kinsman reflectors, Wotton gongs, Hubbell specialties and Wirt rheostats and theatre dimmers. Mr. Thomas Grier, the president of the company, and George A. Gray, sales manager, were in charge of the company's interests.

THE HALLER MACHINE COMPANY, of Chicago, displayed a new line of metal electric signs and dimmers for flashing signs. Mr. William Goltz, the secretary and treasurer, and W. E. St. Clair, superintendent of shops, explained the good points of their apparatus.

THE ELECTRIC STORAGE BATTERY COMPANY was represented by Mr. G. H. Atkin, manager of the Chicago office, and J. M. S. Waring, engineer of the Chicago office, who read a paper on "The Storage Battery in Small Central Stations."

THE ELIOT ADDRESSING MACHINE COMPANY, of Boston, exhibited its machines for printing addresses on bills, papers, etc. The advantages of such a method and of the machines were presented to the delegates in an able manner by R. St. John and A. R. Baker.

Other companies represented at the convention, but not making exhibits were the George Cutter Company, George Cutter, president; the Simplex Electrical Company, W. F. Hruby; the Cutler-Hammer Company, H. H. Cutler, vice-president, and A. Beresford; General Incandescent Arc Light Company, Francis Raymond; American Electrical Works, F. E. Donohoe; Viscosity Oil Company, J. S. Blackford.

Stilwell-Bierce and Smith-Vaile Company's Affairs.

The bankruptcy proceedings instituted against the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, one of the largest builders of water turbines, pumps, etc., in this country, will not interfere with the operation of the plant, whose capacity is now taxed to the utmost. The petitioners are Frank J. McCormick, of the Dayton (Ohio) Supply Company, who has claims for $4,379.53, with interest; John W. Johnson, of Dayton, who files a bill of $1,963.82, with interest, and Alexander Gebhart & Co., also of Dayton, who put in an account for $10,994, with part interest. The petition has been lodged in the District Court of the United States, South Division of Ohio, West Division. Receivers have been appointed in the persons of H. E. Talbott, president of the Stilwell-Bierce & Smith-Vaile Company, and William B. Earnshaw, an attorney of Dayton. The company is incorporated under the laws of the State of New Jersey, with a capital of $1,100,000, practically all of which has been issued. The assets of the company are put at $2,000,000, while the liabilities foot up a total of $1,250,000. The contracts in hand are understood to represent at least $500,000. It is confidently expected that matters will be adjusted satisfactorily within the next month or so. The company is taking orders right along and is figuring on some substantial contracts, especially for export to South America and England, in which countries it has been doing quite an extensive business for some years past.

Distribution of Shawinigan Power.

The Shawinigan Water & Power Co., which recently closed a contract with the Sorel Electric Co. for the delivery of power at Sorel, Quebec, has completed the transmission line to deliver the current from Shawinigan Falls. To meet the requirements, a transformer station was built at Joliette, Que., where the 50,000-volt current from the main line is stepped down to a voltage of 12,500. A line was then built from Joliette to the banks of the St. Lawrence River near Lanorale, following the right of way of the Canadian Pacific Railway. Across the St. Lawrence the current is carried by a submarine copper cable, heavily insulated and armored with lead and steel wire. On the south side of the river the line follows the public road until it reaches Sorel. Necessary steps have been taken to obviate danger from the river current or pressure of ice in the spring. Aluminum cable has been used throughout, this cable being manufactured by the Northern Aluminum Company, at Shawinigan Falls, the whole line being of much lighter construction than that employed in the main transmission line. The construction work was carried out by Messrs. Johnson & Saunders, contractors, of Buffalo, N. Y., the submarine cable having been supplied by the American Steel & Wire Company, of Worcester, Mass. A second line to Montreal, with a capacity of 10,000 hp, will be built, and this Sorel line is only the beginning of a series of short lines which will tap the main lines and carry power to points between Shawinigan Falls and Montreal.

Automobile Manufacturers.

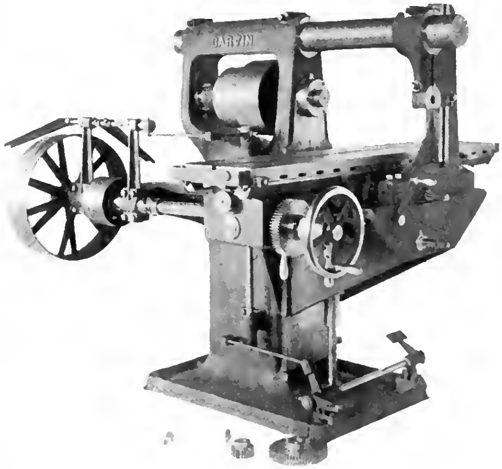
At a well-attended meeting of the executive Committee of the National Association of Automobile Manufacturers, which was held in New York last week, M. J. Budlong was re-elected president, while nearly all the other officers of the association were also retained. All the members of the executive committee were present except R. E. Olds. Windsor T. White was re-elected first vice-president; Charles Clifton, second vice-president, and R. E. Olds, third vice-president. W. R. Innis was elected treasurer in place of Percy Owen, who declined another term of office owing to increased business interests. The next meeting of the executive committee will be held on February 10, during the Chicago show. A special committee was empowered to enter into contracts for the automobile exhibits to be held at the St. Louis Exposition. It was reported that 40,150 square feet had been given to American manufacturers out of a total automobile space of 50,000 square feet. Mr. Budlong made an admirable report, with bright outlook, on the state of the industry.

Milling Machine for Brass Trolley Wire Hangers.

The accompanying illustration shows a milling machine made by the Garvin Machine Company for the rapid milling of brass trolley-wire hangers. It is fitted with power quick-return and automatic stop-motion. The machine is driven by a 5-in. belt, and the feed driven from the countershaft by a 24-in. pulley. The feed is direct through bevel and spur gears to a large steel screw or worm running in oil and meshing into a spiral rack or section of nut cut out of the solid on the under side of the table.

The hand-feed of the table is by hand wheel shown on front of saddle. This wheel is clutched so that it is not affected by the rapid rotation of the quick-return. Changes of feed are provided by change gears seen on front of saddle.

The feed stops at the end of the cut by automatic shifting of feed belt, and the work is taken out and quick-return thrown in by



MILLING MACHINE.

treadle action. The machine is controlled from either side. Special provision is made to check all over-run.

A long saddle is provided and supported by a very wide flat-top knee. The saddle is adjusted in and out by stop-nuts and bolted down on the knee by four bolts with swing handles, as shown. The vertical adjusting screw does not pass through the floor. The reverse is operated both by automatic trips and by hand or foot from either side of the machine. The cutter used is about 5 in. in diameter. In operation, the trolley hangers are held in a special fixture, and the chips flying up from the cutter are caught by an exhaust pipe and thrown into a barrel. Two flour barrels of chips per day gives a fair idea of the chip-removing capacity of the machine. A still further benefit of the exhaust, in addition to the removal of chips, is that it circulates air to the cutters and keeps them cool.

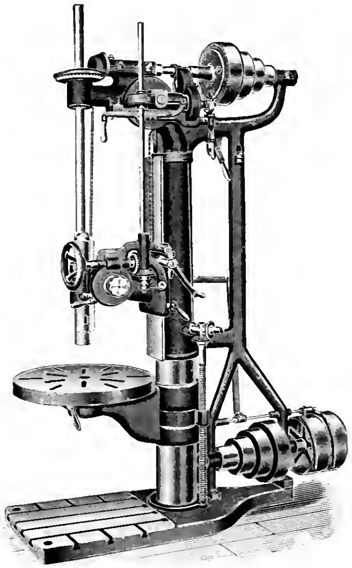
The length of the automatic feed is 30 in., and the in-and-out adjustment is 2 in The feed is 48 in. per minute, the speed of the spindle being 550 r.p.m. The weight is 4,900 pounds and the floor space 5 ft. 6 in. x 9 ft. 6 in. The table is 62 x 13 in.

Positive Self-Feed Upright Drill.

A positive self-feed drill embodying many notable improvements, has been brought out by W. F. & John Barnes Co., Rockford, Ill. The illustration herewith shows plainly the construction. On the larger tools there are eight changes of feed, and on the smaller sizes four changes of feed. All these different feeds vary from one adapted for reamer work, or one for drilling in steel, to one of suitable coarseness for boring in cast iron.

A feed index plate is provided on each machine so that the operator may tell at a glance the feed being used. It is claimed that this positive feed will increase from 15 to 25 per cent. the output of a drill press; firstly, because the action is absolutely positive and does away with any slipping belts; secondly, the feed can be changed by a simple movement of the lever while the drill is running.

There is another point that the drill covers, in that it offers a variety of feeds adapted to the high-speed cutting steels that are

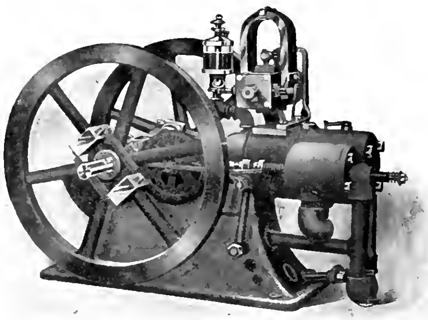


UPRIGHT LATHE.

on the market to-day. With the positive feed the operator is in position to use either slow-speed steel or high-speed steel. The question of high-speed steel is something to be considered, and machines must be adapted for their use.

Small Gas Engines.

The gas engine illustrated below is made up from castings furnished by the Carlisle & Finch Co., Cincinnati, Ohio. This engine will develop ½ hp at a speed of 375 r.p.m. The castings are furnished in the rough; the cylinder, however, is bored out and faced off, but no other work is done on any of the castings. A complete



SMALL GAS ENGINE.

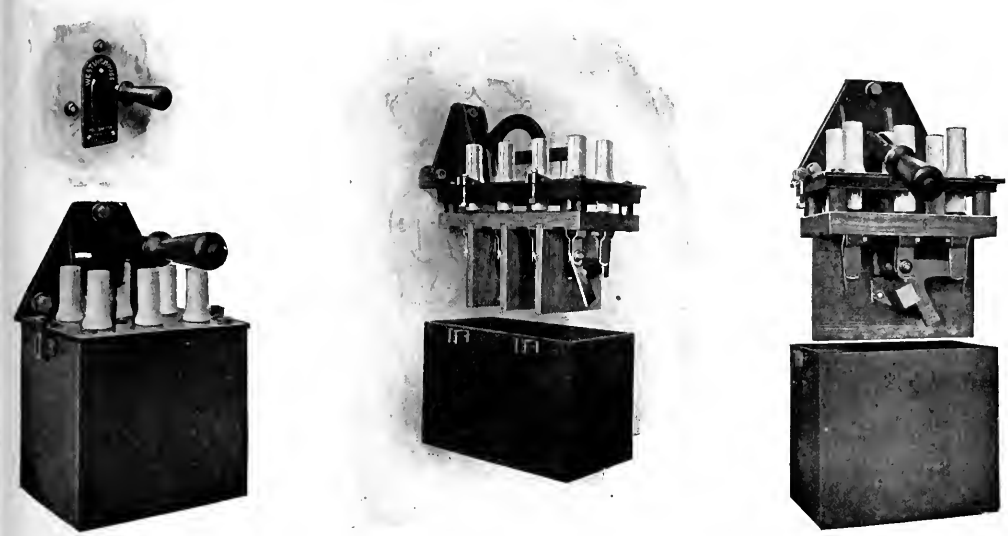
book of instructions telling how to perform every operation is furnished with the castings, and the manufacturer also furnishes all bolts, nuts, springs, screws, forgings, etc., so that nothing has to be purchased elsewhere in making up the finished engine.

The Carlisle & Finch Co. also makes a specialty of furnishing castings and dynamos, motors, electric miniature railways and a complete line of goods for amateur electricians.

New Westinghouse Oil Switch.

The value of oil as an insulating and arc suppressing medium in high-tension current-interrupting devices used where space is a factor is universally known, and the equipment of the modern central station usually contains evidence of the general approval of apparatus of this kind. Its reliability, small amount of attention required to keep it in order, compactness and consequent ease of installation give such apparatus an especial adaptability for use in many locations.

A new addition to the line of oil-immersed circuit-breaking apparatus manufactured by the Westinghouse Electric & Manufacturing Company, and designated as "Type D," is shown in the accompanying illustration. In a number of particulars it has no counterpart in other oil switches now on the market. It is made with two, three and four poles, single and double-throw, in all capacities up to and including 1,000 amp. and voltages up to 3,300. The ultimate breaking capacity is given at 600 kw for single-phase, 1,200 kw for two-phase, and 1,000 kw for three-phase.



Figs. 1, 2, 3 and 4.—Oil Switch.

Styles are made for wall mounting and for switchboard use, as illustrated. When used upon a switchboard, the switch is mounted upon the back of the panel, the handle projecting through to the front. The visible portions are finished in copper and dull black, in pleasing harmony, and forming an effective contrast with the marble panel. As regularly made, the switch is designed for use upon marble two inches thick, but by substituting shorter bolts it can be as easily mounted upon panels of lesser thickness. The handle of the double-throw switch is locked when the switch is open. Pressing upon a button in the end of the handle releases it and the circuit is closed by a pressure either up or down, the directions in which it is the easiest to apply force, and which cause the least strain upon the panel.

This type of oil switch is very generally used with motors, mounted upon an adjacent wall or post. It is one of the smallest oil switches made, and its size, compact form, ease of making connections, thorough insulation of connections when made, and facility with which the interior can be inspected give it a superior adaptability for use under the various conditions applying to such installations.

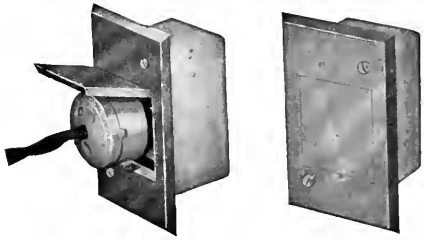
The mechanism is notable for its simplicity and efficiency. The design provides for the fewest possible number of links in the operating device. The switch is of the knife blade or jaw type, and gives a maximum amount of contact with a low temperature rise, which will not exceed 20° with a normal current. The final arc is taken upon an arcing tip, which is renewable. By this provision, no damage is done to the main contacts, and the life of the switch is prolonged indefinitely.

Surface and leakage distances have been carefully studied out and ample provision made. Contacts are thoroughly insulated. They are mounted on a wooden base suspended from the iron supporting frame, and at all times immersed in the oil. Each pole is isolated by a barrier of wood, which has been subjected to a treatment to give it high insulating qualities, and any possibility of communication of an arc between poles is thus avoided. The leads are brought out at the top, connections to the circuit being made inside the switch, and a porcelain insulator slipped over the joint. By this means all conductors are kept outside the oil tank.

The tank is of sheet metal, having a suitable insulating lining and is attached to the case by bolts. The lugs through which the bolts pass are slotted, and when the nuts are loosened the bolts can be lifted out sidewise, thus facilitating removal of the tank. The form of the tank, and the interposition of the wooden barriers between the poles, appreciably reduce the amount of oil required, and the danger of ignition during a fire. "Kilarc" oil is used, which is especially compounded for insulating purposes, and has a fire test of over 400° F. Its freedom from acidity and volatile matter give it high insulating properties, and make the evaporation low, while its viscosity renders it effective for extinguishing the arc.

Flush Wall Receptacle.

A flush pocket wall receptacle manufactured by the General Electric Company, of Schenectady, N. Y., and one offering many advantages, is shown in the accompanying illustration. It presents an attractive



FLUSH POCKET RECEPTACLES, OPEN AND CLOSED.

appearance, whether in use or not, and does not require a special attaching plug which could not be used in other sockets or receptacles in the same installation. It is a very handy device in connection with fan motors, desk lights, etc. The face-plate is of heavy brass having a polished nickel finish, other finishes being furnished when called for.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The market was strong and prices showed an advancing tendency. Standard stocks, like Pennsylvania, Union Pacific and issues of that character, together with the better class of industrials, were strong and active. The United States Steel stocks advanced under the influence of better reports regarding steel trade conditions, the preferred being particularly well bought, rising to 59; while the new 5 per cent. bonds went up to 75½. While sharing in the improvement, nothing of particular importance developed in the traction group apart from the decided strength of Interborough Rapid Transit, or Subway stock, in the curb market. Amalgamated Copper was quieter than usual, improving, however, on the announcement made on Thursday that the regular quarterly dividend of ½ per cent. had been declared. There was considerable selling activity in Brooklyn Rapid Transit, the total number of shares changing hands being 110,260. This stock closed at 50¼, thus gaining 1¾ points net. Metropolitan Street Railway made a net gain of 2 points, closing at 123; and Manhattan Elevated 2¾ points, the closing price being 145. The electrics showed strength under the influence of the improvement in the general market and General Electric made a net gain of 8¾ points, closing at 177¾. Westinghouse common was active, 7,900 shares being sold at prices ranging from 173⅞ to 167, the lowest, the closing figure being 172, which is a net gain of 4½ points. Westinghouse first preferred closed at the highest figure of the week—194—and gained 2⅞ points. Western Union remained about steady, closing at 88, and American Telegraph & Telephone closed at the highest figure of the week—128⅛—being a net gain of 2⅛ points. Following are the closing quotations of January 26:

NEW YORK.

	Jan. 19	Jan. 26		Jan. 19	Jan. 26
American Tel. & Cable	85	85	General Electric	174¼	175
American Tel. & Tel.	126	128⅛	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	122⅝	122¼
Brooklyn Rapid Transit	50⅛	49⅞	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	183	N. Y. & N. J. Tel.	.	147⅛
Electric Boat	18	18	Marconi Tel.	..	..
Electric Boat pfd.	45	46	Western Union Tel.	87⅞	88¾
Electric Lead Reduction	1	⅝	Westinghouse com.	170⅛	171
Electric Vehicle	8¾	10¾	Westinghouse pfd.	190	190
Electric Vehicle pfd.	14	14½			

BOSTON.

	Jan. 19	Jan. 26		Jan. 19	Jan. 26
American Tel. & Tel	125¾	128¾	Western Tel. & Tel. pfd.	79½	82
Cumberland Telephone	*114½	112¼	Mexican Telephone	1¼	1¾
Edison Elec. Illum.	230	235	New England Telephone	*122	121½
General Electric	174	176	Mass. Elec. Ry.	22	22¼
Western Tel. & Tel	8	10⅛	Mass. Elec. Ry. pfd.	79	79

PHILADELPHIA.

	Jan. 19	Jan. 26		Jan. 19	Jan. 26
American Railways	43	45	Phila. Traction	..	97⅝
Elec. Storage Battery	56	59	Phila. Electric	6⅜	6⅛
Elec. Storage Battery pfd.	56	59	Phila. Rapid Trans.	8⅞	14⅝
Elec. Co. of America	8½	8⅛			

CHICAGO.

	Jan. 19	Jan. 26		Jan. 19	Jan. 26
Central Union Tel.	..	..	National Carbon pfd.	93¼	95
Chicago Edison	..	..	Metropolitan Elev. com.	16	17½
Chicago City Ry.	160	160	Union Traction	6¼	5¼
Chicago Tel. Co	..	.	Union Traction pfd.	30	30
National Carbon	26	28			

*Asked

KEYSTONE TELEPHONE.—President John M. Mack, of the Keystone Telephone Company of New Jersey, makes the following annual report for the fiscal year ended December 31, 1903:

Assets:	
50,000 shares, being all of the common stock of Keystone Tel. Co. of Phila.	$4,433,712
2,500 first mortgage of the Keystone Tel. Co. of Phila.	2,500,000
Current assets	439,982
Taxes (prepaid)	2,408
Total	$7,376,102
Liabilities:	
100,000 shs. pfd. stk. (6% cumulative) @ $50 each (less unsubscribed)	$1,936,800
100,000 shs. com. @ $50 each, fully paid	5,000,000
Current liabilities	312,636
Accrued liabilities (interest)	8,150
Int. rec. in excess of int. pay. from Jan. 16, 1903, to Dec. 31, 1903	118,516
Total	$7,376,102

NEW YORK CONSOLIDATED GAS.—The surplus earnings of Consolidated Gas Company for the fiscal year ending December 31, 1903, after the payment of dividends, amounted to more than $2,500,000, as compared with $2,100,000 in 1902 and $1,500,000 in 1901. In the absence of President Gawtry, who was prevented from attending the annual meeting by illness, Vice-President Addicks made a statement regarding the operations during the past year. He pointed out that the company had difficulty in obtaining fuel early in the year, the scarcity caused by the anthracite strike in 1902 extending over to the early part of 1903. The output of gas and electricity, the surplus earnings, together with other operating statistics, compare with the preceding year as follows:

	1903.	1902.
Surplus earnings	$2,500,000	$2,100,000
Sales of gas (cubic feet)	20,227,832,000	18,358,478,000
Average candle power	23.97	24.27
Miles of mains	1,762	1,753
Services	188,973	198,637
Meters	580,287	556,063
Stoves, ranges sold and rented	36,208	42,632
Electric current sold, kilowatts	107,256,189	88,500,040
Electric customers gained	6,325	4,700
Expenditures in construction	$7,035,796	$5,022,987
Charged off for repairs	1,799,015	1,335,428
Charged off for depreciation	1,023,934	744,400
Charged off for taxes	1,727,372	1,755,685
Employes benefit societies	21,753	18,916
Coal and coke used, tons	1,029,433	947,053

CROCKER-WHEELER COMPANY.—The annual report of the Crocker-Wheeler Company, Ampere, N. J., for the year ending December 31, 1903, shows a decided gain over the preceding year. The results of the year's operation must be highly gratifying to the officers and stockholders, and it is certainly an encouraging showing for all interested in electrical development. While this company is widely known as one of the leading manufacturers of large generators and power motors, we think it will come as a surprise to those who have not followed closely the course of electrical development, to learn that last year its gross business amounted to more than two millions of dollars; in other words, it turned its capital over twice in twelve months. The gross profit for the year's operations was $519,781, and after paying fixed charges, dividends, reserves, etc., a balance was carried to surplus of $167,994, making the total surplus to date $408,868. At the time of the report orders amounting to more than a half million dollars were passing through the works, which, though recently enlarged, are now crowded to their capacity. President Wheeler, under whose able management this institution has grown up, is to be congratulated on this evidence of stability and prosperity.

ELECTRIC STORAGE BATTERY.—A director of the Electric Storage Battery Company is quoted as saying: "The Storage Battery Company made net earnings of more than 10 per cent. on its stock during 1903. The surplus will be substantially greater than that of the previous year, which was about $300,000. The company has all the work it can do. There is nothing to prevent our continuing to pay dividends as in the past. The Edison battery has not yet proved itself a factor in the market. The Electric Storage Battery Company has practically all the business in the United States. We are also getting our English company into good shape."

THE FALL RIVER AUTOMATIC TELEPHONE COMPANY has paid its fourth quarterly dividend at the rate of 5 per cent. per annum. It now has 1,160 stations, an increase of about 100 for the quarter. Although its toll rate to the New Bedford Automatic exchange is 10 cents, and the New England Telephone & Telegraph Company has reduced its rate from 15 cents to 5 cents between these points, the earnings of the Automatic Company's toll lines show a steady increase.

ILLINOIS TELEPHONE COMPANY SELLS OUT.—The Illinois Telephone and Telegraph Company, according to advices from Chicago, on January 18 filed a bill of sale of all its property, including tunnels, tracks, automatic switchboard appliances, telephone system, etc., to the Illinois Tunnel Company, which was recently chartered with a capital stock of $3,000,000.

AMERICAN TELEPHONE & TELEGRAPH.—The recent advance in American Telegraph & Cable stock to 86¼ on sales of 1,050 shares drew from President Clowry, of the Western Union, the following remark: "It is a 5 per cent. guaranteed stock, and I have wondered why it has not been quoted higher. The Western Union owns most of the stock."

STOREY RECEIVER DIVIDEND.—George R. Beach, of Jersey City, receiver for the Storey Motor and Electric Company of Harrison, N. J., has announced that he is ready to pay to his creditors a first dividend of 25 per cent. The proved claims against the company amount to $33,500.

NORTHERN OHIO TRACTION shows $882,276 gross for the year, net $399,701 and charges $268,132, leaving a surplus of $131,569.

CENTRAL UNION TELEPHONE.—The Central Union Telephone Company reports for the year ended December 31, 1903, an increase in surplus of $140,000. H. F. Hill has been added to the board. The following comment from Boston as to the outlook in the Central States will be of interest: "The reorganized Bell Telephone properties should do well upon their present basis of capitalization, which is far below the cost of duplication with all the water squeezed out. The Western Telephone Company properties allowing $8 for the common stock, $80 for the preferred and $100 for the bonds, sells at $24,080,000, or not much over $120 per subscriber, against $240 per subscriber for many of the Bell companies that have not been scaled down. The Michigan Telephone property, valued at $13,000,000 in the hands of its bondholders at about $5,500,000, $110 per subscriber, with constantly increasing earnings, will take care of itself in good shape. The Central Union Company capital was cut in two—that is, reduced from $6,000,000 to $3,000,000, increased again to $6,000,000 the Bell and a few stockholders putting in $3,000,000. It has already spent this new money and is a small borrower, and it has out $6,000,000 bonds. The company has not done as well as was expected on account of being in the hot-bed of competition, the Middle West." The Central Union Telephone Company reports as follows for the year ended December 31:

	1903.	1902.	1901.	1900.
Gross	$3,181,120	$3,003,717	$2,584,789	$2,309,471
Expenses	2,426,172	2,341,989	1,973,501	1,674,395
Net	$754,948	$661,728	$611,288	$635,076
Charges	438,796	481,383	386,762	317,567
Surplus	$316,152	$180,345	$224,526	$317,509

MARCONI WIRELESS REVENUES.—It is stated that at a recent meeting of the directors of the Marconi Wireless Telegraph Company of America, there was a lively discussion of questions involving the future policy of the company in its dealings with the English company. The traffic of the Marconi system has increased so rapidly, especially in the matter of dispatches originating abroad for delivery in the United States, that the existing conditions with respect to a distribution of the revenues are considered by the American interests to be inequitable. The English company insists that the basis of the original provision was upon a world-wide foundation, being of universal application to all Marconi companies wherever organized, and that though it appears inequitable at this time, owing to the fact that the foreign business has not yet developed equally with the American business, it will, in the end, prove to be as profitable an arrangement to the American company as to any other. The American company contends that the proportion is not as great as the superior progressiveness of the American people entitles it to receive, and it believes that in the end the arguments of the American interests will prevail and that a new arrangement will be perfected whereby a larger proportion of the earnings of the Marconi system will find its way into its coffers. This question has been under discussion for some time between the officers of the respective companies concerned, but was only recently brought to the attention of the directors.

TORONTO TROLLEYS ANNUAL REPORT.—The Toronto Street Railway reports as follows for the year ended December 31, 1903:

	1903.	1902.		Changes.
Gross	$2,172,087	$1,834,908	Inc.	$337,179
Expenses	1,200,823	1,015,361	Inc.	185,462
Net	$971,264	$819,547	Inc.	$151,717
Passengers carried	53,055,322	44,437,678	Inc.	8,613,644
Transfers	18,654,344	15,979,220	Inc.	2,680,124

After paying all charges and transferring $50,000 to the contingent account there remained a surplus of $180,638. Mr. J. C. Grace was added to the board of directors to take the place of Mr. James Ross, of Montreal, who resigned.

LIGHTING DEAL IN BALTIMORE.—A special telegram of January 18 from Baltimore, Md., says: "New York lighting interests, headed by Anthony N. Brady, were to-day given representation in the directory of the United Electric Light & Power Company. This is the company back of the scheme for utilizing the rapids of the Susquehanna River in the vicinity of Conewago for electric development. The four new members of the board, representing the New York interests, are Anthony N. Brady, his son, Nicholas F. Brady, Samuel A. Beardsley and Thomas E. Murray, all of New York. Mr. Murray is the general manager of the New York Lighting Companies controlled by the Brady syndicate. A. N. Brady is also made a member of the executive committee."

DIVIDENDS.—The American District Telegraph Company, of New Jersey, will pay a quarterly dividend of 1 per cent. on its capital stock January 22. This is a reduction of ¼ of 1 per cent. from the previous payment. The Western Telegraph & Telephone Company has declared a regular semi-annual dividend of $2 per share on the preferred stock, payable February 1, to stockholders of record January 22. National Carbon directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 15. American Graphophone directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 15.

Commercial Intelligence.

THE WEEK IN TRADE.—The conditions everywhere are extremely favorable, and optimism prevails in regard to the outlook for spring business. There is an enlarging volume of business at Southern and Southwestern markets and an awakening of interest at some Northwestern centres and growth at Central Western and Eastern markets. At the South there is confidence, based on the high price for cotton. Preparations for an enormous acreage are going forward. Chicago reports spring trade not yet opened, but signs of life are apparent. The iron trade is irregular as a whole, and variously regarded, according as the point of view shifts from crude to finished products, or the observer is located East or West. The lighter finished products of iron and steel are, however, in pretty good shape, and demand is higher. There is a better feeling in hardware, and in heavy structural steel and rails more talk of business is heard, although it is said that the railroads are rather backward in placing orders. Lumber and building materials are quiet and there is a promising outlook for spring business. In the metals, copper and tin are lower, while lead is higher. Copper was very quiet, and the demand was light. Exports continue on a large scale, at the present time amounting to 15,500 tons for the month, and it is estimated that the total of the entire month will foot up about 20,000 tons. Closing quotations were 12¾c. for Lake, 12⅝c. for electrolytic and 12¼c. for casting stock. It is said that a large German house made an offer to the United Metals Selling Company for 50,000,000 lbs., which was readily accepted, and shipments on this order are being made with equal promptness. *Bradstreet's* reports 266 business failures during the week ended January 21, as against 315 the week previous and 253 the corresponding week last year. About 87 per cent. of the failures had capital of $5,000 or less, and 9 per cent. at from $9,000 to $20,000 capital.

ELECTRICAL PARTS IMPORTED.—United States General Appraiser Israel F. Fischer has handed down a decision on the classification of so-called stamped steel shapes, which are used in the construction of electrical machines. Some of them are plain and others coated on one side with a preparation of flour paste and talcum, which serves to insulate them. Both were assessed at 45 per cent. as manufactures of metal, and the importers, Thomas Meadows & Co., of New York, claimed that they should be classified as "steel not specially provided for" at 1 3/10 cent a pound. This claim was allowed on the uncoated plates, but on the others Mr. Fischer ruled that the coating had so changed their character as to make the claim untenable.

FIVE THOUSAND H.P. EQUIPMENT FOR SYDNEY.—Contracts have at last been awarded for some of the further equipment to be installed in the power station of the Sydney City and Suburban Tramways. This system is being considerably extended by the New South Wales Government. About 70 miles are already in operation. The existing equipment of the power house includes General Electric generators, Allis engines and Babcock & Wilcox boilers. The boilers for the additional installation of 5,000 hp. will also be of Babcock & Wilcox build. The heaters have been ordered from the Joubert Manufacturing Company. The electrical machinery is expected to be contracted for very shortly.

FIRE IN E. W. BLISS COMPANY'S FACTORY.—On Friday afternoon, January 22, fire at the main works of the E. W. Bliss Company, in Brooklyn, destroyed property valued at $250,000. The fire was confined to the new section of the plant, which was six stories in height. The officers of the Bliss Company state that the loss is fully covered by insurance. There were 1,500 employees in the factory at the time, but they all escaped unhurt. A sad feature of the fire was the killing of Lieut. Gibson, of one of the fire companies, who fell from a ladder, 60 feet, and was impaled on a hook on the fire truck. The hook penetrated Gibson's heart, causing death in a few minutes.

MEXICAN HYDRAULIC PROJECT.—The construction of a hydraulic plant is contemplated on the River Grande de Santiago, in the municipality of Hostotipaquillo, Canton of Ahualulco, State of Jalisco, Mexico. The necessary concession has been secured from the Mexican Government by F. Brennan, of Mexico City. The franchise permits of the utilization of 15,000 liters of water per second.

SHIPMENTS OF FRANCKE ENGINES.—The Maxfield-Francke Company, of 120 Liberty Street, New York, reports the following shipments of the Francke Four-Ported engine: Under-Feed Stoker Company of America, Chicago, Ill., first order 7 x 6 engine, direct-connected to steel plate forced-draft blower. Struthers-Wells Company, Warren, Pa., 7 x 6 engine, for operating mechanical stoker. James Beggs & Co., New York, 4 x 3½ engine for operating mechanical stoker. Mershon Patent Shaking Grate Works, Philadelphia, Pa., 5 x 4 engine for operating disc ventilating fan. M. A. Hicks, Springfield, Vt., 4 x 3½ engine for driving dynamo. Under-Feed Stoker Company of America, Chicago, Ill., second order 5 x 4 engine, direct-connected to steel plate forced-draft blower. Iowa Heat, Light & Power Company, Des Moines, Iowa, 7 x 6 engine direct-connected to centrifugal pump. Linn Woolen Mills, Hartland, Me., 5 x 4 engine, direct-connected to steel plate blower. Lever Bros.' Soap Works, Cambridge, Mass., 7 x 6 engine for operating mechanical stoker. Robert Dobson Co., Pittsfield, Me., 7 x 6 engine, direct-connected to steel plate blower. McClave-Brooks Co., Scranton, Pa., 4 x 3½ engine for operating mechanical stoker. George Bowen, South Charleston, N. H., 4 x 3½ engine for driving dynamo. McMurtrie-Guiler Co., New York, 5 x 4 engine, direct-connected to centrifugal pump for export to Porto Rico. Iowa Heat, Light & Power Company, Des Moines, Iowa, second order 5 x 4 engine, direct-connected to centrifugal pump. Northern Engineering Company, New York, 4 x 3½ engine for driving dynamo. J. Heidingsfeld, New Brunswick, N. J., 5 x 4 engine for running printing plant. In addition to the above list, they have several different makes of generators at the works, for which engines are almost ready for direct-connecting, and which will be shipped to various points in the United States at an early date. Some of these engines are operating as low as 100 r.p.m., while others operate at all intermediate speeds up to as high as 800 r.p.m.

BARB WIRE TELEPHONE DEAL.—It is stated that a merger of two telephone lines owned and operated by farmers in Washington State has been made, and that there are prospects that all rural lines centering in or around Pullman in Eastern Washington will be consolidated. There are fully three hundred miles of rural telephone lines constructed and operated on the coöperative plan by farmers in the vicinity of Pullman. The central station is maintained there, with Lewis L. Wright as manager. Wright owns the central station and several rural lines, and all lines are connected with his station, where an operator connects each line with any other line over which it is desired to converse. For this service, "central" charges 35 cents per telephone per month. The merger price will be 40 cents. Fully two hundred families living on farms have telephone connections in this way, and the system has proven a great luxury to the wives of the farmers, as well as a convenience to the farmers themselves. These telephone systems are the outgrowth of the barbed-wire telephone system built by J. S. and J. M. Klemgard and J. L. Metsker, four years ago.

THE HOLTON POWER COMPANY, Holton, Cal., is developing water power on the large Imperial irrigating canal, and will sell electricity for light, heat and power. An electric railway to Imperial, 12 miles distant, is also being built. About 650 hp. will be developed at first, and the station will have an ultimate capacity of 1,500 to 2,000 hp. When it is considered that this canal and the power development are about 200 ft. below sea level, considerable interest attaches to the project. Another interesting feature is that quite a market is anticipated for electric heat for cooking and household purposes. Coal sells as high as $18 a ton at Holton. Wood is correspondingly high, and it is said that electricity can be sold for heating and cooking at a cost not to exceed 1¼ times the cost of gasoline, with, of course, greater convenience and cleanliness. Samuel Starrow, of Los Angeles, is consulting as well as constructing engineer for the Holton Power Company.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended December 20 and since December 20 compares with the month ended December 20 and the period from December 20 in previous years as follows:

	1903.	1902.	1901.
Gross output	88,947	92,732	63,196
Returned	39,678	34,688	23,593
Net output	49,269	58,044	39,603
Since Dec. 20:			
Gross output	1,109,888	960,055	683,955
Returned	480,691	386,861	311,645
Net output	629,197	573,194	372,311
Total outstanding	3,779,517	2,526,010	1,952,816

MORE EQUIPMENT FOR MANILA.—The Manila Electric Railroad & Light Company has just placed some further contracts through J. G. White & Co., 40 Exchange Place, New York, for equipment to be installed in the power house, to be erected in Manila, Philippine Islands, for electric traction and lighting. The Alberger Condenser Company, 95 Liberty Street, New York, has taken the contract for the condensers, which will consist of a high vacuum surface condensing equipment to take care of each of the three 700-kw Westinghouse turbine units. The condensers will operate on the counter current dry system. The United States Steel Products Export Company, which concern was recently formed to handle the foreign trade of the United States Steel Corporation, has been awarded the contract for the steel.

THE BROWNLOW BILL.—There is a strong sentiment apparently throughout the country in favor of the new Brownlow Bill now pending in Congress, which appropriates $24,000,000 as national aid for the building of wagon roads. This money is to be distributed according to the population of each of the States, except that the States having less than 700,000 people are to receive a minimum amount of $250,000. Each State, county or town receiving national aid must add a like amount. This bill will result in the spending of $48,000,000 for the building of wagon roads and will build from 100 to 500 miles of good road in every State of the Union. Such roads would be a universal boon.

ALUMINUM CIRCUITS.—It is stated that within a year the Boston Edison Electric Illuminating Co. has purchased 298,245 pounds of aluminum wire, which represent a total of 246 miles. The Massachusetts Electric Company has purchased about 500,000 pounds as a substitute for copper. The Boston & Maine Railroad, the Tucker, Anthony & Company properties, Hartford Electric Light and the New Milford (Conn.) Power Company have all placed large orders for aluminum wire. The Lewiston & Auburn Electric Light Company also has equipped its lines with aluminum.

IMPORTED ELECTRICAL SCARF PINS.—United States General Appraiser Thaddeus S. Sharretts has overruled a protest by the American Electrical Novelty Company of New York against the assessment of 60 per cent. duty on jewelry on parts of electrical scarf pins. The articles consisted of eight imitation diamonds set in base metal. The importers claimed that they were dutiable at 45 per cent. as manufactures of metal, glass, or paste. Gen. Sharretts overruled these claims on the ground that they were components of articles generally known as jewelry.

NORTHERN CALIFORNIA POWER.—In 1901 the Northern California Power Company contracted for three Pelton water wheel units, each 1,600-hp capacity, operating under a head of 1,150 ft., for its electric transmission plant on Battle Creek, a few miles from Anderson, Cal. In 1902 the Pelton Company received an additional order for two 3,000-hp units, operating under the same head. The Northern California Power Company furnishes electricity for power and lights for all the important mining and farming towns within a distance of 80 miles of its plant.

WILLARD STORAGE BATTERIES.—The Willard Storage Battery Company, Cleveland, Ohio, the well-known manufacturer of storage batteries, has moved into larger quarters at Twenty-seventh and Clair Streets. It will install 200 hp of boilers and engines and two 75-kw generators for lighting and power. It will buy considerable new machine tool equipment and will install a complete wood-working equipment for manufacturing its own battery cases. Mr. T. A. Willard is general manager of the concern.

CALIFORNIA POWER TRANSMISSION.—A very important installation of Pelton water wheels was recently completed near Placerville, Cal., for the American River Electric Company, consisting of two double Pelton units of a capacity of 2,500 hp, operating under a head of 575 ft. This concern is situated on the American River, within a few miles of the state capital, Sacramento, and will generate electricity for near-by towns.

POWER TRANSMISSION IN CALIFORNIA.—Poles and wire have been bought for the Temescal Water Company's 30-mile transmission line in California from its electric power plant at Ethanac to the wells in the Temescal basin. At a regular meeting of the company's board of directors, President F. F. Chase was authorized to select a superintendent to succeed A. C. Miller, resigned.

EQUIPMENT FOR RUSSIA.—M. Gradstone & Company, 2 and 4 Stone Street, New York, who conduct an extensive export trade with Russia exclusively, have received some large inquiries for various electric traction and lighting equipment.

OMAHA POWER HOUSE.—General Manager Smith, of the Omaha-Council Bluffs Street Railway Company, has announced that the new power house capable of generating 6,000 hp., will be completed at a cost of $500,000.

BAKER PLATINUM.—Since January 1, the well-known platinum house of Baker & Company has become Baker & Company, Incorporated, with C. O. Baker as president, and C. W. Baker as vice-president and treasurer.

BALL ENGINE ORDERS.—The South Dakota Agricultural College, of Brookings, S. D., has recently purchased an automatic engine from the Ball Engine Company, Erie, Pa.

General News.

THE TELEPHONE.

DENVER, COL.—The Washington County Telephone Company, with a capital stock of $5000, has been incorporated by H. W. Twombly, C. D. Pickett and M. H. Spere, Akron, Col.

CENTER POINT, IND.—The Center Point Telephone Company has been incorporated with a capital stock of $5000. The directors are H. F. Weber, L. Lansit and others.

INDIANAPOLIS, IND.—The New Long-Distance Telephone Company has paid its regular quarterly dividend of 1 per cent. The company is planning numerous extensions to be made during the summer.

DUNKIRK, IND.—Ed. V. Fitzpatrick, a resident of Portland, has secured a controlling interest in the Citizens Telephone Company, of this city, and has succeeded in electing a board of directors of his choice. The action has displeased the stockholders.

INDIANAPOLIS, IND.—The West Fork & Sulphur Home Telephone Company has filed articles of incorporation with the Secretary of State. The company has a capital of $4000. The principal exchange will be in West Fork. George F. Dewett is president.

SILVER LAKE, IND.—The stockholders of the People's Mutual Telephone Company have elected H. L. Oldfather, Arthur Smith and Amar N. Igo, directors. The company now has 525 telephones and 90 miles of toll lines. Last year 184 telephones were installed.

CRAIGSVILLE, IND.—The people of Craigsville are clamoring for a better telephone service from that which is now furnished them by the Bell Company, which they say is not sufficient to satisfy their needs. The Bell is not an all night service. A movement is on foot to get the United Telephone Company to run a line to Craigsville.

MUNCIE, IND.—The Central Union Telephone Company has decided to expend $50,000 in improving and extending its service in Muncie and Delaware Counties. This is made necessary, it is said, by the competition of the Delaware & Madison Counties' Telephone Company which recently expended a large sum in completing a new plant here and which is giving excellent service over a wide territory.

INDIANAPOLIS, IND.—The ten-party lines of the Central Union Telephone Company in this city, are to be replaced as rapidly as possible by a four-party line system. The ten-party line subscribers paid $1 a month. The four-party line service will cost $1.25. More than $30,000 will be spent by the company during January in new switchboards and dynamos for the central plant. A new switchboard will also be placed in the exchange at Irvington.

GENESEE, IDA.—At a meeting of citizens held here recently, it was decided to organize and operate a local and rural telephone system.

ESTHERVILLE, IA.—The citizens of this place have asked the council for a telephone franchise.

HUDSON, IA.—The Hudson Mutual Telephone Company is the name of a new company just organized here with H. B. Eighmey as president.

HAMILTON, MONT.—The Bitter Root Telephone Company will extend its system as far as Darby. The line will also connect with the logging camps of the Anaconda Copper Mining Company.

ST. JOSEPH, MO.—The Board of Public Works proposes to have all telephone and telegraph wires within the business district of this city placed in underground conduits. The cost of the work will be about $500,000. The matter is in the hands of City Electrician Floyd and an ordinance will soon be drawn up.

SEDALIA, MO.—The strike of the Missouri & Kansas Telephone Company linemen has been settled. A nine-hour day instead of ten hours, and an increase in pay from $2.25 to $2.40 a day were granted. The men asked for $2.50 per day; one and one-half pay for overtime and double pay for Sundays and legal holidays.

RENO, NEV.—A representative of the Automatic Telephone Company has been here looking into the feasibility of establishing a system here and at adjacent points.

LANCASTER, N. Y.—The Bell Telephone Company has applied to the village authorities for a franchise.

RIVERHEAD, L. I., N. Y.—Th Baiting Hollow & Roanoke Telephone Company of this town has increased its capital stock from $5000 to $20,000.

ROME, N. Y.—At the annual meeting of the Rome Home Telephone Company Mr. Fred M. Shelley was re-elected president; John S. Wardwell, vice-president, and D. Odell, secretary, treasurer and manager. The business of the company has increased rapidly and now over 1000 telephones are in service. When the business was first started provision was made for an exchange for 500 telephones.

SALISBURY, N. C.—The Southern Bell Telephone Company has bought the local exchanges at Salisbury and at Spencer, N. C., and it is said that improvements will be made. The transfer of the franchises seems to meet with public favor.

RANDLEMAN, N. C.—The Randleman Telephone Company has been chartered by the Secretary of State with $5000 authorized capital stock and $3000 paid in. S. Bryant, T. E. Marshall, Jr., and H. O. Barber, all of Randleman, are the incorporators.

PAINESVILLE, OHIO.—The Bell Telephone Company is planning to spend $15,000 in improving its plant here.

FINDLAY, OHIO.—The Central Union Telephone Company is preparing to make important improvements at its Findlay exchange.

GARRETTSVILLE, OHIO.—The Portage County Telephone Company has erected a new line from Garrettsville to Parkman and is projecting other extensions.

TOLEDO, OHIO.—The Central Union Telephone Company states that it has added 1200 new subscribers to its service since the issue of its last telephone list.

WEST UNION, OHIO.—The Central Union Telephone Company has just completed a line from North Liberty to West Union and will build a new line to Eckmansville.

BRUNSWICK, OHIO.—The Brunswick Independent Telephone Company has been incorporated with a capital stock of $5000. The directors are M. J. Hawkins, A. D. Alyard and others.

BUCYRUS, OHIO.—The Bucyrus Telephone Company has recently erected a number of farmers' lines and the service is proving so popular that other farmers' lines are to be built throughout the entire district.

IRONTON, OHIO.—The Ohio Valley Telephone Company, capital stock $2000, has been organized by H. P. Gerlach and others of Ironton. The company will build an exchange at Proctorville, Ohio.

BEALLSVILLE, OHIO.—The White Telephone Company is preparing to extend its lines to Woodsfield and Cameron. Connection with the long-distance system of the United States Telephone Company will be made at Bellaire.

AKRON, OHIO.—James B. Douglas, manager of the Alliance exchange of the Central Union Telephone Company has been made manager of the Akron exchange of the company. Extensive improvements are to be made at Akron.

KIRTLAND, OHIO.—The Kirtland Telephone Company has been organized by A. G. Tyron, Henry Hooper, W. R. Creary, W. A. Criswell and I. A. Harris. Capital $2,500. The company will build a local system in Kirtland and vicinity.

AKRON, OHIO.—The Summit Rural Telephone Company has organized with W. F. Laubach, president and general manager; E. A. Hawkins, secretary, and H. C. Spicer, treasurer. The company recently built lines to Ghent, Wordon, Montrose and Hammond.

LORAIN, OHIO.—The mayor has vetoed a franchise application made by the Bell Telephone Company and the latter will appeal to the Probate Court. The Black River Telephone Company, the independent company, is endeavoring to block the entrance of the Bell Company.

MANSFIELD, OHIO.—The Mansfield Telephone Company has elected the following-named officers: S. N. Ford, president; J. L. Baxter, vice-president; M. D. Ward, secretary-treasurer. The company enjoyed much prosperity last year and is planning to make improvements this spring.

WADSWORTH, OHIO.—The Wadsworth General Electric Company contemplates building a six-mile party line. It has 200 subscribers, 40 of which were added last year. The company uses North Electric apparatus and charges $10 a year for residence service and $15 for business.

MARTINS FERRY, OHIO.—The Bell Telephone Company has perfected an arrangement with farmers in this vicinity whereby if they secure a certain number of subscribers and erect their own pole lines the company will supply telephone service at a low price. Connection is made with the Martins Ferry exchange.

BRILLIANT, OHIO.—The Ohio Valley Telephone Company, of Brilliant, has organized with Robert Carpenter, president, and J. G. Gilchrist, secretary. The company will build lines along the river front in Jefferson County and will connect up all the independent companies in that vicinity. A large number of lines will be built at once.

SHEAKLEYVILLE, PA.—The Sheakleyville Telephone Company has been organized with H. Orr as president.

YORK, PA.—The stockholders of the York Telephone Company held their annual meeting recently and elected directors, who elected officers as follows: President, D. F. Lafean; vice-president, John McCoy; secretary, H. H. Weber; treasurer, C. C. Frick. The board of directors recently declared a dividend of 2 per cent on the stock.

CUMBERLAND GAP, TENN.—The Cumberland Gap Telephone Company has been incorporated with a capital stock of $10,000. The directors are G. W. Fortune, J. H. Quillen and others.

EL PASO, TEX.—The Southwestern Telegraph & Telephone Company has purchased a site here for its proposed telephone exchange building and the contract will soon be let for its construction.

SALT LAKE CITY, UTAH.—The Utah Independent Telephone Company has been granted a franchise by the county commissioners to extend its lines through the county.

PULLMAN, WASH.—A consolidation of all the rural telephone lines owned by farmers in the vicinity of this city has been effected. These lines are about 300 miles in extent.

ADAMS, WIS.—The Adams Telephone Company has been incorporated with a capital of $2000. The directors are Christ Reuben Garrison and others.

NEW LONDON, WIS.—The Wisconsin Telephone Company is making arrangements to build an exchange here.

WASHBURN, WIS.—The Bayfield County Telephone Company has been engaged in extending its lines to Bayfield and Houghton, and expects to complete the new line this month. This will give the company toll line facilities to all points on Chequamegon Bay to points along the Wisconsin Central Railroad and to Superior and Duluth.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has just inaugurated service on a new toll line between Abbottsford and Ashland, a distance of 120 miles. During the past year the company has strung 16000 miles of copper wire. Seven telephone exchanges were built and in a number of other exchanges new equipment was installed. The company gained 9500 new subscribers, of which 2500 are in Milwaukee.

Electric Light and Power.

SAN PEDRO, CAL.—The City Trustees have instructed the City Attorney to prepare an ordinance calling for a special bond election for the construction of a municipal lighting plant.

LOS ANGELES, CAL.—J. L. Campbell, of San Bernardino, has submitted a proposition for furnishing this city with electricity. The cost to the city of putting in the plant is placed at $63,000.

CRIPPLE CREEK, COL.—Mayor Schockey advises that arrangements be made at once for the construction of an electric light plant, to cost about $50,000. A committee has been appointed to investigate the matter.

GLASTONBURY, CONN.—L. W. Ripley, of Hartford, is contemplating the erection of a hydro-electric plant at Glastonbury. It is proposed to install four alternating-current generators varying from 50 to 300-kw. These will be driven by probably three wheels, either turbines or of the impulse type, with an auxiliary engine of about 250-hp. It is proposed to build one dam probably of concrete about 115 feet high and 230 feet long, and another dam for storage purposes probably of earth and masonry combined, about 35 feet high and 400 feet long. The power will be used for lighting, for manufacturing purposes and for street railway work. No contracts have been placed as yet.

TAMPA, FLA.—The Tampa Electric Company has decided to proceed at once with the construction of a power house at the mouth of Hillsborough River, to cost about $100,000. Mr. Wells is manager.

CONYERS, GA.—The citizens have voted to issue $10,000 bonds for the construction of an electric light plant.

SAVANNAH, GA.—The Savannah Electric Company has under consideration the extension of its system to Tybee, Ga.

SAVANNAH, GA.—The Director of Public Works, in his annual report, recommends the municipal ownership of an electric lighting plant.

ATLANTA, GA.—The Board of Electrical Control has granted the Georgia Railway & Electric Company permission to lay conduits for the purpose of bringing current from the Bull Sluice plant into the city.

KANKAKEE, ILL.—The Kankakee Electric Light & Power Company will construct a concrete dam here this year to cost about $15,000.

BELLEVILLE, ILL.—The stockholders of the Belleville Gas & Electric Company have elected L. D. Turner, Edward Abend, Henry A. Kircher, George Gauss, M. M. Stephens, R. D. W. Holder and Charles Becker directors for the ensuing year.

ROCK ISLAND, ILL.—There is reported to be a movement on foot here to harness the Mississippi Rapids and use the water power. It is proposed to build a dike 500 feet from the north shore 20 miles up the river and get a 15-foot fall which will develop 20,000 horse-power. Congressman Lorimer is reported to have been here in the interest of the matter.

AURORA, IND.—The city of Aurora wants bids for lighting the city with 75 arcs, as well as incandescent lamps for private consumers. Mr. Eugene Severin is the city clerk.

COLUMBUS, IND.—The General Electric Company is stated to have secured the contract for the electric light plant for $7,033. An engine will now be purchased in open market.

INDIANAPOLIS, IND.—David Wallace, of the Board of Public Works, is interested in a plan to furnish Indianapolis with electric power by building a dam across Eel River in Owen County.

CHICKASHA, IND. TER.—Jas. W. Hockaday, manager of the Chickasha electric light plant, states that from $10,000 to $12,500 will be expended by the company for new machinery.

DAVENPORT, IA.—The Davenport Water Power Company has been formed by F. H. Griggs, Charles Ainley and others to build a canal and develop water power from the Mississippi River.

IOWA CITY, IA.—The Board of Regents of the State University will ask the Legislature for an appropriation of $25,000 to construct a dam below the University grounds to furnish power for the heating and electric plants.

WINFIELD, KAN.—The citizens have voted to issue $134,000 water and lighting bonds.

TOPEKA, KAN.—The City Council is considering the question of making improvements to the electric light plant. E. B. Snyder is chairman of the electric light committee.

LEXINGTON, KY.—W. H. McCorkle is seeking a franchise for an electric light plant.

NEWPORT, KY.—Mayor Helmbold in his message to Council advises a municipal electric light plant.

NEW ORLEANS, LA.—It is reoprted to be the intention of the Consumers' Electric Company to construct an extensive electric plant. Jules Dreyfous is President.

BATON ROUGE, LA.—The Baton Rouge Electric & Gas Company during the next three months will place contracts for a 150-kw, 550-650-volt generator, and a 400-hp steam or gas engine; if the latter, a producer plant also.

BAY CITY, MICH.—The Council has adopted an ordinance providing for the establishment of a municipal light plant.

MARQUETTE, MICH.—The Electric Light and Power Commission has decided to employ a hydraulic engineer with regard to the enlargement of the electric light plant.

AGRICULTURAL COLLEGE, MICH.—Bids are wanted Feb. 3 for constructing a central power house and coal shed at the Agricultural College. Address A. M. Brown, Secretary State Board of Agriculture.

MONTEVIDEO, MINN.—The Montevideo Electric Light & Power Company has secured water rights at Minnesota Falls, and proposes to construct a dam and develop power.

MINNEAPOLIS, MINN.—F. W. Cappelen, City Engineer, has submitted a report to the special council committee on the General Electric Company's franchise. He estimates that the cost of a plant with 1000 arc lights, with a relay capacity of 33 per cent., the lamps to be lighted 3500 hours, or according to the all-night system, at $512,646, provided the plant is located on property already belonging to city; of this the conduit system would require $266,774, the overhead system $105,477, the electrical equipment $37,475; steam equipment, $58,200, and building, $32,000. The cost of operation would be about $87,379 per year.

CANTON, MO.—Bids are wanted Feb. 3 for constructing an electric light plant.

HANNIBAL, MO.—The proposition to issue bonds in the sum of $100,000 to rebuild the municipal electric light plant at this place was carried at the special election held January 11.

GALLUP, N. M.—The Gallup Electric Light Company has been incorporated by Maynard Gunsul and Herbert F. Raynolds, of Albuquerque, and Kenneth K. Scott, of Gallup, with a capital of $50,000.

ITHACA, N. Y.—The matter of placing the electric wires underground is under consideration.

GLENS FALLS, N. Y.—The Village Trustees are considering the application of Frank H. Deal, of Troy, for an exclusive franchise to maintain an underground conduit system.

SCOTTSVILLE, N. Y.—The Wheatland Power Company, of Scottsville, has been incorporated with a capital of $20,000. Directors: I. W. Salverds, of Scottsville; M. E. Lewis and H. C. Brewster, of Rochester.

GRANVILLE, N. Y.—The Granville Electric Light & Gas Co. is reported to have acquired water rights at outlet of Lake Saint Catherine near Granville. It is the purpose to dam the lake and use the fall to generate electricity for lighting and power. F. D. Pember is president.

POMEROY, OHIO.—Bids are wanted Feb. 2 for $18,929 bonds, $4466 to be used for lighting purposes. Abe A. Massar is village clerk.

WILLIAMSBURG, OHIO.—This town will sell at private sale $12,000 electric light and town hall bonds. Chas. Hoffman is village clerk.

WILMINGTON, OHIO.—The Wilmington, Water & Light Company has been organized under the laws of New Jersey to establish a lighting plant in Wilmington.

MONROEVILLE, OHIO.—The financial condition of the municipal lighting plant is in bad shape and in consequence the arc lighting department of the plant has been closed down, leaving the town in darkness.

CINCINNATI, OHIO.—The Hamilton-Otto Company will spend $200,000 in improvements to its electric lighting plant. It is the intention to install sufficient equipment to provide for handling both the lighing and street railway systems in Hamilton if necessary.

COLUMBUS, OHIO.—An ordinance is to be introduced in the council to regulate the price of electricity for lighting furnished by all the companies operating in the city. It is proposed to make the limit 7 cents per kilowatt. At present some of the companies are charging 12½ cents.

XENIA, OHIO.—D. M. Stewart and Charles Darlington, of Xenia, have had estimates prepared on the cost of a lighting plant of sufficient size to illuminate the city and furnish power for general lighting and manufacturing purposes. They are organizing a company for the purpose of erecting a plant.

WILKESBARRE, PA.—The Council has granted the Ashley Electric Company a franchise to furnish light in this city.

BRADDOCK, PA.—The Council has provided for the appointment of a committee to inquire into the cost of an electric light plant.

MAHANOY CITY, PA.—The People's Light, Heat & Power Company, of Mahanoy Township, has been organized with D. M. Graham, president, and A. B. Carney, secretary.

SELINSGROVE, PA.—The Borough Council has decided to accept a proposition from Mr. Callahan, of Sunbury, to light the town with electricity. The plant will be installed here at once.

ELLWOOD CITY, PA.—It is stated that the Manufacturers' Light & Heat Company, of Pittsburg, will, during the year, make extensive improvements on the lines of its Ellwood City division.

PHILADELPHIA, PA.—The Department of Health has approved plans for a light, heat and power plant for the Municipal Hospital, to cost about $125,000. Geo. W. Sunderland is assistant director.

NEW CASTLE, PA.—Wylie McCaslin, chairman of the Police Committee, has been instructed to procure the services of an electrical engineer to give estimates as to the cost of construction and operation of a municipal electric light plant.

ALLENTOWN, PA.—In his annual message to City Councils, Mayor Lewis advocates the installation of municipal electric light plant. The city is now paying to the Allentown Electric Light & Power Company over $20,000 a year for street lighting, and it is claimed that a municipal plant could be installed by the city at a cost much less than that. The Mayor's idea is to operate the lighting plant in conjunction with the pumping station.

SCRANTON, PA.—The Delaware, Lackawanna & Western Railroad Company has just completed a big power plant at the Hampton mine in the Keyser Valley. The plant is equipped with 15 Babcock & Wilcox water-tube boilers of 325 hp each, which evaporate 400,000 gallons of water per day on a consumption of 175 tons of coal. The electrical equipment will include five 500-kw Curtis turbo-generators, two of which are now in operation. Electrical energy will be transmitted at 2300 volts (alternating current) to various mines owned by the company, where it will be transformed into direct current at a lower voltage by means of rotary converters. The power is used for lighting and power purposes at the mines.

AIKEN, S. C.—The Board of Directors of the Carolina Light & Power Company has authorized W. E. Moore, of McConnellsville, Pa., to negotiate for a $20,000 turbine plant for the local electric light system. Mr. Moore is now in New York for the purpose.

WATERTOWN, TENN.—Prominent business men here are reported to be discussing the construction of an electric light plant.

McGREGOR, TEX.—The power house of the McGregor water and electric light plant has been destroyed by fire.

WACO, TEX.—The City Council is considering the employing of an expert to make an estimate of cost of a municipal electric light plant.

DALLAS, TEX.—A resolution has been passed in Council and referred to Committee with instructions to investigate the advisability of constructing a municipal electric light plant.

SALT LAKE CITY, UTAH.—Among the improvements contemplated by the new Utah Light & Railway Company is the construction of a reserve steam plant, which will cost about $250,000.

DAYTON, WASH.—Jas. A. Ralph and Nicholas Codd have purchased the electric light plant here for $40,000.

EVERETT, WASH.—The Everett Development Company has begun work on a water and electric plant on May Creek. There is a head of 2000 feet, and about 10,000 horse-power will be developed.

OLYMPIA, WASH.—The Olympia Light & Power Company has executed a mortgage for $100,000 in favor of the American Loan & Trust Company, of Boston. The money is to be used in the enlargement and improvement of its works and equipment.

SHINNSTON, W. VA.—The Shinnston Light & Water Co., has been incorporated with a capital of $10,000. L. J. Howard is one of the incorporators.

RICHWOOD, W. VA.—The Richwood Light & Power Company, of Richwood, has been formed with $25,000 capital, by Richard M. Dyer, M. E. Dyer, of Cumberland, Md.; P. J. Dyer, of Weston, W. Va., and others, to construct an electric light and ice plant.

SHELL LAKE, WIS.—This city is considering the construction of water works and an electric light plant.

EAU CLAIRE, WIS.—It is reported that the Council will consider the feasibility of a municipal lighting plant.

ELKHART LAKE, WIS.—The electric light plant which has been idle for the last three months has been purchased and put in operation by Dr. Brickhauer.

PORTAGE, WIS.—It is stated that the Chicago, Milwaukee & St. Paul road will put in an electric light plant and pumping station of its own in this city. The road objects to the price it is paying for light and water.

FT. D. A. RUSSELL, WYO.—Bids are wanted Feb. 13 for lighting the Post here by electricity, including wiring of buildings and grounds, furnishing and installing fixtures, arc lights, etc., and necessary electrical current. Address Capt. W. S. Scott, Q. M., U. S. A., Cheyenne.

CATORCE, MEX.—An electric light plant is to be installed at the Dolores Trompeta mine, situated in this district.

CITY OF MEXICO, MEX.—The city council has appropriated $348,000 for providing the city with electric lights during the year 1904.

LA PIEDAD, MEX.—Jesus Avalos will soon commence the construction of a large electric power plant on the Lorma River, near here. He proposes to provide electric lights and power for several towns in this section and to furnish power for the operation of manufacturing concerns.

WOODSTOCK, ONT.—The citizens have voted to issue $25,000 bonds for improvements to the lighting plant.

OTTAWA, ONT.—A deputation representing the large electrical interests of Niagara Falls has interviewed the Ontario Government with a view of obtaining permission to export electrical energy from Canada to the United States. The International Railway Company, which includes the Gorge line and the Niagara Falls Park & River line, has not sufficient power, and its representatives desire that the Canadian power companies shall have the right to export power. It was, however, thought doubtful whether the government, under the Constitution, could allow the exportation of power and the matter has been taken under advisement.

OTTAWA, ONT.—The Ontario government has obtained information from provincial cities, towns and villages regarding municipalities conducting reproductive undertakings, covering a period of 1898 to 1902. The electrical statistics compiled from the returns sent in, show that electric lighting was a losing business in cities, but successful in towns and villages. The following figures, in regard to electric undertakings, are for the average of the years 1898 to 1902: There were 3 cities, 23 towns and 8 villages owning and operating electric light plants in the province. The capital provided for electric lighting by cities amounted to $81,573, by towns $537,355 and by villages $121,565. The average annual income from electric lighting plants in cities was $7,613, with working expenses at $18,418; the average income for towns was $134,803, and working expenses $107,581, and in villages the average income was $11,247 and working expenses $7,893.

OTTAWA, ONT.—According to the report of the officers carrying out the electric light inspection act, there were, last year, 324 plants in the Dominion, with 14,780 arc lights and 1,212,861 incandescent lights. Taking the arc light as equal to 10 incandescent lights, the country had on the 30th of June last, 1,360,661 lights in use. This is an increase of 236,865 lights in the twelve months, or over 21 per cent. The increase since 1898 in arc lights has been 42 per cent and 161 per cent in the number of incandescents. The province of Ontario has 203 of the 324 plants in use. It has considerably more than one-half the total number of arc lights and 47 in each hundred on the incandescents. The province of Quebec has 53 plants, 3,853 arc lights and 409,503 incandescents. The plants in Quebec, however, are much larger than those of Ontario, the average of Quebec's 53 plants being 15,000 arcs and incandescents, and that of Ontario's 203 plants being 3,215 arcs and incandescents. The largest single plant in the Dominion is that of Toronto with its 170,000 lamps, arcs being reckoned at 10 incandescents. The next largest is that of the Lachine Rapids Company, Montreal, with 158,503, and the third in size is that of the Ottawa Electric Company, Ottawa, with 111,927 lights. All the other provinces have made considerable progress, but British Columbia shows the largest proportional increase of any of the divisions of Canada.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—Articles of incorporation have been filed in San Bernardino County for the Holton Interurban Railroad Company, with its principal place of business in Redlands. Its capital stock is $200,000, of which amount $12,500 has been subscribed. The directors are W. F. Holt, C. S. Lombard, C. A. Barker, A. G. Hubbard and M. M. Phiney.

CHICAGO, ILL.—Judge Grosscup has ordered an examination into the financial status between the Chicago Union Traction Company and its underlying companies. Henry W. Bishop, master in chancery, was selected by the court to conduct the examination.

SHELBYVILLE, IND.—Motormen and conductors on the Indianapolis, Shelbyville & Southeastern Traction Company were given an increase in wages from 18 cents to 20 cents an hour beginning with the new year. The working hours were shortened from eleven to nine and one-half.

LEBANON, IND.—Wallace B. Campbell, promoter of the Anderson-Lebanon Traction Railway has been granted a fifty-year franchise to build into this city. Mr. Campbell has secured franchises in all the cities along the proposed line, and will now turn his attention to securing the right of way. He will soon organize the company, and says the money to build the road is ready.

GLOUCESTER, MASS.—The Massachusetts Electric Companies are installing a new high-tension system for supplying current to all the lines included in their properties. There will be three steam turbine alternating-current central stations, which will supersede about 13 engine-driven direct-current stations scattered over the territory served. The lines north of Boston, including those of the Gloucester division, now receive power from 10 separate stations, 5 of which will be replaced by one steam turbine station, aggregating 9000 hp, and located at Danvers. The southern division is now operated from 11 direct-current stations, which will be superseded by 2 steam turbine stations, one of 1200 hp at Fall River, and one of 15,000 hp at Quincy Point.

WOODSTOCK, N. B.—An electric railway between Fredericton and Woodstock, New Brunswick, is projected. American capitalists will be interested in the enterprise. The new line will be used for carrying freight and passengers.

PRINCETON, N. J.—Surveys have been completed for the proposed electric railway between Princeton and Somerville, or Bound Brook, and the business arrangements are being taken up. It is understood that allied interests have a traction charter under which the road can be built, but T. G. Kitchin, of Trenton, N. J., who has represented the promoters in several business transactions, says that a steam railroad charter will be used. The road will be about 17.8 miles long, and will connect at its northerly terminus with a line to be built between Somerville and Morristown, if the present plans are carried out.

MINEOLA, N. Y.—The Cleveland Construction Company, of Cleveland, Ohio, is placing many of the contracts for the equipment of the new power station of the New York & Long Island Traction Company, which is to be erected at Rockville Center, on the line of the road. The company is now extending its South Shore division from Rockville Center through Linbrook, Valley Stream, Rosedale and Springfield to the terminal of the Kings County Elevated Railroad in New York City.

TOLEDO, OHIO.—The Toledo & Fort Wayne Railway Company has been incorporated at Columbus with a capital stock of $100,000.

NORTH AMHERST, OHIO.—The Lorain & Southern Electric Railway Company has been organized here to build an electric railway from Lorain to Oberlin through this place. The distance is 15 miles. The road will be used for hauling freight and stone trains, as well as for passengers, electric locomotives supplying the motive power. It is stated that the Westinghouse Company will furnish the electric locomotives and entire electrical equipment.

OGDEN, UTAH.—It is stated that a deal is pending for the acquisition of the Ogden street railway system by the Consolidated Light & Railway Company, of Salt Lake City. This would give the latter company control of every foot of electric railway in the state. The local management has decided upon numerous improvements if the Salt Lake Company does not secure control of the system.

MONTREAL, QUE.—The Montreal Street Railway Company, in strengthening its operating staff is recalling former employes that have been serving with other companies. Mr. Ludger Trudeau, who has been acting as manager of the Street Railway Company of Alexandria, Egypt, has arrived in Montreal to again assume a position with the company he formerly served there. Three years ago Mr. Trudeau became manager of the street railway in Bordeaux, France, and while in that employ he received his appointment to the Egyptian concern.

OTTAWA, ONT.—Canadians are reaching out for electrical enterprises in many foreign fields. A number of Nova Scotia capitalists recently visited the Island of Trinidad and the opportunity there offering proved so tempting that it was decided to take over the tramways in the town of Port of Spain, and operate them upon modern lines. The tramway in question is 12½ miles in length. The company, which has been formed under the name of the Trinidad Electric Company, secured the plant at the figure of $1,200,000. It has already instituted a new plant and has put a Canadian at the head in the person of Mr. F. W. Teale, who was formerly with the Boston Tramway Company.

New Industrial Companies.

THE ELECTRIC TYPEWRITER COMPANY, of Norfolk, Va., has been incorporated. Mr. H. H. Little is president. The capital stock is $50,000.

THE STANDARD LIGHT & HEAT COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $100,000 by James T. Morgan, Le Roy S. Lewis and Louis G. Morton.

THE ESSINGTON ROTARY STEAM ENGINE COMPANY has been incorporated at Camden, N. J., with a capital of $300,000. The names of the incorporators are Henry C. Essington, James W. Irwin and Almon P. Wint.

THE CIRCUIT-PROTECTING RELAY COMPANY, of Kendall, Orleans County, N. Y., has been incorporated to manufacture telegraph instruments. The capital stock is $3000, and the directors are S. R. Wright, M. J. Storer and John Elliott Morton.

W. H. COVERDALE & COMPANY, of New York City, have been organized to carry on the business of civil, electrical and mechanical engineering, the capital stock being $25,000. The directors are W. H. Coverdale, C. F. Keene and G. C. Atkins, of New York City.

THE ELECTRIC CYCLONE AMUSEMENT COMPANY, of St. Louis, Mo., has been incorporated to operate electrical mechanical devices for amusement. It has a capital stock of $100,000, one-half paid. The incorporators are Edgar P. Voll, J. J. Wehrle, A. E. Hoffman, Myer Morris and John H. Goodfellow.

THE HUTCHISON ACOUSTIC COMPANY, of New York City, was incorporated this week with a capital of $500,000, to manufacture special telephonic mechanisms. The directors are M. R. Hutchison, of New Rochelle; H. B. Babbitt, of Washington, D. C.; and K. M. Turner, J. H. Devlin and J. Shirley Eaton, of New York City.

Obituary.

MR. ERNEST THOMPSON.—We regret to announce that Mr. Thompson, partner in the firm of Nalder Bros. & Thompson, manufacturers of ammeters, voltmeters and various instruments, London, England, died recently, after a long and painful illness. Mr. Thompson had been quite unable to attend to business for about a year, since which time, however, he had undertaken a voyage around the world in the hopes of restoring his health. He was in New York about a year ago. On his return to London, however, and on attempting to take up business, it was found that he was quite unequal to the task, and rapidly got worse. Mr. F. H. Nalder, who is well known in America, as well as in England, will continue the business, and we are sure that many readers of our papers will extend their sympathy to the family and to Mr. Nalder.

MR. W. O. GARRISON.—We noted briefly last week on telegraphic advices the death of Mr. W. O. Garrison, president of the Columbia Incandescent Lamp Company, of St. Louis, and a member of the well-known Missouri family of that name. It is with deep regret that we have thus seen pass away a young man of such ability and sterling worth. He was the eldest son of Daniel E. Garrison and a grandson of the late Oliver Garrison, famous as one of the leaders in building the Missouri Pacific Railroad. He was born in St. Louis 42 years ago, and after graduation went into business there, marrying about 13 years ago Miss Edith Hendel, a granddaughter of the late Jesse Arnott. For several years past he had been prominent in the electrical field, and most highly esteemed by all who met him or knew him intimately. He had been in poor health for a number of months, being confined to his bed since early in September on account of trouble with his leg and hip. The complaint appeared at first to be sciatic rheumatism, but afterwards developed into inflammation, as a result of grippe. The family did not, however, until very recently, take a serious view of the case, as he had been able to conduct the business of the Columbia Company in his wonted vigorous way, while in bed. Just lately, however, he showed a grave weakness of the heart, and this on Sunday evening, January 17, was the direct cause of his death. He was active as well in social as in business affairs, being a member of the Country Club, the Mercantile Club, and other leading social and commercial organizations. His wife survives him. His brother, Mr. A. C. Garrison, formerly connected with the Columbia Company, will again give it his attention and has succeeded to the presidency, to which he will now devote his entire time and attention.

Educational.

A VALUABLE GIFT TO LAFAYETTE COLLEGE.—The Henry W. Oliver chemical and metallurgical library of Lafayette College, Easton, Pa., has received as a gift from a generous friend all the pamphlets, about 3000 in number, belonging to the library of the late Professor Johannes Wislicenus, of the University of Leipsic, Germany. Prof. Wislicenus was a famous chemist. He was a pioneer in the study of lactic acid and led in the work which gave to us our present knowledge of stereoisomerism. This library represents the collection of fifty years of great activity and will be a valuable addition to the Oliver library.

COLUMBIA UNIVERSITY, NEW YORK.—At a recent meeting of the trustees of Columbia University, it was voted to fix the annual fee for tuition in the Schools of Applied Science and in the College of Physicians and Surgeons at $250 from and after July 1, 1904. The annual tuition fee in these schools is at present $200. Since the present fee was fixed the equipment of Columbia University in these departments has been greatly increased, and the number of instructors multiplied. The cost of giving the instruction in applied science and in medicine has steadily grown year by year and is now not less than twice the amount received from fees for tuition. The tuition fee at the Massachusetts Institute of Technology is already $250, and the fee for New York students who attend the Stevens Institute of Technology at Hoboken is $225. The per capita cost of instruction at Columbia is believed to be greater than that at either of the institutions mentioned.

THE AMERICAN SCHOOL OF CORRESPONDENCE has adopted a method of advertising which, even if it is profitable to them, is a very good thing for students of electricity. As readers of the technical periodicals have doubtless noted, that institution has arranged under one cover four of the forty-five text books which it uses in teaching its course in Electrical Engineering, and is selling the whole for seventy cents. The four chosen are: "Elements of Electricity," and "The Electric Current," both by L. K. Sager, S. B., LL. B.; "Electric Wiring," by H. C. Cushing, Jr.; and "Storage Batteries," by F. B. Crocker, E. M., Ph. D., Professor of Electrical Engineering at Columbia University. They are all crisply and concisely written and well condensed. There are incorporated in the volume several tables and a whole lot of reference data, which would be of considerable value to one engaged in any electrical line. The section on Storage Batteries, by Prof. Crocker, gives just the sort of storage battery information and tells it in just the sort of way that will reach the practical telephone man, who should at least have a good idea of this appliance which is now so common in these days of central energy. There are 256 pages in the volume.

Personal.

MR. A. G. BRIGGS, of Alameda, Cal., has now been appointed superintendent of the Merced Falls, Cal., Gas & Electric Company.

MR. J. H. ROSENTHAL, managing director of Babcock & Wilcox, Limited, of London, has sailed for home after a brief sojourn in the States.

MR. GEORGE WESTINGHOUSE is a passenger on the North German Lloyd liner *Kaiser Wilhelm II*, which left New York for Europe Jan. 26.

MR. H. HINE, president of the Guanajuato Electric Light & Power Company, Mexico, is expected back in New York next week from Colorado Springs.

GEORGE A. FERNALD & COMPANY, of Boston, Mass., has bought a controlling interest in the Stoughton, Mass., Gas & Electric Light Company.

MR. ROBERT W. BLACKWELL, of the British electrical engineering and contracting firm of Blackwell & Company, Limited, has sailed for Europe after a short visit to the States.

MR. ALBERT E. DOE, JR., formerly with Norcross Bros. Company, of Boston, has been appointed New England representative by the Thomas H. Dallett Company, of Philadelphia.

MR. H. F. PARSHALL, the well-known American electrical expert, who has been located in London for some years past left New York Jan. 26 for Europe on the *Kaiser Wilhelm II* after a brief stay on this side.

MR. E. A. CAROLAN, manager of the London offices of the General Electric Company, and a director of the British Thomson-Houston Company, Limited, has sailed for Europe after several weeks' visit to this side.

MR. W. S. CHASE, sales manager of the National Acme Manufacturing Company, of Cleveland, Ohio, has taken passage from New York for England and the continent on a business trip which will last about two months.

REAR ADMIRAL CAPPS, Chief of the Navy Bureau of Construction and Repairs, was given a reception at the Engineers' Club last week, when there was a large attendance in spite of the wretched weather. Many electrical men were present.

MR. H. W. SPANG, the veteran electrician and lightning-rod expert has contributed to the *American Gas Light Journal* an interesting article on the unscientific electrical engineering that results in the electrolytic destruction of underground pipes.

MR. CHAS. E. COLLINS, the hydraulic engineer, the Drexel Building, Philadelphia, is preparing plans for the Hoosick River power plant of the Schaghticoke Electric Power Company, of Schaghticoke, N. Y., which proposes to develop about 3500 hp.

MR. JOHN C. McDONALD, wire chief of the New York Telephone Company at the Tremont exchange, has worked out a "safe" third rail method or attachment which he is now having patented. He has rigged up a 30-foot track at his home and may presently experiment on the Interborough tracks.

PROF. A. G. BELL has arrived from Italy with the body of James Smithson from Genoa, where it has lain many years. It was taken on the U. S. S. *Dolphin* to Washington, where it has been interred at the Smithsonian Institution, which Mr. Smithson gave to this country. Mr. Smithson died in 1829.

MR. JOHN E. STARR, for some time past connected with Arthur Koppel, 66 and 68 Broad Street, New York, is about to leave for Russia. He will establish himself at Revel, on the Baltic Sea, where he will conduct an agency for the handling of American electrical equipment and supplies, also machine tools.

PROF. J. BLONDIN has resigned as editor of *Eclairage Electrique* to become editor of a journal shortly to be issued, to be named *Revue Electrique*, and to be published by Gauthier-Villars. The journal will resemble the Digest in plan, its purpose being to review foreign current electrical periodical literature.

MR. ROBERT H. HASSLER, formerly with the Westinghouse Electric & Mfg. Company and more latterly electrical engineer with the Waverly electric automobile interests, etc., has now become connected with the Marion Motor Car Company, of Indianapolis, which is going into the gasoline automobile field.

MR. FRANCIS F. COLEMAN contributes to the *Manufacturers' Record*, of Baltimore, Md., a very interesting article on the recent electrical development of the South, citing a great many instances of new plants, new work, etc. The prosperity of that large and important region has stimulated electrical enterprises of all kinds.

MR. F. A. LA ROCHE, the well-known electrical manufacturer and engineer, has of late found himself overwhelmed with the new business work due to his connection as manager with the American Darracq Automobile Company. He is, however, still deeply interested in electrics when not winning races or challenging competitors to produce as good machines.

MR. JAMES F. CUMMINGS, who recently secured the contract for the laying of the conduit for the St. Petersburg municipal telephone and telegraph lines, is now in Cincinnati, Ohio. He is expected in New York early next week at the Hotel Imperial. The conduit is being manufactured at the Raritan, N. J., plants of the National Fireproofing Company. Further Russian contracts are pending.

PROF. CURIE and his wife deny the statement that they intend to visit America. It is a pity they cannot come over. They would receive a royal welcome from admiring and appreciative citizens of this country in general, and from the scientific world in particular. There is no jealousy here in regard to their splendid work, which has added so greatly to the scientific glory of France.

MR. A. N. BRADY, the electric lighting magnate is largely interested in a theatre at Albany, N. Y. When he heard of the Iroquois Theatre fire in Chicago, he went to the Commissioner of Public Safety and insisted that it should be closed until brought thoroughly up to the best insurance standards of the time. It is a pity there are not more theatre owners as public spirited and prompt to act.

MR. RALPH D. MERSHON, the consulting electrical engineer, is at an early date to give the New York Electrical Society an address on the subject of the gas engine for central station work. This will be a very interesting topic for a great many of the members. Mr. Mershon has made an intimate study of the gas engine and takes an opportune time to give publicity to his views and ideas.

MR. JAMES ROSS, of Montreal, president of the Mexican Light & Power Company, Limited, which is building a huge plant at Necaxa to generate power for transmission to Mexico City and the El Oro mining district, has left for the southern republic in order to inspect the progress made in the work. He is accompanied by Mr. F. L. Wanklyn, formerly vice-president and general manager of the Montreal Street Railway.

MR. RUDOLF WIESER has been commissioned by the Mexican-American Company, 49 Wall Street, New York, to look over the ground with a view to constructing an electric railway between Guadalajara and Lake Chapala—the Saratoga of Mexico. The distance is about 40 miles. The Mexican-American Company also proposes to install some lighting plants in the State of Jalisco. E. H. Talbot is president of the company.

MR. HERBERT LAWS WEBB, who has been away from this country for several months, is again in New York for a time. He has been doing considerable work in England as a telephone expert and consulting engineer. It will be remembered that he was connected for some years with the New York Telephone Company. Mr. Webb is however well known in England, the family being an old one in electrical affairs. He is a nephew of Sir W. H. Preece, F.R.S.

MR. A. M. MATTICE, who is prominently connected with Westinghouse interests and is the chief engineer of the Westinghouse Machine Company, received a high compliment from President Kafer, of the Engineers' Club, last week, in a speech before that body. Mr. Kafer, who was at one time professor of mathematics at the Naval Academy, spoke of Mr. Mattice as by far the most brilliant student there in many years, if not indeed during the whole existence of the Academy. Mr. Mattice for some time was an assistant to Admiral Melville.

MR. CHARLES T. YERKES has sailed for England on the *Kaiser Wilhelm II*, after an extended visit to this side. Shortly after his arrival in London it is expected that the contract will be awarded for the motor equipments to be used in the extensive underground and surface electric traction system which the Underground Electric Railways Company of London, Limited, of which Mr. Yerkes is chairman, and in which the Speyers, the New York Life and Mutual Assurance and other prominent American interests are largely concerned. The motor equipment contract will represent an expenditure of some $3,000,000.

MR. W. C. GOTSHALL.—At the annual dinner of the Lehigh University Club, of New York, at the New York Athletic Club, last week, W. C. Gotshall, president of the Port Chester Street Railway Company, told the guests that Lehigh should establish a chair of railroad engineering or transportation because of the great demand for men schooled in the intricate knowledge of railroad building and operation that has grown up in the past decade. The universities to-day, said Mr. Gotshall, do not appreciate the necessities of every day commercial life. Mr. C. O. Mailloux, who spoke eloquently on the same general topic, has been one of the lecturers lately at Lehigh, with much acceptability.

PROF. A. H. PHILLIPS.—In recognition of the service of Prof. Alexander H. Phillips, of the chemistry department of Princeton University, "the first American mineralogist to extract radium from an American ore," a gift of twelve and a half grains of radio-active barium chloride will be presented to the university this spring. Following the recent extraction of radium from carnolite by Prof. Phillips, a company has been formed in Buffalo, N. Y., for the purpose of producing it at a reasonable price. The first product turned out will be donated to the university by Stephen J. Lockwood, a Princeton graduate and organizer of the Buffalo Company.

MR. T. H. BAILEY WHIPPLE has reurned to the Sawyer-Man Company, and the position which he left last summer in order to take a part in the reorganization of the sales department of the Nernst Lamp Company of Pittsburg. Mr. Whipple is an old hand in the commercial end of the electric lighting field. He was general sales agent with the Buckeye Electric Company of Cleveland, Ohio, and held a similar position with the Jandus Electric Company which was an off-shoot of the Buckeye Electric Company. During his connection with these two companies he established most of their agencies throughout the United States. Early in 1903 Mr. Whipple went to the Sawyer-Man Electric Company, with which he remained until he was called as above noted to the Nernst Lamp Company.

Trade Notes.

THE JEFFREY MANUFACTURING COMPANY, of Columbus, Ohio, through its connection with the Ohio Malleable Iron Company, of the same place, is now in the field soliciting orders for high grade malleable castings.

LAMP TESTING BUREAU.- It is proposed by the Lamp Testing Bureau, of New York City, to change its name, and Mr. John W. Lieb, Jr., its president, has given legal notice of the intended plan to call it the Electrical Testing Laboratories.

ASBESTOS THEATRE CURTAINS.—We have received from the H. W. Johns-Manville Company samples of the cloth used by it in its excellent asbestos theatre curtains, accompanied by a leaflet on the subject, which shows actual tests being made in a New York theatre, and gives some most interesting data on this important subject.

THE INTERNATIONAL BRASS & ELECTRIC COMPANY, 76 Beekman Street, New York, has issued its 1904 catalogue of the line of goods manufactured by it. The catalogue contains illustrations and price lists of induction coils, automobile coils, sparkers, switches, connectors, etc. The company manufactures these articles and many others, and carries goodly sized stocks.

THE AMERICAN WATER SOFTENER COMPANY, of Philadelphia, has opened a branch office in the Outlook Building, Columbus, Ohio, in the immediate charge of Mr. W. H. P. Fisher, general sales agent for the company, and Mr. A. C. Tomlinson, manager of the Columbus office, who for some time has been the assistant manager of the Philadelphia office.

THE CENTRAL ELECTRIC COMPANY, Chicago, is starting in 1904 with renewed enthusiasm to push the sale of D. & W. enclosed fuses and safety devices. The company makes the statement that the popularity of D. & W. material has been steadily growing and with a constantly widening field ahead there is every reason to believe that the coming year will witness very largely increased sales.

INDICATOR WORK TAUGHT BY MAIL.—The Indicator Instruction Company, of Scranton, has been formed to give indicator instruction by mail under Mr. A. C. Lippincott, well known as an indicator expert and the inventor of the Lippincott planimeter for measuring indicator cards. Everything relating to indicator work will be taught, including the subjects of the planimeter, reducing motions, care and repair and testing of indicators. Indicators will be loaned to the students of the course.

THE BEARDSWORTH ENGINEERING & MACHINERY COMPANY, Cleveland, Ohio, has been formed to act as electrical engineer and selling agent for electrical equipment. The company will make a specialty of selling and re-installing complete second-hand power plants that are fully guaranteed by those who wish to dispose of the same. It has a number of complete plants for sale in various parts of the country. Parties having steam and electrical equipment too small for their present requirements can make advantageous exchanges through this company.

PELTON WHEELS.—A large order for Pelton water wheels is being completed for the Columbia Improvement Company, near Tacoma, Wash. The installation consists of four Pelton units, aggregating 31,000 hp operating under an 850-foot head. These are the largest water wheel units in the world, with the exception of those at Niagara Falls, and demonstrate the abilities for handling especially large orders. An 88-page illustrated catalogue containing complete data in reference to hydraulic power is sent free on application to the Pelton Water Wheel Company, 130 Main Street, San Francisco, or 141 Liberty Street, New York.

NEW STURTEVANT PLANT.—One of the features of the new plant of the B. F. Sturtevant Company, at Hyde Park, Mass., peculiarly indicative of the permanent character of the new works now under construction, is the steam tunnel 4½ feet in width and 6½ feet high, extending from the power plant to the most remote part of the manufacturing buildings, a total distance of about 800 feet. This tunnel, which is of concrete construction, will not only accommodate all of the steam piping, but also the electric wires for power, light, telephone, standard time clock, and other service, together with oil, hot water and other pipes for general distribution to the various buildings of the plant. None of these features of the equipment will be carried above ground at any outdoor point. While the expense of such an installation is necessarily large, the convenience of access for changes and repairs will in the future much more than offset any fixed charges thereon.

THE SPRAGUE ELECTRIC COMPANY'S New York office and Watsessing factory forces held their annual bowling tournament and banquet at Smith's Hotel, Roseville, N. J., on Jan. 16, 1904. That it was a grand success goes without saying. Besides the "boys" several of the officers of the company and many heads of the departments were present. Four bowling matches arranged on a "sliding scale basis" were rolled. The representatives of the office force came out victorious in all of the matches after hard-fought battles with their opponents, the representatives of the factory, who acted as hosts on this occasion. It may be noted that although they were beaten in the matches, it was the consensus of opinion of all present that as hosts, Mr. Charles Noll and his confreres were without equals. After the matches everybody sat down to a banquet and tackled the uniquely gotten up bill of fare in such a manner as if a thing as indigestion had not been heard of by any of the party. After the coffee had been served and the last "fuse" had been "blown," the toasts were "thrown into circuit." The voltage of the themes of these toasts was very high and the "circuit breakers" of laughter were continually being "tripped." Mr. Issertel, of the New York office, acted as toastmaster. He is the walking delegate of the Toastmasters' Union, and holds his job on merit.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 19, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

749,716. RAIL CONTACT SHOE; George W. Brady and Lawrence R. Jones, Wheaton, Ill. App. filed Jan. 26, 1903. The shoe has two diverging sides adapted to engage the corners of the rail where least ice is supposed to form.

749,775. ELECTROSTATIC RELAY; Dan. La Cour, Copenhagen, Denmark. App. filed Feb. 7, 1903. An electroscope charged from a local source of electricity effects by its movements the closing or interruption of an electric circuit.

749,785. BATTERY-PLATE; Oskar Frank, Detroit, Mich. App. filed May 2, 1903. (See page 225.)

749,795. TROLLEY STAND; James Kermath, Detroit, Mich. App. filed Oct. 9, 1903. Details of the stand whereby it is supported close to the top of the car and offers no hindrance in passing under viaducts.

749,798. CENTRAL-ENERGY TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed Dec. 19, 1900. (See page 226.)

749,813. PORTABLE X-RAY APPARATUS; Eugene W. Caldwell, New York, N. Y. App. filed Jan. 16, 1903. An organization of the complete outfit with parts arranged for quick adjustment.

749,814. RELAY DEVICE; John P. Downs, Cleveland, Ohio. App. filed May 7, 1902. Details.

749,824. TELEPHONE-EXCHANGE; Nils Emel Norstrom, Chicago, Ill. App. filed Nov. 23, 1900. (See page 226.)

749,835. ELECTROMECHANICAL SWITCHING MECHANISM; Walter J. Bell, Los Angeles, Cal. App. filed May 29, 1903. A motor to move a switch point is connected and disconnected by a clutch controlled by an electro-magnet.

749,842. BURGLAR ALARM FOR SAFES; Henry R. Cassel, London, Eng. App. filed May 3, 1902. A pressure of air is maintained in the safe and a circuit closer therein is actuated when the pressure is altered.

749,843. PROCESS OF EXTRACTING PRECIOUS METALS BY ELECTROLYSIS; Henry R. Cassel, New York, N. Y. App. filed Oct. 25, 1902. (See page 225.)

749,844. APPARATUS FOR EXTRACTING PRECIOUS METALS BY ELECTROLYSIS; Henry R. Cassel, New York, N. Y. App. filed Oct. 25, 1902. (See page 225.)

749,855. PROCESS OF PRODUCING ELECTRODES FOR STORAGE BATTERIES AND ELECTRODE; Frederick A. Feldkamp, Newark, N. J. App. filed May 19, 1903. (See page 225.)

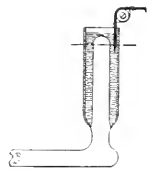
749,867. METHOD OF SECURING ELECTRIC WIRES; Alexander Kline, Jersey City, N. J. App. filed March 31, 1902. The tie-wire used to fasten a conductor in the groove of an insulator is a flat strip which can be wound around the conductor without the use of tools and thus prevents the liability of damaging the conductor by the plier.

749,916. TROLLEY FOR OVERHEAD ELECTRICAL CONDUCTOR SYSTEMS; Eugenio Cantono, Rome, Italy. App. filed Aug. 3, 1903. Details.

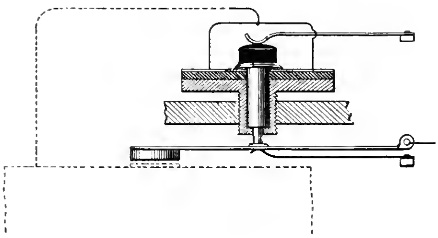
749,919. HANDLE FOR SNAP SWITCHES; Charles A. Clark, Hartford, Conn. App. filed Jan. 3, 1903. The handle contains an internally threaded movable bushing held telescopically by a spring; when it is screwed upon the spindle of the switch, the tension of the spring holds the cap, if it is a surface-switch, or the plate, if it is a flush switch, tightly in position.

749,939. RAILWAY SIGNALING APPARATUS; John F. Mickey, Frank T. Bailey, and Joseph J. Noppenberger, Baltimore, Md. App. filed Aug. 1, 1903. Details.

749,949. INDICATING DIAL FOR SNAP ELECTRIC SWITCHES;



749,999.—Electrode for Electric Tube Lamps.



750,041.—Vibratory Circuit Controller.

Charles G. Perkins, Hartford, Conn. App. filed Oct. 29, 1903. The dial is secured to the spindle sleeve by means of lugs engaging notches in the dial, the engagement being accomplished by an edgewise movement of the dial.

749,952. LAMP SOCKET; Duny A. Schutt, Peru, Ind. App. filed Jan. 28, 1902. Details.

749,977. TELEPHONE-HOOK SWITCH; Ernest E. Yaxley, Chicago, Ill. App. filed June 12, 1901. (See page 226.)

749,982. ELECTRICAL SIGNALING SYSTEM; Henry P. Clausen, Chicago, Ill. App. filed Dec. 19, 1901. A circuit arrangement whereby a telephone signaling lamp will always light up and respond to a signal regardless of whether the circuit of the lamp is closed for some time or only for an instant.

749,988. CABLE CLIP; Otto C. Hoffman, Chicago, Ill. App. filed July 31, 1902. A strap with a novel form of clamping buckle on the end.

749,989. CABLE CLIP; Otto C. Hoffman, Chicago, Ill. App. filed Dec. 8, 1902. A modification of the preceding device.

749,998. ELECTRIC TUBE LAMP; Daniel McF. Moore, Newark, N. J. App. filed Jan. 22, 1903. An electrode for a tube-lamp consisting of a coating of conducting material spread upon the inner surface of the tube and in intimate connection with a leading-in wire.

749,999. ELECTRODE FOR ELECTRIC TUBE LAMPS; Daniel McF. Moore, Newark, N. J. App. filed Feb. 26, 1903. The end of the tube where the connection is made is placed in a holder containing mercury which operates as the conducting cap and avoids using an adherent coating of graphite.

750,012. FIRE ALARM MECHANISM; Leonidas G. Woolley, Kenton, Ohio. App. filed April 27, 1903. Various details.

750,013. FIRE ALARM SYSTEM; Leonidas G. Woolley, Kenton, Ohio. App. filed July 6, 1903. Relating to the preceding patent.

750,038. ATTEMPERATING DEVICE; Milton H. Shoenberg, San Francisco, Cal. App. filed March 16, 1903. A coupling for controlling the admission of air under the pressure to a dental tool and at the same time for regulating the heating of the air.

750,039. RUHMKORFF COIL; Richard Varley, Providence, R. I. App. filed Aug. 21, 1903. The circuit is broken at the vibrator by the joint action of the core of the coil and an auxiliary magnet, the entire vibrator is also bodily removable, being held in place by spring-clamps.

750,040. VIBRATORY CIRCUIT CONTROLLER; Richard Varley, Providence, R. I. App. filed Oct. 19, 1903. The vibrator makes contact with three different points on the back stroke, thus ensuring a low resistance connection.

750,041. VIBRATORY CIRCUIT CONTROLLER; Richard Varley, Providence, R. I. App. filed Oct. 19, 1903. A construction whereby the primary circuit is opened and closed more than once during each to and fro excursion of the vibrator.

750,093. ELECTRIC-RESISTANCE FURNACE; Alfred H. Cowles, Cleveland, Ohio. App. filed Nov. 20, 1902. (See page 225.)

750,094. PROCESS OF SMELTING MATERIALS AND PRODUCING CARBID; Alfred H. Cowles, Cleveland, Ohio. App. filed Oct. 20, 1903. (See page 225.)

750,098. MOTOR; Bertram J. Delzeit, Philadelphia, Pa. App. filed Oct. 31, 1903. A motor is supplied with current from a number of batteries, successively, the motor itself operating the switching device.

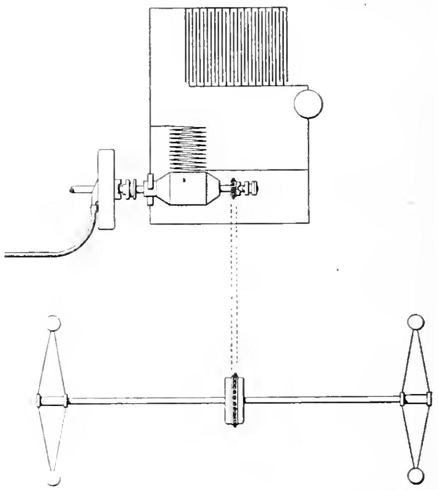
750,102. ELECTRICAL AUTOMOBILE; Thomas A. Edison, Orange, N. J. App. filed Jan. 9, 1903. A turbine steam engine is connected through a clutch with the motor armature shaft, so that by a proper adjustment of the motor circuits, it can be driven as a generator, part of the time, to charge a battery.

750,115. AUTOMATIC ELECTRIC PUMP; Francis L. Orr, Thurman, Iowa. App. filed Sept. 9, 1903. Details.

750,117. ELECTRICAL OPERATED AND CONTROLLED RAILWAY SIGNAL; Robert D. Peters, Knox, Ind. App. filed Nov. 21, 1902. Details.

750,132. ELECTROMAGNET; Illius A. Timmis and Edgar W. Timmis, London, England. App. filed June 19, 1903. A helix having a tapering central cavity and a tapering external surface, the armature having a tapering core and a tapering cylinder or rim.

750,139. ELECTRICAL CONTROLLER FOR RAILWAY CARS; Harlan P. Wellman, Ashland, Ky. App filed Nov. 19, 1903. The exhaust from the



750,102.—Electrical Automobile.

air brake system leads into the controller box to clear the latter of dust and to obtain a muffler effect.

750,150. ELECTRIC FIRE ALARM; Joseph A. Barten and Samuel R. Sneeringer, Philadelphia, Pa. App. filed April 30, 1903. Details.

750,170. METHOD OF ELECTRIC HEATING; Alfred H. Cowles, Cleveland, Ohio. App. filed Nov. 5, 1902. (See page 225.)

750,179. ELECTRIC BLANKET; Charles Foglesong, St. Paul, Minn. App. filed Sept. 14, 1903. A blanket consisting of an asbestos layer and a woolen layer with heating resistance interposed between them.

750,180. METHOD OF CONTROLLING SPARK PRODUCTION; Lee De Forest, New York, N. Y. App. filed June 17, 1903. The method of creating sparks between normally inoperative sparking terminals which consists in increasing at will the condition of ionization of the medium between the sparking terminals.

750,181. DEVICE FOR CLEARING ICE FROM ANTENNAE; Lee De Forest, New York, N. Y., and Walter G. Clark, Seattle, Wash. App. filed June 17, 1903. Apparatus for sending a heating current through the antennae.

750,198. SOCKET FOR INCANDESCENT LAMPS; Owen E. Kenney, Toledo, Ohio. App. filed June 16, 1902. Details.

750,207. ELECTROMAGNETIC BRAKE; John S. Lockwood, Kansas City, Mo. App. filed June 23, 1902. A removable piece acting as a part of the magnet pole and the brake shoe is attached to the core of the magnet.

750,223. ELECTRIC BLOCK SYSTEM; Frederick C. Robinson, Farmington, Me., App. filed Aug. 22, 1903.

750,239. ELECTRICALLY HEATER SOLDERING IRON; William J. Bowen, Cleveland, Ohio. App. filed Aug. 17, 1903. Details.

750,244. FUSE FOR ELECTRIC CIRCUITS; Elwood C. Philips, Chicago, Ill. App. filed Jan. 9, 1903. A fuse plug in which the fusible strip extends around three-quarters of an annular groove, its ends being fixed to proper metallic connections.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, FEBRUARY 6, 1904. No. 6.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, FEBRUARY 6, 1904.

CONTENTS.

THE DINNER AND THE LAMP.

It has been a felicitous idea to associate this year the annual dinner of the American Institute of Electrical Engineers with the twenty-fifth anniversary of the practical perfection and successful introduction of the incandescent lamp, and it was also a happy thought to associate the event next week with the birthday of Mr. Edison, who more than any other man is to be credited with that great accomplishment. The association of the annual dinner with some particular event in electrical history and achievement is, after all, an excellent plan, and we should be glad to see it realized from year to year. This has been a great electrical age and it will be a long time before the Institute runs out of worthy men and events to celebrate.

It seems but yesterday—especially to those of us who have been connected with this utilization of the incandescent lamp—that it was placed in the hands of the public, yet so swift has been its advance and its universal acceptance that already to-day, as compared with electricity, we find gas in the second place in this country as an illuminant. That alone tells the story of the need that existed for such a light and the fitness of the time at which it arrived. Yet twenty-five years ago it was not by any means sure that the incandescent lamp would not itself be worsted by its great rival, the arc lamp; in fact, a great many men of leadership and of force both as inventors and as capitalists, persisted in working at the development of the arc to the neglect of the incandescent. Times have changed and now virtually every central station in the country, besides almost every isolated plant, is on an incandescent lighting basis, while the triumph of the incandescent lamp is most emphatically demonstrated in the fact that in the central station companies of the country the percentage of their income derived from incandescent lighting is 52.4, while arc lighting is only 28.1 per cent. Moreover, all other electric service consisting chiefly of electric motors is 17.7 per cent., and as the success of the motor has been associated also with the incandescent lamp it would appear that to-day the central stations of the country owe 70 per cent. of their income to the little lamp and less than 30 per cent. to the arc. Herein is justification and glory enough for Mr. Edison and for the other great workers in the field of incandescent lighting, and even they, as they look back across the brief space of twenty-five years, must wonder at the wonderful advances of that short quarter century.

DISTRIBUTED LEAKAGE ON TRANSMISSION LINES.

The article by Mr. F. F. Fowle on page 262 of this number relates particularly to the measurement of the insulation of long lines with distributed leakage, by the use of a voltmeter. This problem involves hyperbolic trigonometry for its simplest exposition and computation. The treatment in the article is partly hyperbolic.

There can be no doubt that the direct-reading voltmeter employed as an ammeter is far superior in practical use to a Wheatstone bridge for the measurement of line insulation in telegraphy or telephony. The time has not so long gone by when insulations of telegraph lines used to be measured at regular intervals with a battery and tangent-galvanometer. In these days of dynamos and motors it would be hard to find a place where a tangent-galvanometer would be capable of giving interpretable results; besides which the instrument is relatively slow and insensitive. Nowadays, a common method of measuring insulation of telegraph lines is with a direct-reading voltmeter. By the use of a table, the readings of the voltmeter, when connected between line and a standard voltage, are immediately interpreted into apparent insulation resistances; and multiplying this tabular reading by the length of the line in miles, gives the insulation in megohm-miles. A tabular correction for each line can also be prepared for the effect of distributed leakage, which tends to make the apparent insulation of the line greater than the actual insulation, since the more distant parts of the line are virtually tested for leakage at a reduced pressure, owing to the loss of pressure in the nearer parts.

The formulæ suggested in the article are very unwieldly, and take long computation. Equally correct results may be obtained by shorter methods. The geometric mean of the apparent insulation and conductor resistance of the line gives the surge-resistance, and from this the true insulation of the line follows immediately. Or, when the conductor resistance of the line per mile may be regarded as known, this resistance divided into the product of the apparent conductor and insulation resistances of the line, gives as a quotient the insulation per mile corrected for distributed leakage. As pointed out, however, in the article, the correction for leakage is usually small when the line is short and in good electrical condition. It is only in the cases of relatively long lines of relatively large conductor resistance and poor insulation that the correction for distributed leakage upon the apparent insulation assumes large proportions.

On the Wave Length of Free Vibrations in Wireless Telegraph Antennae.

The conditions and rules affecting electric oscillations in a simple circuit, such as the circuit of a condenser connected to a reactance coil, are fairly well understood. Observations with spark discharges, with oscillographs, and with stationary waves, seem fairly to corroborate the theory. So also in the case of single long wires, or pairs of wires, the waves that run to and fro over their surfaces are fairly well within our mental grasp; but the more complex cases that present themselves when vertical antennæ are linked with local oscillation circuits, are not so thoroughly understood, and experimental evidence in such cases is valuable as a check upon theory. The article by Dr. J. E. Ives appearing on page 260 throws experimental light upon the oscillations of a vertical antenna when connected with a localized oscillation system at its base. It has been known for some time, both from theory and from observation, that although the linear capacity and the linear inductance vary from point to point along a vertical antenna, yet the two quantities always vary reciprocally, and in such a manner that the waves of free disturbance run up and down the antenna with the velocity of light in air. Or, possibly, the reverse mode of thought may be the more logical, and we may say that since unobstructed waves must have the velocity of light in air, the linear inductance and capacity of the antenna at every point are such as will permit of this state of affairs.

Consequently, if we take a 30-meter antenna, a wave will, in a single complete period, run up and down positively and then up and down negatively, making four trips to the complete oscillation, which will last one-tenth of a microsecond in all. It follows from this that four times the antenna height, or 120 meters in the case considered, will be the length of the free emitted wave as it runs off over the earth's surface, provided that there is practically a perfect ground connection at the base of the antenna. When, however, the antenna is loaded by the insertion of an inductance coil at the base, it is known that two things happen: First, there will be an oscillation set up in the complete system of antenna plus load; and, second, there will be oscillations set up in the antenna on its own account, and also in the load on its own account. In other words, the surge-resistance of the antenna being different, in general, from the surge-resistance of the inductance coil, there will be a partial discontinuity, or partial barrier, at their junction, whereby waves passing from one to the other are partially reflected back, instead of going on. The effect is similar to hanging a pendulum of, say, two feet in length, to the bob of a six-foot pendulum. Such a compound pendulum will not only be capable of performing swings as a single system of, say, seven feet in length, but will also vibrate as two independent although mechanically-connected systems, each for itself.

If, however, the surge-resistance of the localized oscillation system be made the same as that of the antenna, then there will be no intermediate discontinuity or reflecting barrier, and the loaded system will oscillate singly, emitting a single series of waves, or waves and harmonics, instead of three associated series of waves, or waves and harmonics. This adjustment of the surge-resistance of the localized system, into equality with the surge-resistance of the antenna, is called tuning the system to the antenna. When the generating system is so tuned there is naturally a marked increase in the power of the waves and frequency of the loaded or compound systems so unified. The illustrations in Dr. Ives' article clearly indicate the effect of loading the antenna on the length of its compound emitted waves. With ten and a half turns of his drum inductance coil, the wave length of the loaded system was double that of the unloaded antenna. With twenty-one turns of the drum the wave length was three times that of the unloaded antenna. When the local oscillation system was tuned to the antenna, the waves in the antenna had an amplitude many times greater than when the antenna and the local system were markedly discordant. It is evident that co-operation between the parts of a wireless generating system is as important as in human affairs; or, that the importance of pulling together, upon the success of a result, is as manifest in the inorganic as in the organic world.

Power Plants as Investments.

The question is often asked by business men as to whether the power transmission plants, now often installed on a very large scale, pay as business propositions. Every one is willing to admit that as engineering feats they are highly successful—but how about the result when the dollar and cent test is vigorously applied? The ultra-conservative are grimly reminiscent of the early days of electric lighting and the doleful tales of failure that are still current. It is a question of very wide scope, this of financial returns, so wide as to be indefinite as would be an inquiry regarding the paying properties of a hardware store, or a saw mill, or a tannery, or a drug store. There is nothing about the electrical business that separates it, as regards its financial features, from any other investment. Its product—power—is always in demand in proper markets, and its manufacturing plant can be erected and operated at an easily ascertainable cost. Building an elaborate plant for a small, uncertain and oversupplied market is simply a piece of financial foolishness like starting an artificial ice factory in Vladivostock or a central heating plant in Aden. The fortune that befell the immortal venture of Lord Timothy Dexter in shipping a cargo of warming pans to Havana cannot be counted upon with regularity in any business—electrical or other. On the other hand, the careful choice of location with reference to raw material and the sale of product, and sound management, will reap their reward as surely in the power business as anywhere else, and very many power transmission plants have given regular and generous returns upon the investment made.

But the strongest claim of electrical power transmission as a practical conservative field of investment lies in the increasing demand for its product on a wholesale scale. The country is rapidly being covered by a network of electric roads, many of them long, and using large amounts of power; the use of electric light is increasing with enormous rapidity; and now electrochemical processes are constantly arising to demand cheap power in very large quantities. Meanwhile, the tendency of fuel prices is steadily upwards, and while in any given year they may seem reasonable, one never knows when they may rise to almost prohibitive figures. With power-using processes steadily on the increase and the cost of fuel very unlikely even to stay down upon its present plane, the utilization of material sources of energy takes on a new importance. A wise manufacturer will to-day adopt electric power even if it shows no present saving over the cost of power from coal, since a great hydraulic plant is a permanent institution with which a long-time contract can be made, looking forward to the average scale of fuel prices for twenty years to come. By making such a contract the interests of both parties are advanced by insuring stability on the one hand, of costs; on the other, of income. Every year the supply of electrical power takes on more and more the character and solidity of a wholesale business. The great plant of the future will not bother itself much about the minute details of distribution, leaving that to be taken care of by local interests, but will devote its energies to cheapening production and to distributing the product over long distances, making long time contracts with its customers, and deriving its revenue from large and reliable sources. So organized, it must rank as an investment of the "gilt-edged" order.

THE REPULSION MOTOR FOR TRACTION.

The papers read at the Institute meeting by Dr. Steinmetz and Mr. Slichter may be taken to represent the line of action of the General Electric Company in the development of alternating-current motors for traction purposes. It has for some time been an open secret that a General Electric single-phase alternating-current motor was under way, and, in fact, perhaps as far along toward commercial application as the alternating motors which have been already announced. The Thomson repulsion motor is one of the most individual and striking of the alternating type and would long ago have been heard from in general power work had it not been possessed of the very characteristics of a series motor which now make it especially useful. Its principle is very simple. Any electric motor must have a magnetic field, wires movable relatively to the field and carrying current, and some means for organizing the resulting torque into continuous rotary motion. In direct-current motors the commutators serve the end last named by systematically reversing the current in the armature coils at the proper times. In the ordinary polyphase induction motor, the workng current being induced in the armature by the field windings is clear out of phase with the magnetization, and is swung into place by the device of providing two or more field windings fed by currents of different phase which serve in cyclic order as transformer and as field coils. In the single-phase induction motor of the ordinary kind there is a compensating phase shift from armature reactance, but a rather unstable one. The Thomson repulsion motor has a simple alternating field, which induces the armature currents, but the latter are organized by short-circuited brushes so as to give a definite polar displacement—as definite as in a continuous-current motor.

As a result of this construction the motor performs well over a wide range of speed, and the machine has, in fact, many of the properties of a series-wound, direct-current motor. Mr. Slichter's curve No. 1 gives a capital idea of the general properties of the repulsion motor as organized for traction purposes. The power factor is much like that of a well-designed polyphase induction motor, holding above 85 per cent. over a wide range of speed. The efficiency curve is likewise steady over a wide range of speed, but is nowhere very high, hardly as high as in common induction motors of similar output. This deficiency may be charged up to the rather large mass of iron which suffers hysteretic loss in a single-phase motor, and is shared by all the types of alternating traction motors on which data have thus far been made public. This deficiency is less marked in the motor compared with a direct-current railway motor in curve 2, but is still conspicuous. Nevertheless, the alternating motor makes a very creditable showing. It is a pity that the power factor curve was not given for this motor, but from the data given it appears to have been respectable. During acceleration the alternating motor has a certain advantage in net efficiency due to the fact that reduced voltage can be obtained with very slight loss of energy, while the direct-current motor suffers from its rheostat. Just how much this advantage will count for in practice it is difficult to say. The repulsion motor shares with the direct-current motor the somewhat problematical advantage of being able to return energy to the line when reversed. It is an interesting property to possess, but has never yet been put to much use in electric railroading. Mr. Slichter's final curves are the computed values for a 175-hp motor, and show properties similar to the others. We regret that all his curves were not obtained from a single machine, as it is difficult to judge results from a torque curve of one motor, an acceleration curve of another, and some other curve of a third; but the general results leave the impression of a pretty useful type of machine with some especial advantages.

In discussing the theory of the motor, Dr. Steinmetz displays his usual deft touch and follows his usual method of treatment. He gives, however, in addition, a very interesting account of the early work of the late Rudolph Eickemeyer on series-wound commutating motors for alternating current. It constituted a wonderfully clever bit of electrical engineering, but was hopelessly handicapped by the prevalent high frequency, which fact should be borne in mind in inspecting Fig. 4 of Dr. Steinmetz's paper. Under present conditions the series alternating motor, as developed, for example, by Dr. Finzi, shows as high a power factor as could reasonably be asked. We refer here to the Finzi motor merely because it is stated to be an unmitigated series machine without any unusual features in the winding. The vital question with respect to all these new alternating motors is the sparking. It is uniformly reported to be small, or negligible, or absent under working conditions. Unhappily, there is no exact method of defining the amount of sparking, and individual judgment in spite of the best intentions is liable to bias. Even the renowned Liebig, who firmly disbelieved in bacterial action, when shown a vigorous colony under the microscope, is said to have closed the eye over the tube, asseverating that he saw no bacteria at all. There seems to be little doubt that the new alternating railway motors have good practical qualities in a general way; that they give ample torque; have very respectable power factors, and efficiency enough to make the distribution via rotary converters look like wilful waste. But there is as yet no good way of settling the sparking question. A few months of actual service in charge of hardened old railway men will bring out the facts with a thoroughness not to be reached in shop tests. And we hope that ere long enough of the new motors will be in service to secure just this sort of trial. If from it they emerge triumphant, it is safe to say that for the future the direct-current railway motor will have to assume the defensive and show cause why it should not be replaced.

The Annual Dinner of the American Institute of Electrical Engineers.

The annual dinner of the American Institute of Electrical Engineers will be held in the main ball room of the Waldorf-Astoria, New York City, Thursday, February 11, 1904, at 7 P.M., precisely. The guest of honor will be Mr. Thomas Alva Edison, and it is expected that an opportunity will be given to meet Mr. Edison at an informal reception, at half-past 6. This dinner will commemorate the twenty-fifth anniversary of the introduction of the incandescent lamp, and will also celebrate Mr. Edison's birthday. Upon this occasion will also be presented the deed of gift of the Edison Medal Association, which has raised a fund of several thousand dollars.

The following guests have accepted invitations: Mr. Ambrose Swasey, president American Society of Mechanical Engineers; Dr. A. R. Ledoux, president American Institute of Mining Engineers; Col. Robert Clowry, president Western Union Telegraph Company; Mr. George G. Ward, vice-president and manager Commercial Cable Company; Mr. W. H. Baker, vice-president Postal Telegraph Cable Company; Mr. John Fritz, founder Bethlehem Steel & Iron Works; Mr. W. H. Fletcher, president Engineers' Club; Mr. A. B. Chandler, president Postal Telegraph-Cable Company.

Autographed souvenir menus have been prepared containing a colored photogravure of Mr. Edison and two original poems prepared by Mr. R. R. Bowker. The exercises will be as follows: Salutatory address by President B. J. Arnold; presentation of the medal fund and deed of gift by Mr. Samuel Insull, chairman of the Edison Medal Association; acceptance of same on behalf of the Institute by Dr. A. E. Kennelly, of Harvard University, past president; address on behalf of the colleges and universities by Prof. Cyrus F. Brackett, of Princeton University; address on behalf of the Association of Edison Illuminating Companies by President J. B. McCall; address on behalf of the National Electric Light Association by President Charles L. Edgar.

Mr. Edison has flatly declined to speak, but in response to the toast in his honor has agreed to send from the table a telegraphic acknowledgment. It is a great many years since he used the key. He will use one of the original quad sets built by him for, and loaned by the Western Union Telegraph Company. The message will be received in the banquet hall on a Postal quad of latest date by President A. B. Chandler, of the Postal Telegraph Cable Company, and will then be read to the audience. These arrangements are in the hands of Mr. C. P. Bruch, assistant general manager of the Postal system, and Mr. J. C. Barclay, chief engineer of the Western Union system. A number of special cable messages and telegrams will also be received at the same time.

The seating arrangements provide for the accommodation of eight persons at each table. Orders for seats should be sent in at once and should be accompanied by cash or check, payable to Mr. Ralph W. Pope, secretary. Price of tickets, without wine: Gentlemen, $7; ladies, $5; admission to galleries, $1. In order to secure accommodation, responses should reach Mr. Pope not later than February 9, 1904, 95 Liberty Street, New York. Mr. Arthur Williams, chairman of the committee on decorations, has made elaborate preparations for ornamenting and illuminating the ball room, and the effect will be very pretty and appropriate.

A Striking Tesla Manifesto.

We reproduce herewith in slightly reduced fac-simile the first page of a four-page circular which has been issued this week by Mr. Nikola Tesla in a large square envelope bearing a large red wax seal with the initials, "N. T." At the back of the page which we reproduce is given a list of 93 patents issued in this country to Mr. Tesla. The fourth page is blank. The third page has a little vignette of Niagara Falls and is devoted to quotations from various utterances of Mr. Tesla. The first of these is from his lecture delivered

New York, January 1, 1904

I wish to announce that in connection with the commercial introduction of my inventions I shall render professional services in the general capacity of consulting electrician and engineer.

The near future, I expect with confidence, will be a witness of revolutionary departures in the production, transformation and transmission of energy, transportation, lighting, manufacture of chemical compounds, telegraphy, telephony and other arts and industries.

In my opinion, these advances are certain to follow from the universal adoption of high-potential and high-frequency currents and novel regenerative processes of refrigeration to very low temperatures.

Much of the old apparatus will have to be improved, and much of the new developed, and I believe that while furthering my own inventions, I shall be more helpful in this evolution by placing at the disposal of others the knowledge and experience I have gained.

Special attention will be given by me to the solution of problems requiring both expert information and inventive resource—work coming within the sphere of my constant training and predilection.

I shall undertake the experimental investigation and perfection of ideas, methods and appliances the devising of useful expedients and, in particular, the design and construction of machinery for the attainment of desired results.

Any task submitted to and accepted by me, will be carried out thoroughly and conscientiously.

Laboratory, Long Island, N. Y.
Residence, Waldorf, New York City.

Nikola Tesla

PAGE FROM CIRCULAR SHOWING TESLA TOWER, WARDENCLIFFE, LONG ISLAND.

in 1893 before the Franklin Institute and the National Electric Light Association, as to transmission of intelligible signals and power to any distance without the use of wires. The second quotation is from his article on the problem of increasing human energy, which appeared in the *Century Magazine* in June, 1900, dealing with virtually the same subject. The third item quotes from his patents, Nos. 645,576 and 649,621, dealing with the transmission of electrical energy in any quantity to any distance, with transmitting and receiving apparatus movable as in ships or balloons. The circular is an extremely interesting one. It is most sumptuously got up on vellum paper and altogether constitutes a manifesto worthy of the original genius issuing it. It is to be gathered from the circular that Mr. Tesla proposes to enter the field of consulting engineering, in which he already has enjoyed an extensive connection here and abroad.

Three-Wire Direct-Current Railway System.

THE country in the neighborhood of Grenoble, suituated as it is in the Alpine region to the southeast of France, is justly renowned for its picturesque scenery, and this part of the Dauphiné is visited by numerous tourists every year. On the other hand, a certain number of villages, especially those lying in the picturesque valley of Gresivaudan, were lacking in a good means of communication. Owing to these reasons it was considered desirable to construct an electric railway system which should start from Grenoble and take in a number of the suurounding localities. Hydraulic power, which is already used to such a large extent for operating electric plants in the Grenoble region, was called upon here to give the necessary current for the plant.

The line which has been recently constructed starts from Grenoble and runs to the town of Chapareillan, covering a total distance of 26 miles. It gives tourists an opportunity to admire the natural beauties of the country and its advent has been warmly welcomed by the inhabitants of the different localities, as it has given a great stimulus to the commerce and industry of the region.

The Grenoble system presents a novel feature in the use of the direct-current, three-wire system for supplying the motors of the cars. The trolley line is double and constitutes the two outside wires of the system. The middle wire is connected to ground. The motors work

FIG. 1.—MAP OF LINE.

two in series upon 1,200 volts between the trolley wires. The middle connection between the motors is grounded.

Up to the present the maximum voltage which has been employed for direct current traction systems in Europe varies from 550 to 650 volts. The limit of tension, which is relatively small, kept the section of copper which is needed for the circuits at a high value. While the three-wire system now effects a considerable saving in copper for lighting and power circuits, it has not been applied to any extent upon electric traction systems, and therefore a description of the Grenoble-Chapareillan road may prove not without interest.

The tension of the overhead line at the terminals is 1,200 volts, the third or neutral wire being connected to the ground by means of a copper cable of 125 square millimeters section which is connected to the rails of the track, this forming the return circuit.

After leaving Grenoble the traction line crosses the Isère River and follows along its right hand. Besides a number of small villages, it supplies the stations of Meylan, Montbonnot-St. Martin and St. Ismier. It crosses the torrent of Manval over a metallic viaduct of 50 ft. length, and passes through Bermin, Crolles and Lounet. After crossing the torrent of Bresson by a stone-arched bridge 40 ft. long, it passes through St. Vincent de Mercuze and Barraux, and finally arrives at the terminus at Chapareillan after crossing the stream of

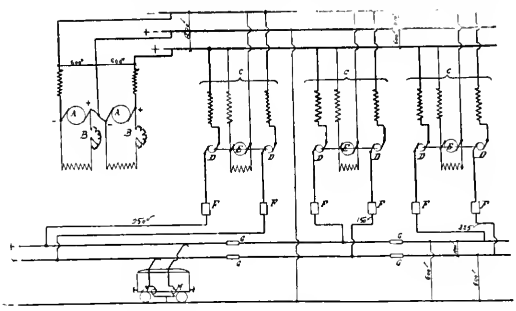


FIG. 2.—DIAGRAM OF CIRCUITS.

the Cernon over a steel bridge of 32 ft. As will be observed, the construction of the line has not required a great amount of engineering work, but steep grades have been frequently met with. The altitude of Grenoble is about 212 meters above the sea-level. The highest point of the line is at La Flachère, which is situated at 423 meters above sea-level. The difference of level between these two points is thus more than 200 meters. It is in the neighborhood of La Flachère that the heaviest grades are encountered.

The total length of the traction line is 26 miles. The overhead line consists of two hard-drawn copper wires 9 millimeters in diameter stretched at a distance of 28 inches apart. The line is supported by bracket poles or by suspension wires which are stretched across the track from poles or rosettes. At the crossing points, four overhead wires have been established, as also at the larger stations along the line, in order to allow the cars to be easily switched. The portion of the track which has been laid within the city of Grenoble is constructed of grooved rails on the Broca system weighing 80 pounds per yard. Outside the city the track is laid with rails of the railroad type which weigh 50 pounds per yard. The line is of one meter gauge throughout the entire length. Special care has been given to secure the proper bonding of the rails.

The motor cars and trailers for the Grenoble line have been constructed by the Compagnie Française du Material de Chemins de Fer, at the large establishment at Ivry, near Paris. The cars have been fitted out by Schneider & Company, of Creusot. The motor cars are of the usual tramway pattern with central passage and side seats, with sufficient motor capacity to draw two trailers of the same size or a freight car. These cars will contain 36 persons and their weight when empty is 9.2 tons. Each of the motor cars is equipped with two four-pole motors of the Thury pattern which have a capacity of 35-hp each. The motors are coupled in series and work at a tension of 1,200 volts. The starting switches and resistances are placed on the roof of the car and are operated from the motorman's platform by a hand-wheel and transmission system. The two ends of the car are symmetrical so as to avoid turning the car about at the terminal stations. When the car comes to the end of the line, the motorman detaches his hand wheel and carries it to the other platform. By putting it in place he makes an automatic connection which changes the direction of the current in the motors. The latter work on the single reduction system

The trains are made up usually of a motor car and two trailers, and are equipped with hand and electric brakes, which are applied on all the cars. The electric brakes can either receive their current from the overhead line, or the motors themselves are used as brakes, in which case the latter are operated as dynamos on short-circuit. The passenger cars are electrically lighted and heated. In this case the current is taken from only one of the overhead wires. The car carries two trolleys which use the ordinary type of pole; the trolley itself consists of a sliding cross-bar which is pressed against the overhead wires by a spring giving a pressure of 22 pounds. The present plant is laid out so as to secure the continuous operation of 9 trains of 30 tons each, comprising 8 trains for passengers and one freight train. Of the latter several different types of cars are now in use as well as a combination freight and passenger train.

The generating station which supplies the entire line is situated at Lancey, a small village about 10 miles from Grenoble and along the line of the road, but distant from it by three kilometers, lying on the other side of the Isère River. The water is taken from a hydraulic establishment which has been already installed by M. Berges. It affords a head of water of 1,470 ft. with a large available supply of power. The water arrives at the new hydraulic station of Lancey by a high-pressure penstock of riveted sheet iron, at a pressure of about 600 pounds per sq. in. It is distributed to the turbines by a large collector conduit which is placed outside of the station building. From the main conduit a separate branch runs into the building to supply each of the turbines. The latter, which are of the centrifugal type, are provided with gate-valves of special construction in order to take up the high water pressure.

The turbines, which have been built by Brenier and Neyret, of Grenoble, one of the largest French constructors, are at present three in number, of which one is used as a reserve. Each of these turbines has a capacity of 340-hp and operates at 325 revolutions per minute. These turbines are provided with speed regulators which keep the speed nearly constant at varying loads.

As the turbines use a considerable water supply, it became very difficult to measure the water which passed through them by a direct method. M. Berges adopts an indirect method by which a fractional part of the water is measured. The water coming from the turbines passes into the bottom of a large funnel-shaped recipient and mounts to the top. The upper portion of the vessel is cylindrical and is pierced with 80 rectangular openings or windows which are disposed around the periphery. These openings have been carefully calibrated to the same size and the lower edges are all on the same line. The water which arrives in the reservoir will flow out of the openings, and the height of the water in the opening gives an indication of the volume of flow. The system thus gives 80 streams of water, all alike, seeing that the size of the openings is equal.

FIG. 3.—OVERHEAD CONSTRUCTION.

One of these streams is then used to measure the volume of the total flow. The stream which is chosen for the purpose is sent through a water-meter of suitable construction and it only remains to multiply the reading by 80 in order to obtain the final result.

The station is equipped with three railway generators which deliver continuous current for the line. These generators, which have been constructed by Schneider & Company at the large Creusot works (France) are direct-coupled to the turbines which have been previously mentioned. They are of the Thury type with the hexagonal form and consequent pole disposition which is characteristic of this system. These machines have a capacity of 420 amperes and operate at 600 volts. The field, which has 6 poles, is compound wound. The fine wire winding of the field circuit has in series with it a rheostat for the field regulation. An automatic Thury electric regulator is used to operate this rheostat, and keeps the difference of potential at the bus-bars constant.

The two generators which are employed for the tramway lines are coupled in series, with a neutral wire coming from the middle connection, so as to produce a difference of potential of 1,200 volts between the end bars of the switchboard, of 600 volts between each of the outside bars and the middle. The distribution switchboard of the machines carries the apparatus which are generally employed in traction plants, together with some special devices which are needed for working the two machines in series on the three-wire system. The middle or neutral bar of the switchboard is connected directly with the tramway rails, which serve as a return conductor. The connection is made by a cable having a section of 125 square millimeters copper.

FIG. 4.—MOTOR CAR AND TRAILER.

From the bars of the switchboard start three groups of two feeders each, for supplying the traction line. In consequence, the feeding points are three in number and the cables are connected in at the points where the consumption of current and therefore the drop in the line is the highest. These points occur at Grenoble and Chapareillan, the ends of the traction line, and at Les Drogeaux, near the middle. In order to compensate automatically for this drop in the line, each of the feeders is made to pass through a booster group which is composed of a motor and two generators which give the extra voltage.

The motors of the booster groups are connected across the end bars of the switchboard, or upon 1,200 volts. Their fields are compound-wound and the motors are thus able to operate at a nearly constant speed under varying conditions of load. The motors vary in size and horse-power according to the number of volts which the generators they drive are required to furnish for the boosting action. The Grenoble feeder requires 360 volts, and the Chapareillan feeder 225 volts. The third feeder connecting in at Les Drogeaux needs but 150 volts additional. The booster set for the Grenoble feeder is composed of a motor which drives two generators having a total capacity of 80-hp. The second group uses a 56-hp set consisting of a motor which drives two four-pole generators and gives 225 volts. The group for the Les Drogeaux feeder is similar, but gives only 40-hp. In all these groups the generators which serve as boosters are direct-connected to the motors by Rafford elastic couplings and work at constant speed. The generators are series wound.

Before connecting with the traction line the feeders pass through a second switchboard where connection is made with the booster circuits. The switchboard carries the measuring and regulating apparatus which are usual in such case; among others, a set of automatic circuit-breakers placed on the feeders protects the boosters against overloads or short circuits. An automatic mechanical device is used with the boosters. Each machine carries at the end of the shaft a governor which comes into action should the boosters tend to rotate in the opposite direction. It throws the armatures of the boosters in short-circuit in the case where the motor is disabled, so as to prevent the generators from acting as motors under the current which they receive, in which case they would have a tendency to race, seeing that they would then work under no load. Improved lightning arresters of the Thury pattern give an efficient protection of the circuits. These lightning arresters are formed of a long articulated arm, which carries a set of teeth on the extremity and breaks the circuit by drawing out a long arc.

The general arrangement of circuits for the Grenoble system is shown in the diagram, Fig. 2, where *A* is the compound-wound generator; *B*, automatic rheostat for generator; *C*, booster group; *D*, series booster; *E*, compound-wound booster of motor group; *F*, automatic circuit breaker; *G*, section insulator; *M*, car motor.

The main three-wire circuit which will be noted in the upper part of the diagram, starts from the Lancey hydraulic station, crosses the railroad line on a special bridge and then traverses the isère River which is about 400 ft. wide at this point. The three-wire circuit is formed of 6 conductors of bare copper, having a section varying from 125 to 65 square millimeters and a return cable of 125

FIG. 5.—END VIEW OF A CAR.

square millimeters section. A telephone line which unites all the tramway stations and posts of the sytem follows the same traject. All the conductors are supported by double porcelain insulators which are fixed upon metallic poles of the André system.

The above description will serve to bring out the main features of this somewhat novel system of traction lines. The operation of the road from the start has proved eminently satisfactory, and does credit to the system of direct-current motors and generators which has been designed by M. René Thury and which are now in successful operation in a large number of European plants. The use of boosters in connection with a plant of this kind will also be remarked as somewhat of a novelty.

N. E. L. A. Convention Date.

The date of the twenty-seventh annual convention of the National Electric Light Association has been fixed by the executive committee. The meeting will be held in Boston May 24, 25 and 26, a very agreeable period of the year in that vicinity. The name of the hotel selected as headquarters has not yet been announced.

Legal Conditions of Co-operative Telephony.

A very interesting decision as to the rights of a member of a "co-operative" telephone company has recently been given by the Supreme Court of the State of Indiana in the appeal of Arthur B. Irvin against the Rushville, Ind., Co-operative Telephone Company. The lower decision in favor of the company was sustained. The company has been for more than eight years past engaged in carrying on a general telephone business in the city of Rushville, Ind., and had, at the time of its organization, adopted the plan of allowing patrons who desired telephone service to become stockholders in the company, to purchase and own their own telephones, and to purchase and own their own wires leading from the location of their said telephones over the pole lines of the defendant to its exchange, and to pay a rental at the end of each month of a sum sufficient to pay the operating expenses of said company. Under this arrangement the plaintiff purchased and paid for one share of stock in said company, purchased a first-class telephone, and also paid for a line of wire leading from his residence to the local switchboard. A dispute arose over the monthly payment and at last Mr. Irvin was cut off. The points are enumerated clearly below summarizing the decision, which is of more than usual interest:

"Where, in an action against a telephone company for refusing to furnish plaintiff with switchboard connections, the complaint did not allege that there had been any discrimination against plaintiff's 'business,' it did not state a cause of action within Burns' Rev. St. 1901, §5529, providing that no telephone company shall discriminate against any individual or company engaged in any lawful business.

"A rule of a co-operative telephone company that all moneys due from its patrons for toll-line connections are payable on or before the 5th day of the month succeeding the maturity of the indebtedness, and, if not paid, the service of the delinquent patron shall be disconnected until the indebtedness is paid, is a reasonable regulation, which the company is entitled to enforce.

"Where a telephone company had promulgated a rule that claims for service must be paid on a particular day on pain of having the patron's service refused, and the patron was charged with notice of the rule, and with the fact that he had violated it, the telephone company was justified in refusing service without informing him at the time of its refusal as to its reason therefor.

"Where a telephone company had established and promulgated a rule requiring payment of previous tolls on a particular day on pain of having the service discontinued, the mere fact that the company had not enforced such rule against third persons before cutting off plaintiff's service for non-compliance therewith did not, of itself deprive the company of its right to enforce the rule against plaintiff.

"Where a public telephone company had promulgated a rule requiring payment of past tolls by subscribers on a particular day on pain of discontinuance of service, it was entitled to enforce payment of such dues and tolls by denying service, regardless of the fact that the subscriber claimed that the company was indebted to him to an amount exceeding the tolls due.

"Where, in an action to recover a statutory penalty against a telephone company for cutting off plaintiff's service for its failure to comply with a rule requiring payment of past tolls on a particular day, the complaint alleged that the rule had not been enforced as against 35 other patrons of the company who 'were in like situation with the plaintiff,' but did not allege that such other patrons were in default, or had refused to pay, it was insufficient to show a discrimination against plaintiff in the enforcement of the rule prohibited by Burns' Rev. St. §5529.

"Plaintiff owned stock in a co-operative telephone company, together with his telephone instrument and his line of wire to the exchange. Plaintiff was entitled to exchange connections on payment of certain tolls, and was subject to a rule providing that the company might discontinue connections for failure to pay past tolls on a specified date. Plaintiff, claiming that the company was indebted to him in excess of tolls claimed, refused to pay the tolls, and his service was discontinued. Held, that such discontinuance did not deprive plaintiff of his property without due process of law."

A New Wireless Telegraph System.

A Washington dispatch states that the Department of Agriculture has perfected a system of wireless telegraph which differs both from the Marconi and De Forest systems. The system, it is stated, is now in successful operation between San Francisco and the Farallones Islands, a distance of about 27 miles.

On the Wave Length of Free Vibrations in Antennae and Closed Oscillating Circuits.

By Dr. James E. Ives.

CERTAIN experiments on the wave lengths of antennæ and of closed circuits, which I have recently made on behalf of the De Forest Wireless Telegraph Company, appear to me to be of sufficient general interest to warrant their publication. They deal with the change in wave length produced by inserting turns of a wire helix in the antenna, or in a closed circuit, and also with the reaction between a closed circuit and the antenna. All the experiments described were made at the De Forest station at the Hotel Castleton, Staten Island, N. Y.

The measurements of wave length were made with an instrument designed conjointly by Dr. Lee De Forest and the author. The details of its construction, the method of calibrating it and the manner of its use will be described in another article. The experiments may best be discussed by referring to the figures and diagrams.

Fig. 1 shows the effect of inserting turns of a wire helix in the antenna. A diagram of the connections is shown in the right-hand lower corner of the figure. *e* is the earth wire, going to the ground plate; *a*, the aerial wire passing through the roof of the station, and *h* is the helix. *a* consisted of two No. 14 wires about a foot apart, and 62 ft. long; *e* of a single wire about 27 ft. long. The total length of the antenna, measured to the earth plate was, therefore, about 89 ft. The helix had a diameter of one foot, and consisted of 21 turns of No. 14 wire, an inch apart.

The curve shown in the figure is very nearly a straight line, as

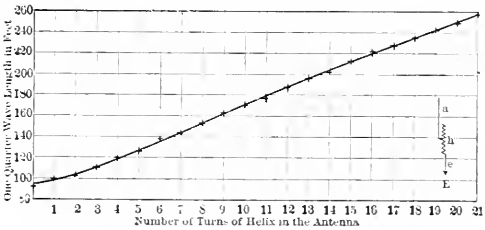


FIG. 1.—CURVE SHOWING EFFECT OF PUTTING TURNS OF HELIX IN ANTENNA.

might have been expected, since the wave length of the antenna varies as the square root of its inductance, and its inductance varies roughly as the square of the number of turns inserted. This may be stated mathematically as follows:

Let v represent the velocity of light or of electric waves in air.
n, the frequency of the electrical oscillations in the antenna.
λ, the wave length of the oscillation.
T, the period of the oscillation.
L, the inductance of the antenna.
C, its capacity.

Then since

$$v = n\lambda \tag{1}$$

$$\lambda = \frac{v}{n} \tag{2}$$

and since

$$n = \frac{1}{T} \tag{3}$$

and

$$T = 2\pi\sqrt{LC}, \tag{4}$$

$$\lambda = 2\pi v\sqrt{LC}. \tag{5}$$

But

$$L = k^2n^2, \text{ approximately,} \tag{6}$$

where k is a constant, depending upon the shape and size of the helix. Therefore,

$$\lambda = 2\pi v k n \sqrt{C} \tag{7}$$

But C, the capacity of the antenna, may be considered a constant for an antenna of a given height, since the potential loop being at its free end and the node at its base, the charge that it holds will not be much affected by putting in turns of a helix near its base. Therefore,

$$\lambda = n \times \text{constant} \tag{8}$$

Fig. 2 deals with a closed oscillating circuit made up of four Leyden jars in series, and a certain number of turns of the helix

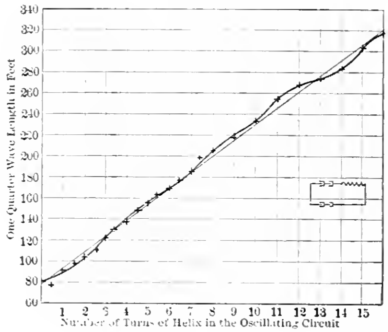


FIG. 2.—CURVE SHOWING EFFECT OF ADDING TURNS OF HELIX TO A CLOSED CIRCUIT.

already described. It shows how the wave length of the circuit is changed by adding turns of the helix. The quarter wave length is plotted as a function of the number of turns inserted. The curve varies irregularly on both sides of a straight line. For the reasons

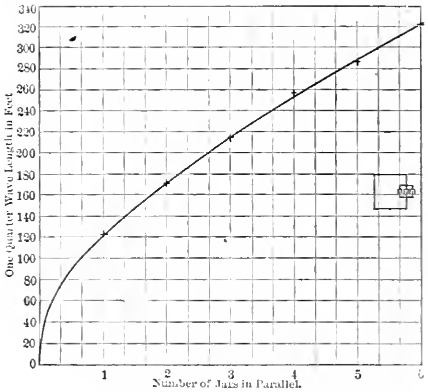


FIG. 3.—CURVE SHOWING EFFECT OF INCREASING THE CAPACITY OF A CLOSED CIRCUIT.

already given we should expect it to approximate to a straight line, since the wave length should be approximately a linear function of the number of turns inserted.

Fig. 3 also deals with a closed circuit and shows the effect upon its wave length of changing the number of Leyden jars inserted in

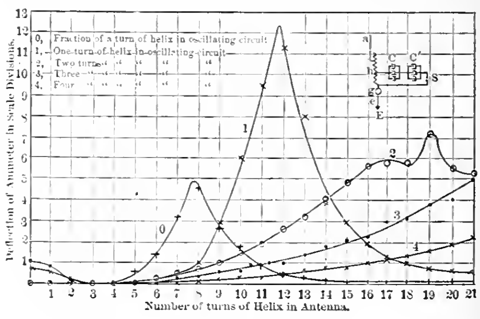


FIG. 4.—CURVE SHOWING RESONANCE OF ANTENNA WITH THE OSCILLATING CIRCUIT.

parallel. In this case the capacity of the circuit is changed, while its inductance is kept constant. The curve obtained is parabolic in form, as might be expected from equation (7), where it is seen that if the inductance remains constant the wave length of the circuit will vary as the square root of the capacity.

Fig. 4 is perhaps the most interesting curve of the series. As shown by the diagram of the circuits (in the right-hand upper corner of the figure), the antenna and the closed circuit are linked together, so that certain turns of the helix are common to both. The spark-gap is placed in the closed circuit, and the electrical disturbances set up in this circuit are, therefore, communicated to the antenna through the linked portion of the helix. The curve shows that the oscillating current in the antenna may be greatly increased by bringing the antenna into resonance with the closed circuit.

In the diagram, *a* is the antenna proper; *h* the helix already described; *e* the earth wire containing the hot-wire ammeter, *g*, on which the current readings were taken; *c* and *c'*, two sets of three Leyden jars, and *s* a spark-gap. The spark-gap was excited by an induction coil. The experiment was made by putting a certain number of turns of the helix in the closed circuit, and then varying the

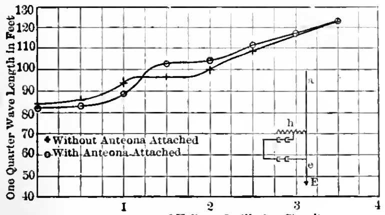


FIG. 5.—CURVE SHOWING EFFECT OF A LINKED ANTENNA ON WAVE LENGTH OF A CLOSED CIRCUIT.

number of turns in the antenna from 0 to 21. Five sets of readings were made giving the five curves shown in the figure. It is evident from the figure that for the cases of 3 and 4 turns in the closed circuit, more than 21 turns would have to be inserted in the antenna to

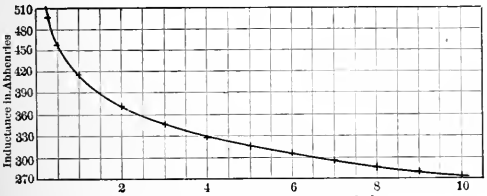


FIG. 6.—CURVE SHOWING RELATION BETWEEN THE INDUCTANCE OF A WIRE ONE FOOT LONG AND THE DIAMETER OF THE WIRE.

bring it into resonance with the closed circuit. The irregularity of the peak of curve 2 is perhaps due to the presence of an overtone.

Fig. 5 shows the results of an experiment made to determine how the wave length of a closed circuit is affected by a linked antenna.

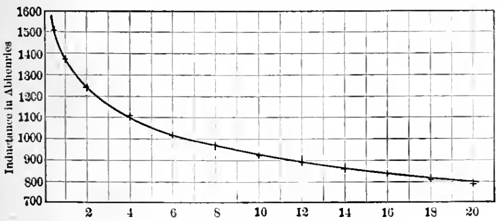


FIG. 7.—CURVE SHOWING RELATION BETWEEN THE INDUCTANCE OF A CIRCLE OF WIRE ONE FOOT IN DIAMETER AND THE DIAMETER OF THE WIRE.

The wave length of the closed circuit was first measured without the antenna attached, and then with it attached. The character of the closed circuit was varied by changing the number of turns of the helix. The connections are shown by the diagram in the lower right-hand corner of the figure. The solid and dotted curves respectively give the wave lengths for the two cases. It will be noticed that the two curves cross each other for a quarter wave length of 96 ft., which was the quarter wave length of the antenna as used in this experiment, i. e., without any turns of the helix. It will be noticed in the figure that for three and a half turns of the helix in the closed circuit, the two curves come together. For any number of turns greater than this it was found that the two curves still coincided. It therefore follows that when the wave length of the antenna is in the neighborhood of that of the closed circuit, the wave length of the closed circuit is decreased or increased by the linked antenna, according as the wave length of the oscillating circuit is less or greater than that of the antenna.

Figs. 6, 7 and 8 give theoretical and not experimental data. Fig.

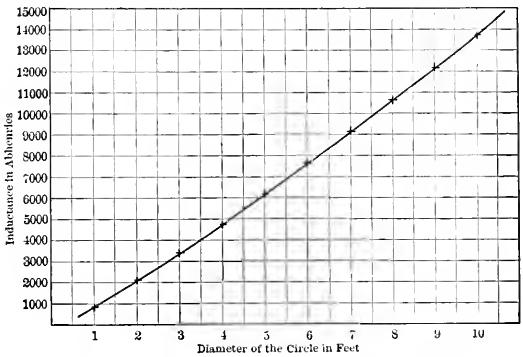


FIG. 8.—CURVE SHOWING THE RELATION BETWEEN THE INDUCTANCE OF A CIRCLE OF NO. 10 WIRE AND ITS DIAMETER.

6 is a calculated curve showing the relation between the inductance of a wire one foot long and the diameter of the wire. The diameter of the wire is given in one-hundredths of an inch, and the inductance in abhenries, or absolute units. The curve was calculated from the formula for rapid oscillations,

$$L = 2l \left[\log_e \frac{2l}{\varrho} - 1 \right]$$

where l is the length of the wire, and ϱ its radius, both in centimeters. This curve can be used to calculate the inductance of a single-wire antenna of any length and diameter.

Fig. 7 is a calculated curve, showing the relation between the inductance of a circle of wire one foot in diameter, and the diameter of the wire. The diameter of the wire is given in one-hundredths of an inch, and the inductance in abhenries. The inductance was calculated from the formula for rapid oscillations,

$$L = 4\pi R \left[\log_e \frac{R}{\varrho} + .08 \right]$$

where R is the radius of the circle, and ϱ the radius of the wire, both in centimeters.

Fig. 8 is a calculated curve showing the relation between the inductance of a circle of No. 10 wire and the diameter of the circle. (The diameter of No. 10 wire is .102 inch.) The diameter of the circle is given in feet, and the inductance in abhenries. This curve was calculated from the same formula as Fig. 7.

My thanks are due to my assistant, Mr. James B. Gottsberger, for his assistance in these experiments, and for plotting the curves.

Paris Subway Charms.

A cable dispatch to the newspaper press from Paris, dated January 23 says: "Vital statistics published lately concerning the Paris Metropolitan are not likely to encourage New Yorkers to seek jobs on Manhattan's new subway unless better conditions prevail. The figures show that since the Metropolitan was established, four years ago, no less than 50 per cent. of the employees have died, been killed or have left on account of bad health. The publication of statistics has started another spasm of reform, which may have permanent result in good." We think New York's subway will be able to do better than this.

The Measurement of Distributed Leakage on Transmission Lines.

BY FRANK F. FOWLE.

THE line insulation of circuits employed in various kinds of transmission often determines one of the limits of commercial operation. Especially is this true as regards the effect of weather on very long lines of bare wire. On short lines the requirements of insulation are usually prescribed by considerations of electrical balance, stray foreign currents, lost energy, electrolysis and fire risks. On very long lines the requirements of insulation are usually prescribed by the permissible attenuation of energy. With bare wires the limiting weather conditions will determine the maximum attenuation.

There being no sources of potential in the leakage paths, the leakage will depend on the state and the material of the insulating covering on the wire, on the size, shape and frequency of the insulating supports and on the specific resistance, and the surface conditions of the supports. On long lines insulated wire is usually employed only at places exposed to injurious gases or contact with foreign wires or objects. On long aerial lines the leakage resistance is practically concentrated in the thin films of matter on the surfaces of the insulators. Dry wood is a very fair insulator if it has not been treated by any preserving process. Under wet weather conditions the poles and cross arms become conducting, to a very considerable extent, in those portions penetrated by moisture. The practice of fastening iron wires to the poles with staples, from the top to the butt below ground, as a protection from lightning, considerably increases the leakage in wet weather, in the case of circuits having earth returns. The surfaces of the insulators, which are dry under all conditions, constitute the constant part of the insulation resistance and these surfaces should be of maximum length and minimum breadth. Direct escape into the atmosphere is probably very slight except where saturated vapors of a conducting nature are encountered.

The number of insulating supports per mile varies from twenty-five to fifty; it may be assumed without question that the leakage on long lines is uniformly distributed. The methods of measuring insulation resistance are based on the laws of distribution of current and potential, in the steady state, on a uniform line possessing resistance and leakage. Consider a line of length l, of uniform resistance r, and leakage conductance g per unit length. The leakage conductance is the reciprocal of the leakage resistance per unit length.

If r = resistance in ohms per mile,
g = leakage conductance in mhos per mile,
l = length of the line in miles,
E = the potential of the line at any point x,
I = the current at the point x, the fundamental equations are:

$$-\frac{\delta E}{\delta x} = r I \tag{1}$$

$$-\frac{\delta I}{\delta x} = g E \tag{2}$$

whose solution may be derived as follows:

$$\frac{\delta^2 E}{\delta x^2} = -r\frac{\delta I}{\delta x} = r g E \tag{3}$$

$$\frac{\delta^2 I}{\delta x^2} = -g\frac{\delta E}{\delta x} = r g I \tag{4}$$

$$\therefore \quad E = A\,\varepsilon^{\beta x} + B\varepsilon^{-\beta x} \tag{5}$$

where A and B are the arbitrary constants of integration and ε is the base of the Naperian system of logarithms.

$$\frac{\delta^2 E}{\delta x^2} = \beta^2 E \tag{6}$$

from (5).

$$\therefore \quad \beta = \sqrt{r g} \tag{7}$$

From (1)

$$I = -\frac{1}{r}\frac{\delta E}{\delta x}$$

$$= -\frac{\beta}{r}\left(A\,\varepsilon^{\beta x} - B\,\varepsilon^{-\beta x}\right)$$

$$I = \frac{-A\,\varepsilon^{\beta x} + B\,\varepsilon^{-\beta x}}{K} \tag{8}$$

where

$$K = \sqrt{\frac{r}{g}}\,. \tag{9}$$

The distribution of current and potential in the line is now determined in so far as the properties of the line determine it. The conditions at the two terminals determine the constants A and B, and completely solve the problem. At $x = 0$, the home or sending terminal, assume an e.m.f. acting on the line through a resistance. From (5) we have,

$$A + B = E_0 - I_1 r_1, \tag{10}$$

and from (8)

$$\frac{-A + B}{K} = I_1 \tag{11}$$

where I_1 is the current through the resistance r_1, due to the e.m.f. E_0.

At $x = l$, the distant or receiving terminal, assume the line to be closed through a resistance r_2.

From (5) and (8) we have,

$$A\,\varepsilon^{\beta l} + B\,\varepsilon^{-\beta l} = I_2\, r_2 \tag{12}$$

$$\frac{-A\,\varepsilon^{\beta l} + B\,\varepsilon^{-\beta l}}{K} = I_2 \tag{13}$$

$$A\left(1 - \frac{r_1}{K}\right) + B\left(1 + \frac{\;}{K}\right) = E_0$$

$$A\,\alpha_1 + B = \frac{1 + \alpha_1}{2}\,E_0,$$

$$\text{where } \alpha_1 = \frac{K - r_1}{K + r_1} \tag{14}$$

$$A\left(1 + \frac{r_2}{K}\right)\varepsilon^{\beta l} + B\left(1 - \frac{r_2}{K}\right)\varepsilon^{-\beta l} = 0,$$

$$A\,\varepsilon^{\beta l} + \alpha_2\, B\,\varepsilon^{-\beta l} = 0,$$

$$\text{where } \alpha_2 = \frac{K - r_2}{K + r_2} \tag{15}$$

$$-B\alpha_1\alpha_2\,\varepsilon^{-2\beta l} + B = \frac{1 + \alpha_1}{2}\,E_0.$$

And finally,

$$A = \frac{-\alpha_2\,\dfrac{1 + \alpha_1}{2}\,E_0\,\varepsilon^{-2\beta l}}{1 - \alpha_1\,\alpha_2\,\varepsilon^{-2\beta l}} \tag{16}$$

$$B = \frac{\dfrac{1 + \alpha_1}{2}\,E_0}{1 - \alpha_1\,\alpha_2\,\varepsilon^{-2\beta l}} \tag{17}$$

The usual methods of measuring insulation resistance employ a battery and measuring apparatus at the home end, with an insulated or open terminal at the distant end. An exact method, presented later, employs both an insulated and a short-circuited terminal at the distant end.

When $r_2 = \infty$

$$\alpha_2 = -1 \tag{18}$$

and when $r_2 = 0$,

$$\alpha_2 = 1 \tag{19}$$

Also, when $r_2 = K$,

$$\alpha_2 = 0 \tag{20}$$

and

$$\left.\begin{aligned} A &= 0, \\ B &= \frac{1 + \alpha_1}{2} E_0 \end{aligned}\right\} \tag{21}$$

By an inspection of (11) and (20) it will be seen that the physical interpretation of K is the outgoing resistance of an indefinitely long line, measured at the home end. Also, if the line be cut at any point and closed through a terminal resistance equal to K, the distribution of current and potential will be the same as in the indefinitely long line, and as though the terminal did not exist. The coefficients α_1 and α_2 are termed coefficients of reflection.

In the general case the outgoing resistance of a line is, from (10) and (11),

$$K_1 = K \frac{A + B}{-A + B} \tag{22}$$

$$= K \frac{1 - \alpha_2 e^{-2\beta l}}{1 + \alpha_2 e^{-2\beta l}}$$

$$= K \frac{e^{\beta l} - \alpha_2 e^{-\beta l}}{e^{\beta l} + \alpha_2 e^{-\beta l}}$$

When $r_2 =$ and $\alpha_2 = -1$,

$$K_1 = K \coth \beta l. \tag{24}$$

When $r_2 = 0$ and $\alpha_2 = 1$,

$$K_1{}^1 = K \tanh \beta l. \tag{25}$$

The exact method of measuring insulation resistance consists in measuring the current and the potential on the line at the home end,

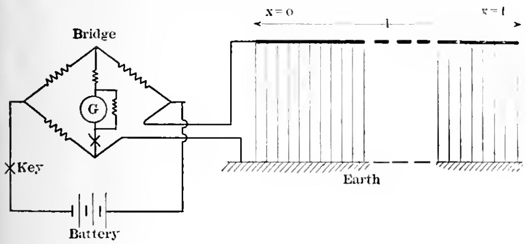


FIG. 1.

when the distant end is open or insulated and also when it is closed through zero resistance or short-circuited.

If K_1 is the measured resistance at $x = 0$, when $r_2 =$ and $K_1{}^1$ is the measured resistance when $r_2 = 0$, we have from (24) and (25):

$$\tanh \beta l = \frac{K}{K_1} = \frac{K_1{}^1}{K}, \tag{26}$$

$$K^2 = \frac{r}{g} = K_1 K_1{}^1 \tag{27}$$

and

$$g = \frac{r}{K_1 K_1{}^1}$$

or

$$R = \frac{K_1 K_1{}^1}{r} \tag{28}$$

where R is the insulation resistance in ohms per mile and r, K_1 and $K_1{}^1$ are expressed in ohms.

The bridge method consists in using the ordinary Wheatstone bridge for measuring K_1 and $K_1{}^1$, and the circuit employed is shown in Fig. 1.

When l and g are small, the approximate formula (29) may be used:

$$R = l K_1 \tag{29}$$

and only one reading is necessary. Readings should be taken with the positive and the negative poles of the battery to line. The average reading may be used in the formula. A marked discrepancy in the readings indicates a source of e.m.f. in the leakage paths. The objections to the method are the effect of earth currents or

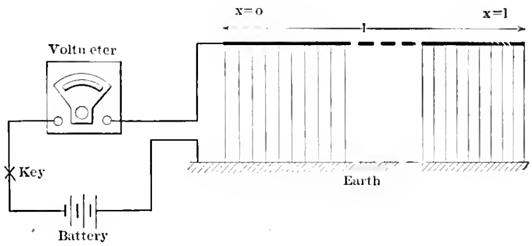


FIG. 2.

induced currents on the galvanometer and the time required to take readings.

The voltmeter method is simpler, quicker and requires less apparatus. It is necessary to know the voltage of the measuring battery and the internal resistance of the voltmeter. The procedure is the same as in the last method, readings being taken with $r_2 = \infty$ and $r_2 = 0$. The circuit is shown in Fig. 2.

Let the voltmeter reading be V_1 when $r_2 = \infty$, and $V_1{}^1$ when $r_2 = 0$. Then

$$K_1 = \frac{E_0 - V_1}{\frac{V_1}{r_1}} = \left(\frac{E_0}{V_1} - 1\right) r_1 \tag{30}$$

And

$$K_1{}^1 = \frac{E_0 - V_1{}^1}{\frac{V_1{}^1}{r_1}} = \left(\frac{E_0}{V_1{}^1} - 1\right) r_1 \tag{31}$$

where r_1 is the voltmeter resistance. Therefore, we have from (28):

$$R = \left(\frac{E_0}{V_1} - 1\right)\left(\frac{E_0}{V_1{}^1} - 1\right)\frac{r_1{}^2}{r} \tag{32}$$

It is interesting to note that the length of the line does not appear in the formula. It is necessary to know the line temperature unless r is measured on a very short section of the line at the time the readings, V_1 and $V_1{}^1$, are taken. Slight variations in temperature may be neglected; the necessary precision in the temperature, when r is computed rather than measured, may be obtained from the equation expressing resistance as a function of the temperature and the resistance at a standard temperature.

It sometimes occurs that there is additional resistance at $x = 0$, due to protective coils or lamps in the battery taps. In this case V_1 and $V_1{}^1$ must be corrected. If

$$r_1 = r_1{}^1 + r_1{}^{11} \tag{33}$$

where $r_1{}^1$ is the additional resistance and $r_1{}^{11}$ is the voltmeter resistance, we have

$$V_1 = V\left(\frac{r_1{}^1}{r_1{}^{11}} + 1\right) \tag{34}$$

where V is the actual reading and V_1 the true corrected reading.

It often occurs that there is considerable cable between the measuring apparatus and the aerial line. In this case it is safe to assume that the cable leakage may be neglected and the cable resistance be inserted as r_1^1 in equation (34). If there is leakage in the cable the case becomes that of two lines, having resistance and leakage of different magnitudes, connected in sequence. The general formulas (1) to (17) may be extended to cover this case, but the number of necessary readings would be increased.

If l and g are small the following approximation may be made, because the line drop, lr, is very small compared with the total leakage resistance, $\frac{1}{lg}$. When $r_2 = 0$, we have:

$$E_0 = V_1^1 + \frac{V_1^1}{r_1} lr = V_1^1\left(1 + \frac{lr}{r_1}\right) \qquad (35)$$

$$\frac{E_0}{V_1^1} - 1 = \frac{lr}{r_1} \qquad (36)$$

And substituting in (32) we get

$$R = lr_1\left(\frac{E_0}{V_1} - 1\right) \qquad (37)$$

where the length of the line appears, but the resistance does not. This is the well-known formula used in the method requiring only a single reading. The extreme conditions of insulation give

$$\left.\begin{array}{l} V_1 = 0 \quad \text{when } R = \infty \\ V_1 = E_0 \text{ when } R = 0 \end{array}\right\} \qquad (38)$$

In measuring metallic circuits, it should be noted that r is twice the resistance of one wire per mile. If earth potentials are troublesome, in measuring the insulation resistance to earth in the exact method, the voltmeter should be read with no battery in circuit, in order to obtain a correction for the observations.

Measurements on a metallic circuit, from each wire to earth and from one wire to the other, should show that

$$(R_1 + R_2) \geqq R_{12} \qquad (39)$$

if R_1 and R_2 are the insulation resistances to earth of the two wires, respectively, and R_{12} is the insulation resistance between them. R_{12} should always be measured with a battery to which there is no earth connection.

The number of variables in equations (32) and (37) make the work of plotting curves a laborious matter. Curves would be of little use because of the variation of r_1 in practical work. The calculation of a few actual cases will serve to illustrate the matter.

EXAMPLE I.

Take 50 miles of No. 12 (N.B.S.G.) copper wire; a voltmeter with a scale of 0 to 150 volts and a resistance of 15,000 ohms; a battery of 100 volts and negligible internal resistance compared with the voltmeter resistance.

$$\text{Then}\left.\begin{array}{l} l = 50. \\ r = 5.13 \\ r_1 = 15{,}000. \\ E_0 = 100. \end{array}\right\}$$

Assume $R = 100$ megohms per mile,
or $g = 10^{-8}$ mhos per mile.

By calculation it is found that

$\beta = 0.0002265$ from (7)
$\beta l = 0.01132$,
$K = 22{,}650$ ohms, from (9)
$K_1 = 2{,}000{,}000$ ohms, from (24)
$K_1^1 = 256.5$ ohms, from (25)
$R = 100{,}000{,}000$ ohms, from (28)
$V_1 = 0.7444$ volt,
$V_1^1 = 98.32$ volts.

The error in (37) is negligible. The precision of V_1 is very poor, but for most cases R is so great that its effect is negligible, as far as transmission is concerned.

EXAMPLE II.

Take the wire of example I and assume
$R = 10$ megohms per mile,
or $g = 10^{-7}$ mhos per mile.

By calculation,

$\beta = 0.0007162$ from (7)
$\beta l = 0.03581$,
$K = 7{,}162$ ohms, from (9)
$K_1 = 200{,}100$ ohms, from (24)
$K_1^1 = 256.4$ ohms, from (25)
$R = 10{,}000{,}000$ ohms, from (28)
$V_1 = 6.974$ volts,
$V_1^1 = 98.32$ volts.

The error in (37) is negligible in this case also.

EXAMPLE III.

Take the wire of example I and assume
$R = 1.0$ megohm per mile,
or $g = 10^{-6}$ mhos per mile.

By calculation,

$\beta = 0.002265$ from (7)
$\beta l = 0.1132$,
$K = 2{,}265$ ohms, from (9)
$K_1 = 20{,}080$ ohms, from (24)
$K_1^1 = 255.4$ ohms, from (25)
$R = 1{,}000{,}000$ ohms, from (28)
$V_1 = 42.76$ volts,
$V_1^1 = 98.33$ volts.
$R = 1{,}004{,}000$ ohms, from (37)

The error in (37) is $+ 0.4$ per cent.

EXAMPLE IV.

Take the wire of example I and assume
$R = 0.1$ megohm per mile,
or $g = 10^{-5}$ mhos per mile.

By calculation,

$\beta = 0.007162$ ohms, from (7)
$\beta l = 0.3581$,
$K = 716.2$ ohms, from (9)
$K_1 = 2{,}085$ ohms, from (24)
$K_1^1 = 246.1$ ohms, from (25)
$R = 100{,}000$ ohms, from (28)
$V_1 = 87.80$ volts,
$V_1^1 = 98.39$ volts,
$R = 104{,}300$ ohms, from (37).

The error in (37) is $+ 4.3$ per cent.

EXAMPLE V.

Take 150 miles of No. 9 (B. W. G.) iron wire, with the same voltmeter and battery.

$$\text{Then}\left.\begin{array}{l} l = 150. \\ r = 20. \\ r_1 = 15{,}000. \\ E_0 = 100. \end{array}\right\}$$

Assume $R = 1.000$ megohm per mile,
or $g = 10^{-6}$ mhos per mile.

By calculation,

$\beta = 0.004472$ ohms, from (7)
$\beta l = 0.6708$,
$K = 4{,}472$ ohms, from (9)
$K_1 = 7{,}638$ ohms, from (24)
$K_1^1 = 2{,}619$ ohms, from (25)
$R = 1{,}000{,}000$ ohms, from (28)
$V_1 = 66.25$ volts,
$V_1^1 = 85.13$ volts,
$R = 1{,}146{,}000$ ohms, from (37).

The error in (37) is $+ 14.6$ per cent.

For short lines of copper the approximate method of (37) is sufficiently precise for most purposes. If the exact method of (32) is used the precision in R is poor if R is great, owing to the great difference between K_1 and K_1^1. For iron lines of moderate length and all very long lines the exact method of (32) should be used. For a given value of g, the error in (37) increases as r and l increase.

A method for the exact measurement of R and r has been given by Heaviside[1], and is of interest in this connection. The existence of concentrated leaks or non-uniformly distributed leakage renders the above theory inapplicable and the formulæ incorrect, and the theory of such cases belongs more properly to the subject of location of faults.

Direct escape into the atmosphere or the insulating dielectric is ordinarily negligible. The resistance of such paths may be calculated when the form and the specific resistance of the conductors are known, as shown by J. J. Thomson[2]. If the static capacity per

[1] "Electrical Papers," by Oliver Heaviside, vol. I, page 41, "On a Test for Telegraph Wires."

[2] "Elements of the Mathematical Theory of Electricity and Magnetism," by J. J. Thomson, page 312, §§ 196 and 197, on "Distribution of Current Through an Infinite Conductor."

unit length is C and σ is the specific resistance of the dielectric:

$$R = \frac{\sigma}{4 \pi C} \quad (40)$$

For a grounded line,

$$C = \frac{1}{2 \log \frac{2h}{r}} \quad (41)$$

For a metallic line,

$$C = \frac{1}{4 \log \frac{d}{r}} \quad (42)$$

And for concentric conductors,

$$C = \frac{1}{2 \log \frac{r_2}{r_1}} \quad (43)$$

where r is the radius of a wire, h the height of a wire above the earth and d the distance between two wires. Therefore, we have, for a single wire with earth return,

$$R = \frac{\sigma}{2 \pi} \log \frac{2h}{r} \quad (44)$$

For a metallic circuit,

$$R = \frac{\sigma}{4 \pi} \log \frac{d}{r} \quad (45)$$

And for concentric conductors,

$$R = \frac{\sigma}{2 \pi} \log \frac{r_2}{r_1} \quad (46)$$

If σ is the resistance in ohms between parallel faces of a cubic centimeter of the insulation and the logarithms be taken to the base ten, expressions (44), (45) and (46) will be expressed in ohms per mile if multiplied by the constant,

$$1.431 \times 10^{-5} \quad (47)$$

The value of the constant is small, but σ is ordinarily very great. The data on the subject of direct escape into saturated vapors, from suspended wires, is very meagre.

Elihu Thomson on Aeroplanes.

Considerable public interest has been shown in the remarks made by Prof. Elihu Thomson at the recent Walker dinner to Prof. Langley, on the subject of aeroplanes. Those remarks have been variously twisted and misquoted. Through the kind courtesy of Prof. Thomson we are now able to gratify the interest of our readers by presenting a revised abstract. Prof. Thomson says:

"I began by stating that I was very glad to be present on the occasion, and to do honor to Prof. Langley, whose work, in my opinion, had been of the highest importance to the problem of aerial flight; and by aerial flight I did not mean the moving about in the air of a dirigible balloon; for it seems to me that a gas-bag (however well arranged or braced) will always be at the mercy of the winds. If speeds of 100 to 150 miles an hour are ever to be attained in flight (and they should be attained to make aerial flight worth while) then the gas-bag must be left out of it, and we must rely upon the support of the air as a bird relies upon it.

"Looking at the subject from the standpoint of an engineer, it seems to me that when Dr. Langley constructed his original aerodrome which flew—the machine having within itself propelling machinery which could support itself in the air, and even rise in the air—he had solved the problem of aerial flight, from a mechanical standpoint. The small aerodrome of Prof. Langley (it was stated) had made numerous trips without difficulty; and surely it makes no difference to the problem whether it carried live freight or not. Who could doubt that a larger machine would have carried a man? It probably would have alighted with no greater difficulty. Nature has, in the bird, produced a mechanism for flying which it is not necessary that man should copy, any more than man should make his automobile with legs and feet, or his steamship with fins.

"The ideal machine must, however, have some of the bird's qualities. It will be noticed that the feathers of a bird have been evolved so that within these feathers a film of air may be carried by the bird, giving the result that in flying air is really moving upon air, resulting, as nearly as possible, in the absence of friction, which is the real obstacle calling for the expenditure of power. The feathers of the bird, also, by their yielding character and open structure practically reduce eddies to a minimum by conforming to the stream lines. The provision of the bird's feathers corresponds in function with that other most perfect covering for a fish, its body being covered with a gelatinous film, something which is as nearly like water as is possible, but is not washed off by the water; the result being that in the fish's motion there is almost (if not quite) a motion of one liquid upon another, with the elimination of much of the resistance encountered. Here again the long, tapering body of the fish, and the delicate tail and fins, result in conforming to the relative motion of the water alongside, and the elimination of eddies which consume power.

"The ideal machine for flying is necessarily, it seems to me, of the nature of a kite, which, instead of having a string to hold it up on the air, is pushed through the air by means of propellers, as in Prof. Langley's aerodrome and other similar machines. Obviously, it is here that a very light engine for its output in power will be needed. Dr. Langley has said that he has succeeded in obtaining an engine which did not require to weigh more than four or five pounds to the horse-power.

"It would be out of place here to speak of the commercial possibilities of the flying machine. It seems to me that it will naturally be a machine for emergency work; a most effective war engine, for example, and by a war engine I, of course, mean a peace engine. The more effective it is, the less likelihood there is of war being declared; and the menace of a sudden visit by a flying enemy would probably have the result of making those who declare war but do not fight the battles a little more cautious as to such declaration.

"We must not be impatient as to unavoidable accidents in the pioneer work of flying. There are undoubtedly difficulties yet to be overcome in launching the airship, and in alighting with it safely in all cases. A child may have the muscles and necessary organization permitting it to walk, but it will have to learn to walk; to co-ordinate its muscular actions and balance the nervous impulses. Even the young bird, on leaving the nest, is by no means an expert at flying until it has practised or learned the art. In the same way, given a machine which is controllable and which is able to fly, a machine perfect in every particular, it will be necessary even then for the operator to learn to manipulate it, just as one learns to manipulate a bicycle, i. e., to do the right thing, and not the wrong thing, on occasion.

"I have confidence that before many years we shall have operative machines which can traverse the air. I do not consider them, however, as substitutes for steamships, for freight trains, or even for passenger trains; their field being supplementary to these agencies, adding to our capabilities already mentioned another means of our getting about. The danger of collision in the air would, it seems to me, be less than on the surface of the earth, as there is room to pass not only to the right or to the left, but above and below. We are not confined to a road or a track, but we may count on two or three miles deep of air as the common highway. Man has accomplished so much in the past 100 years that it will not do to be pessimistic as to the possibilities of the future."

Electrical Words Wanted.

The *St. James Gazette*, of London, calls the attention of professional neologists to the pressing need of some new verbs. "We want," it says, "popular verbs for several operations introduced by modern science. The X-rays, the Finsen treatment for lupus, the operation of radium for cancer, and what not—what are the words for these? A man is guillotined or hanged; his leg is amputated; he is trepanned. What is it when he is rayed, Finsened, radiumed? We still want a wireless word. 'Marconigram,' which was suggested, seems to have died a natural death. What is the synonym for telephone when one speaks over the instrument to which a phonograph is attached? And have we finally agreed that 'motor' is the verb to travel by automobile?"

Speed-Torque Characteristics of the Single-Phase Repulsion Motor.

In opening his paper with the above title, read last week before the American Institute of Electrical Engineers, Mr. Walter I. Slichter said that for some months past he has been in charge of a series of experiments with various types of alternating-current motors, during which much attention was given to alternating-current commutator motors. The repulsion motor resembles very much a regular direct-current armature in an induction-motor field. The resemblance to the induction motor is carried still further in that there is no electrical connection between the primary and secondary. This makes it possible to wind the primary for a high line voltage, while the voltage of the secondary winding is chosen at such a value as may be commutated satisfactorily, since it is short circuited on itself through its brushes.

The motor has the same characteristics as the direct-current series motor; namely, maximum torque at starting, increasing torque with increasing current and decreasing speed, and comparatively constant efficiency through a wide range of speed. The maximum speed of the motor is limited only by the load and impressed voltage and has no relation to the synchronous speed.

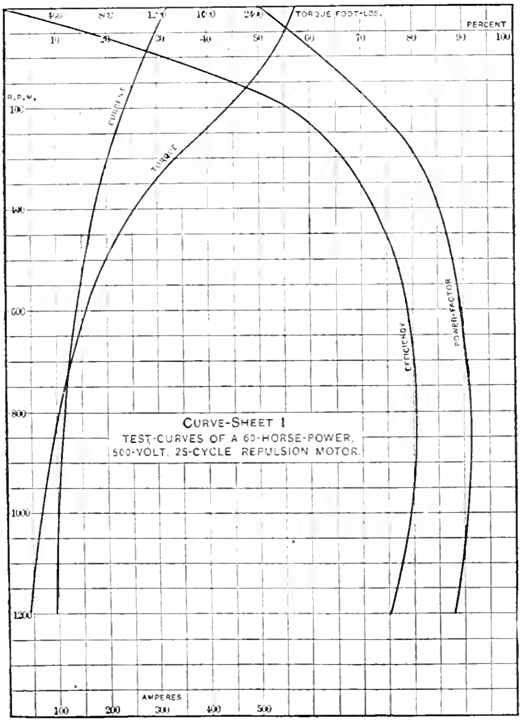


FIG. 1.—TEST CURVES OF 60-HP REPULSION MOTOR.

Due to the reactance of the motor circuits, the power-factor at starting is low and will be with any alternating-current motor; but in the repulsion motor a low power-factor does not mean small torque. On the contrary, the maximum torque occurs simultaneously with the lowest power-factor; that is, at starting. The power-factor of the repulsion motor rises very rapidly with the speed; it reaches a good value at one-third synchronous speed, and values near to 90 per cent. are obtained over a considerable range of speed. For this reason a large number of poles is not necessary and frequencies of 25, 40 and even 60 cycles may be employed.

The rotating conductors of the secondary cutting the primary flux, generate a leading e.m.f., which causes a leading current to flow therein and gives the high power-factor of the motor. In the plain repulsion motor, this leading current never reaches a value great enough to compensate entirely for the magnetizing and other wattless currents at available speeds, but the phenomenon is utilized to obtain unity power-factor in the compensated type by the addition of a second circuit. The inherently good power-factor of the repulsion motor makes it possible to use larger clearance between field and armature than is permitted in induction motors, thus greatly increasing its value in railway work where comparatively large air-gaps are necessary.

The curves given are partly from test and partly from calculation of motors having air-gaps on a side of ⅛ inch and more. The air-gap of corresponding stationary induction motors would be .040 inch and more. The efficiency, while not so good as in a direct-current motor, is yet very good, reaching values of from 80 to 85, including gear-loss for sizes ranging from 50 to 200 horse-power.

Commutation at normal speeds is inherently good, due to the revolving field. As the speed decreases, the current increases rapidly, producing a tendency to spark, but with the reduced voltage of starting the rush of current is limited to values within the range of good commutation, as in the direct-current motor. At higher speeds, ranging above one and a half times synchronism, the frequency of commutation becomes high and sparking appears.

The motor of Curve-Sheet 1 (Fig. 1) will start with 75 per cent. of full voltage and twice full-load current with no trouble from sparking. As these curves are prepared upon a railway-motor basis, and full-load current will produce a rise of 75° C. after one hour's run, the ability of the repulsion motor successfully to commutate overloads is equal to that of the direct-current series motor; in fact, better, due to the short-circuited commutator which makes flashing-over impossible.

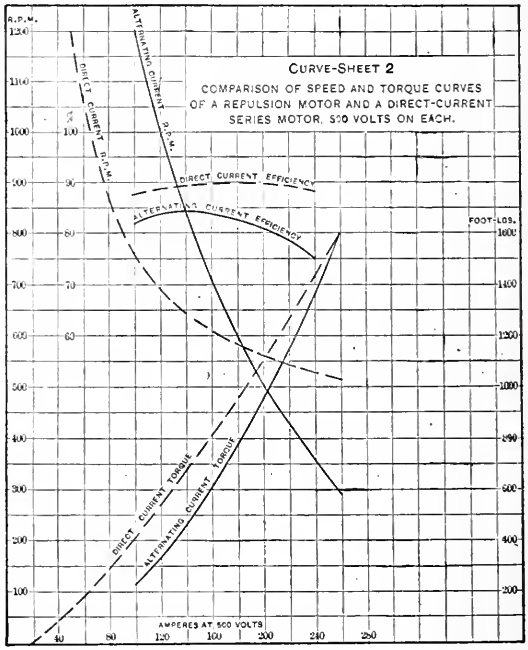


FIG. 2.—CURVES OF REPULSION AND DIRECT-CURRENT MOTORS.

Curve-Sheet 1 (Fig. 1) shows the characteristics of a repulsion motor plotted with revolutions per minute as a base. These curves are taken from tests on a 60-hp, 25-cycle, 500-volt motor; they show the rapidly rising efficiency and power-factor and the large torque at starting. The starting torque is 2,300 ft. lbs., with an input of 325 amperes, and the normal torque during acceleration, 450 ft. lbs. at 750 revolutions and 125 amperes. Thus the starting torque is five times normal and the starting current 2.6 times normal; or the torque per ampere at starting is 1.92 times what it is at normal speed, should occasion demand the full starting capacity of the motor.

This statement gives an idea of the steep speed-characteristics of the motor, which are even better shown in Curve-Sheet 2 (Fig. 2). The full lines refer to a later type of repulsion motor and the broken lines to a standard direct-current series railway motor; these curves are plotted in the usual way with current as a base. This shows that the torque increases more rapidly with increasing current in the repulsion motor than in the series; and conversely that the speed of the repulsion motor increases more rapidly with decreasing current than in the series motor. Efficiency, including gear-loss, is given and is 84.5 per cent. at the maximum for the alternating-current motor. This motor was designed with the steep speed-characteristics for acceleration work, while the motor of Curve-Sheet 4 (Fig. 4) is designed for constant-speed running and has not such steep curves but better constants at light loads.

The characteristics show the repulsion motor to be admirably adapted for acceleration work, the efficiency of acceleration being higher than in direct-current work, due to the possibility of obtaining fractional e.m.f's with alternating currents without introducing the dead resistance losses of the direct-current system of control.

This is shown in the curves on Curve-Sheet 3 (Fig. 3) which gives the acceleration curves from test of a 25-ton car equipped with two 60-hp repulsion motors. The full lines indicate the repulsion motor characteristics and the broken lines those calculated for a direct-current equipment. The gearing is chosen for the same free running speed, 33 miles per hour, the same average acceleration and the same distance covered in sixty seconds. For the direct-current motor the curve of wilowatts input, miles per hour, and miles traveled, are given as calculated; and for the alternating-current motor the kilovolt-ampere input, kilowatt input, miles per hour, and miles traveled, from test.

The repulsion motor remains on the controller only sixteen seconds and the direct-current motor 25 seconds. The maximum power taken by the direct-current motor is 70 kw and by the repulsion motor 61 kw or 67 kilovolt-amperes. At the end of 25 seconds, the total kw-hour input in the two cases is .375 for the direct current and .30 for the alternating current. At the end of 60 seconds both cars have covered a distance of .039 mile and have reached practically the same speed of 32.5 miles per hour, the kw-hour input being .72 for the direct current and .685 for the alternating current.

By comparing the areas of the kilowatt curves in the two cases the gain or rather the saving by the use of the alternating current is readily seen. It is also worthy of note that the volt-ampere input of the alternating-current motor is least at starting; that is, the line current is least. As this is the time at which the power-factor

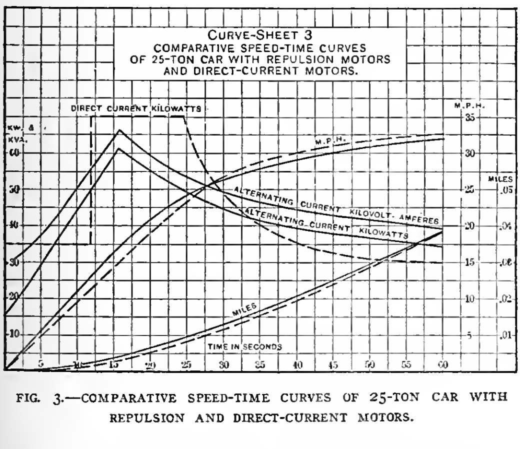


FIG. 3.—COMPARATIVE SPEED-TIME CURVES OF 25-TON CAR WITH REPULSION AND DIRECT-CURRENT MOTORS.

is lowest, it is seen that the effect of the low power-factor on the regulation of the system is much modified by the small value of the current.

Curve-Sheet 4 (Fig. 4) shows the calculated characteristics of a 175-hp railway repulsion motor having an air-gap of .15 inch and wound for 1,500 volts and 25 cycles. The efficiency, including gear-loss, is 85 per cent. at the maximum and the power-factor is 93. Such a motor is designed for heavy, slow-speed locomotive work, which is probably one of the most promising fields for the alternating-current motor. It is readily seen how well it is adapted for freight haulage by the fact that the efficiency of 85 per cent. is attained at a speed as low as 500 revolutions, thus permitting a speed of 12 to 15 miles per hour, with a good gear reduction.

Thus the repulsion motor is well adapted for acceleration work as well as for efficient running at light loads, and having good constants at low speeds is well adapted for freight haulage at low speeds.

The curves given in the paper all refer to the simple repulsion motor, the theory of which is given in a paper read at the same meeting by Mr. C. P. Steinmetz, printed elsewhere in abstract in this issue. There are many variations of the repulsion motor, more or less complicated, from which a better power-factor and even a

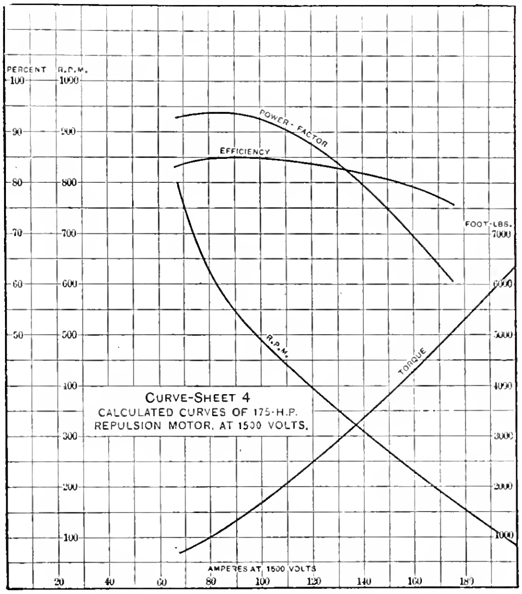


FIG. 4.—CALCULATED CHARACTERISTICS OF A 175-HP, 1,500-VOLT REPULSION MOTOR.

better efficiency have been obtained in test, but Mr. Schlecter said that a description of these various schemes with their characteristics would require sufficient space to warrant a distinct paper and intimated that such a paper would be presented before the Institute at some future date.

Electric Traction in Cuba.

Mr. Max J. Baehr, the United States Consul at Cienfuegos, Cuba, says: "Cienfuegos has railway communication with Habana, Matanzas, Cardenas, Sagua la Grande and Caibarien on the north coast, with Santa Clara in the interior, and thence, since the completion of the new Cuban Central Railroad, with Santiago.

"A project is now under consideration by local and American capitalists for the construction of an electric railway extending from this city into the interior, a distance of 30 miles or more, which would give rapid transit between Cienfuegos and several important villages in the sugar-producing belt, these towns now having very inadequate communication with this port. I am credibly informed that a company has been organized to carry the project into effect, that a charter has been applied for and obtained, and that only a short time will elapse before the beginning of active work on the grading of the road. If this enterprise is carried to fulfillment, as seems reasonably certain, it will not only give employment to a large number of laborers who now find steady work only during the sugar-grinding season, but will contribute in no small degree to the material upbuilding of this section of Cuba.

"For the information of American dealers in electric and railroad supplies, I will state that the name of the company undertaking this work is the Cienfuegos, Palmira and Cruces Electric & Power Company, with headquarters at Cienfuegos."

The Repulsion Type of Alternating Current Motor.

In a paper presented last week before the American Institute of Electrical Engineers, entitled "The Alternating-Current Railway Motor," Mr. C. P. Steinmetz, after referring to the early work of the late Rudolph Eickemeyer with the single-phase alternating-current motor, gave in extenso the theory of the Thomson repulsion type of motor.

In introducing the paper Mr. Steinmetz said that for electric railway work a motor is required which maintains a high value of efficiency over a wide range of speed. That is, the torque per ampere input at constant impressed voltage must increase with decrease of speed, the speed increasing with decrease of load.

In electric motors, torque is produced by the action of a magnetic field upon currents flowing in an armature movable with regard to the field. If then the field is constantly excited—shunt motor on constant potential—the torque is approximately proportional to the current, the speed approximately constant at all loads. If the field is excited by the main current of the motor—series motor on constant potential—the field strength and thereby the torque per ampere varies approximately proportional to the current, and thereby the load, the whole torque approximately to the current, and thereby load, the whole torque approximately proportional to the square of the current and the speed inversely proportional to the current, leaving saturation out of consideration. That is, the motor has the characteristic specified above for a railway motor.

Since the direction of rotation of the direct-current motor is independent of the direction of the impressed e.m.f., with laminated field the direct-current motor can be operated with alternating-currents. By the use of alternating currents it becomes possible to transfer current from circuit to circuit by induction, and instead of passing the main-line current through the armature of the alternating-current motor, the armature circuit can be closed upon itself and the current induced therein as transformer secondary by a stationary primary coil in the main circuit surrounding the armature.

The condition of operation of the direct-current motor type on alternating current is, however, that the current in field and armature reverses simultaneously. This is by necessity the case in the series motor. In the shunt motor, however, the armature current as energy current should be in phase with the impressed e.m.f., while the field current as magnetizing current lags nearly 90°. To bring it back into phase, Stanley tried condensers in series in the field circuit, but failed, due to the impossibility of neutralizing the self-induction of the field which varies with the commutation and the frequency, by the negative self-induction of the condensers, which varies with the frequency in the opposite direction. The solution of the problem has been found in the use of polyphase systems, by utilizing for the field excitation the e.m.f. in quadrature with the armature currents acted upon by the field magnetism. Mr. Steinmetz says that as he has shown elsewhere, the polyphase induction motor can be considered as a development of the direct-current shunt motor for alternating-current circuits, and indeed has all the shunt motor characteristics regarding speed, torque, etc. As a railway motor the induction motor has therefore not been exploited, although it has been strongly recommended in those very few cases where it appeared good engineering. Experimental work with polyphase induction motor railways has been carried on continuously since 1893.

While in the early days of alternating-current motor development, all other engineers were industriously developing the type with shunt motor characteristic, Rudolph Eickemeyer, of Yonkers, alone was far-sighted enough to realize the absolute necessity of the series motor characteristic for railway work and undertake the development of the single-phase alternating-current series motor. Mr. Steinmetz added that he had the good fortune at that time to be associated with Mr. Eickemeyer.

As was pointed out by Kapp, in 1888, the power factor of the alternating-current series motor is inherently low, since the same magnetic flux which induces, proportional to the frequency of rotation, the e.m.f. of useful work in the armature conductors, induces in the field coils an e.m.f. of self-induction, proportional to the frequency of alternation, thereby giving the armature the same number of turns as the field (which is more than permissible in good practice, since good practice requires weak armature and strong field). Even at synchronous speed the e. m. f. of rotation of the armature would still only be equal to the e. m. f. of self-induction of the field; and the power-factor, allowing for an additional self-induction of the armature, would be below 70 per cent. This probably deterred the other engineers from considering the alternating-current series motor.

Eickemeyer solved the difficulty by designing the armature with a number of turns several times greater than the field (25 to 7 in the first motor built) and neutralizing the armature self-induction and reaction by a stationary secondary circuit surrounding the armature at right angles electrically to the field circuit (the "cross-coil," as he called it), and either short-circuited upon itself or energized by the main current in opposite direction to the current in the armature.

In January, 1891, Mr. Steinmetz tested the first motor of this type, a bipolar motor with the following constants:

Field: Two coils of 14 turns No. 10 B. S. wire, connected in parallel. Armature: 24 coils of four turns each of No. 12 B. S. wire. Secondary circuit: Two coils of 18 turns each of No. 10 B. S. wire connected in parallel.

At 100 cycles and 150 volts impressed e.m.f., this motor gave

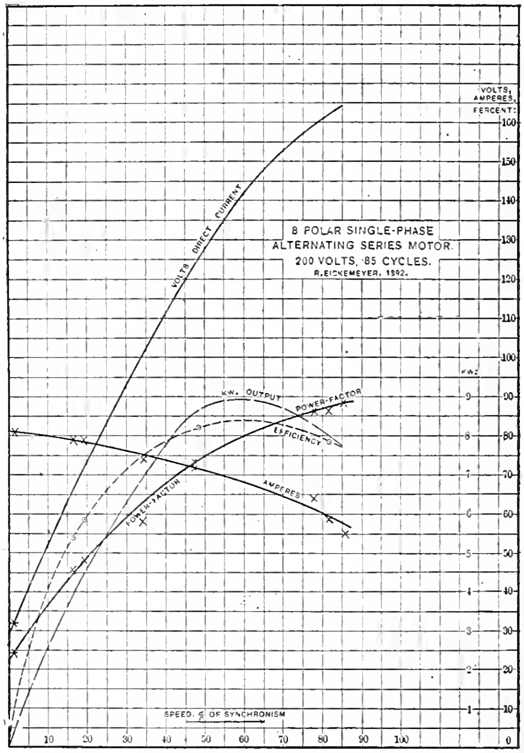


FIG. 1.—TEST CURVES OF EICKEMEYER MOTOR.

a three-fourths synchronous speed, and its starting current at 150 volts and 70 amperes.

Current: 45 amperes. I^2R: 400 watts. Hysteresis and eddy currents: 900 watts. Total output, including friction: 4,000 watts.

Hence the efficiency was 75.5 per cent., and the power factor, 79 per cent.

As a bipolar motor with the very high frequency then used, the speed, 4,500 revolutions at three-fourth synchronism, was undesirably high, so immediately an 8-polar motor was built. In this, solid copper rings were used as secondary circuits surrounding the armature and neutralizing its self-induction, with an effective copper section more than four times that of the armature conductors. The ratio of armature series turns to field series turns was about 4. This motor was tested in 1892. The record of tests is given in Fig. 1, the observed values being marked on the curves. For comparison on this sheet is also given the direct-current voltage required to operate this motor at the same speed and current.

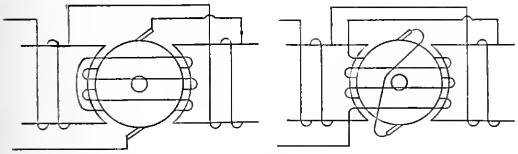
As will be seen, when approaching synchronous speed, the power-factor is nearly 90 per cent. The commutation was fair at 85 cycles, the highest frequency at which the factory engine was able to drive the alternator, and attain at 33 cycles.

A number of railway motors of this type were designed. The great difficulty, however, was that during these early days 125 to 133 cycles was the standard frequency in this country, 60 cycles hardly considered, and 25 cycles not yet proposed.

The efficiency of this alternating-current series motor is slightly lower than that of the same motor on direct-current circuit, due: (1) To the hysteresis loss in the field. (2) The hysteresis loss in the armature core, which is of full frequency up to synchronous and of still higher frequency, the frequency of rotation, beyond synchronism. (3) The I^2R loss in the short-circuited secondary conductors surrounding the armature.

As will be seen, to make the alternating-current series motor practicable, the transformer feature must be introduced, by having its armature as primary circuit closely surrounded by a short-circuited secondary circuit, as shown diagrammatically in Fig. 2.

Instead of closing the stationary circuit upon itself as secondary



FIGS. 2 AND 3.—DIAGRAMS OF ALTERNATING-CURRENT SERIES MOTOR.

circuit and feeding the main current into the rotating armature as primary circuit, mechanically the same results would obviously be obtained by using the stationary circuit as primary energized by the main current and closing the armature upon itself as secondary by short circuiting the brushes and thereby keeping the main current and the line potential away from the armature, as shown diagrammatically in Fig. 3. This introduces the great advantage of reversing the sign of the uncompensated part of the armature self-induction, so that it is subtractive, which results in an essential improvement of the power-factor, especially at low speed.

This is shown in Fig. 4, where with the speed as abscissas, in per cent. of synchronism, are plotted the power factor of the Eicke-

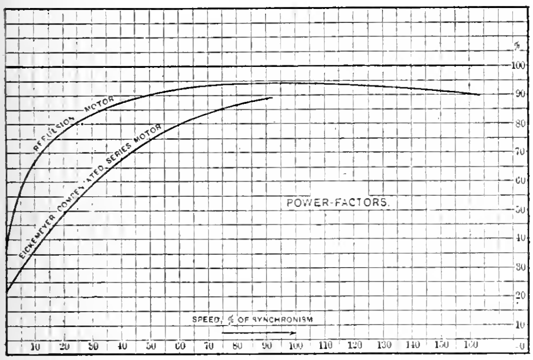


FIG. 4.—POWER FACTOR CURVES.

meyer compensated series motor of Fig. 1, of ratio armature to field = 4, and the power-factor of one of the first railway repulsion motors, of ratio armature to field = 3.5.

The compensation of the armature self-induction in Fig. 3 is based on the feature of the transformer that primary and secondary current are in opposition to each other. The secondary current of the transformer, however, lags slightly less than 180° behind the primary current; that is, considering it in the reverse direction, is a leading current with regard to the primary current. The current in the armature in Fig. 3, is, therefore, a leading current with respect to the line current, and so not only does not add an additional lag but reduces the lag caused by the self-induction of the field-exciting coil.

This motor then consists of a short-circuited armature surrounded by two coils at right angles with each other and connected in series, as illustrated in Fig. 5; the one A_2, parallel with the effective armature circuit, acting as primary of a transformer to induce the secondary armature current; the other, A_1, the field exciting coil. The ratio of turns of the coils, n_2 to n_1, is the ratio of ef-

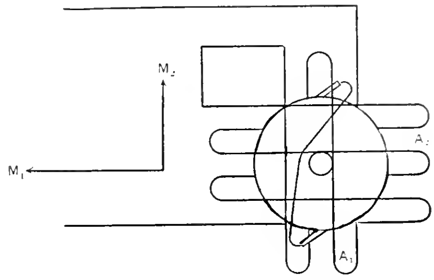


FIG. 5.—DIAGRAM OF EICKEMEYER MOTOR.

fective armature series turns to field turns, as discussed before. Obviously, these two coils can be replaced by one coil at an angle with the position of brushes as shown in Fig. 6, and the cotangent of the angle of the axis of this coil with the position of the brushes is above ratio; that is, the smaller this angle the greater is the ratio of armature to field turns; that is, the better the power-factor of the

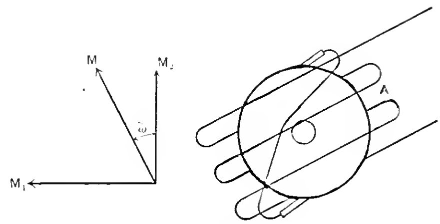


FIG. 6.—DIAGRAM OF THOMSON REPULSION MOTOR.

motor. This motor is Professor Elihu Thomson's repulsion motor.

In the armature an e.m.f. is induced by the alternation of the magnetic field, M_2, of coil A_2, proportional to M_2 and to the impressed frequency and in quadrature with M_2, and an e.m.f. is induced by the rotation through the magnetic flux M_1 of coil A_1, proportional to M_1 and to the frequency of rotation and in phase with M_1. These two e.m.f's must be equal and opposite, since the armature is short circuited (neglecting the resistance and self-inductive reactance of the armature) and at synchronism. Therefore M_1 and M_2 are equal and in quadrature with each other; that is, in the armature of the motor, Fig. 5, and therefore of the repulsion motor, Fig. 6. At synchornism a uniform rotating field exists and the hysteresis loss in the armature core is therefore zero at synchronism and at other speeds proportional to the difference between speed and synchronism; that is, to the slip, just as in the polyphase induction motor, while in the motor, Fig. 2, the hysteresis loss in the armature core is proportional to the impressed frequency or the frequency of rotation, whichever is the higher frequency. The hysteresis loss of the repulsion motor is, therefore, lower than that of the same motor as compensated series motor.

In Fig. 6 the magnetic flux in line with the brushes, which does not induce e.m.f. by rotation but only by alternation, is denoted by M_2; the magnetic flux in quadrature with the brushes which induces e.m.f. in the armature by its rotation but not by the alternation of the flux, by M_1; and the magnetic flux in the axis of the primary coil A, which is much nearer to M_2 than to M_1, since a good power factor requires a small angle ω, by M. Mr. Steinmetz then shows mathematically that M_1 and M_2 are in quatrature in phase and the ratio of their intensity is inversely proportional to the ratio of speed to synchronism. Fig. 7 shows the two quadrature components, M and M_2 of the magnetic field of the repulsion motor for $\omega = 16°$ and $M = 1.0$.

That is, in the repulsion motor an elliptically rotating field exists which becomes circular; in other words, a uniformly rotating field, at synchronism. Below synchronism the component, M_1, which induces e.m.f. by the rotation of the armature is greater than M_2, the more the lower the speed. The flux M interlinked with the primary coil is, however, nearer to M_2 and therefore below synchronism, especially at low speeds. The magnetic flux which induces e.m.f. by the rotation of the armature and so represents the useful work, is greater than the magnetic flux which interlinks with the primary coil and so gives the lag of the primary current. This accounts for the high power-factor of the repulsion motor at low speeds.

The paper then proceeds to give a theoretical investigation of the repulsion motor considered as a transformer, the secondary of which is standing at a constant angle ω with regard to the primary, so that motion results from the repulsive thrust existing between primary and secondary.

One of the deductions is that, unlike the plain series motor, which can never return power into the line, the repulsion motor when reversed becomes a generator, consumes mechanical power as brake and returns electric power into the line, even at low speeds. Experiment verifies this feature.

In discussing the mathematical theory developed, it is stated that

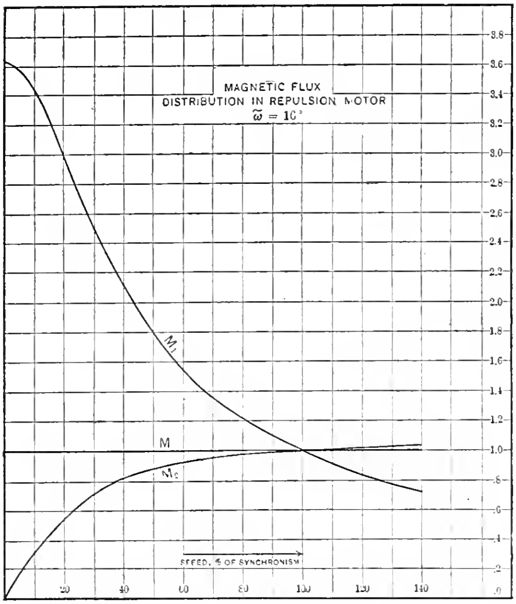


FIG. 7.—MAGNETIC DISTRIBUTION IN REPULSION MOTOR.

the primary exciting, primary self-inductive and secondary self-inductive impedances have been assumed as constant. While this is approximately the case in the ordinary induction motor, it is not the case with the repulsion motor which works over a wide range of magnetic flux densities.

With increasing load and thereby increasing current and decreasing speed, magnetic saturation is approached and causes a decrease of the impedances, which has to be taken into consideration in predetermining the characteristic curves of such a motor. Furthermore the different component magnetic fluxes are affected differently by saturation. The flux, M, interlinked with the primary coil is approximately constant and therefore affected by saturation only indirectly, while the flux, M_1, at right angles to the line of polarization of the secondary coil is approximately proportional to the load and so reaches saturation at high loads, and the impedances become thereby different in the different directions of the magnetic structure.

The m.m.f's in the investigation were treated as vector quantities, independent of their distribution around the periphery of the armature. This distribution, however, is different with the different m.m.f's. The m.m.f. causing the effective flux, M_1, is due to a zone of the primary winding within the angle $\pm\ \omega$ from the axis of the secondary coil, hence nearly a concentrated winding, which gives a flat-topped flux distribution, while the flux, M_2, in the direction of the axis of the secondary coil is that of a distributed winding or peaked. For the same m.m.f the effective flux, M_1, is, therefore, greater than the effective M_2. Taking this into consideration, gives the motor somewhat better characteristics than calculated above. Owing to the different wave shapes of the fluxes, M_1 and M_2, they are affected differently by saturation. The flat-topped flux M_1 reaches saturation at a much higher value, but then over the whole range, while the peaked flux M_2 shows the effect of saturation at a lower value but then gradually, by a rounding off of the peak. In the repulsion motor it is therefore not sufficient merely to consider the resultant m.m.fs. as vectors but their distribution in the air-gap and the effect of saturation must be taken into consideration in the calculation and design of the motor. Mr. Steinmetz adds that an exhaustive investigation of this point has been made by his assistant, Mr. M. Milch, and may be communicated at a later date.

The secondary circuit of the motor has been considered as the seat of two e.m.fs. induced respectively by the rotation through flux M_1 and by the alternation of flux M_2. These e.m.fs., however, have no separate existence. At synchronism, for instance, the magnetic field is an approximately uniformly rotating field and, therefore, no e.m.f. is induced in the armature conductors except that required to overcome the resistance. The secondary frequency varies with the load and thereby the secondary self-inductive reactance which we assumed as constant in the preceding discussion. Mr. Steinmetz says this is best taken into consideration by a theory developed by his former assistant. Mr. S. Sugiyama, of Japan. The primary impressed alternating m.m.f. of the current I is resolved into two component m.m.fs. of half intensity, revolving synchronously in opposite directions. If now $a =$ the ratio of speed to synchronism, the two oppositely revolving components of I revolve with regard to the secondary system with the speeds $(1 - a)$ and $(1 + a)$ respectively. The same consideration applies to the secondary m.m.f. I_1, and in the secondary system we then have induction at two frequencies, $1 - a$ and $1 + a$, of which the former becomes zero at synchronism. That is, at synchronism the secondary current in the armature conductors is of double frequency, similar as in the ordinary single-phase induction motor. At other speeds it is the superposition of two currents of the frequencies $1 - a$ and $1 + a$, respectively. This theory more closely allies the repulsion motor with the ordinary induction motor. Using the same values of secondary impedance, Z_1 for both components, obviously leads to identically the same equations as given in the preceding.

The complete investigation of the repulsion motor must also take into consideration the current flowing in the armature coil during the moment where the coil is short circuited by the brushes passing from commutator segment to segment. The m.m.f. of this short-circuit current of commutation is at right angles to the axis of secondary polarization of current I_1, hence has the angle of brush-shaft — $(90 - \omega)$. A corrective term must, therefore, be applied, taking this phenomenon into consideration, essentially of the character of a repulsion machine with negative or generator brush-angle of $(90 - \omega$ and very high effective secondary resistance. This term is very small or negligible at speeds up to a point somewhat beyond synchronism but becomes noticeable at speeds considerably above synchronism, due to the decrease of the main current at these speeds. The main effect of this phenomenon is that the power-factor of the motor instead of increasing indefinitely with the speed up to 100 per cent at some very high speed (and then decreasing again slightly with leading current), reaches a maximum somewhere between 90 and 97 per cent., according to the constants of the motor, and then very slightly decreases with increasing speed, as is shown in the curve of the power factor of a repulsion motor in Fig. 2.

Cables as Heartstrings.

At the dinner of the Pilgrims' Society, January 29, the London and New York contingents banquetted on the same night; here at Delmonico's, and in London at the Carlton. The Commercial Cable wire was run into both rooms and friendly messages freely exchanged. In London, the unique feature of the evening consisted in the installation by the cable company of two old grandfather's clocks, one showing English and the other American time which enabled Mr. Choate, Lord Salisbury and the others to keep an eye on the progress of the New York banquet. The usual cable company's clock, with a red hand showing American time, was placed between the two clocks. The tables were also decked with telegraph wires and miniature poles.

Women in the German Telegraph-Telephone Service.

In a recent report on the subject of the employment of women in the telegraph and telephone service in Germany, Mr. J. F. Monaghan, United States Consul at Chemnitz, says:

"While women were employed in the postal and telegraphic service of France and England as early as 1820 and 1830, Germany did not make a trial of feminine service until 1874. The main circumstance that led to the employment of women at that time was a scarcity of available men. When later the administrations of the postal and telegraphic services were combined under one head, a general discharge of the women who had obtained positions in the service followed, largely, so it is reported, because Postmaster-General Stephan, who wielded a determining influence at the time, was irreconcilable in his opposition to the employment of women in the postal and telegraphic service. Hence, all women engaged in the telegraphic service were removed, and only a comparatively small number of those employed in the postal service reluctantly retained as a further experiment. Three years later, in 1876, these also were separated from the service of the Empire.

"The successor of Stephan, Postmaster-General Podbielski, was favorably disposed toward the employment of women. He laid considerable weight upon the successful experience with women in foreign countries, especially in the United States. Through his support and influence women were again introduced into the postal service, though only in limited numbers and purely for the purpose of further trial. The result was quite as satisfactory as had been expected, and since then the number of women in the German postal, telegraphic and telephonic service has been rapidly increasing, until to-day they comprise an invaluable and indispensable part of the same.

"In all post offices of the third class women assistants are appointed by the postmasters of the place, under strict limitations, however, of government regulations respecting age, character and education. Such assistants must be of sound health, certified to by a government medical examiner. They must be entirely free from all deformities, of stainless character, from 18 to 30 years of age, and must possess a good common school education. The highest salary that may be paid to such assistants at third-class post offices is 500 marks ($119) per year. In post offices of the first-class and at railroad post offices women may be engaged for service as typewriters or similar duties only. All women assistants have the character of government officials (Beamteneigenschaft), which means that on their withdrawal from the service after faithful, competent work during a prescribed number of years they have a claim to a pension (Ruhegehalt), under the law of the Empire, if their circumstances are adjudged such as to require it. Instead of being qualified to occupy only a certain class of specified positions, as was found to be the case in the German postal service, women are privileged to take any positions whatever in the telegraphic service, subject at all times to the above-enumerated regulations respecting age, character and education. They have a similar claim to a pension as those engaged in the postal service and in all respects are similarly employed, privileged and discharged.

"At the present time 4,000 women are employed in the telephone service of the German Empire. In Berlin alone 1,000 women are engaged. These positions are so popular and the number of applications is so large that the number of accepted and qualified women whose names have been registered in the order in which they were considered is so large as to supply occupants for any possible vacancies that may result in the course of the next few years. Only physically strong girls are admitted to the service. They must possess a good character and be of respectable families. They must be between 18 and 30 years of age and either unmarried girls or widows without children. Every applicant must possess an education equivalent to graduation from an elementary school (Elementarschule). In making the application for a position it is necessary to produce a birth certificate, school certificate, certificate of conduct (Leumundszeugnis), in which are registered all praise or dissatisfaction expressed by previous employers of the person in question, and a brief biography. The latter must have been written and constructed solely by the applicant. The written consent of the father or guardian is also necessary. Some time after the application, accompanied by all the required papers, has been filed notice is sent to the applicant to appear for an examination, which embraces ordinary questions of arithmetic, German and geography.

"After successfully passing the examination the applicant is sent to an official medical examiner, who must certify as to her physical and nervous soundness, and especially as to the condition of her lungs and nerves.

"Having successfully acquitted herself in all the foregoing tests, the applicant is now ready to begin a period of practical preparation. This work as an apprentice covers from three to four weeks, and during the time the learner receives no salary. Having satisfactorily completed her period of practical study, the applicant is ready to enter upon a regularly paid position. Since, as was already stated, the number of applicants is always extremely large, a number of months or even a year or two may pass before a vacancy occurs. A position being open, the applicant cannot enter upon the same if she has in any way, in the meantime, spoiled her record or failed to preserve a stainless character. She must also, at the time of her employment, be living with her parents, or in some other respectable place free from all question.

"The daily hours of employment vary from six to eight; sometimes Sunday work is required. The employee must, immediately after being engaged, begin her contributions to the sick fund (Krankenkasse beitreten), and in case she succumbs to sickness or injury she continues to draw three-fourths of her regular salary and receives free medical treatment. Her pay to begin with is 2.25 marks (53.5 cents) per day. After two years of satisfactory service this is raised to 2.50 marks (59.5 cents) per day. After two additional years—that is, after having been four years in the service—her pay is raised to 3 marks (71.4 cents). If, after service for several more years, the girl has shown herself capable and unusually diligent, she may be appointed as supervisor (Aufsichtsdame), with an annual increase in pay of 100 marks ($23.80).

"After ten years of faithful service another advantage is added in the form of appointment with full claim to a pension (Anstellung mit Pensionsberechtigung). After being thus engaged, her salary amounts to 1,100 marks ($261.80). This salary is then increased every three years by the amount of 100 marks ($23.80) until it amounts to 1,500 marks ($357). This is the highest salary that a woman can draw in the German telephonic service. It is sufficient to insure a comfortable existence to the employee, though to an American the amount may seem somewhat small, even for an exceedingly plain living. It must be remembered that the German women living in Germany who belong to this class of wage earners can live with considerably less expense and with much greater comfort than would be possible in the United States.

"In England the salaries of positions of this kind are much better paid. Girls are admitted to the service at 15 years of age. During the first years, while they are 'girl clerks,' they receive from 800 to 900 marks ($190.40 to $214.20). When they receive a permanent position as 'women clerks' their salary is increased to 1,100 to 1,200 marks ($261.80 to $285.60). After twelve years of faithful service they receive the considerable salary of 2,400 to 2,500 marks ($571.20 to $595). The best women are even appointed to positions as chief supervisors or assistants in first-class offices, with a salary of 10,000 marks ($2,380)."

A Canadian Electrothermic Commission.

The commission recently appointed by the Canadian Government to investigate all existing electrothermic processes of manufacturing iron and steel in Europe, sailed from New York January 23 on the Cunard Line steamer *Lucania* for Liverpool. The commission is made up of Dr. Eugene Haanel, superintendent of mines in Canada; Mr. C. E. Brown, electrical engineer; Mr. Nystrom, draughtsman; Mr. Thomas Cota, secretary, and a steel expert and photographer who will join the party in England.

The commission will visit Sweden, France and Italy, and it is probable that some four months or more will be used in carrying on the work of investigation and research. For years the rich iron mines of Canada have remained dormant with abundance of water power available on all sides. But it is now believed by the Minister of the Interior in Canada, and by financiers, that the work of this commission will pave the way for great industrial prosperity in the Dominion.

Nowhere in America has the electric furnace been commercially applied to the manufacture of iron and steel, but in Europe much has been done in this direction. There the possibilities of the furnace in the metallurgy of iron and steel are well recognized, and much good work has been done.

New Telephone Patents.

IMPROVED LINE APPARATUS.

There was a time when all details of telephone pole line construction were entirely in the hands of the line foreman. There was little apparatus especially designed to meet his needs and he, therefore, had to makeshift with the various materials at hand in overcoming the difficulties, and in solving the problems met. This is now, however, all changed, as the requirements for poles, arms, guys and wires are well understood and the assembling of them into a line is prescribed in comprehensive specifications. These latter, however, are continually undergoing a revision to keep pace with the inventors, who are at frequent intervals developing improved accessories.

We have at hand for present consideration four patents covering line accessories, which have been lately invented. One of these patents describes a new method of "tying-in" line wires. The preferred scheme employs a tie wire, the middle portion of which is flattened out into a ribbon. This ribbon portion is wrapped in a close spiral around the wire to be secured, at the joint where the line wire passes the insulator. The two ends of the tie wire are then passed around the insulator and secured by twisting them together on the side opposite the line wire. This invention is the work of Alexander Kline, of Jersey City, N. J.

Another patent concerns an apparatus for anchoring guys. For many years the only anchor known was a rock, or log buried in the earth. The labor of digging is a matter of such trouble and expense that a great deal of ingenuity has been displayed in developing an anchor which can be driven, and a number of such are now upon the market. The present patent describes an anchor of this type comprising a shank with pivoted wing pieces, which assume a position at right angles to the shank in case any attempt is made to pull it up. The only improvement claimed is a shaping of the butts of these wings so as to concentrate all stresses upon their pivots. W. G. Beach, of Grandlake, Kan., is the patentee of this anchor.

Two cable suspension clips form the subjects of the remaining line material patents. These are both the work of one inventor, O. C. Hoffmann, of Chicago. Both follow the general design of the most successful clips of to-day, consisting of a strip of sheet zinc to surround the cable and a suspension hook of wire so formed that by intertwining the end of the zinc strip with it the whole forms a secure fastening. The exact method of using the clips will be better understood from a glance at Fig. 1 than from any description. The clip in the lower part of the figure is shown just ready to hook over the messenger strand.

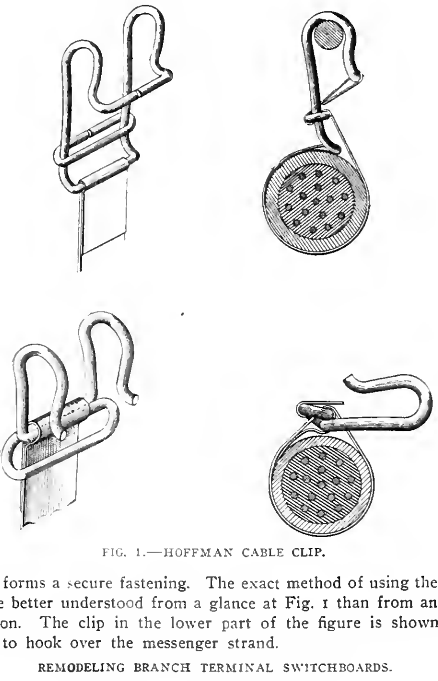


FIG. 1.—HOFFMAN CABLE CLIP.

REMODELING BRANCH TERMINAL SWITCHBOARDS.

Before the advent of the common battery switchboard the most approved form of board for large central offices was the multiple bridging or branch terminal board. Many of these are doubtless in use to-day and in a state of preservation such that the improvement in service with the central battery board does not seem of sufficient weight to warrant their rejection. Several suggestions as to methods of remodeling such switchboards so that much of their apparatus and wiring might be retained, and yet providing a central battery service, have been put forward as a solution of the difficulty; but heretofore a practical trial has proved all such suggestions to have been faulty in conception. A new idea in this direction, which appears encouraging, is disclosed in a patent issued to M. C. Rorty, of Dedham, Mass., and assigned to the American Telegraph & Telephone Company. The remodeled system contemplates the use of the drops and jacks, both answering and multiple, together with practically all of the magneto system wiring associated with them—a great saving. The connecting cord circuits must, however, be reversed, although the keys and plugs are suitable for reuse. In Fig. 2 is shown the remodeled system in diagram, in which will be recognized at once the standard Bell common battery subscriber's station set, and the standard bridging line circuit. The only changes in this latter are the insertion of a battery and retardation coil in the drop circuit. The battery, of course, causes the drop to fall as soon as the line circuit is closed by the release of the subscriber's hook switch. The retardation coil serves to balance inductively the effect of the earthed line drop coil, which, as there is no cut-off device, remains legged to ground at all times. The cord circuit is novel only in the provision of a relay in the battery supply to the repeating coils, which, through its contacts, controls the supervisory lamps, so that these may glow only when the plugs are in the jacks. The busy test is quite similar to that of the standard bridging switchboard.

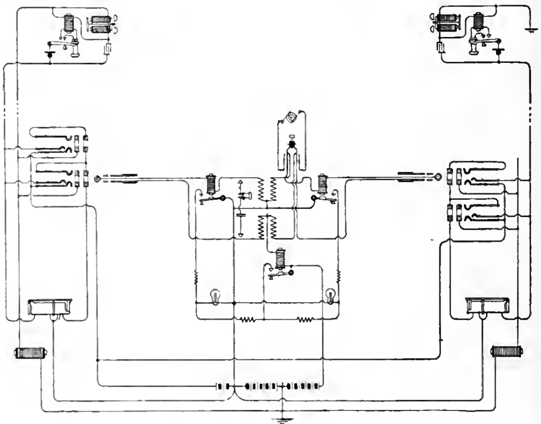


FIG. 2.—RORTY SWITCH AND SIGNAL SYSTEM.

NEW APPARATUS.

An improvement in magneto bells has been made by A. M. Knudson, which consists essentially in providing a base plate upon one side of which the gong posts are secured and from the side of which the ringer frame and magnets project. This arrangement makes the bell complete in itself, and it may be removed from its containing box as a whole. The base plate serves as an escutcheon for the opening in the box through which the bell is to be inserted, and thus the whole gives a neat appearance. The Kellogg Switchboard & Supply Company have obtained Mr. Knudsen's patent by assignment.

A rather unusual piece of apparatus is a plug with an automatic switching device contained within its shank, which has been designed and patented by F. D. Pearne, of Chicago. It is evidently Mr. Pearne's idea to use this switching device in the plug to control the supervisory lamp circuit of modern switchboards and to save thereby one of the relays of the cord circuit in two-wire switchboards. The automatic switch consists of mercury traveling in a glass tube carrying sealed-in terminals. It is doubtful if any material gain will result from its use, in the first place because the connecting cords must contain conductors to lead to and from it, and secondly because of the untrustworthy characteristics of mercury switches in continual use.

Fig. 3 shows a new form of dust-proof relay. This, it will be noted, follows in many details some of its predecessors, the chief novelty lying in the use of an intermediate lever member between the contact springs and the armature. It is impossible to predict just of

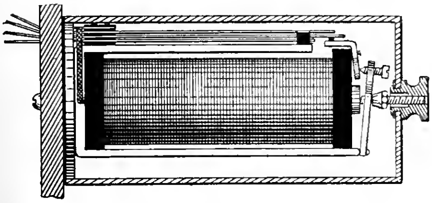


FIG. 3.—DOWNS RELAY.

what advantage such an arrangement will prove, but a multiplication of parts always raises some doubt. The patent for this relay has been granted to J. P. Downs, of Cleveland, Ohio, and has been assigned to the North Electric Company.

SIGNALING SYSTEM.

Everyone has observed the appreciable interval of time required for the filament of an incandescent lamp to cool after the current is shut off, and it is only reasonable to suppose that there must be some corresponding though shorter interval ordinarily required for the filament to attain its brilliancy. Mr. H. P. Claussen, of Chicago, feels that this retarded lighting may result in a failure of the signal of an incandescent switchboard signal lamp, in case its controlling circuit be rapidly closed and opened by a rapid vibration of the switchhook or other circuit-closing device. He, consequently, in endeavoring to overcome any such difficulty, has arranged and patented a signal lamp circuit such that a large rush of current far above the normal current of the lamp flows in the first moment of the closing of its circuit. This sudden abnormal current lights the lamp at once, after which the current is reduced automatically to normal by a relay wired in the lamp circuit and controlling a shunt about the lamp. The American Electric Telephone Company has been assigned the patent for this method of causing lamps to glow.

AUTOMATIC SWITCHING MECHANISM FOR PRIVATE LINES.

Two patents have been issued to U. S. Jackson, of Boston, describing an automatic switching mechanism for use on party private lines, which operate without any central office. Each station is provided with a spring motor, which becomes locked at such times as the line is in use. This precludes any interruption to conversation between two stations from the selective currents of other stations, and as the talking circuit of each set is also controlled by existing conversations, no interruption or listening can be done. The selection of desired stations is performed by impulse currents from a circuit-breaker driven by the spring motor and controlled by the calling party. These currents cause the operation through an electromagnet, and a ratchet and pawl revolve the selecting commutators at all stations, arresting their motion in position for the signaling of the desired station only. Such an arrangement, unmodified, of course, permits one station to hold up the whole line. The necessary modification to prevent this has, however, been provided in the form of a switch upon the receiver of the calling station. This switch must be depressed at all times during conversation or the line will be automatically returned to the normal condition, releasing all stations.

COMBINED ALARM AND TELEPHONE SYSTEM FOR POLICE SERVICE.

In many cities the patrol boxes for the use of the police have for a number of years been provided with alarm signals and in others with telephone instruments. It is now proposed to combine these systems in the same boxes, using the same wires to the central station. This new system provides the usual alarm apparatus to send in automatically the number of the box from which an office is reporting. It provides an answer-back signal signifying the receipt of the telegraphic report, this signal being a hum on the line produced by a buzzer at the central, and to be noted by the office by the use of the telephone receiver; and lastly it provides an alarm signal to notify the officer that he is to use the telephone to receive orders or other information. W. E. Decrow is the patentee, he having assigned his patents to the Gamewell Fire Alarm Telegraph Company.

Wilkinsburg Electric Club.

Organized in the spring of 1902, the Electric Club, of Wilkinsburg, Pa., has at present a membership of more than 500, handsome quarters and a most efficient organization for carrying out the technical purposes which form no small part of the object of the body. Evidently much thought has been given to the organization of the club in order to properly balance its several features, and particularly to render it of the greatest use in every possible direction to its members, who are mostly employees of the Westinghouse Electric & Manufacturing Company. The accompanying illustrations give an idea of the manner in which the club is housed. Its main rooms occupy the whole of a floor of a large building in Wilkinsburg, Pa., with additional space on another floor for games and smoking rooms. The illustrations show the assembly room, which has a seating capacity of about 300 and is used for general and technical lectures, meetings

FIG. 1.—ASSEMBLY ROOM.

of the local section of the A. I. E. E., weekly meetings of the East Pittsburg Drawing Class, and for Saturday evening entertainments and dances. Another illustration shows the reading room, and a third one of the three class rooms.

The organization is very thorough, consisting of a board of direc-

FIG. 2.—READING ROOM.

tors and seven committees, namely, house, library, excursion and research committees, and committees on lectures, section and class work. Every Saturday evening entertainments are held in the club room under the auspices of the ladies' committee. Several times a month technical papers are read by members of the Westinghouse staff and other authorities on the subjects treated. During the month of last February, for example, Prof. W. S. Franklin read a paper on the "Choice of Signs in Polyphase Systems and Ratings of Polyphase Transformers"; Mr. L. M. Aspinwall, of the Westinghouse Company, one on "Systems of Control for Electric Street Railway Work"; Mr. Paul M. Lincoln a paper entitled "Some Features of

Niagara Falls Power Work"; Mr. W. K. Dunlap one on "Some Problems in Construction Work," and Mr. W. J. Beck a paper on the "Testing of Iron and Steel for Electrical Purposes." Classes have been organized for the benefit of the members of the club who have not received a technical education, to enable them to study elementary electrical theory as applied to the apparatus manufactured by the Westinghouse Company. At present there are two classes, one meeting every Tuesday and the other every Friday evening. There are also ten sections which meet to discuss apparatus, shop methods and technical subjects. These sections cover the subjects of direct current, alternating current and railway work, transformers, testing,

FIG. 3.—ONE OF THE CLASS ROOMS.

detail apparatus, road engineering and switchboard, alternating-current work and transformers, having each two sections.

An idea of the activity of the club may be gathered from the following calendar for the spring of 1903:

On Mondays there was a general or technical lecture; on Tuesday evenings a meeting of Class A and Sections 1, 4 and 8; on Wednesday evenings, Drawing Class lectures and meetings of Sections 2, 3 and 5; on Thursdays a general or technical lecture; on Fridays, meetings of Class B and Sections 3, 6 and 7, and on Saturday evenings social meetings with an excursion the third Saturday of each month. The local section of the American Institute of Electrical Engineers meets each month at the club room, all members of the club having the privilege of attending. In the evening drawing classes there are about 100 students, divided into four sections, instruction being given on Mondays, Tuesdays, Thursdays and Fridays. We gather the above information from a handsome brochure issued by the club, which contains illustrations of the club quarters, and information in detail as to the personnel and work of the body.

Recent Electrochemical Developments.

ELECTRIC FURNACES.

In a patent granted on January 26, Mr. Henri Harmet, of St. Etienne, France, who is well known from his work in the electrometallurgy of iron and steel, describes a form of electric blast furnace which contains a lower fusion zone and an upper reduction zone. Electrodes extend into the fusion zone from the outside. The ore, with an excess of reducing carbon, is charged into the top of the furnace and current is supplied through the electrodes so as to form a local fusion zone. There is at this place an excess of heat which would be wasted, if it would pass downward with the molten metal. To prevent this, the inventor proposes to take away the gas escaping at the top of the furnace and carry it downwards with the aid of a fan or blower into the fusion zone, whence it is pressed upwards. The heat of the fusion zone is thus diffused upwards, and the gas when coming into contact with the incandescent coke adjacent to the fusion zone is converted into carbon monoxide, which, when passing through the charge, creates a reduction zone above the fusion zone. The reduction of the charge thus precedes the fusion, and the operation is continuous.

A patent granted to Mr. R. C. Contardo, of Sèvres, France, relates to the design of an electric furnace, the hearth of which has a curved surface, with electrodes above the same. The arch above the hearth consists of two downwardly inclined surfaces, while parallel with the same there are side walls so as to form two inclined flues through which the ore is passed downwards. The heat radiated from the arcs upwards is thus utilized to preheat the charge passing through the flues. The gases developed during the reduction are led away, and the inventor proposes to utilize their caloric effect in gas engines driving generators which are to furnish current for the operation of the furnace.

BATTERY INVENTION.

A patent granted to Messrs. C. P. Elieson and V. de Bobinsky, of Paris, France, relates to the construction of a storage battery plate with a central conducting core of lead, and strips of this lead alternately flat and corrugated, attached at one end to each side of the core and free at their other end. A strengthening frame, comprising upper and lower cross pieces of insulating material and india rubber ligatures, bind the whole together, but allow a free lateral expansion of the thin lead strips.

Radium in Medicinal Springs.

Note was made in these columns recently of the fact that radium in appreciable quantities has been found in the famous springs at Bath, and it is stated on high scientific authority that there is little doubt there are large quantities of it deep down in the earth. Further details are to hand from England. For some time Prof. Dewar has, at the expense of the Royal Society, collected the gases that rise in the largest and best-known of the Bath springs—the King's Bath—and the result of his analysis revealed the fact that the rare element helium existed in the Bath waters.

The existence of helium led to the belief that something more of scientific interest might be found in the deposits in the tanks and pipes at the three springs, inasmuch as Sir William Ramsay recently discovered that helium is slowly evolved from radium. A quantity of deposit from the New Royal Spring was obtained, and was sent to the Hon. R. J. Strutt, son of Lord Rayleigh, who made a careful investigation of the material submitted to him. The result of his investigation he has just communicated in a letter to the Bath authorities.

"I have found," says Mr. Strutt, "that the deposit contains radium in appreciable quantities, though I am sorry to say not enough to pay for extraction. I think there can be little doubt that the helium of Bath owes its origin to large quantities of radium at a great depth below the earth's surface. A little of this radium is carried up by the rush of hot water, and it is found in the deposit. My experiments promise further interesting developments."

This letter was read at a meeting of the Bath City Council by Mr. T. Sturge Cotterell, who added that Mr. Strutt had since written that by "appreciable quantities" he meant quantities such that its presence "may quite easily be detected." But the percentage found was less than in the ore from which radium is at present obtained. About ninety-eight gases are given off by the Bath waters, and Prof. Dewar examined samples of them all. The deposit which Mr. Strutt examined is one of countless peculiar features of the Bath waters. It settles on walls and the bottoms of tanks and corrodes pipes, being like mud of a rich orange color. When dry it is orange-colored powder, but duller in hue and very fine in substance. Settling on stone or projections, it hardens and assumes the appearance of coral or fungus.

The estimated yield of the Bath springs is a million tons of water per annum, and this includes very considerable solid deposits, mainly sand. While the radium is too small in quantity for extraction now, better methods of extracting it are hoped for at Bath.

Pacific Cables.

A bill has been introduced in the United States Senate, at Washington, by Senator Mitchell, authorizing the North American Telegraph & Cable Company to operate telegraph lines or cables between the shores of Alaska and Washington, in order to reach the Aleutian Islands, Siberia, Manchuria, China, Japanese Empire and the Philippine Islands.

January Meeting of the American Institute of Electrical Engineers.

In calling to order the regular monthly meeting of the American Institute of Electrical Engineers, which was held in the rooms of the Chemists' Club, New York, January 29, President Arnold announced that at the meeting of the directors in the afternoon action was taken which will insure harmonious co-operation between the Institute and the International Electrical Congress to be held in St. Louis next September. He referred to the annual dinner of the Institute to be held February 11 at the Waldorf-Astoria, and said it promised to be one of the most successful affairs of the kind that the Institute has yet given. In introducing the papers of the evening, President Arnold referred to the great change in sentiment in this country during the past two years on the alternating-current railway motor question, there being at the present time three systems advocated by men in this country and several in Europe.

In presenting his paper, an abstract of which is printed elsewhere, Mr. C. P. Steinmetz said that his purpose was to give a brief history or review of the development of the alternating-current railway motor as far as he can speak from personal experience. The occasion also serves to bring to the notice of those who have not specially followed this line of development the work of Mr. Eickmeyer, now dead ten years, which at the time was hardly noticed, but which with the development of electrical engineering has become of great importance, and indicates how far ahead of his time Mr. Eickmeyer was in his investigations.

Mr. Schlicter, in introducing his paper, which is reprinted elsewhere, said that it is intended largely to be a practical illustration of the motor which Mr. Steinmetz discusses generally and theoretically, and also to offer in curves some experiments made with the motor.

The discussion of the two papers of the evening was participated in by Messrs. Arnold, Lamme, McAllister, Lincoln, Mershon, Armstrong, Lundell, Lyford, Wagner, Torchio, Steinmetz and Schlicter. The remarks of Messrs. Lamme and Steinmetz were of considerable length and will be reprinted in full in a subsequent issue, being here merely epitomized.

Mr. Lamme defined series alternating-current motors as a type in which the field varies automatically with the change in voltage in the armature. This type can be subdivided into two classes, one of which may be called a straight series motor, the armature being in direct series with the field, and the other a transformer series motor. This latter can again be subdivided into two classes, one with the transformer external to the motor and the other with the transformer in the motor. The latter is the repulsion motor and has the characteristics of the series motor. For a straight series motor to have a good power factor, it is necessary to make it as far as possible non-inductive and have the armature voltage relatively low in comparison with the field voltage. The direction in improvement, then, is to increase the armature and decrease the field turns, or increase the armature turns as compared with the field turns. The alternating-current motor of either the repulsion or straight series type is designed to run at low saturation, and at low saturation it will have torque characteristics better than those of an ordinary direct-current series motor, though the latter will give as good torque characteristics with an unsaturated field. The entire proportioning of a repulsion motor for good power factor depends upon high ampere-turns in the transformer element and low ampere-turns in the exciting element.

A transformer type of motor should have poorer starting properties than a straight series motor, and this is indicated by the curves shown in the papers and by tests made. This means that for the same current at starting slightly less torque is obtained than with the series motor, and for the same torque there is a greater ampere input, which may amount to as much as 30 per cent. Comparing the material in the two motors, it would seem that slightly less material is required for the straight series than for the transformer type. In the armature the series motor carries only the working current, while the repulsion motor carries the working current plus the magnetizing current; but as the latter is not in phase and ordinarily may be a small component, it will not be of great importance. In any of the present types of motors so far devised there is a very considerable loss in the short-circuited coil at starting and this will be slightly greater in the repulsion than in the straight series motor. The difference may not be enough to amount to anything, but it is in favor of the straight series motor. As to the flashing of this type of motor, the point has been mentioned that the repulsion motor cannot flash, and Mr. Lamme points out that the same is true of the straight series type.

Mr. Lamme said there is one point connected with the question of high power factor which should not be ignored, which is that a rather high power factor accompanies machines of rather low efficiency, and this is true of all kinds of alternating-current motors. The low efficiency, in fact, to a certain extent, accounts for the high power factors, and the power factor can be increased in any motor by increasing the losses; therefore, in considering the question of high power factors the efficiency should be looked at also. Referring to comparisons between the acceleration of the direct current and the alternating-current motor, Mr. Lamme said that he thought part of the superiority of the latter should be attributed to the unsaturated condition of its working; and that any direct-current motor if working with an unsaturated field will give better accelerating conditions and more economical starting than a saturated motor. The reason for saturating the direct-current motor is to give it lighter weight, while in alternating-current motors we normally work to an unsaturated condition.

Prof. A. S. McAllister referred to a statement of Mr. Steinmetz that the repulsion motor may also be operated as a generator, and he gave a simple graphical method to show why such a motor acts as a generator, and also a graphical method for representing some of Mr. Steinmetz's equations.

Mr. Steinmetz said he was pleased that Mr. Lamme agreed with him concerning the relations of the repulsion motor, the plain alternating-current series motor and the alternating-current series motor fed by a transformer; and he was also pleased that Mr. Lamme had come to the same conclusion at which Mr. Eickmeyer and he had arrived in their early work, namely, that the only way to make an alternating-current series motor operate at reasonably satisfactory power factor is to combine as high armature reaction as possible with as low field excitation as possible, then increasing the ratio of armature to field magnetism, thus eliminating useless current. He did not consider it correct, however, to assume that the armature of an alternating-current motor can be made non-inductive. There is an ultimate limit between the ratio of armature reaction and field excitation, beyond which one cannot go without again losing. Referring to the power factor of the repulsion motor, he said that it is inherently high. In the ordinary induction motor one can use large magnetic saturations, though not nearly the saturations used in the direct-current motor. As to differences in weight and efficiency of the direct series and repulsion motor, if one and the same motor were experimented with at times as a straight series and at times as a straight repulsion motor, a wrong conclusion on this point might be arrived at. A motor which is a good series motor will make a very poor repulsion motor and vice versa. One cannot take one and the same motor and run it first as one and then as the other and draw general conclusions, because the transformer feature introduced requires redesigning of the motor.

Mr. Paul M. Lincoln, referring to a remark of Mr. Steinmetz to the effect that the repulsion motor, when reversed, becomes a generator, and can then be used for braking or returning power into the line, said that the same is true of the straight series motor, as shown in experiments in which a wattmeter indicated that the motor was returning power to the line, and on one occasion, when an airbrake failed, the car was stopped by the motor.

Mr. Mershon asked a number of questions concerning practical points in connection with the repulsion motor, to which Mr. A. H. Armstrong replied. He said that the repulsion motor can be designed to operate on direct current good enough to help through a town along the right-of-way; but that a good repulsion motor and a good direct-current motor cannot be combined in the same structure any more than can a good straight series motor—it is necessary to make sacrifice in one feature or the other.

As to the e.m.f. of the repulsion motor, they can be built for 2,000 or 3,000 volts on the field without the use of transformers, though in this case some advantages in motor control would be lost; however, motors of high potential would hardly be used in service calling for frequent stops, and without frequent stops the small difference in efficiency at starting would have no appreciable effect on the general efficiency of the system as a whole. As to the weight of alternating-current and direct-current motors, the former will weigh some more, but just how much added weight there will be is at present not known. As to the weight of the rest of the equipment, with the case of a high potential motor with 3,000 volts direct on the field, the control equipment would not weigh very much more; with low potentials, however, there would be the added weight of the transformer in addition to the rest of the apparatus.

President Arnold said that the practicability of using high voltages has been pretty thoroughly demonstrated in practice abroad; in Italy, for example, 3,000-volt motors have been operated for two or three years and there has been no report of deterioration of insulation. In reply to a question from Mr. Lundell, Mr. Steinmetz said that comparing the present alternating-current motor of the plain series or repulsion type with the highly developed direct-current motor, the former is somewhat less efficient and weighs somewhat more. He considered, however, that the difference is altogether less than should be anticipated considering the short time of development of one and the long period of development of the other. While at present and perhaps for some years to come the alternating-current railway motor will, as a new type of apparatus, be handicapped by somewhat lower efficiency and somewhat greater weight, Mr. Steinmetz does not consider this inherent in the motor and does not consider it impossible that they will come to a quality with, or even in some cases superior to, the direct-current motor.

Mr. O. S. Lyford having made an inquiry as to the relative dimensions of direct and alternating-current motors, Mr. Schlicter said that a 100-hp motor could be used with a 33-in. or 36-in. wheel. Mr. Lamme added that his company is now building 150-hp motors, which will go in on 33-in. wheels, and that they have concluded that they can put 200-hp motors on 36-in. wheels.

In reply to a question from Mr. H. A. Wagner, Mr. Steinmetz said that the repulsion motor takes more copper and less iron than the direct-current series motor. The straight series motor will have a smaller armature diameter than the repulsion motor, probably larger external diameter, more iron and less copper, but in general he does not expect there will be any important difference between the two types.

Mr. Philip Torchio said he considered that the present traction question is one of distribution, not only for the ordinary kinds of electric railways, but for large trunk lines where heavy traffic is to be handled, and consequently the question of the motor itself is not of paramount importance, provided apparatus can be obtained that will do the work. President Arnold added that if we get an alternating-current motor which will do the work as well as the present series motor, though nothing has been gained, by virtue of the advantage of distribution, a great step forward will have been made. In point of fact the alternating-current and direct-current motors have almost the same efficiency, and with the former is gained the great advantage of distribution inherent in alternating currents. This will enable us to construct electric railways at less first cost than we can do to-day with the direct-current system, and will open up new fields to electric traction.

When and How Incandescent Lamps are Used.

By MORTIMER NORDEN.

The following data has been collated by me showing the yearly consumption of current per 16-cp lamp on the circuits of a large central station company, giving the yearly average of current used in kw-hours. I believe that many of your readers will be interested to see this analysis at the time of the twenty-fifth anniversary of the incandescent lamp. The data represent ten plants all operated by the one company:

Totals of Average Consumption, Showing Yearly Consumption per 16-cp Lamp Connected.

		Lights.	Kw-hours.
1	Green house	54	1.33
24	Colleges and schools	2,863	5.70
127	Churches	11,616	7.75
3	Parks	416	9.24
1343	Residences	40,095	10.73
64	Dentists' and physicians' offices	1,066	15.10
344	Factories	21,936	15.53
8	Signs	365	18.48
14	Public halls	1,781	18.81
6	Dressmakers	111	20.24
1	Grain elevator	24	20.75
102	Municipal buildings, hospitals, armories and city halls	14,654	24.79
104	Clubs and lodge rooms	7,391	24.82
147	Nine o'clock stores	4,433	26.35
401	Seven o'clock stores	17,623	26.55
449	Eight o'clock stores	13,228	27.10
137	Livery stables and stables	1,775	29.56
26	Eleven o'clock stores	624	30.01
287	Office buildings and offices	7,363	30.65
10	Theatres	10,581	32.13
9	Road houses	305	32.70
45	Banks and insurance companies	3,322	33.80
11	Ten o'clock stores	339	38.34
2	Cold storage companies	158	40.82
4	R. R. terminals and docks	854	42.14
180	Drug, confectionery and cigar stores	4,370	42.44
640	Saloons, restaurants and concert halls	17,592	43.62
327	Six o'clock stores	23,584	45.61
22	Wholesale butchers	1,012	46.92
25	Commission dealers	518	48.06
8	Twelve o'clock stores	170	52.44
3	Steamship docks	2,293	61.71
5	Hotels	1,099	65.
23	Railroad stations	909	118.98
2	All night stores	410	218.06
4004	customers.	214,934	
		Grand average	27.28

Statistics of Export Trade.

The figures of 1903 in United States export and import trade have already been noted in these pages, and now further details as to this record year are obtainable. For the twelve months ending December 31 the exports of domestic manufactures amounted to \$421,453,915, against \$410,650,967 in December, 1902, an increase of \$10,802,948. The increase for December alone was thus more than one-half of the total increase for the calendar year. In 1902 many of the leading articles of export fell behind the record for the previous calendar year. The most notable decline was in the exports of cotton cloths, which fell off about \$7,000,000. Exports of copper manufactures fell off about \$2,000,000, and exports of vegetable oils about \$3,000,000. The most notable increase was that of about \$5,000,000 in exports of agricultural machinery. Other important increases were \$3,000,000 in the exports of refined mineral oils and \$1,000,000 in steel rails.

The following table shows the values of exports of some of the leading articles of domestic manufacture during the twelve months ending December 31, 1903, as compared with the same period in 1902:

Articles—	1902.	1903.
Agricultural implements	\$17,981,597	\$22,951,805
Books, maps, etc.	4,407,028	4,336,732
Cycles and parts	2,581,255	2,099,092
Automobiles and parts	1,069,782	1,643,029
Cars, carriages, etc.	7,500,064	8,506,092
Clocks and watches	2,121,657	2,216,346
Copper ingots and manufactures	45,485,598	43,509,788
Cotton cloths, colored	8,838,724	6,395,219
Cotton cloths, uncolored	18,030,589	13,337,851
Fibre manufactures	5,111,865	5,642,405
Glass and glassware	2,094,701	2,053,516
Gunpowder and explosives	2,393,480	2,367,148
India rubber manufactures	3,815,754	4,360,965
Electrical and scientific apparatus	6,466,201	8,145,923
Steel rails	1,902,396	937,779
Structural iron and steel	2,828,460	1,788,556
Steel wire	5,140,702	5,528,726
Builders' hardware	11,320,765	12,141,058
Miscellaneous castings	1,685,660	1,765,901
Cash registers	1,220,791	1,825,503
Electrical machinery	5,937,643	5,104,502
Metal working machinery	2,863,709	3,316,088
Pumps and pumping machinery	2,516,300	2,729,288
Sewing machines and parts	4,606,794	5,340,474
Locomotive engines	3,966,007	3,099,521
Boilers and parts of engines	2,432,098	2,273,834
Typewriters and parts	3,575,909	4,537,396
Miscellaneous machinery	20,930,519	20,068,810
Iron pipes and fittings	5,107,183	5,919,340
Miscellaneous manufactures of iron and steel	10,052,766	9,073,059
Sole leather	6,720,966	6,320,665
Upper and other leather, except sole	16,099,430	17,376,746
Boots and shoes	6,470,412	7,244,726
Muscial instruments and parts	3,437,337	3,354,108
Naval stores	13,299,861	14,299,296
Refined mineral oils	62,266,132	65,846,389
Vegetable oils	16,203,002	13,160,379
Paints, pigments and colors	2,219,438	2,566,936
Paper and manufactures	7,251,517	7,339,914
Paraffine and wax	8,398,450	9,596,308
Soap	2,028,264	2,627,633

Articles—	1902.	1903.
Tobacco manufactures	5,523,234	5,204,407
Wood manufactures	12,437,864	13,634,065
Woolen manufactures	1,588,058	2,002,913

The showing for electrical apparatus and machinery, etc., will be noted in particular. Taken together the two items show a total of $13,250,425, as compared with $12,403,844 in 1902. Part of the apparatus is scientific other than electrical, but the general showing is splendid. The slight falling off in electrical machinery value is attributed to the lower range of prices prevalent, but not to any decline in bulk. There is great encouragement in these statistics for electrical manufacturers in pushing for foreign markets. Many of the other items on the list include or conceal material of an electrical nature or purpose.

Vapor Tube Telephone Repeater.

In a patent issued January 19 Mr. Peter Cooper Hewitt describes an important application of the vapor tube for reproducing variations of current in an electric circuit, the latter being either wholly independent or a branch of a divided circuit. The striking feature of the principle is that it enables the production in the secondary circuit of electrical variations of greater magnitude than the original electrical variations in the primary or transmitting circuit. In other words, it offers a solution to the problem of the telephone repeater. As illustrated and described, a magnet in the telephone transmitting circuit is in close proximity with a vapor tube, and the telephone receiving device is in series in the vapor tube circuit. In one form shown the core of the magnet in the transmitting circuit embraces the vapor tube. It is stated that the amplification of the electrical variations in the secondary circuit is due to the fact that a given magnetic variation may cause a wider fluctuation of effective resistance in the gas or vapor than the fluctuations of electrical energy producing the variation of the magnetic field of force. Accordingly, by employing the vapor tube the vibrations of the circuit are magnified, not by induction effects, but by varying the ohmic resistance of the circuit in which the apparatus is placed.

CURRENT NEWS AND NOTES.

ATLANTA BRANCH A. I. E. E.—Plans are being made for the organization in Atlanta, Ga., of a branch of the American Institute of Electrical Engineers.

ELEVEN CENTS PER K. W.—Eleven cents per kilowatt will be the maximum price which is to be charged by the Cincinnati Gas & Electric Company during the next ten years. This scale has been fixed by the city council.

TRANSMUTING METALS.—In a speech on radium at the Hotel Cecil, London, on January 23, Prof. Sir William Ramsay hinted that his recent discovery would possibly open up the question of the transmutation of one element into another. He did not mean to say that silver and copper were transmutable into gold, but it might very well be asked what would happen if gold were made very much cheaper.

ELECTRICAL POSTAGE STAMPS.—King Victor Emmanuel is of opinion that the Italian stamps are not sufficiently artistic, and has, therefore, decided to issue a completely new set of stamps. The new stamps are said to be remarkably artistic and there is a different design for each value. Two of the most interesting stamps are those of one and two centimes, for the first bears the head of Volta and the second that of the modern electrician, Marconi, the inventor of the wireless telegraph.

KAISER HONORS ELECTRICITY.—A cable dispatch from Berlin of January 29 says: "In recognition of their services to the State, Emperor William has had decorations conferred upon Dr. Schulz, president, and Herr Rathenau, general manager, of the General Electrical Company, of Berlin; Herr Denninghoff, manager of the Society for Experimentation in Rapid Electrical Transit, and on several engineers who have been connected with the recent experiments."

PARIS SUBWAY LINES.—Another fire, caused by the short circuiting of the electric current of a train on the Metropolitan Railroad, occurred on January 30, near the La Chapelle Station. A panic followed, in which four persons were injured, none of them seriously. Boring operations in connection with the new Metropolitan line from Courcelles to Menilmontant, which crosses the Place de l'Opera, have been completed, and the work of laying the rails has been begun. The cars will be larger and safer than those now in use, and a tunnel has also been constructed, so as to have a grand station at the Gare Saint Lazare, connecting the Metropolitan with the Western Railway and the Ceinture. The inauguration of the line is expected in July.

IMPORTATION OF CURRENT.—According to advices from Niagara Falls, the question of the exportation of electricity from Canada to the United States has reached a point where it must be decided one way or the other. A deputation, consisting of W. B. Rankine, vice-president. and M. Munro Grier, secretary, of the Canadian Niagara Power Company; J. W. Langmuir, chairman of the Queen Victoria Park Board; G. T. Blackstock and W. Caryl Ely, of the International Railway Company; H. H. McRae, of the Electrical Development Company, and A. W. Maltby, of the Ontario Power Company, have interviewed Premier Ross on the situation. The International Railway Company has made application for permission to bring electric power from its power house on the Canadian side of the river to this side and use it to operate its cars.

RADIUM AND CANCER.—A cable dispatch from St. Petersburg, of January 27th, says: "Prof. Prince Tarkhanov, a well-known scientist, lecturing recently before the Military Association, made some interesting statements in regard to the possibilities of radium. He presented to his audience two cancer patients who had been cured of malignant growths on the face by the use of radium, and expressed the opinion that the problem of determining the sex of children, which Professor Schenck had failed to solve, will soon be settled by the aid of radium. The prince added that he had prevented the development of hydrophobia in dogs inoculated with the virus of rabies, by using radium. When large quantities of radium were available, the prince contended, the whole system of modern warfare would be revolutionized, as powder magazines, whether in forts or in the holds of vessels, would be at the mercy of radium rays, which could explode them at long distances."

MORE THIRD RAIL ROADS.—There appears to be a good deal of activity in various parts of the country in developing third rail enterprises. A corporation to be known as the Minnesota Central Railway Company is being organized by John J. Allen, J. Quist, and others of Minneapolis; F. B. Rossom, of Virginia, prominent in iron land matters on the Mezaba, and some Eastern capitalists. The plans of the company are to build an air line from the twin cities to Duluth and operate it by electricity. It is to be a standard gauge road, and will be 135 miles long, seventeen miles shorter than the Northern Securities roads, the Great Northern or Northern Pacific lines, between the points named, and will be a rival of them for business. Last week also announcement was made that arrangements have been concluded for the building of a third rail street car system between Elmira, N. Y., and Corning. The necessary application will be made to the State Railroad Commissioners at once. A private right of way has been secured and only one grade crossing will be made.

ELECTRIC POWER FOR FACTORIES.—One of the most important lines of work undertaken lately by the National Electric Light Association deals with the sale of current for power purposes by central stations. Of late years the day circuit and the motor load have become vital features of progressive development in the industry and now, on every hand, there is inquiry for fuller information on all branches of the subject. Having this in mind, President Edgar has appointed, on behalf of the association, a committee to obtain and present data in regard to "Purchased Electric Power in Factories," and W. H. Atkins, chairman of the committee, is issuing a circular of inquiry which is well calculated to elicit a large amount of valuable data. Mr. Atkins can be addressed at 3 Head Place, Boston. The other members of his committee are Messrs. S. M. Bushnell and G. W. Brine. It is hoped and believed that responses will be copious and numerous, so that the report will give a further stimulus to the sale of current for power as well as extend the application of motors on central-station circuits. The useful work that the Association thus attempts and carries out so well is highly beneficial to the art, and should have a reflex action in increasing its influence and membership.

THE INVENTION OF THE TELEPHONE.—The newspaper press has once again returned to the subject of priority of invention of the telephone. The story is that in 1901 Judge Kohlsaat, of the United States Circuit Court at Chicago, appointed a special examiner to take evidence in the suit for $50,000,000 damages brought by the Atlantic & Western Telephone Company against the American Bell Telephone Company, American Telephone & Telegraph Company, Chicago Telephone Company, and the Central Union Telephone Company for alleged infringements on Henry C. Strong's inventions. A few days ago the examiner, it is stated, filed testimony tending to deprive Prof. Bell of the credit of inventing the telephone and bestowing the honor upon Strong. According to a dispatch from Chicago, the basis for the suit is an invention to facilitate long-distance telephoning, for which Strong secured a patent in 1885. Strong is nearly 80 years of age and a resident of Chicago.

LETTERS TO THE EDITORS.

Theories in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

SIRS:—The letter and extracts from M. Blondel's paper published in your issue of January 2nd last afford interesting reading in view of the statements which have sometimes been made imputing priority of publication of the sliding wave theory to M. Blondel. If refutation of Mr. Fessenden's statement ascribing such priority in any degree to M. Blondel were needed, a more admirable answer could not have been forthcoming. M. Blondel's theory, as I have always been fully aware, is *not* mine. It differs in the vital point that his theory involves space-propagated radiation whereas my theory is essentially a theory of surface-propagated or sliding waves. The one does not to any extent account for the great range over which signals can be detected, whilst the other supplies an obvious and simple reason for the effects observed. At the time that I originally framed my theory I need hardly say I was quite unaware of M. Blondel's work, but the theory which he advances was at once so obvious that it was given full consideration and dismissed as not affording a rational explanation of the various phenomena observed. I have therefore no intention whatever to lay claim to a theory to which M. Blondel is so very welcome.

Before baldly referring to my "erroneous ideas" it would savor of better judgment on M. Blondel's part if he took the trouble to prove the existence of the errors he so groundlessly imputes to me, as statements of this kind cannot but be resented unless substantially backed up, whether made by M. Blondel or Mr. Fessenden. I contend most emphatically that it is they who are in error.

In the first place, M. Blondel's theory, despite his statements to the contrary, does not fit in with the facts elucidated by experiments. It is plain from the diagram given of the wave distribution that at quite moderate distances from the transmitter the intensity of the effects produced on a vertical antenna will not materially diminish at very considerable heights above the surface of the ground on this theory. So long as the plan of polarization is sensibly vertical the action on a vertical antenna dependent from a balloon will remain constant whatever be the height. I am not aware that this is in accord with experiment. In the second place the theory involves a denial of the fact that Hertzian waves can be guided by conductors, for, if waves on wires expand as M. Blondel would have them, there is nothing whatever to distinguish them from the ordinary free or space-propagated Hertzian waves which spread through space somewhat in the manner indicated in the theory.

It is certain, therefore, that waves on wires such as were investigated by Hertz himself and by Von Bezold before him have not any such form. Inasmuch as wires prevent the dissipation into space of waves which they conduct it is abundantly clear that two distinct classes of waves are concerned, and this was fully recognized by Hertz as indicated in the diagrams given on page 156 of the English translation of his papers, 1893 edition. If, then, waves on wires differ in form from space-propagated waves there is surely every reason, apart from experimental evidence, for the assumption that wireless telegraphy waves where the surface of the earth replaces the conducting wire are rather of the type of waves on wires than of space-propagated waves.

I fully appreciate the considerations which lead M. Blondel to his view of the case and to the idea that the waves must expand vertically as well as laterally. To some small extent this must be the case, especially when the wave train is a very short and rapidly-damped one, but the effect will generally be quite negligible. Consider the case of an electric shadow thrown by a large conducting obstacle in the path of the waves. The existence of the shadow proves that the expansion of the waves into the region of the shadow after passing the obstacle is not a necessity. Of course, diffraction effects come into play, but if the size of the object be sufficient in relation to the wave length these effects become negligible. Here there is a perfectly analogous case so far as the tops of flanks of the waves are concerned. Indeed, it is a question of the application of Huygens' principle, which is really at the bottom of the matter.

The peculiar way in which M. Blondel makes his lines of force twist and squirm in their frantic endeavors to form a true expanding hemisphere is decidedly quaint and would do them credit if it were true.

I do not for a moment claim infallibility, and I should like to take this opportunity of pointing out a slight inaccuracy which appears in one part of my original publication in the London *Electrical Review*, and which I have for a long time past fully intend to correct. It is, however, just the part which has been accepted as gospel on all hands and which has also been ascribed to Hertz as Hertz's conception of wave formation. I have, however, no desire to palm off my mistakes as those of Hertz. The misconception alluded to is that regarding the ends of the lines of force as gliding along the oscillator or antenna in the formation of self-closed fields of force which are resolved into waves. Strictly speaking there is no lateral motion of the lines of force *at the surface of the oscillator*, at any rate after the oscillations are fully established, a fact which I find Hertz recognized (see page 255 of Hertz's papers quoted above); for if such a motion be assumed it becomes necessary to make the further assumption that the rate of movement is infinitely rapid, thus destroying the value of the conception.

I propose to explain this point more clearly in a further publication shortly, but will here merely point out that although strictly correct as applied to the conception of travelling waves the lateral motion of the lines is not a true explanation of the effects taking place at and near the oscillator itself. In other words it does not properly apply within the quarter-wave-length range about the oscillator or the resonant receiver, either with respect to the electric or the magnetic lines of force. The result arrived at is correct, but the method of deduction is not quite accurate. This may appear foreign to accepted notions on the subject and is rather hard on the electron theory as applied to wireless telegraphy, but I am fully prepared to substantiate the statement.

Another point on which I entirely disagree with M. Blondel. He assumes for obvious reasons that the speed of propagation of wireless waves is not the same as that of light until they have proceeded a large number of wave-lengths from the source. This is in conflict with known laws. The speed of propagation is that of light at distances beyond the first quarter-wave length or thereabouts, provided disturbing factors in the way of reflection, opposing wave-trains, resonance effects, etc., are absent, and that the medium is perfectly homogeneous.

LONDON, ENGLAND. J. E. TAYLOR.

"Cannon Ball Trolley Cars."

To the Editors of Electrical World and Engineer:

SIRS:—Your query, "Why 'cannon-ball'?" at the conclusion of your note entitled "Third Rail in Pennsylvania," and citing that epithet calls forth a reply that may be of interest. The introduction of the high-speed interurban electric line by the Lackawanna & Wyoming Valley Railway Company was an epoch-marking event for this section of the State. Although such a road had been in operation between Hazleton and Wilkesbarre, it does not seem to have elicited as much comment as the L. & W. V. R. R. Prior to its christening that road was known as the "Cannon Ball," presumably on account of the fanciful notion held by this provincial community that the speed of the cars rivalled that of an ordnance projectile. As a result of a prize contest the road was named the Laurel Line, but in spite of advertising under that name, "the Cannon-Ball road" is still its vernacular title.

The distance from Scranton to Wilkesbarre is 19 miles, and is covered in about 43 minutes by both the Laurel Line and the D. & H. R. R. The former has the advantage of better service and so gets a large part of the traffic. Its rate of fare is 50c. for the round trip. That on the D. & H. R. R. was formerly 85c., but the decrease in traffic due to the inroads made by the Laurel Line caused a reduction of fare to 40c. for the round trip. That did not have the effect of winning back the former business, so it has been apparently decided to fight the newcomer with its own weapon.

In confirmation of the current belief comes the announcement that the Lehigh Valley R. R. (or in other words the Pennsylvania R. R.) will use the tracks of the Laurel Line to provide service in connection with their principal express trains. For years the "P. R. R." has sought entry into this city, and now it has it over a well-built double-tracked road, capable of withstanding heavy traffic and high speeds.

Scranton, Pa. L. S. Levy.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Double-Current Generators.—Horschitz.—A mathematical article illustrated by diagrams in which he discusses the copper losses in double-current generators. While a double-current generator is quite similar to a synchronous converter, yet there are two main distinguishing features. The two currents in the converter have opposite directions, while they have the same direction in the double-current generator. In the converter the alternating-current energy is nearly equal to the direct-current energy, while this is not the case in the double-current generator. The author discusses in detail in which way the current in every armature coil is resolved into the direct and alternating currents, which are taken off from the machine. He shows which copper losses and heating are produced by this combination in the whole armature and he compares these losses with the losses which would occur, if the armature would give only direct current. For the double-current generator, when operated on a non-inductive load, he reaches the following conclusions: If generating single-phase current, the losses are very great, as soon as the alternating-current load is 25 per cent. of the maximum possible direct-current load; and the greater the single-phase load becomes the greater become the losses. A double-current generator, giving three-phase and direct-currents, is economical as long as the apparent three-phase power is not beyond 67 per cent. of the maximum possible direct-current power; that is, for instance, as long as an armature which can give 100 kw direct current has not to furnish more than 67 kw, three-phase currents at a power factor equal to unity. The more phases are used the smaller become the copper losses; but there is no use to increase the number of phases beyond six. If the double-current generator is operated on an inductive load, the copper losses become smaller than in the former case.—*Elek. Zeit.*, January 14.

Single-Phase Motor.—An illustrated description of the Schüler-Ferranti single-phase motor, which is a combination of an ordinary

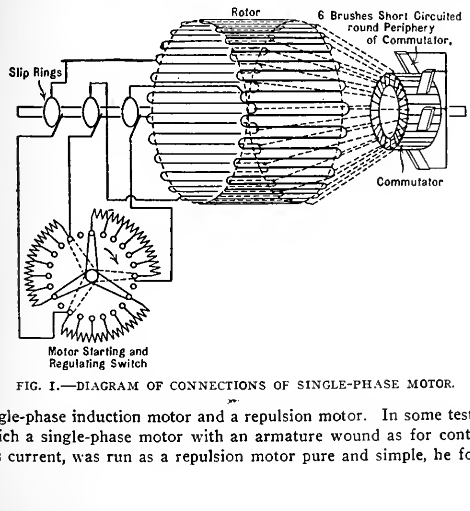


Fig. 1.—Diagram of Connections of Single-Phase Motor.

single-phase induction motor and a repulsion motor. In some tests in which a single-phase motor with an armature wound as for continuous current, was run as a repulsion motor pure and simple, he found the starting torque to be good, but to decrease rapidly. On the other hand, when the same motor was run as a single-phase induction motor with a three-legged resistance in its rotor circuit, the torque is zero at start, but increases gradually to a maximum. This behavior is exactly opposite to that of the repulsion motor. Schüler combined, therefore, these features of both types of machines in one motor and the outcome is the arrangement shown in Fig. 1. At any speed the motor torque is approximately equal to the sum of the torques due to the repulsion motor and to the induction single-phase motor, respectively. This feature is shown in the curve of Fig. 2. At starting the three-legged resistance is inserted in full in the

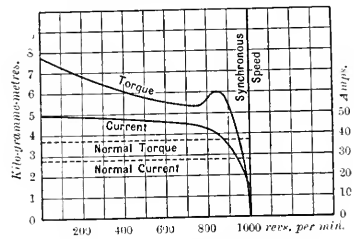


Fig. 2.—Characteristic Curves.

rotor circuit, and the current flows by way of the commutator and the short-circuited brushes. The motor then starts as a repulsion motor. By gradually cutting out the starting resistance, part of the induced armature current flows through the resistances and the motor begins to act as an ordinary single-phase induction motor. By means of the three-legged resistance, the motor speed may be varied in wide limits, the torque varying to a comparatively small extent.—Lond. *Elec.*, January 15.

Reference.

Single-Phase Commutator Motors.—Osnos.—The conclusion of his long illustrated article in which he discusses the various forms of single-phase commutator motors. After having described the compensated series motor and the compensated shunt motor, he discusses the methods of regulating the speed and torque, of changing the direction of rotation and of avoiding short-circuit currents in the various types of motors discussed by him.—*Elek. Zeit.*, January 14.

Lights and Lighting.

Arc Light for Photochemical Purposes.—An article in which it is said that for photochemical purposes (making blue prints, etc.), the ordinary arc lamp is uneconomical. An arc lamp of a German company is described which is claimed to be specially suitable for such purposes. It is an enclosed arc lamp, the life of the carbons being given as 250 hours. By carefully keeping the air away and using a high-voltage (say, 200 volts direct current) an arc of 25 to 30 mm. is obtained, which is chemically very active. With such a special 200-volt lamp the consumption of current for the same chemical effect is claimed to be less than one-fourth for the ordinary 55-volt lamp.—*Zeit. f. Beleucht.*, December.

Electric Arc Between Carbons.—Blondel.—A long article in which the author summarizes and critically discusses the work of Mrs. Ayrton on the mechanism of the electric arc between carbon electrodes.—*L'Eclairage Elec.*, January 2, 9.

Mercury Arc.—De Valbreuze.—A fully illustrated article in which the author gives a summary of the various investigations on the electric arc through mercury vapor.—*L'Eclairage Elec.*, January 16.

Power.

Blast Furnace Gas as a Source of Power.—An illustrated description of the Thwaite system for using the blast furnace gases, now largely wasted, for driving gas engines and generating electric power. In an editorial on this subject it is pointed out that about 50 per cent. of the effluent gases of a blast furnace are available for use for other purposes than those connected with the operation of the furnace itself. For every ton of pig iron produced per hour about 840 hp is available for other uses. Considering the immense production of pig iron at many plants, it appears that these plants are bound to become centers of generation and distribution for large amounts of power in their vicinities.—*Power*, January.

References.

Electric Pumps and Compressors.—Richard.—In a continuation of his serial on mechanical applications of electricity he gives brief, concise and illustrated descriptions of various electric pumps constructed during recent years, especially for use in mines and metallurgical plants. Among the apparatus described are the pumps of Deane, Knowles, Mavor & Coulson, Merryweather, Hammersmith. There are also described several air compressors for use in connection with compressed air brakes in traction, compressors of Christensen, Batchelder and the Thomson-Houston Company being described.—*L'Eclairage Elec.*, January 2.

French Water Power Plant.—Domar.—An illustrated description of the plant of the Electrometallurgical Society of Saint-Beron. It contains five turbine-driven, two-phase generators, giving 3,000 or 6,000 amp. at 80 or 40 volts, respectively. They supply 12 electric furnaces for making calcium carbide.—*L'Eclairage Elec.*, January 16.

Shawinigan Falls.—Perkins.—An illustrated description of recent equipment for the power house of the Shawinigan Falls Power Company.—*West. Elec.*, January 23.

Superheated Steam.—Buhle.—An illustrated description of the Pielock system of superheated steam.—*Dingler's Polytech. Jour.*, January 2.

Traction.

"Electrothermic" Operation of Railways.—Lengenhazer.—An illustrated article on a peculiar system which is said to be now under consideration by the general management of the railways of Switzerland. The main idea is to retain the old locomotives, but to produce the heat for heating the water not by burning coal, but by the electric current in resistance, properly arranged, so as to get a very high efficiency for the transformation of electrical energy into heat. For this purpose the resistances consist of extremely thin layers of "noble metals," burned into mica plates, so as to have a very small cross-section and a very large surface. If the boiler has a capacity of 4,000 liters water it is calculated that to heat them from 10° to 190° C., corresponding to a steam pressure of 15 kg. per sq. cm., 300 kw are required. For a steam consumption of 1,000 kg. per hour, about 225 kw would be required. The following advantages are claimed for this system. When a train starts there is no sudden increase in current consumption, so that the load curve is more uniform. Direct or alternating current may be used. The regulation of the heat is very simple, since only resistances are inserted to or switched off from the circuit. The present railway engineers would easily become acquainted with the new system.—*Elek. Anz.*, January 7.

Jackson & Battle Creek Railway.—A description of this new third-rail road, 45½ miles in length, recently put in operation in Michigan and operating cars at a maximum speed of 60 miles per hour. The third rail weighs 70 pounds per yard and is used throughout the line except in the cities, where the overhead construction is employed. Power is purchased from a water power plant located 45 miles from one terminus and 90 miles from the other terminus, and is transmitted at 40,000 volts and 60 cycles. Rotary converters are used in the substations. The railway company pays 1¼ cents per kw-hour for the first 3,000 kw-hours per day, and after that at the rate of one cent per kw-hour.—*St. R'y Jour.*, January 2.

Rail Bonds.—Harrington.—The first part of a fully illustrated Franklin Institute paper on rail bonds. As the vital features he considers: primary, life and conductivity; secondary, cost and design. He describes types of bonds which now represent the best practice in the United States, and starts with a discussion of protected rail bonds.—*Jour. Frank. Inst.*, January.

Sheffield.—Sample.—An illustrated description of the trolley system of Sheffield, England, which comprises 29 miles of double-track and 7 miles of single-track. The nominal capacity of the power plant is 3,675 kw.—*St. R'y Review*, January 20.

Seattle.—A fully illustrated article on the "Stone & Webster properties on the Puget Sound," and especially the Seattle Electric Company, which does the electric railway lighting and power business of Seattle. The company has eight power stations, the equipment of which is described. The traction system is dealt with at length.—*St. R'y Review*, January 20.

Tram Cars.—Herzog.—The first part of an article on the construction of cars built by Swiss companies for electric tramways. Some detailed drawings are given.—*Zeit. f. Elek. ü. Masch.* (Potsdam), January 16.

Installations, Systems and Appliances.

Electromechanical Compounding System.—Brock.—An illustrated description of the electromechanical compounding system of Routin. In the regulation of steam-driven dynamos, the speed must be adjusted by varying the admission of steam to the engine and on the other hand the voltage must be varied by changing the excitation. Both changes should be made simultaneously, but the changes of admission of steam require time, since the mechanical devices are subject to the law of inertia. The condition for the successful regulation is, that with increasing current consumption and with decreasing voltage or decreasing speed, the admission of steam should be increased and the excitation simultaneously increased, while with decreasing current consumption and increasing voltage or speed, both the admission of steam and the excitation should be diminished. The device of Routin, as shown in Fig. 3, consists of an iron

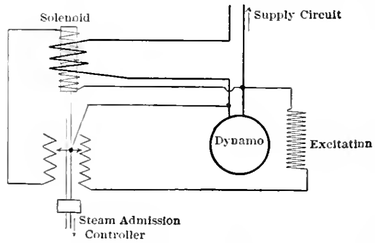


Fig. 3.—Electromechanical Compounding System.

core, on which is acting the difference of the ampere windings of a main current coil and of a voltage coil. Through the main coil flows the current given out in any moment from the machine, while the shunt coil (which is connected in opposition to the main coil), is connected across the terminals of the generator is in series with a resistance which may be regulated by the sliding contact, *a*. Simultaneously with the sliding contact, *a*, the sliding contact, *b*, moves which, by its changed position on the resistance, *R*, influences the excitation of the machine. The dimensions of the coils are so chosen that the action of the shunt coil is always superior to that of the main current coil. The iron core of the solenoid is coupled to the devices which determine the steam admission to the engine, and carries a weight, *P*, which gives an attractive effort downwards. When the iron core sinks downwards the steam admission is increased, and if it rises upwards the steam admission is diminished. The motion of the iron core is the result of the differential action of the two ampere windings.—*Elek. Zeit.*, January 14.

French Gas-Driven Power Plant.—A note on what is considered to be one of the largest gas-driven power plants in France. It is the plant in Valenciennes which was formerly operated by steam, but has been converted to a gas-driven one in consequence of a dispute arising with the local gas company with regard to certain concessions held by the company. A settlement was arrived at, the electric company agreeing to a minimum purchase of 50,000 cu. m. of gas per year at a price of 2 cents per cu. m. Four 110-hp gas engines have been erected in the engine room and they are remarkable for the fact that one of the two cylinders, which are mounted in tandem, is double-acting, the other being single-acting. They drive four direct-current dynamos, each giving about 400 amp. at a voltage of from 225 to 250. A smaller set of about 40-hp capacity is used in connection with the buffer battery and for light loads. The three-wire system of distribution is used and electricity is sold for lighting at a price from 11 to 15 cents per kw-hour, and for power purposes at a price of 7 to 10 cents.—Lond. *Elec.*, January 15.

Electric Installation on Board Ship.—A very long and profusely illustrated description of the Chilian battleship *Libertad*. The following information is given concerning the electric equipment. The use of incandescent lamps throughout the vessel is most complete. The total number of lamps is about 1,000—generally of 16 cp—with 50-cp lamps in clusters on the yard arms, and lamps of 50 cp for the coal bunkers. There are five dynamos in the vessel, each of 500 amp. at 100 volts, when running at 400 revolutions, together with the necessary engines, these dynamos being all coupled up to the switchboard by specially insulated cables. The switchboard is suitable for parallel running, is capable of dealing with the total number of dynamos and circuits required, and fitted in a position adjacent to the dynamos, easily accessible and convenient as regards manipulation of switches and other necessary work at the switchboard. The circuits are distributed by means of specially insulated cables to gun metal section boxes, which boxes feed the water-tight distributing or cut-out boxes, from which the lamps are controlled. In addition to the above, there is a rotary transformer, the whole being arranged so that the complete electrical equipment is entirely under the manipulation of one engineer. Five powerful searchlights of a special pattern are fitted, and generally arranged so that they can be withdrawn into cover during action or stress of weather. All the projectors are provided with automatic feed lamps and mirrors on the Mangin principle. In addition to the electric lighting plant there are about 70 electric motors in the vessel, generally for ventilating purposes; electric ammunition hoists are also arranged for the 7½-in. guns, and, wherever suitable, electrical power has been applied so as to reduce, as far as possible, manual labor on board.—Lond. *Eng'ing*, January 15.

Electric Installations on Board Ships.—LEBLOND.—The first part of what appears to become a long serial discussing in detail the design of electric installations on board ship and emphasizing those points in which such installations differ from installations on land. For instance, while on land always one central station would be used to distribute electricity over a comparatively small area, there are often two separate plants on board ship. Direct current is always used and while formerly the voltage was 70 or 80 it is now the intention in France to use in future 120 volts.—*L'Ind. Elec.*, January 10.

ELECTRO-PHYSICS AND MAGNETISM.

REFERENCES.

Electric Oscillations.—WAGNER.—An article in which the author endeavors to give in concise form the foundation of the theory of physical phenomena in the transmitting and receiving apparatus for wireless telegraphy. He gives the fundamental differential equations and their general solution for waves along a straight wire and in a closed oscillation circuit.—*Dingler's Polytech. Jour.*, January 16.

Radioactivity.—CURIE.—A long summary of recent researches on radioactivity. The subject is dealt with under the following headings: Radioactive substances; the different rays given off; heat developed by the salt of radium; induced radioactivity and radioactive emanations.—*Jour. de Chimie Phys.*, December.

ELECTRO-PHYSICS AND MAGNETISM.

Electrolytic Stripping of Metals.—BURGESS.—An illustrated article on the method of removing brass from iron. A number of years ago, when the manufacture of bicycles was in its most prosperous stage, an important department in each factory was that devoted to filing, where the thin layer of brass on the surface of the frames was removed by a corps of workmen stationed at benches around the room. Later, however, the filing room was changed to an electrolytic stripping room, since the latter method was found to be much more economical and convenient. The method itself is described in detail and the tanks and special fittings for the treatment of the bicycles are illustrated. The gist of the method is that the brass-covered iron is placed as anode in a sodium nitrate solution; when the current passes from it toward an iron cathode, the zinc and copper are completely removed, while the iron which is in its passive state is left smooth and bright. The current density is between 5 and 15 amp. per sq. ft., while the pressure required is 3 to 5 volts. Silver, copper, tin, zinc, lead, cadmium and the various alloys can be removed from iron in this way and this points out various other applications of the process. It offers a convenient and rapid method for removing silver from plated articles of iron, which are to be re-silvered and also for removing silver from suspension rods, hooks and baskets used in silver plating, thus not only recovering the suspension devices themselves, but the silver as well. Files which have been used upon brass, copper, lead or other soft metal and have become clogged may be quickly and effectively cleaned by suspending them as anode in a sodium nitrate solution. A layer of tin on tinned iron may be removed completely in a few minutes in the same manner without dissolving any of the iron.—*Electrochem. Ind.*, January.

Manufacture of Steel in the Electric Furnace.—BENNIE.—A fully illustrated article on the process of Gin for the electric manufacture of steel in a resistance furnace of special design. The furnace used is in form of a channel of great length and small cross-section, filled with fused cast iron and having at its terminals blocks of steel cooled by an internal current of water. The passage of the proper amount of current in the conductor of fused metal sets free a sufficient quantity of heat to maintain the whole mass in fusion, and to bring it to the most favorable temperature for producing the refining reactions. The large section of the blocks forming the terminals of the circuit prevents a great rise of temperature in them, being aided in this respect by the circulation of cold water. To give a convenient form to the hearth, the channel in which the metal is held is doubled on itself several times, so that there is formed a sort of huge incandescent lamp, of which the filament consists of a stream of molten iron. In practice the furnace is carried on a movable carriage on wheels in an arched furnace, the fused pig iron being introduced from the latter into the electric furnace. There are two essentially different methods of operation, the one being the "dilution method" (scrap process) in which the calculated proportion of scrap iron is added to the fused bath in which it dissolves. The carbon diffuses with great rapidity throughout the mass and the conversion of the whole into steel takes but very little more time than that needed for the fusion of the added metal. The other method is to add some iron oxide (ore process); the oxygen of the iron oxide added to the bath burns the silicon, manganese and carbon. A mixed method involves the use of a certain amount of scrap and oxidation by the addition of iron oxide. The pig iron is treated with some iron ore and lime, so as to oxidize the impurities while producing basic slag, which facilitates the elimination of the phosphorus. When the purification is sufficient the scrap iron is introduced into the very hot bath, the slag is removed when fusion is complete, and the final additions of ferromanganese are made, to reduce the oxide dissolved in the metal. The use of this mixed process depends upon the nature of the possible supply of raw materials. The process is thought to be well adapted for the manufacture of special steels. An example of the application of the process of oxidation is discussed at length and some data are given on the cost of the process. —*Electrochem. Ind.*, January. An illustrated article by Gin on this same process is given in *L'Eclairage Elec.*, January 9.

REFERENCES.

Action of Sodium and Potassium Amalgams on Various Aqueous Solutions.—FERNEKES.—A long account of an experimental investigation on this subject in which he reaches the conclusion that the electrolytic dissociation theory is unable to explain the facts. He gives an explanation based on Kahlenberg's hypothesis that a theory of solutions is to be based on chemical affinity, the affinity between solvent and dissolved substance, and the formation of a true chemical compound whose properties are different from either constituent. The author believes that an explanation of the various catalytic actions can be given on the basis of this theory.—*Jour. Phys. Chem.*, December.

Electrotypes.—COWPER-COLES.—An illustrated description of various methods, mainly taken from patent specifications or trade publications, for rapidly producing electrotypes. Some kind of agitation is necessary and the following four methods are distinguished: The electrolyte is circulated and at the same time agitated; the electrolye is circulated only; it is agitated only; the electrodes are moved;

the electrolyte is circulated and filtered.—*Electrochem. & Met.*, December.

Units, Measurements and Instruments.

Double-Tariff Meter.—A note on an instrument of an English company for registering electrical energy supplied at a double rate of charging, according to the hours of the day during which energy is consumed. It consists of two watt-hour meters of any make and a contractor clock. On the arbor, to which the hands are attached, are mounted two cams, these actuating two contact springs. By setting the cams suitably, the shunt circuits of the two watt-hour meters are opened and closed by the contact springs at the pre-determined times. The clock is made to run for one month with one winding. One of the meters referred to registers the total number of units consumed, while the other marks the number of units sold during any particular period. All the contacts of the contactor are on the front of the clock, and periodical inspection may be made without disturbing the seals. These double-tariff meters may be used either for continuous or for alternating current.—Lond. *Elec.*, January 15.

REFERENCE.

Selenium Cells.—An illustrated description of various forms of selenium cells and apparatus made by Ruhmer. A practical application of the same is the use of a selenium cell in combination with a relay for automatically lighting and turning off gas and electric light, when it gets dark or with the coming of dawn. Whether such an apparatus is used in real practice is not stated.—*Elek. Anz.*, December 17.

Telegraphy, Telephony and Signals.

The Antenna in Wireless Telegraphy.—Chant.—A fully-illustrated account of an experimental investigation on the variation of potential along the transmitting antenna in wireless telegraphy. In the simple Marconi method and the method of direct excitation, when the antenna is joined to earth, the effect is similar to using a wire the same as the antenna to balance it; that is, considered from an optical point of view, the earth acts as a plane mirror. In these conditions the chief oscillation is the fundamental of the antenna, with a wave length four times its length. The condenser circuit in the method of direct excitation impresses its wave length on the antenna, but its oscillations are not nearly so intense as those proper to the antenna itself. Thus the manner of oscillation is essentially the same in the two methods, but the latter is more regular and powerful than the former. In the inductive method of excitation, on the other hand, the prominent feature of the oscillations is that one due to the condenser circuit. With antennas of different lengths, there is little change in this oscillation, the curve indicating it being decided and definite; but only one-quarter of its wave length is shown. This may be due to the great losses from radiation by the wire. The fundamental proper to the antenna is also present, but it is not nearly so intense as in either of the other two systems. The most effective length of the antenna, therefore, is one-quarter wave length, not a higher multiple. When inductance is inserted between the condenser circuit and the earth, the fundamental oscillation is not so regular or intense, other oscillations (overtones) being superposed. For the production of oscillations by the direct method a small capacity cannot satisfactorily balance the antenna; in the inductive method, however, a capacity acts like an earth connection or a similar wire.—*Am. Jour. Science*, January.

Measuring the Wave Length in Wireless Telegraphy.—Drude.—A communication in which he describes the following method of measuring the wave length which he has found to be quite exact, while the apparatus used is so simple that any one can make it himself. The principle is to adjust the secondary circuit so as to be in resonance with the primary circuit to be tested. The secondary circuit consists of a circular plate condenser (with air, petroleum or water as dielectrics, while glass is better avoided since its dielectric constant depends on the frequency), and the self-induction in the form of an exactly rectangular coil. The length of the rectangle may be varied by means of a sliding contact piece, the position of which is changed by hand. The position of this sliding contact is read off on a scale which is calibrated in wave lengths. As wave indicator he uses in the laboratory or in open air at night a vacuum tube containing sodium or during day time a small air-gap over the condenser plates.—*Elek. Zeit.*, January 7.

Miscellaneous.

REFERENCES.

Manufacturing Plant.—A fully-illustrated description of the new workshops of the Société Alsacienne de Constructions Mecaniques in Belford for the manufacture of large dynamos. The power used is taken from a 200-kw central station. The intention is to drive each tool directly by an electric motor, and it has been decided to do so with any new tool which consumes not less than 1 to 1.5 kw, while the older tools have not been changed. Some special machine tools are described.—*L'Ind. Elec.*, December 25.

Metric System.—A note stating that the Parliament of New Zealand has authorized the Governor to adopt, beginning with January 1, 1906, the metric system of weights and measures, so that from this date this system will be the only one officially recognized in New Zealand.—*L'Ind. Elec.*, December 25.

Electrical Law.—Ball.—A comparison of the law of electric lighting in England and America. The subject is dealt with under the following heads: Interference with property and vested interests; responsibility for accidents; responsibility for nuisance; damage caused by escaping current; transmission of messages by electricity; relations between companies and local authorities.—*Traction and Transmission*, January.

Fuel Handling Machinery.—Dawson.—The first part of a profusely illustrated serial on this subject. Various American firms are mentioned as originators of special types of coal and ash handling machinery.—*Taction and Transmission*, January.

New Books.

The Gas Engine. By Frederick Remsen Hutton, E.M., Ph.D. New York: John Wiley & Sons. 483 pages, 243 illustrations. Price, $5.00.

This book is intended as a complement to the author's previous work on the "Mechanical Engineering of Power Plants," and thus to complete the discussion of the general subject of engineering as related to the liberation of heat energy by processes of combustion, and its transformation into mechanical form by some type of mechanism constituting a heat engine. The point of departure in the present work is the liberation of heat energy by some process of combustion involving an explosive gaseous mixture. Then follows a discussion of the cycle of operations which the heat medium undergoes in transforming the heat energy into mechanical work, taken in connection with the types of motor in which these transformations are effected. The succeeding chapters then open up the details of mechanically effecting the mixture of fuel and air, its ignition, and the control of fuel supply in correspondence with the external work. Following these matters of practical arrangement, an extended theoretical discussion is given of the various possible cycles of operation. The treatment of this topic is clear and full in scope and gives perhaps the most satisfactory and complete general exposition of the subject at present in print. Credit for this chapter is given by the author to Dr. Charles E. Gucke, who developed the subject matter as a student under the author's direction.

Some reference is also made to internal combustion engines with heating at constant pressure, and to the possibilities of developing practical types, either of the reciprocating or turbine variety. The book closes with an account of various experiments on explosive mixtures, with a historical summary of the development of practice in this field of engineering, and with a bibliography of most of the important literature of the subject. No attempt is made to enter upon the field of design of the gas engine as a machine. The author considers that this field has been already sufficiently covered, and that the space at his disposal might be better used by a discussion of the engine with reference rather to its thermal and general relations, as indicated above.

The preparation of the book as a whole displays industry in gathering together the materials from varied sources, together with skill and judgment in combining them so as to form a satisfactory and fairly adequate presentation of the subject. The book should go far toward answering a distinct want in our present engineering literature on this subject, and it will be an acceptable addition to the library of all those who are specially concerned with the latest phases of power plant engineering practice.

Crompton Potentiometer.

The Crompton form of potentiometer, shown in the accompanying illustration, has been largely adopted in English lighting and power stations as a standard for verifying apparatus of all kinds, and for measuring the output of the machines and stations. It also forms part of the equipment of many technical schools and laboratories.

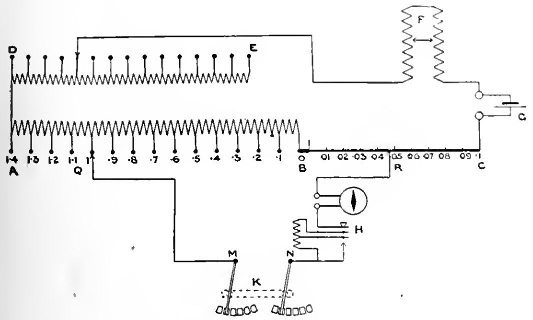


FIG. 1.—DIAGRAM SHOWING CONSTRUCTION OF INSTRUMENT.

The construction of the instrument is diagrammatically represented in Fig. 1.

The calibrated wire is arranged in 14 coils, called potentiometer coils, lettered *A B*, and a straight section, *B C*, called the scale wire, the resistances of the several coils and of the straight section being equal. One sliding contact, *Q*, moves over the terminals of the 14 coils, and another, *R*, along the straight wire. The reading of the instrument in the position shown is 1.046. The pairs of points whose potential differences are to be compared are connected to the blocks of the double pole switch, *K*, whose levers, *M N*, connect them, one pair at a time, to the sliding contacts, *Q R*, through the galvanometer. The galvanometer key, *H*, is arranged to complete the circuit through two resistances, which are short-circuited in succession as the key is depressed. The current required is derived from a small secondary battery, *G*. An adjustable resistance, consisting of a set of coils, *D E*, and a continuous rheostat, *F*, is placed in the circuit. By adjusting these the resistance of the circuit and the current passing through it from the storage cell, and consequently the fall of potential along the scale wire, can be continuously altered, and the operator is able to obtain a galvanometer balance against a standard cell when the reading of the sliders is that of the known e.m.f. of the cell at its actual temperature. If, for example, the temperature of the cell be 15°, so that its e.m.f. is 1.434 volt, the sliders may be set to that reading, and the galvanometer brought to zero by adjusting the resistance, *D E*, and the rheostat, *F*. When this has been done the scale readings at all points are direct readings in volts.

A view of the potentiometer is given in Fig. 2 and a diagram of its internal connections in Fig. 3. Here *a b* is the scale wire; *c* the set of equal potentiometer coils in series with it; *d* is the double pole switch connecting the 6 pairs of terminals, *A B C D E F*, in succession to the slide contacts; *e f* are the resistance coils and rheostat respectively, and *G* is the galvanometer key. All the moving contacts are under glass, and the coils and the scale wire are inside the box. The box itself is completely closed, but the inside can be inspected by removing a sliding bottom. Nearly all the measurements made involve the use of a standard cell, and one pair of terminals, the pair, *A*, is assigned to its connections to save confusion in working. Fuses of fine wire are inserted at all terminals except those for the galvanometer to save the instrument coils in the case of an accidental connection to a source of high pressure.

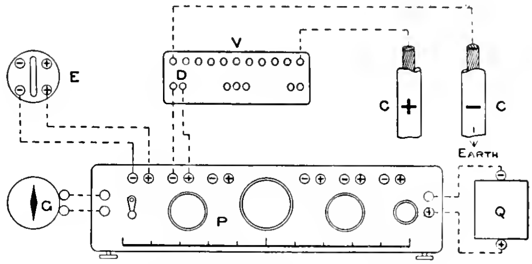


FIG. 4.—CONNECTIONS FOR TEST OF SUPPLY MAINS.

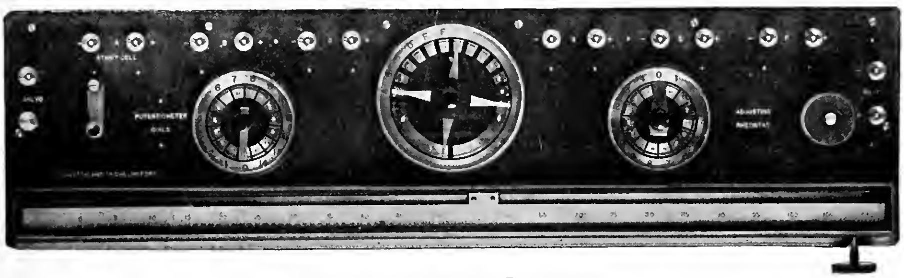


FIG. 2.—GENERAL VIEW OF POTENTIOMETER.

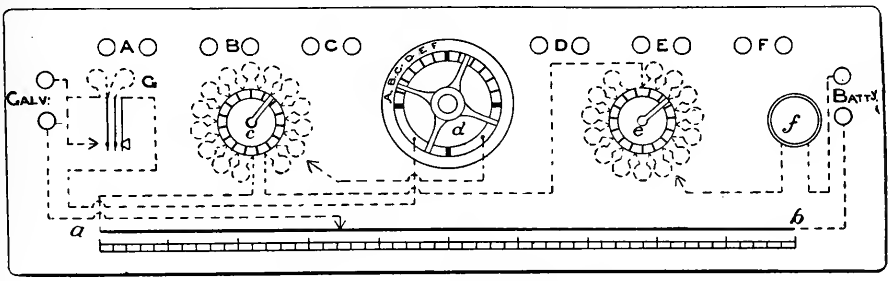


FIG. 3.—CONNECTIONS OF POTENTIOMETER.

Two scales are engraved for slide wire readings. One is a series of even divisions from 0 to 105, the resistance of the scale wire between 0 and 100 being the same as that of each potentiometer coil. It has been found convenient to be able to take readings a little beyond the 100 mark without having to move the potentiometer coil switch, and the scale is extended to 105 to admit of this. The other scale gives the values of the Clark cell at different temperatures, and is used in the following way: The potentiometer coil switch is set to 14, and the slide to the temperature of the Clark cell taken from the thermometer attached to it. The potentiometer reading is then the correct value in volts of the Clark cell at that temperature. By adjustment of the rheostat the galvanometer is balanced, and when this has been done the current in the potentiometer wire is such that readings at all points give correct values in volts, and the instrument is a direct-reading voltmeter. Its maximum range is then 1.5 volt, reading in thousandths of a volt, and by inspection to ten thousandths.

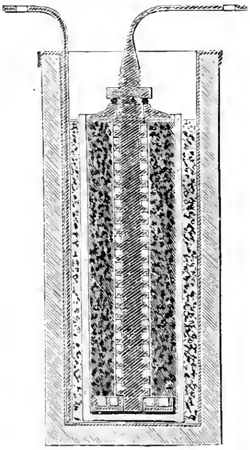
Volt boxes are employed consisting of sectional resistances. For example, a box designed to carry up to 1,500 volts consists of ten resistances in series, each of 10,000 ohms connections. Connections to various points of this resistance are made to terminals. Thus, between the terminals connected across 100 ohms, if the voltage applied is 1,500, the voltage across these terminals will be 1.5, a convenient quantity for comparison with the Clark cell.

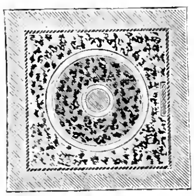
The accompanying diagram illustrates the application of the potentiometer to the measurement of the voltage of electric light mains. The volt box, *V*, is connected across the supply mains, *C* and *C*, and the one pair, *D*, of potential terminals is connected to the potentiometer, that pair being chosen which is nearest to zero potential. The difference of potential between the terminals, *D*, is compared with the e.m.f. of the Clark cell, *E*, and the voltage of the mains supply calculated from it.

A New English Storage Battery.

The illustrations herewith show a new type of storage battery, known as the N. S. storage, and being introduced by the N. S. Electric Storage Battery Company, Limited, 139 Queen Victoria Street, London, England. The inventor is Mr. J. T. Niblett, well known as the author of a treatise on storage batteries. While certain of the principles in the battery are not entirely new, yet there are a number of novelties in it and Mr. Niblett has arranged his active material in a way different from anything that has been previously done. The cell is of the porous pot type, a section of which is represented in Figs. 1 and 2, one showing a vertical section and the other showing a horizontal section. While this is the leading type manufactured, for the purpose of suiting other demands, the company also manufactures forms more suitable for other purposes, such as those illustrated in Figs. 3 and 4.

The active material consists of pellets or small cylinders, about 5/16 in. in diameter and the same length. These are made by compression in die plates, and when dry are exceedingly hard; at the same time they are very porous, and will absorb a considerable amount of the electrolyte. The

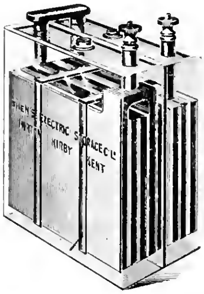


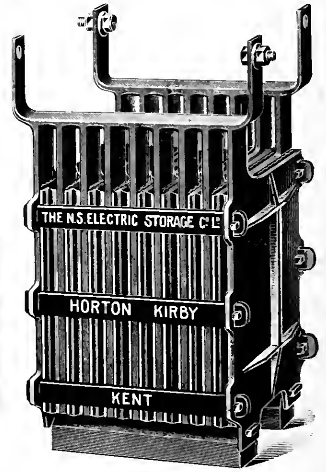


FIGS. 1 AND 2.—VERTICAL AND HORIZONTAL SECTIONS OF CELL.

pellets are packed in a porous pot round the positive electrode, of the form shown in the figure, while the space between the pot and the lead containing box (the negative electrode) is packed with disintegrated lead. A wooden case surrounds the whole. One of the advantages claimed for these cells is that, should the electrolyte escape by any means, it would not stop the discharge, as such a large quantity of solution is absorbed in the pores of the active material and the separator, that it allows action to go on for some considerable time. Cells have been emptied and then discharged at the normal rate, and have given half their normal capacity under these conditions.

Three distinct types of cell are made. The solid, which is more suitable for large electric lighting installations, central stations and tramway work, is considered the best, as in its present form it can be supplied at low rates, and it has the advantage that short-circuiting has practically no injurious effect. Owing to the large amount of exposed active material on both the positive and negative sides, very high rates of charge and discharge may be taken from the cell without in any way injuring it. It is stated that even if excessive rates of discharge were taken from the elements, so as to cause slight expansion and disintegration, this would do no harm, as the material would tend to settle at the bottom of the cell, and would, in time, solidify and become active, so that no loss in capacity of the cell would occur.





FIGS. 3 AND 4.—TWO FORMS OF N. S. STORAGE CELL.

The second type is termed the semi-solid accumulator. This is built up of special grids, which are thick, and contain a large amount of active material. This material is of the same composition as that used in the solid cells, and, being highly porous, may be used in thick masses. In this case ribbed porous plates are employed for the separators, and the elements are held together by stout clamping plates, which really constitute the outside negatives of the sets of elements. These clamping plates are pressed together by connecting bars having a flange at one end and an india rubber pad pressing against this, so as to allow for expansion and contraction during the charging and discharging operations. These cells are used for low-capacity batteries, and in cases where a small and light battery is required, also for motor-car driving.

The third type of cell is termed the portable type. These are supplied made up into batteries ranging from two to six cells for medical purposes, carriage lighting, X-ray work, actuating small electromotors, and for ignition purposes for petrol engines and motor cars. In constructing these cells, which are also of a semi-solid type, the first consideration has been durability, and the elements are of a very robust character, well calculated to withstand the jerking and jarring which they may receive when on vehicles or when being carried about. The elements are mounted in vulcanite or celluloid cases, enclosed in a hard-wood containing box, and are fitted either with two terminals, or with terminals to each cell as required.

The makers state that the cells behave much in the same way as the ordinary form of accumulator. The electrical pressure of the cells immediately after charging is about 2.2 volts, but this quickly sinks to the normal 2 volts. On the discharge the fall of potential is proportional to the rate of discharge, but to discharge down to 1.7 volts for a lighting circuit is quite permissible, and in the case of tramway and power circuits they may be discharged down to as low as 1 volt per cell. This apparently does not injure them in any way.

As much as 95 per cent. quantity efficiency and from 70 to 75 per cent. energy efficiency has been obtained with both the solid and the semi-solid types of cell. The capacity per pound of complete cell, in the case of the solid batteries, is about 4 watt-hours. In the case of the smaller cells it may be somewhat less, but as the capacity of the cell increases, the capacity per pound of complete cell tends to increase, a condition not usually met with. In the case of the semi-solid cells, about 10 watt-hours per pound of complete cell are obtained, but this, of course, is regulated by the nature of the containing boxes, whether they are of vulcanite, glass or lead-lined wood. With the small portable batteries, capacities have been obtained up to 12 watt-hours per pound of complete cell.

A solid cell made up some 15 months ago was taken out of a battery, discharged, and then emptied, and was allowed to stand idle for a matter of four months. At the expiration of this time the cell was filled up with electrolyte, and put on charge, and after one or two charges and discharges it was found to be in perfect condition.

The cells have been frequently short-circuited, but no detrimental effect seems to occur; they have also been run down until they showed absolutely no pressure whatever, and on the re-charge they appeared to come up quite well. This is believed to be due to the fact that the elements have an enormous amount of exposed surface, and the active material cannot disintegrate or leave the conductor. The simple construction of the "solid" cell, rendering skilled labor superfluous, both in manufacture and in working, is one of its most prominent features.

The Allis-Chalmers Nurnberg Gas Engine.

It is but a few years ago that the engineering fraternity in general looked askance at gas engines of even 150 hp, and the field was generally slighted. It was not until the industrial conditions in Europe rendered it absolutely essential to reduce the cost of power production to a minimum, when, aided by a more thorough comprehension of the action of such engines, the modern large gas engine came into being and was installed and operated with such success in Europe, that it has already been accepted as a staple.

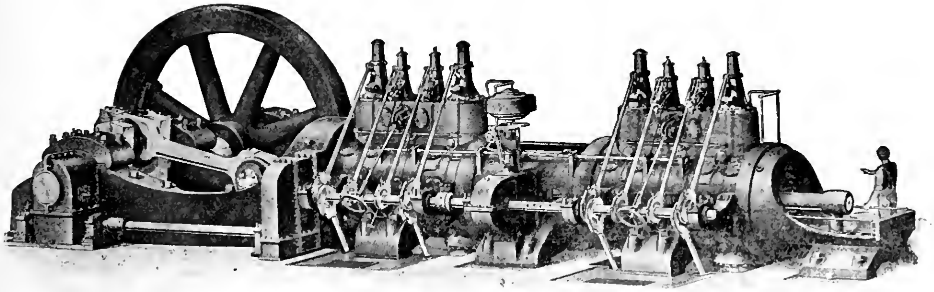
Realizing the vast importance of these developments and in the consistent pursuit of its traditional ambition to remain in the van of American builders of power generators, the Allis-Chalmers Company spent considerable time and utilized the best talent in the thorough investigation of gas engines of high power, with the result that it has acquired sole rights for, and is now building in the Edward P. Allis Works at Milwaukee, the Nürnberg gas engine illustrated herewith. This engine is built in units ranging from 130 to 6,000 brake hp to operate with all classes of gaseous fuel, and is adapted to all work that can be performed by a stationary steam engine, including the driving of alternating-current generators for light and power purposes. The Nürnberg gas engine is of the four-cycle system and double-acting type; it embodies the latest improvements which make for reliability, efficiency and permanency; and its builders give the most stringent guarantee in reference thereto.

A glance at the cut will indicate a few of the main features in which the Nürnberg gas engine is a striking improvement upon the familiar gas engine of the last decade. It is double-acting, like a modern steam engine, and will, therefore, develop the same power with a cylinder of one-half the cubic contents required by the older type, while an equal number of Nürnberg cylinders will give the crank shaft a double number of impulses. In its standard construction, with two cylinders placed in tandem and a single set of transmitting parts, the engine utilizes these parts to their full extent, instead of to the extent of only 25 per cent., as is the case in the ordinary single cylinder, single-acting gas engine: and the Nürnberg gas engine accomplishes this without increasing the maximum stresses to which the moving parts are subjected. The valves are operated by means of eccentrics in place of the noisy and short-lived, old-time cams. The pistons are positively supported by outside cross heads running on cool slides, so that the cylinder walls are not called upon to bear any weight, whereby their efficient lubrication and permanent tightness are assured. The inlet and governing valves and their gearing are readily accessible and always in sight, while the exhaust valves are located at the lowest point of the cylinder, to insure the expulsion of such solid matter as may be carried into the cylinder by the gas, or result from carbonization of the lubricant. The cylinder heads can be removed and replaced without the disconnection or deranging of any part of the valve gearing, and, likewise, the pistons may be withdrawn from their cylinders examined, and fitted with new rings, without disturbing any valve mechanism, or even the metallic packing of the piston rods. In a similar manner access to the inside of the cylinder and valve chambers is rendered easy and quick. All parts of one cylinder are interchangeable with any corresponding parts of all other cylinders of the engine.

The regulation is most effective and simple. It is attained by the use of an ordinary high-grade, fly-ball governor, and by a novel construction which combines close regulation with high efficiency under light loads; the whole effect being very similar to that of a modern steam engine.

The crank shaft is journaled in bearings of special construction, giving firm support without undesirable rigidity. Great care has been exercised to allow all parts of the engine full freedom to expand and contract without endangering its perfect alignment. Unusually extensive and carefully distributed water-cooling is provided for, and all important moving parts are automatically lubricated under pressure, for which purpose special oil pumps are furnished.

The Nürnberg gas engine is not in any sense of the term an experiment, for it has been thoroughly developed, perfected and proved by its original designers and builders in Germany. Its introduction into this country by a manufacturing establishment of the high standing earned and enjoyed by Allis-Chalmers Company is a sufficient guarantee of its design and construction.



Nürnberg Gas Engine.

Blind Telephone Operator.

It is stated that Mrs. Post, of North English, Ia., who is totally blind, successfully manages the local telephone exchange with over 300 subscribers. Each line is provided with a special bell of a special tone, and those bells are all mounted in a cabinet a few feet from the switchboard. There are large bells, small bells, wire clock gongs, sleigh bells and high-keyed bicycle bells. A fine bit of steel wire four inches long is soldered to each bell hammer, and a square sheet of paper attached to this wire bears the line, name and number, forming a visual signal for the assistant operator, who can see. The bell cabinet is so situated that the paper squares may be plainly seen from the operator's seat. Mrs. Post is able to distinguish not only each one of the forty-five bells by its peculiar tone, but also the voices of hundreds of men, women and children whom she serves. She is a graduate of Iowa College for the Blind, and was noted at that institution for quick and retentive memory. We ought to hear next of a deaf telephone operator—in an automatic exchange.

The Heany Arc Lamp.

Since the Heany arc lamp was described in these pages just about a year ago, a number of changes and improvements have been made in it, which are worthy of note. To begin with, it may be mentioned that the supporting stays are made of 3/8-in. tubing instead of 5/32-in. rods. The lamp has been provided with a top casting, on which is mounted a substantial switch and binding posts. The binding posts are mounted on porcelain, and have — and + signs plainly visible. They have also large binding screws and wire holes large enough to accommodate No. 6 wire. The resistance wire is wound on a porcelain ring which surrounds the supporting tubes; the porcelain ring is cut with a thread of 10 pitch, and the wire is wound in this thread. A novel vice-like clamp slides in a slot in the porcelain ring to cut in or out the resistance wire for various line voltages. The solenoid spool is held on the supporting tubes by six strap clamps, instead of screws, as in the old lamp.

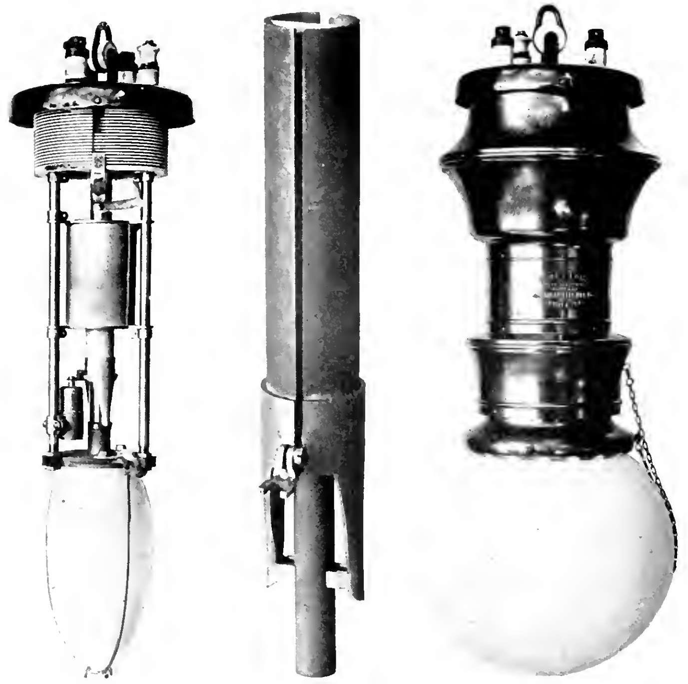
The dash-pot in the earlier lamp was made of drawn tubing, the new is cast and reamed, increased from 1/2-in. to 5/8-in., and is fastened to one of the supporting tubes with a clamp, the supporting tube being provided with a locating pin, which brings the dash-pot to the proper place. In the old lamp no provision was made for locating the dash-pot, and in the hands of inexperienced persons might have caused trouble. In the new lamp any one can place the dash-pot in position. The clutch is made entirely of stampings, instead of castings.

The carbon receiving tube has been increased in diameter from 5/8-in. to 3/4-in., so that 1/2-in. carbon may be used if desired, and to interchange with the other types of Heany lamps. In fact, in improving the lamp this point has been carefully considered, and the casing, carbon receiving tube, supporting tubes, globes and all principal parts will interchange on all the types.

The casings are made of solid copper, and well ventilated, as well as weather-proof. The lower carbon holder has been provided with a cam to lock the carbon, instead of a screw, and has a projection which limits the weight of carbon and is of importance in trimming. The spider on base of the old lamp has been dispensed with and a projection from the base of the lamp takes its place.

In the old lamp the carbon was exposed partially; in the new lamp this space is closed, making a bearing for the carbon, and preventing admission of oxygen to the inner globe, prolonging life of carbons, and at the same time simplifying the construction.

The internal parts are copper and nickel-plated to prevent corrosion and oxidation. Mica and porcelain are used throughout as insulation.



FIGS. 1, 2 AND 3.—ARC LAMP.

Telephone "Express" Switchboard.

The International Telephone Manufacturing Company of Chicago has produced a mechanical self-restoring drop or "express" type telephone switchboard claimed to embody in its construction many new and important features. The new board is made up in any capacity, ranging from the small village sizes to those of one thousand lines, the larger equipments being provided with the necessary trunking, or transfer, systems, which may consist of the common method of equipping the various sections with trunking jacks and order-wire keys, or the more elaborate equipment of flash lights, trunking cords, etc. Each operator's position, or section of cabinet, is provided with either one hundred, one hundred and fifty or two hundred lines. Fig. 1 shows the board equipped for one hundred and fifty lines divided into three panels of fifty lines each.

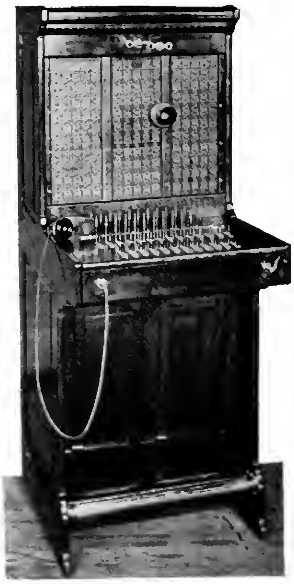


FIG. 1.—"EXPRESS" SWITCHBOARD.

The entire equipment is mounted in a highly polished quarter-sawed golden oak cabinet with five-ply hinged key shelf, hinged double panel back, and with a substantial brass foot-rail. On the hinged shelf are mounted the well-known "International" keys having all the terminals at one end, thus making it possible to contain all of the wiring in one key cable and leaving all of the springs and contact points easy of access and inspection. The plug board is covered by heavy belt leather stained to match the wood-work. In the front of the board and immediately under the key shelf are mounted the necessary night alarm and power generator switches, which are of the locking plunger type with the buttons almost flush with the woodwork. The hand generator is mounted in the back of the cabinet on a substantial shelf which serves the triple purpose of a mounting for the generator, the cord terminals and that of adding strength and rigidity to the frame.

The combined drops and jacks are mounted in strips of five on strong steel plates, as shown in Fig. 2. These supporting strips in turn are securely fastened to a well-constructed steel frame by means of heavy machine screws which are covered by wooden stile strips stained and finished to match the cabinet.

A side view of the drop and jack is shown in Fig. 3. The drop shutter is mounted on the front of the steel mounting plate and the back plate of the shutter has part of the stock formed out at the bottom to provide a positive stop for the shutter to prevent its falling far enough to cover the jack.

FIG. 2.—STRIP OF DROPS AND JACKS.

The drop is of the non-inductive tubular type and is mounted on the base of the jack by means of two screws. The jack springs are of the best grade of German silver and are made of very heavy stock. Near the front they are brought strongly against an insulated stop pin which makes it possible to give them a heavy tension in their normal position and insures a positive plug contact at all times with but the slightest displacement, or bending, of the springs. The jack springs are mounted on the brass cast base and are firmly clamped by heavy machine screws and properly formed washers. The insulation is of mica. The combined drop and jack are mounted on the steel strip by the use of a threaded jack ferrule which passes through the strip from the front of the board into the end piece of the brass jack base. This form of insulation makes it possible to remove any one of the drops and jacks from the front of the board in the smallest fraction of a minute and without disturbing the drop shutters or any other line equipment. A small friction wrench which fits firmly into the jack ferrule is used for this purpose. The tubular drop covering or shell is provided with a guide pin, thus making it impossible to place the coil in any other than its proper position.

The drops and jacks are perfectly insulated from the frame and the mounting strip by a heavy mica sheet and with hard rubber bushings for the jack ferrules and binding screws. This method assembling and construction absolutely prevents cross talk and other inductive troubles. The shutter restoring trigger is also mounted on the base of the jack by means of a heavy German silver compensating spring, the peculiar construction of which makes it absolutely impossible for the drop to ever fail to restore. The night bell spring is mounted immediately above the restoring trigger and is brought into connection with the night bell contact by the falling of the drop and the consequent raising of the trigger. The night bell contacts for each bank of five drops are made of one solid brass strip which leads out to the end of the mounting strip where connection is made by a small spiral spring to the common night bellstrip which is placed in the rear of the board in an accessible position between the drop panels or immediately back of the stile strips. It is provided with small hooks so that the night bell circuit of each bank of five drops may be easily disconnected for testing.

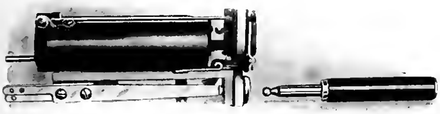


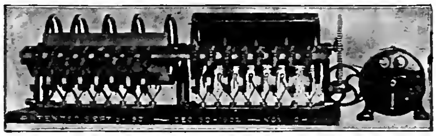
FIG. 3.—DROP AND JACK.

The boards are wired full metallic throughout and for their full capacity. They are provided with sufficient cable to reach the lightning arrester or distributing rack. The cables may be either permanently soldered to the line equipments or to clips, in which latter event connection is made by means of screws and washers. Each part of the apparatus is constructed with special tools and dies so that all like parts are exactly uniform in size, shape and form. This makes it possible to assemble the complete equipment without in any way altering or filing any of the parts and insuring accuracy and permanency of adjustment.

Improvements in Sign Flashers.

It is frequently the case that electrical apparatus has to go through a considerable evolution before being reduced to its simplest form. This seems to have been the case with sign flashers. An improvement in the direction of simplicity and more satisfactory operation has recently been made in the design of the electric sign flashers made by the Reynolds Electric Flasher Manufacturing Company, of Chicago. As flashers were formerly made, each make-and-break switch was operated by a cam or segment bolted to a wheel. There were as many of these wheels with cams as there were make-and-break switches on the flasher.

The new design does away with these cams and substitutes a segment of a sheet steel cylinder, which is notched or slotted so as to give the proper combination. This construction is especially an advantage where a number of circuits are to be flashed simultaneously. With the cams it was found difficult to adjust them so

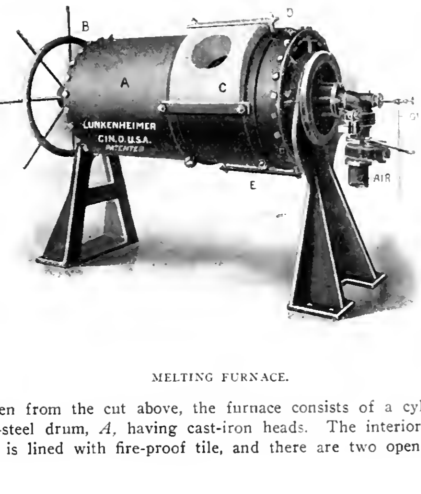


SIGN FLASHER.

they would snap all the switches at exactly the same instant, and the result was a ragged effect on the sign. With the sheet steel it is simply necessary to provide a straight edge in order to have the switches operate simultaneously. If they are not to be operated simultaneously, the edge is notched. The accompanying illustration shows a flasher which is adapted to flash two views of a sign alternately, the circuits on each half being all lighted and extinguished at the same instant. Another advantage of this construction is that there need not be a wheel on the shaft for each switch. It is only necessary to have enough wheels to support the stiff sheet steel segment.

Metal Melting Furnace.

We illustrate herewith the Lunkenheimer metal melting furnace, which has been found to afford a very efficient and economical method of melting metals, particularly brasses and bronzes. As will



MELTING FURNACE.

be seen from the cut above, the furnace consists of a cylindrical sheet-steel drum, *A*, having cast-iron heads. The interior of the drum is lined with fire-proof tile, and there are two openings on opposite sides of the drum. Only one of these openings is in use, the other being closed by a fire clay filling. The object of having two openings is to increase the life of the linings of the furnace. It has been found that the furnace wears out quicker around the filling hole (which also serves as outlet for the flame) than elsewhere. The advantage is that, when one filling hole is worn out this can be closed by a fire clay filling and plate, the furnace reversed and the other hole cut out and put in service.

The oil burner is of a special type, designed to give the greatest amount of heat with a minimum consumption of oil. In the Lunkenheimer foundry there are ten of these furnaces in use, and they are able to secure from six to seven heats per working day of ten hours from each furnace. The weight of each heat will average about five hundred and fifty pounds, and the oil consumption varies from two to two and one-half gallons of crude oil per hundred pounds of metal melted. The life of the linings is from three to four hundred heats, this varying with the kind of metal melted.

This furnace is made in two sizes, the No. 1 size having a capacity of five hundred and fifty pounds of metal per heat, and the No. 2 size having a capacity of twelve hundred pounds of metal per heat.

Steel Frame Generators and Motors.

Some excellent apparatus has been produced by the Triumph Electric Company, of Cincinnati, Ohio, and we are now able to illustrate and describe their latest types of steel frame bipolar motors and generators, made as motors in sizes from ½ to 5 hp, inclusive, and as generators from ½ to 5 kw, inclusive.

The crown and pole pieces are made of soft close-grained steel. The poles are accurately fitted and bolted to the crown and are readily removable in case of necessity. Cast-iron yokes, heavily ribbed, are centered against the sides of the crown, and are held firmly in position with bolts. These yokes, by removing the bolts, can easily be rotated, thereby adjusting the machine for wall or ceiling suspension, the oil well always remaining in the proper position. The bearings are of gun metal, of the self-oiling type, and are interchangeable. When desired, end plates are furnished, completely enclosing all of the working parts.

The armature core is built up of thin sheet discs and is mounted on a shaft made of the best hammered steel. These discs are notched, and when mounted on the shaft these notches form slots on the circumference of the core, in which the armature conductors are imbedded. The discs are annealed after punching, and in addition to this are varnished before being assembled on the shaft. The armature conductors are thoroughly insulated from the core, every precaution being taken to protect them from injury. The commutator segments are of pure drop-forged copper and are insulated from each other and from the shell with the very best mica. The commutator shell is so constructed that it is impossible for a segment to become loose and cause trouble, and has wells to prevent the oil from getting under the segments.

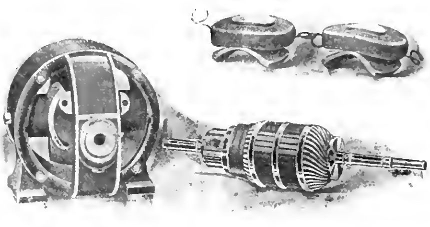


FIG. 1.—ELEMENTAL PARTS OF MOTOR.

The field coils are form-wound and thoroughly insulated. Every coil is soaked in a varnish bath, then baked, after which it is covered with two layers of friction tape, finally receiving two coats of insulating paint.

The brush holders are of the very simplest and most effective design, and of the lightest possible construction consistent with necessary strength and durability. The brushes are of carbon and are fastened rigidly at the end of the holder. As there is no sliding friction of the brush in the holder, the spring has but little weight to move, so that the tension is very light; this results in a very quick and sensitive adjustment of the brush, which eliminates sparking and heating and wearing of the commutator. The holder is clamped to the stud and is provided with a simple and ready means for adjustment if that is ever required. The brushes are properly set in the factory and should not require adjusting under any condition of load, or overload.

The machines are rated well within their limits of capacity, and, as open machines, no part will heat more than 40° C. above the surrounding air, when operated for ten hours under full load. They will withstand an overload of 50 per cent. for a period of one hour, and a momentary overload of 100 per cent. without injury. As entirely enclosed machines the ratings will be somewhat less, to meet these requirements.

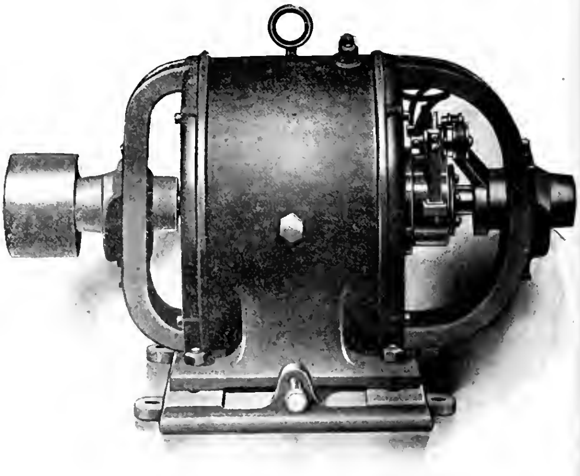
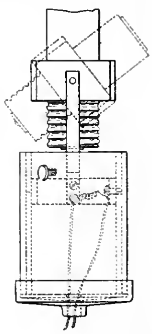


FIG. 2.—STEEL GENERATOR AND MOTOR.

Attaching Plug and Socket.

A patent was recently allowed to Mr. W. H. Kelsey, of the Electric Building, Cleveland, on an attaching plug and lamp socket, herewith illustrated. When this device is made as an electric attaching plug, and the reversing ends contain an Edison or Thomson-Houston plug contact, with electric connections to the supporting arms within the holder, then, by the simple turning or reversing of the ends of the double plug, either the Edison or the Thomson-Houston plug end is presented for attaching to its proper socket. Another feature this device has is the avoidance of twisting the attaching cord. This is avoided by manipulating this plug as follows: Remove the double plug from the holding arms to which are attached the conducting wires, then screw this detached double plug part into the corresponding socket, Edison or Thomson-Houston, then raise the holder in which are the connecting arms with cord attached thereto, and snap these arms tightly to the side contacts on the plug, and the cord remains in its undisturbed state without kinks or twists. Various styles of plugs are made to fit any kind of a single or double-pole socket.



PLUG AND SOCKET.

When this device is made as a lamp socket, the removable reversible part contains two sockets, an Edison and a Thomson-Houston, one on each end, either of which may be turned outward, as is the case with the plugs above described. Therefore, either lamp may be used in this double socket. In addition to this feature of reversibility the device can be made to hold these lamps either one at a time, or both at the same time, and in multiple or in series, by simply placing them across the opening of the holder. Hence, if desired, two lamps can be burned at the same time, or one lamp and an electric fan, or electric stove, or any two such devices can be placed in multiple or in series with each other.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Quotations closed steady after an irregular reaction due to less favorable Eastern news and profit-taking by professional traders. The manipulative and artificial character of the recent advance and the limited nature of the outside buying have had an effect, while adverse reports on iron and steel trade conditions also influenced the trading. The latter led to a renewal of pressure in the United States Steel securities toward the end of the week, when foreign houses were considrable sellers, both of the preferred shares and the new 5 per cent. bonds. In the electrics and tractions the gains that were recorded last week were largely lost. There was little business done in these securities. Brooklyn Rapid Transit closed at the lowest quotation of the week, namely, 47⅛, this being a net loss of 3⅛ points. Metropolitan Street Railway lost 2 points, closing also at the week's lowest figure—121—the sales aggregating 6,000 shares. General Electric lost practically all of its gain of the week previous, closing at 170⅛, a net loss of 7⅝ points; and Westinghouse common closed at 167, a loss of 5 points. The extreme quotations of this stock were 166½, the lowest, and 173, the highest. Western Union closed at 88½ and was steady throughout the week. American Telephone & Telegraph closed at 128, this being a net loss of ⅛ point and the lowest price of the week. Following are the closing quotations of February 2:

NEW YORK.

	Jan. 26	Feb. 2		Jan. 26	Feb. 2
American Tel. & Cable	85	82	General Electric	175	170
American Tel. & Tel.	128½	126	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	122¼	120¼
Brooklyn Rapid Transit	49⅞	45⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable	183	175	N. Y. & N. J. Tel.	147⅛	137½
Electric Boat	18	18	Marconi Tel.	..	..
Electric Boat pfd.	46	45	Western Union Tel.	88¾	88
Electric Lead Reduction	⅝	1	Westinghouse com.	171	165
Electric Vehicle	10¾	9	Westinghouse pfd.	190	180
Electric Vehicle pfd.	14½	13½			

BOSTON.

	Jan. 26	Feb. 2		Jan. 26	Feb. 2
American Tel. & Tel.	128¾	127	Western Tel. & Tel. pfd.	82	82
Cumberland Telephone	112¼	113	Mexican Telephone	1¾	1½
Edison Elec. Illum.	235	236	New England Telephone	121½	121
General Electric	176	170	Mass. Elec. Ry.	22¼	21½
Western Tel. & Tel.	10½	10	Mass. Elec. Ry. pfd.	79	78

PHILADELPHIA.

	Jan. 23	Feb. 2		Jan. 26	Feb. 2
American Railways	45	44	Phila. Traction	97⅝	97⅝
Elec. Storage Battery	59	59	Phila. Electric	6⅛	6
Elec. Storage Battery pfd.	59	59	Phila. Rapid Trans.	14⅞	14⅝
Elec. Co. of America	8⅛	8⅛			

CHICAGO.

	Jan. 26	Feb. 2		Jan. 26	Feb. 2
Central Union Tel.	..	..	National Carbon pfd.	95	70
Chicago Edison	..	150	Metropolitan Elev. com.	17½	17
Chicago City Ry.	160	165	Union Traction	5¼	5
Chicago Tel. Co.	..	..	Union Traction pfd.	30	30
National Carbon	28	28			

*Asked

TROLLEY IN TEXAS.—Conversion of the Gulf & Interstate Railroad into an electric line and the consolidation of two other electric lines, all three under one control, is reported to have been practically accomplished by John W. Gates and his associates. It is said that the new company has practically consummated a deal whereby it will take the Gulf & Interstate, which is the short line between Galveston and Beaumont. At Beaumont this road will connect with the Beaumont & Sour Lake electric line and later join the projected Port Arthur & Beaumont electric line, of which Gates is the founder. Gates is largely interested at Port Arthur and in the oil fields, and the Port Arthur road will be started within a few weeks. The Gulf & Interstate runs through a productive territory, and is 74 miles long. With the three lines consolidated, the electric system would traverse the oil, lumber and rice section of East Texas with a Gulf outlet at Galveston and Port Arthur. It is also stated that another electric line is projected from Beaumont, which will be the center of the system, northeast to the Jasper gold field. It is said that the project will involve nearly $2,000,000.

CHICAGO TELEPHONE.—The Chicago (Bell) Telephone Company reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.	1906.
Gross	$5,534,590	$4,570,806	$3,775,002	$3,129,238
Expenses	4,113,246	3,368,335	2,691,129	2,258,780
Net	$1,421,344	$1,202,471	$1,083,873	$870,458
Dividends paid	1,274,835	1,075,193	960,000	749,808
Surplus	$146,509	$127,278	$123,873	$120,650
Cash on hand	547,640	134,706	....	....

Assets of the company show an increase of $2,348,475, making a total of $15,251,354. During the year $1,428,320 was invested in a new plant. There was an increase of $2,007,000 in stock issue. The report is considered excellent. No changes were made in the directorate. The Chicago Telephone officials say the earnings from extensions easily guarantee the regular dividends on the new stock issue, which will be at par as usual.

DETROIT TROLLEYS ANNUAL REPORT.—The Detroit United Railway system reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.	1900.
Gross	$4,386,975	$3,961,403	$2,919,171	$2,575,276
Ex. and tax.	2,613,977	2,260,786	1,596,765	1,439,057
Net	$1,772,998	$1,700,617	$1,322,406	$1,136,219
Other income	38,863	31,247	23,067	14,559
Total income	$1,811,861	$1,731,864	$1,345,473	$1,150,778
Charges	1,000,000	948,902	675,344	638,317
Surplus	$811,861	$782,952	$670,129	$512,461
Dividends	500,000	500,000	500,000	....
Surplus	$311,861	$282,952	$170,129	$512,461

The above includes Detroit United Railway, Rapid Railway System and Sandwich, Windsor & Amherstburg Railway. Over $1,200,000 was spent on betterments for the entire system during the year. The system carried 104,018,886 passengers, the average receipts being $0.358 per passenger. The car mileage made was 19,114,970 miles.

BROCKTON LIGHTING ANNUAL.—The annual report of the Edison Electric Illuminating Company, of Brockton, Mass., shows as follows:

	Nov. 30, '03.	Nov. 30, '02.	Increase.
Gross earnings	$104,967.24	$95,044.93	$9,922.31
Operating expenses	71,721.15	61,567.86	10,153.29
Net earnings	$33,246.09	$33,477.07	*$230.98
Fixed charges	11,347.82	8,920.88	2,426.94
Net profit	$21,898.27	$24,556.19	*$2,657.92

* Decrease.

LOWELL ELECTRIC LIGHT REPORT.—The annual report of the Lowell (Mass.) Electric Light Corporation shows as follows:

	Nov. 30, '03.	Nov. 30, '02.	Increase.
Gross earnings	$230,854.72	$207,298.26	$23,556.46
Operating expenses	153,128.27	130,177.31	22,950.96
Net earnings	$77,726.45	$77,120.95	$605.50
Fixed charges	12,724.43	13,587.33	*862.90
Net profit	$65,002.02	$63,533.62	$1,468.40

* Decrease.

MINNEAPOLIS LIGHTING ANNUAL.—The Minneapolis General Electric Company reports as follows for the past year:

	Nov. 30, '03.	Nov. 30, '02.	Increase.
Gross earnings	$551,711.29	$496,122.03	$55,589.26
Operating expenses	308,832.96	257,311.66	51,521.30
Net earnings	$242,878.33	$238,810.37	$4,067.96
Fixed charges	110,021.52	97,803.92	12,217.60
Net profit	$132,856.81	$141,006.45	*$8,149.64

* Decrease.

DIVIDENDS.—The New England Telephone & Telegraph Company has declared its regular quarterly dividend of 1½ per cent. to stock of record January 30. Books close February 1 to February 13, inclusive. The North American Company has declared a 5 per cent. dividend, payable in quarterly instalments. This is an increase of 1 per cent.

NEW YORK AND NEW JERSEY TELEPHONE COMPANY.—The directors of the New York & New Jersey Telephone Company have voted to offer at par to the stockholders $1,252,000 of the unissued stock of the company. The offer will be in proportion of one share for each ten shares held, and expires on March 1.

AMERICAN DISTRICT TELEGRAPH.—The American District Telegraph Company, of New York, reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.	1900.
Revenue all sources	$577,676	$610,043	$624,194	$590,536
*Operating expenses	511,808	513,176	535,544	503,690
Net	$65,868	$96,867	$88,650	$86,846
Dividends	76,888	76,886	96,107	86,497
Deficit	$11,020	Sur.$19,981	$7,457	Sur.$349
Miles wire	1,552	1,552	1,548	1,537
Offices	85	85	85	86
Instruments	29,143	27,940	27,905	27,943

*Includes construction expense.

The general balance sheet as of December 31, 1903, compares as follows:

Assets:	1903.	1902.
Plants, patents, stocks merged, etc.	$4,052,997	$4,018,865
Stocks and bonds, companies not merged	207,540	235,700
Supplies and uniforms	34,204	21,413
Sundry accounts receivable	58,884	46,487
Advances	90	746
Due from managers	7,669	22,241
Due from agents	1,234	2,023
Cash	21,778	18,725
Total	$4,384,397	$4,366,200
Liabilities:		
Capital stock	$3,844,700	$3,844,700
Sundry accounts payable	27,239	7,260
Contingent liabilities	8,830	5,940
Profit and loss surplus	503,628	508,300
Total	$4,384,397	$4,366,200

President Robert C. Clowry says in part: "The revenues of the company were effected by the distinctly unfavorable local conditions which prevailed throughout the year. The loss is largely in earnings from messenger service and has as far as possible been offset by reductions in the expenses, aggregating $22,025. The work of improving the company's plant has been steadily pursued. This work, together with the cost of wiring new buildings connecting new subscribers, fitting up new offices, etc., amounting in all to $34,508, has been paid out of current earnings and surplus."

MICHIGAN STATE TELEPHONE.—The Michigan State Telephone Company has filed articles of incorporation in Michigan with a capital stock, all paid in, of $25,000, par $100, divided into $10,000 6 per cent. cumulative preferred and $15,000 common. The right is reserved to increase the capital stock. The voting powers of the common and preferred are equal. The incorporators and directors are: William A. Jackson, founder of the Michigan Telephone Company, who will probably be president of the new company; John T. Shaw (vice-president), cashier of the First National Bank; James Cullen and Elliott G. Stevenson, partner of Don M. Dickinson, counsel for the bondholders of the Michigan Telephone Company here. This is a preliminary step to the reorganization of the Michigan Telephone Company. Much Detroit capital is believed to be going into the new concern. When the regular company is organized the present new company will be dissolved. The minority interests in Michigan Telephone have not yet filed an appeal. They say they may, but it is believed they will not. This step indicates progress on the part of the bondholders.

NORTH AMERICAN DIVIDEND.—A dividend of 5 per cent. for the year was declared last week by the directors of the North American Company, this dividend representing an increase of 1 per cent. over that paid during the past year. That such action would be taken had long been predicted in Wall Street, where for some time it had been said that the earnings jusified a larger distribution upon the company's stock. In connection with the increased dividend it is explained that the policy of the company is to declare dividends out of its fixed income derived from interest and dividends receive from its investments, while earnings from other sources are employed to increase the company's surplus or for the development of the company's light and power properties. The present capitalization of the North American Company is $17,000,000, to which amount it was last year increased from $12,000,000. In 1901 the capital stock had been reduced from $40,000,000 to $12,000,000. The dividend declared is payable in four quarterly installments of 1¼ per cent. each, beginning March 1.

STANDARD UNDERGROUND CABLE.—The annual report of the Standard Underground Cable Company shows gross business for 1903 of $9,192,618, and net earnings of $704,438, or about 35 per cent. on the company's $2,000,000 capital. Dividends amounting to 12 per cent. were paid, leaving $474,706 to add to surplus, which now amounts to $1,229,112. The company's business for 1903 was more than double that of 1902. The company has no outstanding notes, mortgages, bonds or preferred stock, and no contingent liabilities on business paper of customers. The mills of the company handled during 1903 copper equal to 5 per cent. of the total production of copper of the entire North American continent for that period. On December 31, 1903, the company had unfilled orders amounting to over $1,000,000, and orders have been booked since that date amounting to over $600,000.

SOUTHERN NEW ENGLAND TELEPHONE.—The Southern New England Telephone Company reports for the year ended December 31, 1903, as follows:

	1903.	1902.	Changes.
Gross	$1,098,289	$919,556	Inc. $178,733
Expenses	897,226	746,812	Inc. 150,414
Net	$201,063	$172,744	Inc. $28,319
Dividends	187,050	172,500	Inc. 14,550
Surplus	$14,013	$244	Inc. $13,769

At the annual meeting of the stockholders the retiring board of directors was re-elected. The increase in the amount of business during the year was the greatest in the company's history. Of the capital stock of $3,500,000, the American Telegraph & Telephone Company owns $955,400.

SOUTH SIDE ELEVATED.—The South Side Elevated, of Chicago, reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.	1900.
Gross	$1,679,310	$1,483,843	$1,362,231	$1,286,638
Expenses and taxes	994,376	862,338	844,960	748,482
Net	$684,934	$621,505	$517,271	$538,236
Interest and dividends	442,883	442,874	391,705	340,515
Surplus	$242,051	$178,631	$125,566	$197,721

President Carter, in his annual report, outlined the plan to issue $7,000,000 new stock to stockholders at about 93, payable in three equal quarterly installments, viz.: April 30, 1904; April 30, 1905, and April 30, 1906. The stock is to be issued on the last payment.

LEHIGH VALLEY TRACTION.—The Lehigh Valley Traction reorganization committee expect within a few weeks to have the audit report of the American Audit Appraisement Company for the last half of the year 1903. They will then, it is stated, be prepared to offer a reorganization plan within a reasonably short time. This has been delayed because 1902 was an unusually bad year on account of flood damages, and it was desired to base the plan on a normal year such as 1903 has been. The physical examination of the properties by Mr. Foster was completed months ago. Signatures are being obtained from Philadelphia & Lehigh Valley Traction bondholders to a written agreement favoring the application for the proposed issue of about $160,000 receivers' certificates.

AUGUSTA RAILWAY & ELECTRIC.—Mr. James U. Jackson has completed arrangements by which the control of the Augusta-Aiken Company, the Augusta Railway & Electric Railway Company, Augusta & Aiken Railway Company, North Augusta Land Company and all the interests which Mr. Jackson organized in and around Augusta, are to be reorganized, controlled entirely by Augusta people, with himself as president. A year or so ago Mr. Jackson completed a transaction by which a majority interest in the Augusta Railway & Electric Company was secured by the Augusta-Aiken Railway, and now he has also purchased the minority interest, and both companies will be under one management. The transaction required the raising of about $1,000,000.

NORTHWEST ELEVATED OF CHICAGO.—The Northwest Elevated, of Chicago, reports as follows for the year ended December 31, 1903, as the result of electric traction:

	1903.	1902.	1901.
Gross	$1,542,039	$1,410,998	$1,100,863
Operating expenses	345,247	464,401	376,140
Net	$996,792	$946,597	$724,723
Charges	794,257	757,173	565,435
Surplus	$202,535	$189,424	$159,288

UNITED GAS & ELECTRIC.—The income account of the constituent companies of the United Gas & Electric Company for the year ended December 31, 1903, follows:

	1903.	1902.	Changes.
Gross	$1,224,047	$1,115,297	Inc. $108,750
*Expenses	1,010,363	914,887	Inc. 95,476
Net	$213,684	$200,410	Inc. $13,274

*Includes all costs of operation, insurance, taxes, depreciation and interest.

PITTSBURG BELL TELEPHONE.—The annual meeting of the Central District & Printing Telegraph Company will be held in Pittsburg February 11. The question of increasing the capital stock from $10,000,000 to such an amount as may be decided upon at the meeting will be submitted for the approval of the stockholders. Of the $10,000,000 stock outstanding, the American Telephone & Telegraph owns $6,191,290.

COMMERCIAL CABLE.—Reports show that Commercial Cable stock has recently been active and higher in Montreal on purchases growing out of the steadily increasing earnings and particularly because of the large business of the new Pacific cable and the promise of large earnings as war news becomes more important. The company has been extending its business by putting earnings into new construction which has added largely to equity values.

LONG ISLAND TROLLEY MORTGAGE.—The Central Long Island Electric Railroad, which purposes to operate from Port Jefferson to Patchogue, L. I., has been granted authority by the New York State Railroad Commission to issue a mortgage on its property for $500,000. The Ithaca-Cortland Traction Company has been authorized to issue a mortgage for $650,000. The companies are to use the proceeds of the mortgages for purposes of construction.

CINCINNATI STREET RAILWAY.—The next dividend on Cincinnati Street Railway stock in April will be at the rate of 6 per cent. per annum, guaranteed by the Cincinnati Traction Company. The dividend has been graduated from a 5 per cent. rate covering a period of several years.

STROWGER TELEPHONE.—The directors of the Strowger Automatic Telephone Company have issued a statement to stockholders saying the company is prosperous and that the dividend rate of 1 per cent. yearly will be increased shortly.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received by the mercantile agencies indicate that the weather conditions have been unfavorable throughout a wide area, and while in some instances helpful to retail trade, extreme cold or heavy snows have rather sharply checked spring trade and retarded transportation. There is also a quieter feeling in several lines of speculation and of industry, the exception to this being found in the south where, stimulated by the extraordinarily high cotton prices, preparations for the planting of an enormous acreage are going forward. A turn in the tide of speculation occurred and brought about lower prices for most of the cereals and securities. Staple prices, however, are generally very strong. Reports from the iron and steel trade are somewhat unsatisfactory. The railroads are still out of the market for rails, and finished products except at a few western markets are rather duller. A despatch received during the week from Montreal stated that the Pennsylvania Steel Company had obtained a contract from the Canadian Pacific Railway for 40,000 tons of 80-lb steel rails at $21.50 a ton, and that the United States Steel Corporation had also quoted for the contract at the same figure, but had failed to secure it. Structural material is quiet, but there is an active demand for wire, wire products and tubing at Pittsburg. Lumber and kindred industries are very active at all southern points. The pig iron production for 1903 surpassed expectations, the large decrease of the second half having been offset by the immense production of the first six months. The total output—18,009,000—exceeded by one per cent. the record production of 1902. Copper prices declined, but otherwise the situation is unchanged. The official quotations are: Lake, 12⅝ to 12⅞c.; electrolytic, 12½ to 12¾c.; and casting stock, 12⅜ to 12⅝c. Outside lots can be purchased at concessions from these figures of about ⅛ cent. The exports have been going on at an unexpected rate. It was noted last week that the total shipment for the month would probably reach 20,000,000 tons, and notwithstanding this heavy drain upon the available supplies, the metal was freely offered. This is taken to indicate that there are ample stocks in the hands of producers. The business failures for the week ending January 28, according to *Bradstreet's*, aggregated 242 against 266 the week previous, and 230 in the corresponding week last year.

EUREKA TELEPHONE EQUIPMENT.—The Belvidere Telephone Company, at Belvidere, Ill., in order to meet its service and render it more rapid have contracted with the Eureka Electric Company, of Chicago, and Genoa, Ill., to equip the 800-line express switchboard which it now has with the Eureka flashlight transfer system, consisting of 56 trunking lines having lamp signals at each end of the trunk. This trunking system will be able to accommodate 1,000 lines, as there will soon be that number in use. This board is also to be equipped with new listening and ringing keys and Eureka flashlight supervisory. The addition of the above apparatus gives the operator complete flashlight supervision over all calls, both trunking and those in her own section, and will greatly facilitate her work, enabling her to take care of more calls than would otherwise be possible. Among recent shipments are one Eureka magneto express switchboard of 400 capacity to McPherson Telephone Company, McPherson, Kan.; one 100-capacity board to Lawton Telephone Company, Lawton, Iowa; one 100-capacity board to Indiana Electric Company, Hillsdale, Ind.; one 100-capacity board to Citizens' Mutual Telephone Company, Newport, Ind.; one toll line board to J. E. Briglin, Orleans, N. Y.; one 100-capacity board to Larue Co. Telephone Exchange Company, Hodgenville, Ky.; one combination telephone and switchboard and one 100-capacity board to Quincy Mining Company, Hancock, Mich.; one 100-capacity board to Jas. A. Helm, De Soto, Ill.; one 100-capacity board to Chas. Causey, West Union, Ind.; one 100-capacity board to Mitchell Telephone Company, Georgia, Ind.; one 50-capacity board to Theresa Union Telephone Company, Theresa, Wis.; one 25-capacity board to Morgantown Telephone Company, Morgantown, Ind.; one combination telephone and switchboard to J. W. Reynolds, Simpson, Ill.; also a large shipment of telephones for Valparaiso, S. A., and a shipment of 100 telephones for San Salvador, C. A.

SOME C & C ORDERS.—The C & C Electric Company, 143 Liberty Street, New York City, reports recent receipt of British and African orders for motors. The British orders were secured through C. R. Heap, of London. A 45-hp series parallel equipment has been requisitioned for hoisting machinery in South African gold mines. The company has a number of domestic orders in hand for equipment to be installed in hotels, manufacturing plants, private residences, printing plants, etc. The Hotel Albert is to be equipped with two 60-kw and one 40-kw generator. These generators will be direct-connected to Payne engines of 90-hp and 60-hp capacity. This equipment will be used for lighting the hotel and driving the elevators. The Coco Cola Company, of Chicago, has ordered a 50-kw generator and marble switchboard. The generators will be direct-connected to a Shepherd vertical engine of 75-hp capacity. This outfit will be utilized for both light and power purposes. A 75-kw belted generator and switchboard has been ordered for light and power use in the quarries of William Bradley & Son, of Bedford, Ind. A 12½-kw generator has been called for, for direct connection to a Nash gas engine for lighting a private residence at Ossining, N. Y. A special slow-speed motor will be used for driving a large blower in the Union County Court House, Elizabeth, N. J. A 100-hp series parallel equipment has been ordered for driving a big Goss color press in the New York *Herald* plant.

COPPER IN ENGLAND.—The annual copper review of James Lewis & Son, of Liverpool, presents the following statistics of the total consumption of copper in the principal countries of Europe:

	1903.	1902.	1901.	1900.
Consumption of England	60,637	84,377	76,946	81,376
Manufactured copper exported ..	25,745	22,145	16,765	16,100
Sulphate of copper exported	13,361	10,822	9,004	10,728
Consumption of France	45,147	49,254	39,883	42,436
Consumption of Germany	*79,000	71,514	52,885	77,146
Consumption Am. copper in Italy, Austria and Russia	13,513	14,802	6,638	8,863
Total tons	243,403	252,914	202,121	236,649

* December estimated.

The circular says: "Our statistics of consumption for the year show an increase in the United States of 2,700 tons, and in Germany of about 7,500 tons, but a decrease in England of 17,740 tons and in France of 4,107 tons. The exports of manufactured copper (chiefly to India) and of sulphate have increased 6,139 tons. There is, however, little doubt that the actual consumption of England has not fallen off, but on the contrary has increased, the above apparent decrease being due to the greatly reduced stocks held by smelters and manufacturers. Much more copper has been used for electrical purposes; an increased quantity of sulphate has been consumed in Ireland, and though there is a decrease of 206,605 tons in the ships launched, there is an increase of 65,791 tons in the indicated horse-power of the marine engines supplied to them."

TORPEDO CABLE FOR JAPAN.—The Safety Insulated Wire and Cable Company, 114 Liberty Street, New York, reports brisk business. The New Haven plant of the company has been working at high pressure both night and day for some time past, and the Bayonne, N. J., works will begin continuous operation within the next few days. The Japanese Government has just requisitioned for a large lot of torpedo cable. A contract has been secured from the Philippine civil government for 30 miles of standard type cable which will be utilized to connect the last of the numerous islands with the mainland. The Safety Insulated Wire and Cable Company has taken contracts from the same source which will represent in all nearly 2000 miles of cable. The United States War Department has ordered a big quantity of range-finder cable for use in different fortifications along the Atlantic, Pacific and Gulf coasts. The company will ship next week 13 miles of single conductor cable to be used for connecting the fortifications of Puget Sound with Seattle, Washington.

THE WARREN ELECTRIC COMPANY, of Sandusky, Ohio, is shipping a 10,000-light generator to Martinsburg, W. Va.

GAS ENGINE POWER PLANTS.—The Power & Mining Machinery Company, of 52-54 William Street, New York City, reports some important recent work, especially for the Elmira (N. Y.) Water, Light & Railroad Company. Its contract with that company covers a four-cylinder American Crossley gas engine of the opposed type, with cylinders 32 in. in diameter x 36 in. stroke, to run 138 r.p.m. and to develop, under normal load, 1,300 brake hp, with natural gas containing 1,000 B.T.U. per cu. ft. This engine will be direct-coupled to a General Electric 60-cycle alternator of the fly-wheel type, and will run in parallel with their existing steam engines and with such other gas engines as they may install in the future. This engine will be used for both lighting and power; the direct current for their railway work secured by the use of rotary converters. The above order was placed after the Elmira Water, Light & Railroad Company had thoroughly investigated the gas engine field for over a year. In addition to the above, it has entered the following recent orders: Milford Electric Light Company, Milford, N. H., one 80-brake-hp high-speed Crossley gas engine, with cylinders 17 in. x 24 in., and one Crossley suction type producer plant of the same capacity. The Motor Engine Company, 15 William Street, New York City, one 20-brake-hp Crossley new type suction gas producer, to be installed at its Staten Island shops. The Ampara Mining Company, Philadelphia, Pa., one 190-brake-hp Crossley high-speed, double-cylinder gas engine, with cylinders 18½ in. x 24 in.; and two high-speed, single-cylinder Crossley gas engines, of 130-brake-hp each, with cylinders 20 in. x 30 in.; six 9-ft. x 15-ft. Loomis generators, with two 10,000 cu. ft. holders.

WESTINGHOUSE TURBINES IN A TEXTILE MILL.—The Westinghouse Machine Company has recently received an order from Joseph Benn & Sons for a turbo-generator set to be used in furnishing light and power for driving machinery in their new alpaca mills, which are to be built at Olneyville, R. I. This factory will be an American branch to their Yorkshire, England, mills. The turbine is of the Westinghouse-Parsons type, of 400-kw capacity, and is to operate under a steam pressure of about 150 pounds. Superheated steam will probably be used. The turbine will drive a 400-kw, three-phase Westinghouse alternator which will deliver power to the motors situated in the various parts of the mill for the purpose of driving machinery in the different departments. A 7½ x 7 Westinghouse standard engine type outfit is also being supplied and will be direct-connected to the generator rig for furnishing the exciter current. F. P. Sheldon & Co., mill engineer, of Providence, are now at work designing the plans for these mills.

LOS ANGELES ELECTRICAL SPECIALTY COMPANY, of 145 West Fourteenth Street, Los Angeles, Cal., has just completed a plant for the manufacture of high-grade dry cells for automobiles, gas engines, telephones, bells and all open-circuit work. The officers are David W. Coons, treasurer, and Arthur W. Coons, superintendent, who say: "With three years' practical experience with manufacturing batteries in the East, and several months spent in German and French battery works, investigating latest and most improved methods, and with the use of the best imported materials, we are able to produce the highest possible grade of cells and batteries for all electrical work where dry cells are used. We make all standard sizes and furnish estimates for special sizes where desired." They are catering primarily to Pacific Coast trade, but will be glad to hear from any part of the country.

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, has recently sold complete telephone equipment for 1,000 stations to the Auburn Telephone Company, Auburn, N. Y. It has also received an order for 800 stations from the Ideal Construction Company, Hopkinsville, Ky. These figures are for present installation, and the ultimate capacity for each exchange will be 10,000 stations. About seven years ago the Auburn company installed an "Automatic" board with an ultimate capacity of 400 stations. This was soon filled, and in order to increase the list of its subscribers it purchased two manual boards of two operators' positions each and connected them with the automatic switchboard by means of trunk lines. The new equipment replaces the old "Automatic" board and the two manual boards which were later installed to give service in conjunction with it.

DENVER TROLLEY POWER HOUSE.—The maximum boiler horse-power in central power stations is only attained during a few hours of the day. During the greater part of the day the capacity required is much less than this maximum. On this account it has been found economical and practical to design the boilers and chimneys of ample capacity for this load and to force them above and up to the maximum by means of mechanical draft. This is applied with equal success to old and new plants. In the new power station of the Denver Tramway Power Company, Denver, Colo., mechanical draft is used as an auxiliary to the natural draft provided by a chimney 240 ft. high. Artificial draft is furnished by three Sturtevant electrically-driven steel plate fans. The boiler capacity of the plant is approximately 6,000 hp.

PAYNE ENGINEERING COMPANY, 26 Cortlandt Street, New York City, has issued recently the following notice, signed by Messrs. H. S. Whitney and M. A. Hudson: "We wish to inform our friends and customers, that we have completed arrangements whereby on January 1, 1904, we assumed the management of the Western business of the Ashcroft Manufacturing Company, the Hayden & Derby Manufacturing Company, the Hancock Inspirator Company and the Consolidated Safety Valve Company. On the same date the management of this company, with which we have been identified for the past eighteen months, was turned over to Mr. W. S. Montgomery."

FAILURES OF JANUARY.—The commercial failures in the United States in January, according to reports received by R. G. Dun & Co., numbered 1,406, with an aggregate defaulted indebtedness of $18,483,573, as compared with 1,269 failures in January, 1903, for $12,978,979. Of the 1,406, 271 were of manufacturers, for $6,687,637. On account of annual payments and inventory disclosures January is usually a month of many failures, but careful comparison shows that losses last month were heavier than in the corresponding month of any year since 1896, and heavier than in any month since May, 1900, excepting only December last.

EQUIPMENT FOR APARTMENT HOUSE.—The Construction Realty Company is about to ask estimates on the power plant to be installed in a new apartment house at Sixty-ninth Street and Broadway. There will be three direct-connected simple automatic high-speed engines, 13 x 12 in. The generators will be direct-current compound-wound multipolar machines, 125 volts, 65 kw. The wiring will be a two-wire 125-volt system. Percival Robert Moses is acting as consulting engineer for the company in this matter.

NATIONAL CARBON COMPANY.—The National Carbon Company, which closed its fiscal year January 31, has now completed the fifth year of its existence. The company has earned and paid dividends on the preferred stock at the rate of 7 per cent. If the company follows precedent it is expected to charge off about $300,000 for depreciation. Up to the last statement January 31, 1903, the company had charged off more than $900,000 since its inception, while the profit and loss surplus, according to the last statement, was only $156,000.

BALL ENGINE ORDER.—The Eastman Kodak Company, of Rochester, N. Y., has contracted with the Ball Engine Company, of Erie, Pa., for two 400-hp. vertical cross-compound engines, to be direct-connected to a 250-kw Crocker-Wheeler generator. The Ball Company has just installed two 350-hp vertical cross-compound, direct-connected units in the First National Bank Building, Chicago, and is also building two additional units of the same size for this plant.

CAHALL BOILERS FOR WORLD'S FAIR PLANT.—The important contract for boilers which will furnish the steam for nearly two-thirds the entire power plant for the World's Fair has just been awarded. The Aultman & Taylor Machinery Company, of Mansfield, O., secured the work. The boilers, 16 in number, will have an aggregate capacity of 7500 boiler hp. They will be installed in the Steam and Fuel Building at St. Louis.

THE GREAT NORTHERN POWER COMPANY, of Duluth, Minn., is asking for proposals for vertical turbines to operate under a head of 365 ft. at 250 r.p.m., together with other necessary apparatus. According to the present plans of the company it is expected to have a 35,000-hp plant in operation in 1905. The plans provide for an increase of power up to 80,000 hp. Another hydraulic installation of 12,000 hp at a 70-ft. dam is also in contemplation.

PELTON WATER WHEELS FOR SOUTH BRAZIL.—The Pelton Water Wheel Company, 143 Liberty Street, New York, has secured a contract for a 300-hp water wheel outfit which will be used for developing power for lighting a small city in South Brazil. The generator—200 kw—will be built by the General Electric Company. The contracts came through Guinle & Aschoff, of Rio Janeiro.

MEXICAN HYDRAULIC PLANT.—The construction of a hydraulic plant is projected on the River Plomosas in the district of Rosario, State of Sinoloa, Mexico. An American, Dell Linderman, who operates extensive mines in that district, is primarily interested in the project. He intends to operate his mines by electric power. The plant will have a capacity of about 1500 hp.

SALE OF LIGHTING PLANTS.—The J. S. Maurer & Co. agency, 804 Monadnock Block, Chicago, reports the sale of central electric light plants, for investment purposes, in the towns of Pecatonica and Pittsfield, Ill., and Blairstown, Iowa.

McCREARY SPECIALTIES FOR EUROPE.—The A. A. McCreary Company, of 136 Liberty Street, New York, has some substantial orders in hand for its electrical specialties for shipment to Mexico City, London and Paris.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. General meeting, Washington, D. C., April 7, 8 and 9, 1904.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Ave., Detroit, Mich.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, 1904.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, New York City and Portland, Ore.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

Chicago Electrical Association. Secretary, W. B. Hale, 242 South Jefferson Street, Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, F. P. Ide, Springfield, Ill. Next meeting, December, 1903.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, H. E. Chubbuck, LaSalle Ill.

Indiana Public Utilities Association. Secretary, A. M. Barron, Indianapolis, Ind.

Independent Telephone Association of the United States. Secretary, Frank G. Jones.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Pichardt, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

Iowa Electrical Association. Secretary, W. S. Porter, Eldora, Ia.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia. Annual meeting, Des Moines, March 8, 1904.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ind.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

National Arm, Pin & Bracket Association. Secretary J. B. Magers, Madison, Ind. Next meeting St. Louis, July, 1904.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting St. Louis, Mo., September 14, 15 and 16, 1904.

New England Street Railway Club. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May 24, 25 and 26.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, Canton, O.

Southwestern Electrical Association. Secretary, J. L. Ellis, Oklahoma City, Okla. Next meeting, Dallas, April or May, 1904.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scovill, Austin, Texas.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

United Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

General News.

THE TELEPHONE.

MOBILE, ALA.—At the meeting of the Home Telephone Company the following-named officers were elected for the ensuing year: E. Eichold, president; A. S. Lyons, treasurer; Robert L. Douglas, secretary.

OXNARD, CAL.—When the franchise for the Home Telephone Company was refused by the town trustees some time ago, the Sunset Telephone Company made certain promises which are being amply fulfilled. Continuous service has been installed, in place of special hours on Sundays, evenings and holidays. A force of fifteen men has entirely rebuilt the town system, replacing the old iron wire with copper wire, changing the ten-party lines to two and four-party lines, installing two new switchboards, putting in new poles, painting them and placing them wherever possible in the alleys. The toll lines between Oxnard and Montalvo have been rebuilt and men are now at work stringing a line so that Oxnard will be able to call Los Angeles directly.

CARROLLTON, GA.—The Gainsboro Telephone Company, of Carrollton, has purchased the lines of the Commercial Telephone Company at Atlanta and has merged the latter into its own property. This acquisition gives the Gainsboro Company about 400 miles of line, 10 city exchanges and 60 stations, all under the control of the Carrollton exchange.

OBLONG, ILL.—The Oblong Telephone Company has been incorporated with a capital stock of $6000. The names of the incorporators are E. T. Shire, F. P. Willard and Zach Wirt.

LOGANSPORT, IND.—The Home Telephone Company has increased its rate for business telephones from $18 to $30 per year.

FAIRMOUNT, IND.—The Citizens' Telephone Company is installing a new switchboard which will accommodate an additional 100 subscribers.

INDIANAPOLIS, IND.—The Denver County Telephone Company has been incorporated with a capital stock of $3000. The directors are I. L. Eckenberry and others.

ZIONSVILLE, IND.—The Citizens' Telephone Company, of Zionsville, has been incorporated with a capital stock of $15,000. The officers of the company are: President, James O. Hurst; secretary and treasurer, H. F. Gallimore.

INDIANAPOLIS, IND.—Contracts have been made by the Board of Public Safety for telephone service for the Police Department. The new company will furnish 74 telephones and a new switchboard at the headquarters for $1250 and the old (Bell) company will furnish 84 instruments for $1248.

MUNCIE, IND.—The strike of the Electrical Workers' Union of Delaware and Madison Counties Telephone Company, which began last April was formally declared off Jan. 12, a compromise having been effected. It is given out that hereafter none but union electrical workers will be employed by the company.

INDIANAPOLIS, IND.—The Independent telephone people of Indiana are somewhat concerned over the action of Postmaster-General Payne, in ordering the independent telephones removed from the post offics in the Northwest. Should such an order be applied to Indiana it would displace or silence a large number of telephones.

HOLLANDSBURG, IND.—The New Home Telephone Company has been organized by the citizens of this place. An exchange will be established and lines constructed in Wayne and Randolph counties. Connections will be had with towns in Ohio that are connected with the independent companies. Oliver Spencer is secretary of the new company.

SHELBYVILLE, IND.—A new section of switchboard is being put in at the exchange of the Mutual Telephone Company of this city which will increase the capacity to 1100 lines. Another line will be built between this city and Indianapolis as the two lines which are now stretched between the two cities are not sufficient to carry the heavy business of the company.

INDIANAPOLIS, IND.—Judge Anderson, of the United States District Court, has refused the petition of the Cumberland Telephone Company, of Evansville, for a rehearing of its suit against the city to prevent the city authorities from ousting it from the streets for the lack of a franchise to operate therein. The case will now be appealed to the U. S. Court of Appeals.

BROWNSBURG, IND.—At the annual meeting of the Brownsburg Telephone Company J. S. Thorp was elected president; D. R. Marsh, secretary; Alpha Medsker, treasurer, and J. R. Flinn, superintendent of construction. The company is figuring with both the Bell and the Independent Telephone Company relative to getting a direct line to Indianapolis and there is apparently some rivalry between the two companies.

DELPHI, IND.—The Carroll Telephone Company, of this city, and all the co-operative companies throughout the county have effected a consolidation and all the lines are now connected for business. The arrangement is on trial for three months, and if it proves satisfactory a permanent contract will be made. It gives service all over the country, and connects nearly 2000 rural telephones with the local exchange in this city.

ANDERSON, IND.—The December earnings of the Delaware and Madison Counties Telephone Company amounted to $6550 gross; expenses were $2802; interest, $1441; surplus to be applied to stock, $2306. The surplus for December was $2211. The company which operates the Muncie, Anderson, Elwood and Alexandria exchanges is expected soon to reach a dividend basis, although only in operation a year or so. At Alexandria the company is hustling to keep ahead of the Central Union and to that end a new section of board, cable and other equipments to handle 200 or 300 more telephones will be installed.

DES MOINES, IA.—The Mutual Telephone Company contemplates issuing bonds for the extension and improvement of its system.

SLOAN, IA.—The Lawton Telephone Company has been incorporated with a capital stock of $2000. The directors are J. H. Abernathy, R. I. Marshall and others.

OSCEOLA, IA.—The Murray & Lacelle Telephone Company, of Osceola, has been incorporated with a capital stock of $450. The incorporators are George Coon, Jacob Reueder and E. D. Hamm.

STRATFORD, IA.—The Stratford Independent Telephone Company has purchased the system and franchise of the Chamberlain Independent Telephone Company. The name of the new company will probably be changed to Hamilton County Independent Telephone Company. Mr. C. Williams is president.

HOPKINSVILLE, KY.—The Hopkinsville Home Telephone Company has been incorporated with a capital stock of $100,000. R. E. Cooper is president.

BRAINERD, MINN.—It is stated that the Northwestern Telephone Exchange Company will build a line to Walker, Minn., in the spring.

SPRINGFIELD, MINN.—The Citizens' Mutual Telephone Company has been formed here with a capital stock of $25,000. It will build a local and rural system.

HELENA, MONT.—The city council has decided to submit to a vote the proposition of granting a franchise to the Rocky Mountain Bell Telephone Company.

KANSAS CITY, MO.—The Independent Telephone Construction Company, of Kansas City, has been incorporated for the purpose of constructing toll lines of the Home Telephone Company. It is capitalized at $100,000, all paid up. J. S. Brailey, Jr., of Toledo, Ohio, is one of the principal promotors of the enterprise.

HANNIBAL, MO.—An appeal in the case of the Missouri & Kansas Telephone Company, which was fined $150 in the police court on the charge of violating the city ordinances by constructing lines within the city limits without securing the consent of the city council, has been taken to the Hannibal court of common pleas. The case is one in which the city seeks to compel the company to take out a franchise.

LINCOLN, NEB.—The Independent telephone companies of the state have asked the Omaha commercial club to use its influence in getting through the city council of Omaha a franchise for the establishment of an independent telephone exchange in that city, with which all independent companies may connect. The request indicates that a fight will be made on the Bell Telephone people by the independents in Nebraska.

JERSEY CITY, N. J.—The corporation council has drafted a bill providing for the placing underground of telegraph, telephone and other wires. The bill will be introduced in the legislature.

LE ROY, N. Y.—The Canton & Le Roy Telephone Company has been granted a franchise to conduct business in Canton.

LOCKPORT, N. Y.—The Niagara Telephone Company, of Barkers, N. Y., has been absorbed by the Bell Telephone Company, of Buffalo. The independent company had 127 subscribers.

NEW YORK, N. Y.—Sealed bids were received by the police commissioner of the Police Department of the City of New York on Feb. 1 for furnishing and delivering telegraph and telephone supplies.

PRATTSBURGH, N. Y.—The Prattsburgh Overland Telephone Company has filed articles of incorporation at Albany with a capital stock of $10,000. The directors are Estelle Conine, G. T. Conine and L. H. Conine.

UTICA, N. Y.—At the annual meeting of the Utica Home Telephone Company the following-named officers were elected: President, Edgar B. Odell; vice-president, H. F. Miller; treasurer, Edward Bushinger; secretary and manager, C. H. Poole.

BYRON, N. Y.—The Byron Telephone Company has been organized and incorporated to operate a system in Genesee and Orleans counties with an exchange at Byron. The capital stock is $1200. The board of directors is composed of Dr. Prince, A. G. Steele, I. W. White, C. H. Green, H. C. Norton, F. C. Walker and H. C. Warker

ELMIRA, N. Y.—The stockholders of the York State Telephone Company held their first annual meeting a few days ago. Officers were elected as follows: President, W. D. Barnard; vice-president, Edward Davis; secretary and treasurer, Robert M. Dougal. The annual report shows that the increase in the number of telephones during the year was from 2461 to 3617, which is a growth of 50 per cent.

LIBERTY CENTER, OHIO.—The Farmers' Mutual Telephone Company has been organized here. Mr. A. C. Clifton is president. The company has 46 subscribers.

AKRON, OHIO.—The Akron People's Telephone Company directors have elected Will Christy, president; J. S. Benner, secretary; W. F. Laubach, treasurere and general manager.

URBANA, OHIO.—Stockholders of the Urbana Telephone Company re-elected the present officers. The company is planning to make improvements to its exchange.

CHERRYVALE, OHIO.—The Cherryvale Mutual Telephone Company has been incorporated with a capital stock of $350. The directors are J. H. Scofield, O. N. Hamilton and others.

DELPHOS, OHIO.—The Delphos Home Telephone Company has secured a 15-year franchise, being an extension of the old franchise. Having settled this point, the company will now make improvements.

LIMA, OHIO.—The Ideal Construction Company, of this city, will erect a telephone exchange at Hopkinsville for the Hopkinsville Home Telephone Company. R. E. Cooper, of Lima, is president of the company.

CRESTLINE, OHIO.—The Central Union Telephone Company has a franchise ordinance pending in Crestline and hopes to secure the grant, as this is the only town in the district not reached by the Bell Company.

GIRARD, OHIO.—An independent company is being organized here and will ask for a franchise. At present the Bell Company has the field alone and a great many people are dissatisfied because of a recent advance in rates.

PLAIN CITY, OHIO.—The Home Telephone Company, of this place, has been incorporated with a capital stock of $50,000. The company will operate in Franklin, Union and Madison counties. The names of the incorporators are Calvin Liggett, C. W. White, L. H. Elliott, F. N. Mattoon, L. S. Lane and L. Worthington.

NEW LEBANON, OHIO.—V. E. Weaver, of this place, is organizing a mutual telephone company among the farmers of this district. Each member of the company will furnish his own poles and wire. An exchange will be located in South Lebanon. Brooksville, Liberty, Johnsville, Arcanium, Alexandria and Germantown will be connected.

BRYAN, OHIO.—The Bryan Telephone Company has secured control of and absorbed the Williams County Toll Line Company. Nearly $100,000 worth of property changes hands by the deal. O. L. Spangler, formerly auditor for the Williams County Company, has been made general manager of the new company. The other officers remain as heretofore.

INGERSOLL, O. T.—The Union Telephone Company, of Ingersoll, has been incorporated with a capital stock of $10,000 by A. W. Leonard, and M. M. Taylor, of Driftwood; B. F. Blue, E. Bradley and J. B. McGinniss, of Ingersoll.

NEWKIRK, O. T.—A charter has been issued by the secretary of state to the Newkirk Home Telephone Company which has been organized with a capital stock of $5000. The incorporators are J. H. Smock, J. H. Thompson and Guy Stovall.

AMES, O. T.—The Phœnix Telephone Company, of Ames has been incorporated with a capital stock of $10,000 by A. Mathis, B. F. Hogard and W. H. Mathis.

TAMAQUA, PA.—The telephone exchange of the United Telephone Company has been destroyed by fire.

SCRANTON, PA.—The Pennsylvania Telephone Company has expended $200,000 in the general improvement of its service in this city, including the placing of the wires underground. The work is not yet completed. Provision has been made for the installation of a new central energy switchboard with a capacity of 10,000 lines.

READING, PA.—At the annual meeting of the directors of the Consolidated Telephone Company of this city, it was reported that there are now 1800 telephone connections in this city, while contracts for over 400 more have been made. The following-named gentlemen were elected officers: President, Robert E. Wright; vice-president, C. W. Kline; secretary and general manager, S. E. Wayland; treasurer, C. M. W. Keck.

TRIPP, S. D.—The Tripp Telephone Company has been incorporated with a capital stock of $2000.

COLORADO CITY, TEX.—The Texas & Pacific Telephone Company has increased its capital stock from $30,000 to $40,000 and has changed its headquarters from Abilene to this place.

BATSON, TEX.—A telephone system will be established here by the Southwestern Telegraph & Telephone Company. J. E. Farnsworth, of Dallas, Tex., general manager, can give information.

SALT LAKE CITY, UTAH.—The experiments of the Oregon Short Line Railway Company in establishing a telephone system in connection with its telegraph lines has proved an entire success, and many extensions in this direction will be made in the near future.

McDONALDS MILLS, VA.—The North Fork Telephone Company with a capital of $5000 has been incorporated.

ETNA MILLS, VA.—The Richmond & Ayletts Telephone Company has decided to extend its line from Etna Mills to Hanover.

VIRGILINA, VA.—The Virgilina Telephone Company has declared a dividend of 6% and re-elected the present officers. This company operates over 42 miles of wire, connecting at South Boston, Va., with the system there, also with systems in other places.

PORTAGE, WIS.—The Portage Telephone Company has increased its capital from $3000 to $30,000.

MONCLOVA, STATE OF COAHUILA, MEX.—The Monclova Telephone Company will extend its system and make other important improvements.

HERMOSILLO, MEX.—The Mexican Government is extending its system of telegraph wires to all parts of this state. A large amount of material is required for this work of improvement.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—It is proposed to construct an electric light plant in the West End at a cost of between $10,000 and $15,000. P. S. Milner, of the West End, is interested.

STOCKTON, CAL.—R. G. Paddock has applied for an electric light franchise, and bids for same will be received Feb. 19. Eugene D. Graham is county clerk.

WILLIMANTIC, CONN.—At the annual meeting of the Willimantic (Conn.) Gas & Electric Light Company the officers elected were: Directors, J. F. Church, Geo. A. Lewis, Emerson Stone, David F. Tilley and Chas. F. Evans who succeeds his father—the late Edwin Evans; president, J. F. Church; treasurer, George A. Lewis; assistant treasurer, D. F. Tilley; secretary, C. W. Noyes.

ANDERSON, IND.—The Philadelphia Quartz Company, of this city, has abandoned gas, coal and steam for power in its local plant in favor of electricity. It is the first factory in this city to do so.

VINCENNES, IND.—The City Council recently voted down the ordinance relating to the New City Electric Lighting Company, in which Mr. P. K. Tyng is interested. The statement that the ordinance was passed was erroneous.

LOGANSPORT, IND.—The recent flood damaged the local electric light plant to the amount of many thousand dollars. The north wall gave way and tumbled into the river. The plant was compelled to close which left the city in darkness.

TIPTON, IND.—The municipal electric light plant, erected several years ago at a cost of $40,000, is overloaded and the service is not satisfactory. It is planned to enlarge the plant and the old dynamos will be replaced with machines with twice the capacity in order to keep pace with the growing city.

IDAHO FALLS, IDA.—Geo. Chapin, president of the Idaho Power & Transportation Company, writes that it is proposed to construct a plant on Snake River, at a cost of $75,000. No engineer has been selected as yet.

DE WITT, IA.—At the last annual meeting of the stockholders of the De Witt Electric Light & Power Co., it was decided to expend a few thousand dollars in improving, and enlarging the capacity of the plant as the business has outgrown the present facilities. It will be necessary to install some new and larger machinery.

SIOUX CITY, IA.—It is reported that about $24,000 will be expended on improving the city lighting plant.

LIVERMORE FALLS, ME.—The Livermore Falls Water Company and the Livermore Falls Light & Power Company, which are practically one concern, and the Richmond Manufacturing Company, have elected Edwin Riley, president; John H. Maxwell, treasurer and clerk, and Fred E. Riley, engineer.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Company has elected officers as follows: President, Frank Curtiss; vice-president, treasurer and general manager, Parley A. Russell; superintendent, Clyde Parrish.

RAPID RIVER, MICH.—The business men are considering the installation of an electric light plant.

NEGAUNEE, MICH.—The Central Construction Company, of Oshkosh, Wis., has secured the contract for improvements to the electric light plant, for about $15,000.

FLINT, MICH.—Wm. L. Fisher, Superintendent of Water Works, and A. W. Hall, City Engineer, have been requested to report on the cost of installing a municipal electric light plant of about 150 enclosed arc lamps, requiring about 40 miles of wire.

SWANVILLE, MINN.—It is reported that an electric plant will be installed at the milling plant of Koenig Bros. & Meschke.

HANNIBAL, MO.—The citizens voted Jan. 11 to issue $100,000 bonds for rebuilding the electric light and power plant.

BALTIMORE, MD.—At a meeting of the board of directors of the United Electric Light & Power Company, Messrs. A. N. Brady, Samuel A. Beardsley, Nicholas F. Brady and Thomas E. Murray, of New York, were elected directors to represent the new interests who recently purchased a large bulk of the stock of the lighting company.

CONCORD, N. C.—Jas. C. Fink, City Clerk, writes that the matter of constructing an electric light plant is being considered. Dr. W. D. Pemberton is Chairman of the Committee.

WINSTON-SALEM, N. C.—The Board of Aldermen on Jan. 20 awarded to the Fries Mfg. & Power Company the contract for lighting the city for a period of 13 years, beginning March 31, at $60 per light per year.

LEBANON, N. H.—The Lebanon Electric Light & Power Company has elected officers as follows: President, W. S. Carter; vice-president, George S. Rogers; clerk, G. C. Whipple; treasurer, H. M. Day.

CLEMENTON, N. J.—The Clementon Township Electric Light Company has surveyed a route for an extension of its system to Clementon and Overbrook.

JERSEY CITY, N. J.—The Jekyl Island Light & Power Company, of Jersey City, has been incorporated; capital, $50,000. Incorporators: Chas. Lanier, Robt. W. De Forest, and John L. Scrymser.

TRENTON, N. J.—The Columbus Public Service Company, with an authorized capital of $1,500,000, was incorporated at Trenton, N. J., to make and distribute heat, light and power. The incorporators are Horace S. Gould, H. O. Coughlan, of New York, Joseph M. Mitchell, of Newark, B. S. Lantz, of Brooklyn, and Louis B. Dailey, of Jersey City. The location of Columbus is not stated in the dispatches.

IRVINGTON, N. J.—The Council on Jan. 5 opened bids as follows for lighting the town: United Electric Company, for 430 lights of 30-cp each, for a period of five years, $15 per lamp; on a three-year contract, $15.50, and for one year, $16. Wm. L. Glorieux, of Irvington, offered to purchase necessary generators and furnish the current from his smelting works at Enterprise Hill at $9 per lamp per year.

OWEGO, N. Y.—The stockholders of the Owego Light & Power Company have elected W. S. Truman, president; Hon. W. G. Phelps, vice-president, and G. F. Andrews, secretary and treasurer.

POUGHKEEPSIE, N. Y.—Officers of the Poughkeepsie Light, Heat & Power Company have been elected as follows: F. R. Bain, president; T. R. Beal, secretary; William Shickle, treasurer.

NEWBURGH, N. Y.—At the annual meeting of the Newburgh Electric Light, Heat & Power Company, officers were elected as follows: Wm. R. Beal, president and general manager; T. R. Beal, secretary and treasurer.

OGDENSBURG, N. Y.—The town of Waddington, at a special election a few days ago, voted to sell its municipal electric light plant and water power and rights to a Canadian company for $3750, the amount which now remains unpaid on the plant. It is stated that the municipal operation of the plant did not prove satisfactory.

ATHENS, OHIO.—The new municipal lighting plant is being erected and a number of manufacturing establishments are contracting for power.

SIDNEY, OHIO.—The Sidney Electric Light Company will install two new engines; an incandescent machine and will make other improvements to its system.

COLUMBUS, OHIO.—The recent floods and high water caused serious damage to electric lighting plants in a number of Ohio cities. Lighting plants at Columbus, Toledo, Youngstown, Grand Rapids and other towns were out of service, leaving portions of the towns in darkness.

MECHANICSBURG, OHIO.—T. J. Long has closed a contract with the village council to install a lighting plant and furnish light for the town as well as for private service. He agreed to supply 30 arc lights at $66 each, and $60 for each additional lamp. The plant is to be completed by May 1, 1904. Work will start as soon as the weather permits.

NEW FREEDOM, PA.—Bids will soon be asked for water works and an electric light plant.

HARRISBURG, PA.—Bids will be received Feb. 19 for installing electric light and power in the county jail.

MARIETTA, PA.—The directors of the Elizabethtown & Marietta Light Company have decided to enlarge the plant.

BEAVER, PA.—Wm. H. Iron and Eugene S. Hoopes are on the committee to solicit subscriptions of an electric light plant, which is to be purchased by the borough.

HARRISBURG, PA.—The Southampton Light, Heat & Power Company, of Southampton township, Franklin County, has been incorporated with a capital stock of $5000.

HARRISBURG, PA.—The Middlespring Light, Heat & Power Company, of Southampton township, Cumberland County, has been incorporated with a capital stock of $5000.

READING, PA.—The mayor has vetoed the ordinance enabling the city to borrow $200,000 to establish a municipal electric light plant. The veto was sustained by the select council.

PROVIDENCE, R. I.—The Narragansett Lighting Company held its annual meeting last week in the office of the president when the following gentlemen were elected for the coming year: President and general manager, Marsden J. Perry; vice-president, Arthur H. Watson; assistant general manager, Arthur B. Lisle; treasurer and secretary, Edward A. Barrows. Mr. T. A. Pierce, who formerly held the office of treasurer and secretary, stated that the increasing business in the company required more time than he could give to it and he desired to be relieved of further responsibility after a continuous service of 18 years.

NASHVILLE, TENN.—Mr. J. W. Pentecost, superintendent of the city electric light plant, has submitted to the Board of Public Works his annual report for the year 1903. Two additional boilers have been installed during the year, increasing the boiler equipment of the plant by 200 horse-power and more than 70 miles of live wires have been put out. From 510 on Jan. 1 the arc lights were increased to 642 at the end of the year. There were 392 incandescent lamps put in during the year. The expense of operating amounted to $27,293.37. Twelve thousand dollars was paid in interest and into the sinking fund on account of light bonds. This $12,000 added to the cost of operation, makes $39,293.37. The wages and salaries of the employes amounted to $15,142.27. The amount expended for coal was $7,015.99. At the end of the year there were 1,839 incandescent lamps in service. The output for the year amounted to 1,433,014 kw-hours. Construction work during the year cost $39,822.17. Of this amount $14,000 was expended for boilers; $7,653 for engines and generators; $5,712.30 for wiring; $5,099.75 for labor; $1,797.43 for stationary equipment; $1,824 for poles, etc.; $1,579.93 for foundations. If all the construction were considered as repairs and renewals, the cost per kw-hour would figure out at about 6 cents per kw-hour, a very high rate of production and supply chiefly for arc lighting with overhead wires. Rate of depreciation is not stated, nor is distinction made between new investment and ordinary upkeep.

HILLSBORO, TEX.—E. D. Kelley, superintendent of the Hillsboro Gas & Electric Company, writes that it is proposed to purchase a 200-hp boiler.

CLEBURNE, TEX.—The Cleburne Gas & Electric Light Company, has been organized with a capital of $150,000, by J. F. Strickland, of Waxahachie; R. Vickery, of Ft. Worth, and others.

CLEBURNE, TEX.—The Cleburne Gas & Electric Light Company has been organized here with a capital stock of $150,000 by R. B. Sticher, J. F. Strickland, Osce Goodwin and M. B. Templeton, all of Waxahachie, and R. Vickery, of Fort Worth.

BALLINGER, TEX.—The Ballinger Light & Ice Company has been organized here for the purpose of constructing and operating an electric light and power plant. It has a capital stock of $10,000. The incorporators are W. A. Norman, R. B. Creasey, E. J. Hardgrave and Lewis Alexander.

DEL RIO, TEX.—J. W. Maxey, an engineer of Houston, is preparing plans for a large electric power plant which is to be established at San Felipe Springs, adjacent to this place. It is proposed to generate 375 horse-power by means of the flow of water from the springs. The electrical energy will be conducted to the town where it will be used for lighting and power purposes. It will also be transmitted to irrigation and manufacturing plants in this section. G. Bedell Moore, of San Antonio, who owns the San Felipe Springs, is back of the project.

PRAIRIE DU CHIEN, WIS.—The electric light plant at McGregor was totally destroyed by fire a few days ago, the loss being about $11,000.

BLACK RIVER FALLS, WIS.—The citizens have voted to issue $25,000 bonds to purchase the Owens water power to run the electric light plant.

LAMARTINE, WIS.—The Lamartine Peat, Light & Power Company has been organized with a capital of $150,000 by Dr. C. A. Beebe, C. T. Medberry, F. J. Rueping and others, to develop peat marshes in Lamartine. Application has been made for a franchise to furnish light and power.

The Electric Railway.

VENICE, ILL.—The management of the Granite City & Venice Electric Railway Company is preparing plans for a new power house and car houses at Venice.

CRAWFORDSVILLE, IND.—The Consolidated Traction Company is arranging to build a large power house in Crawfordsville in the spring. Edward Hawkins is president.

WABASH, IND.—The stockholders of the Wabash & Rochester Railway Company, organized to build a line from this city to Rochester, 35 miles, have elected the following officers: Charles Crane, president, P. E. Wilcox, vice-president; E. S. Pratt, secretary, and C. E. Barnum, treasurer.

BEDFORD, IND.—The City Council has granted an electric street railway franchise to a company of local men, including Col. A. C. Voris, W. M. Mathews, J. W. Gouser, M. N. Messick, E. B. Thornton, V. V. Williams, I. N. Glover and Frank Owens. The company will incorporate at once.

VINCENNES, IND.—The Western Indiana Traction Company has elected officers, as follows: Samuel Williams, of Vincennes, president; F. S. Robinson, of Cloverland, vice-president; John Le Croix, of Vincennes, secretary-treasurer. The company will build a line from this city to Terre Haute this spring.

WOLFSVILLE, MD.—The Catoctin Railway Comapny has been formed here to operate an electric railway. The officers are John H. Maugans, president; W. B. Stottlemyer, vice-president, and H. M. Warrenfeltz, secretary.

ESCANABA, MICH.—The Escanaba Electric Street Railway Company is to extend its line and make improvements to the power house.

BENTON HARBOR, MICH.—The Kalamazoo & Lake Michigan Electric Railway Company will soon begin the construction of its proposed line between Kalamazoo, Benton Harbor and South Haven, Mich. In all, 66 miles of track will be built. Estimates for building and equipping the line are now being received. The engineers are the Western Engineering & Construction Company.

MINNEAPOLIS, MINN.—The Minneapolis method of curing the spitting evil is to have the conductor hand the offender a red card, with the city ordinance about spitting printed on it.

CROOKSTON, MINN.—An electric railway throughout the Red River valley is planned by J. P. Booker and other capitalists of Crookston. Eastern capitalists have agreed to put $100,000 into the enterprise if local capital can raise an additional $100,000.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company announces that the new 6000-hp generator station will be completed at a cost of $500,000. The line between South Omaha and Omaha will be extended to Fort Crook, 5 miles from the present terminus. The Sherman Avenue line, the West Leavenworth Street and Walnut Hill lines will be rebuilt.

UTICA, N. Y.—It is stated that an extensive system of electric railways will be constructed in the North Woods next summer. The first step in the projected enterprise will be the building of a line connecting upper St. Regis Lake and Lake Clear with Paul Smith's. Power for the proposed road will be taken from Franklin Falls in the Saranac River, 20 miles away.

WILLIAMSBURG, N. Y.—A railroad company known as the Eastern Traction Company of Waterbury, Conn., has had representatives in Williamsburg for several weeks, getting the consents of property owners on Roebling Street, from the plaza of the new Williamsburg Bridge, for an electric road through Greenpoint into Long Island City, connecting at Astoria with the new Blackwell's Island Bridge. The promoters of the movement, in addition to obtaining consents, are giving an opportunity to property holders of becoming stockholders in the railroad company. It is stated that many consents had already been obtained, and that the company is capitalized at $5,000,000.

BROOKLYN, N. Y.—The American Realty Traffic Association of Brooklyn has been incorporated at Albany, with a capital of $1,000,000, to conduct railway construction business and to enter into contract with railway companies for the transportation of personal property of every description. The directors are John L. Wells, Lewis B. Grant, Ashley T. Cole, William J. Bagnall and Charles T. Lark. President Winter, of the Brooklyn Rapid Transit, explains that the corporation is a small private concern to operate as a branch of the Brooklyn Rapid Transit system. Its organization was the result of the Brooklyn Rapid Transit taking over the ash collecting contracts held by Milton H. Kennedy some time ago. It was deemed advisable to have a corporation organized to do this work.

FELICITY, OHIO.—The Felicity & Bethel Railroad Company, capital stock $50,000, has been incorporated by Frank Scott. S. F. Kennedy, J. W. Hayden, J. C. Gunnings and W. A. Gregg, of Felicity.

ZANESVILLE, OHIO.—A movement is said to be on foot whereby Tucker, Anthony & Company, of Boston, will obtain control of the property of the Zanesville Railway, Light & Power Company. The Columbus, Newark & Zanesville Railway, which is owned by the Boston people, will soon be completed into Zanesville, and the local system could be consolidated with the interurban line to considerable advantage.

UNION, ORE.—A franchise to extend an electric railway system from this city to Hot Lake. Cove and other nearby cities will be asked for in the near future by T. H. Crawford. The estimated cost of the contemplated extension is $60,000.

CHESTER, PA.—The merger of the Wilmington & New Castle Electric Railway Company and the New Castle & Delaware City Railway Company into the Wilmington, New Castle & Southern Railway Company will soon be effected and a charter applied for. It is reported that the new company and the Middletown & Odessa Railway Company are negotiating for the construction of a line from Delaware City to Odessa, connecting the two lines.

PROVIDENCE, R. I.—It is intended to amend the charter of the Valley Falls & Franklin Street Railway Company, by giving the company authority to furnish and sell electricity for lighting, heating and power.

SALT LAKE CITY, UTAH.—A contract which involves the uniting of Salt Lake and Ogden by an electric railway system has been signed by Simon Bamberger, of this city, and J. J. Burns. At Farmington, a power plant will be established at an estimated cost of $115,000. By the terms of the contract the capital stock of Mr. Bamberger's road which runs as far as Farmington will be increased from $800,000 to $1,000,000 and bonds to the amount of $1,000,000 will be issued and sold, although Burns and Bamberger will retain control.

BARABOO, WIS.—William J. Bell, for many years manager of the Baraboo Telephone Company, is endeavoring to interest the business men of Portage in building an electric railway from that city to Grand Rapids. He is backed by Chicago capitalists.

TORONTO, ONT.—At the annual meeting of the Toronto Street Railway Company, held Jan. 20, reports of directors stated that gross earnings for the year as $2,172,089, an increase of $337,179 over the gross earnings of the previous year. The company's net earnings were $971,264, an increase of 18.5 per cent. Out of the net profits there have been declared four quarterly dividends, amounting to $326,548. After deducting permanent charges paid to city, and having transferred $50,000 to contingent accounts, there remains a surplus of $180,628. There has been expended for the general purposes of the company and charged to capital account, $379,615. The present officers and directors were re-elected, with the exception of James Ross, Montreal, resigned, who is succeeded by J. C. Grace.

New Industrial Companies.

THE W. & B. ELECTRIC SAND-BOX COMPANY, of Philadelphia, has been incorporated in Delaware to manufacture the Whiting & Bacon electric sand-box. The capital stock is $75,000.

THE INTERNATIONAL POWER COMPANY has been incorporated in the District of Columbia, with a capital stock of $5,000,000, by A. A. Connally, R. S. Donaldson and E. W. McCormick.

THE ELECTRIC BATTERY COMPOUND COMPANY, of St. Louis, Mo., has filed articles of incorporation. The capital stock, full paid, is $100,000, and the stockholders are G. W. Greener and Frank M. Holmes, Geo. W. Holmes, Wm. Conway, R. W. Hebard and R. H. Stevens.

THE BINNIE ELECTRIC DRILL & MACHINERY COMPANY, of Fairfield township, Westmoreland County, Pa., has been chartered with a capital stock of $10,000. Among the directors are Robert Binnie, sr., and Robert Binnie, jr.

THE SHANAHAN TROLLEY SPECIALTY COMPANY, of Little Falls, N. Y., has been incorporated with a capital of $50,000. The directors are T. B. Shanahan and J. N. Shanahan, of Gloversville, and H. P. Snyder, of Little Falls.

THE PIEDMONT CONSTRUCTION COMPANY, Indianapolis, Ind., has incorporated for the purpose of promoting, financing, constructing, equipping and operating street and interurban railways and electric plants. The capital stock is $75,000. The principal office will be in Indianapolis. Joseph Little, Jas. F. Wilson and G. E. Coghlin are the incorporators.

THE WELLS MANUFACTURING & SUPPLY COMPANY, of Indianapolis, Ind., has incorporated with a capital stock of $25,000. The company will manufacture supplies for steam and electric railways, electric lighting, telephone and telegraph companies and for contractors and builders. A. H. Wells, B. W. Forkner and E. G. Storms are directors.

THE OVERLAND & MARINE TELEGRAPH COMPANY of New York City has been incorporated to conduct a business of wireless telegraphy, and to manufacture telegraph apparatus. The capital stock is $100,000, and the directors are John W. Chapman, W. R. Sainsbury, H. R. Dennis, J. Norris Miller, Jesse W. Tobey and Harry J. Peel, of New York City.

Legal.

CONSOLIDATION IN ST. LOUIS.—The Union Electric Light & Power and Motor Edison Company's motion before Judge Ryan, in St. Louis, to strike out the amended petition in the case of Ruf, which held that the consolidation was contrary to law, has been decided in favor of the plaintiff. The decision is considered of great importance.

NEW YORK PIPE GALLERIES.—The New York Supreme Court, Justice Fitzgerald, has issued an injunction, upon application of J. Rhinelander Dillon, restraining the President of the Borough of Manhattan from opening bids, or taking any steps toward making a contract for the construction of pipe galleries to carry gas and water pipes and telegraphs, telephone and electric wires in the rapid transit subway in Broadway, between Fulton and Morris Streets. Justice Fitzgerald holds that the Commissioner of Water Supply, Gas and Electricity has control of these matters.

TELEPHONE LINES AND ELECTRIC RAILWAYS.—Judge Artman, of the Boone County Circuit Court at Lebanon, Ind., has just rendered a decision in a case involving the superior rights of telephone and electric railway companies. The New Long Distance Telephone Company, of Indianapolis, complained of Townsend Reed & Co., builders of the Northwestern Traction line, and asked that the latter be enjoined from interfering with its wires. Judge Artman denied the writ and held that when a traction company has to string its trolley wires in a certain way, telephone companies are required to change their wires to conform thereto. A telephone company cannot enjoin a traction company from thus interfering with its wires, but may recover from the traction company by a suit at law, the expense incurred by the enforced change of wires to conform to those of the electric line. This is the first ruling in the state on the direct question. Similar suits have been brought but were compromised before reaching trial.

THE EVANSVILLE, IND., TELEPHONE LITIGATION.—The litigation between the Cumberland Telephone Company and the City of Evansville has raised a question of great interest and much concern. The decision of the United States Court is that the Evansville Telephone Exchange has no right to transfer its franchise to the Cumberland Telephone Company without a specific provision for such transfer, although the franchise was granted the Evansville Telephone Exchange, its successors and assigns, and contains no provision that prohibited the transfer. The court holds that there is nothing valid in the claims of the company and no reason why the city should not remove its poles and wires. The company, however, has filed an appeal bond and contends that the higher courts will not fail to take an entirely different view. A large number of public utility corporations are doing business under purchased rights and it is a question of much concern whether the law protects them in case of transfer without specific authority.

TELEPHONE RENTALS.—The Indiana Supreme Court has affirmed the lower court decision refusing Arthur B. Irvin the statutory penalties he demanded from the Rushville Co-operative Telephone Company for its refusal to connect him with other subscribers, while his telephone bill was unpaid. Irvin, who is a lawyer, refused to pay on the ground that the company owed him a sum of money in excess of the bill on a claim assigned to him by one of his clients who had worked for the company. He claimed a set off and also that he was discriminated against, contrary to the statute. It was shown that thirty-five other subscribers were also behind in their rents, but were being served at the time Irvin was disconnected. The court held that his positive refusal to pay except by setting off the bill for labor against the unpaid rent justified the company in its treatment of him. The company was not bound to take unpaid labor claims in satisfaction of telephone rentals. Irvin had a right to sue on his claim but could not force a set off in an action for statutory penalties. Irvin sued for ten penalties of $100 each for ten refusals to connect his telephone.

TROLLEY TRANSFERS.—The New York State Court of Appeals has dismissed the appeal of James S. Lehmaier from a decision of the lower courts denying him a mandamus to compel the Interurban Street Railway Company of New York to give free transfers at Eighth Avenue and One Hundred and Twenty-fifth Street. Justice O'Brien, writing the opinion, declares that this is not the proper remedy, and suggests that the statute provides a penalty of $50 in favor of any individual who has been refused a transfer where one should legally be issued, and that in addition he may institute an action for damages to which he may have been subjected in consequence. In addition, Justice O'Brien says, the Attorney General is authorized to bring action to vacate the charter of any railroad company that violates the law, and a refusal to give transfers in certain cases would doubtless bring a corporation within the scope of that statute. Provision is also made, it is added, by the law for the investigation by the Railroad Commissioners of complaints of neglect of duty by railroad corporations, and their recommendation is enforceable by mandamus. A mandamus, it is held, is not the proper remedy until after action by the Commissioners.

POWER SUIT FOR $300,000.—Alleging that the Toluca Light & Power Company of Toluca, Mexico, has fraudulently misappropriated $80,000 in money and securities, which are the rightful property of Alexander Potter and William Tuteur, mining engineers of New York City, Mr. Potter and Mr. Tuteur have begun suit in the New York City Supreme Court here for the recovery of that amount. It is charged that the company has violated its agreement to transfer $50,000 in securities and $30,000 in money to the engineers as a return for their obtaining for the company certain large contracts in and near Toluca, a city of about 12,000 population, situated about 50 miles west of the City of Mexico. The Toluca Electric Light & Power Company was organized by Clinton L. Rossiter, formerly President of the Brooklyn Rapid Transit Company, last Spring. Mr. Rossiter had visited Mexico and obtained valuable concessions from the Government for the enterprise, and when he returned to New York he incorporated the company under the laws of this State. J. Aspinwall Hodge is counsel for Mr. Potter, who has an office at 143 Liberty Street, this city. Mr. Tuteur is in Mexico at the present time. Issues have been joined in the suit, and it is expected that it will be placed on the calendar within a month.

PASSENGERS FEET BURNED.—In a recent New York decision, it has been held by the Third Appellate Division, in the case of Mary Powell against the Hudson Valley Railway Company, that evidence that, owing to the overcrowded condition of a street car, the plate above one of the wheels of the car was pressed down upon such wheel, and that the resulting friction heated the plate to such an extent that a passenger who was standing thereon, there being no vacant seats, had her shoes and her feet and her dress burned, is sufficient to raise a presumption that the street railway company did not perform the duty incumbent upon it of using the utmost diligence and care for the protection of its passengers. In answer to questions by the defendant's counsel, an expert for the injured passenger admitted that the injuries to her nervous system were due wholly to shock caused by the burning, and not to the physical burn inself. It was therefore asserted that no physical injury was connected with the plaintiff's nervous, condition. Justice Smith, for the court, said that while the Court of Appeals has held that no recovery can be had for injuries sustained by fright occasioned by the negligence of another, where there is no immediate personal injury, our courts have never gone so far as to hold that where there is a physical injury for which a party is legally responsible that that party is not responsible for any damages which follow from the shock or fright incident thereto.

TROLLEYS VS. STEAM.—The encroachments of parallel electric roads upon the steam roads, and the determination of the latter to conserve their interests in this respect, are reflected in two cases now on argument in the Appellate Division at Albany, N. Y. One is that of the people ex rel. New York Central and Hudson River Railroad Co. vs. the State Railroad Commissioners and the Rochester, Syracuse and Eastern Railroad Co., the other that of the people ex rel. New York Central and Hudson River Railroad Co. vs. the State Railroad Commissioners and the Monroe County Electric Belt Line Co. In the first case the relator seeks to review by writ of certiorari the determination of the Railroad Commissioners that public convenience and a necessity require the construction and operation of an electric railroad between Syracuse and Rochester. The Commissioners granted a certificate on Aug. 28, 1902. The New York Central claims that there is no necessity for such a road, and that the Central now serves all of the villages in the applicant's territory. In the second case the proceeding is similar. The electric road proposes to build an electric railway commencing at the eastern limit of the city and running thence to Pittsford, Fairport, Despatch, and back to the eastern limit of Rochester, a distance of twenty miles. The Central makes the same claim in this case, that public convenience does not require such a belt line, and that the territory is now served, not only by the Central, but by two trolley lines now in operation.

PERSONAL.

E. O. SESSIONS.

MR. E. O. SESSIONS has been appointed engineer of the western sales office of the Stanley Electric Mfg. Company, with headquarters at Chicago. He has just completed the installation of three 3500-kw generators for the New York Edison Company. During the past summer, Mr. Sessions was actively engaged on the engineering work connected with the installation of Stanley sub-stations of the Cleveland and Southwestern Traction Company. A Kentuckian by birth, Mr. Sessions received his education in the public and high schools of Louisville, and by private instruction at Boston. This was further supplemented by post-graduate work at the Ecole de Polytechnique at Paris and, from a practical standpoint, in the testing laboratories of the old Thomson-Houston Company at Lynn, Mass. This was an excellent preparation for the important work of which he has had charge in the last few years. His quick perception, aggressive spirit and pleasing personality combined with his engineering knowledge and executive ability have stood him in good stead under many trying conditions. Mr. Sessions' electrical career began in 1888 in the early days of the electrical industry. His professional career includes his connection with the old Thomson-Houston Company, as already noted; the superintendency of the electrical properties of Mr. Frank Jones, the capitalist of New England, with whom he was connected for four years; engineer for the General Electric Company and later for the Stanley Electric Mfg. Company. It will be recalled that he was resident engineer for the latter at Sault Ste. Marie, Mich., in connection with the installation of the immense power plant of the Michigan Lake Superior Power Company. He has also acted as consulting engineer for Mr. W. S. Stratton, the well-known Cripple Creek magnate, in connection with the design of the power plant and betterments of the street railway system at Colorado Springs, Colo. In fact, Mr. Sessions has installed plants in all quarters of the globe. These have included in both the railway, lighting and power field, not only steam power plants, but turbo-electrical installations as well, the latter including the second largest one in the world. He has given considerable attention to high tension work, having installed several of the most important high tension transmissions. Mr. Sessions furthermore has frequently been called in to present reports on the physical and financial condition of properties.

MR. HORACE F. HARDY has succeeded Mr. John H. Glade as secretary of the South Side Elevated Railroad of Chicago.

REAR-ADMIRAL MELVILLE, U. S. N., has sailed for Europe to study steam turbine machinery, particularly for use in the new 4000-ton scout ships of the navy.

MR. ARTHUR WARREN, who created and organized the Westinghouse Companies' Publishing Department, and has managed it from the beginning, resigned his position on Feb. 1.

MR. CARL HERRING has recently been elected president of the Engineers' Club of Philadelphia. That important organization will find him an executive of great force and ability, as proved by his record as president of the American Institute of Electrical Engineers.

MR. FRANK C. PERKINS has carried on for six years a school for teaching electricity at Buffalo, N. Y., known as the Cataract Electrical School, and has lately developed its field considerably.

MR. GEORGE H. WATSON has resigned the presidency of the Northern Engineering Company, incorporated. Prior to associating himself with that concern he was connected with H. B. Coho & Company. His present location is Paterson, N. J.

MR. F. PEARSON, vice-president and consulting engineer of the Mexican Light & Power Company, Limited, has left New York for the Southern Republic, in order to inspect the progress made in the construction of the company's extensive power transmission system.

MR. FRED D. SAMPSON, manager and engineer of the Charlotte Electric Railway, Light & Power Company, of Charlotte, N. C., has resigned and is now associated with the D. A. Tompkins Company, engineers, of Charlotte, N. C., in the capacity of electrical engineer.

MR. P. SANDOVAL, of P. Sandoval & Company, of Nogales, State of Sonora, Mexico, is now in New York. The Sandoval people are largely interested in mines in Sonora. Mr. Sandoval is expected to place some fair sized contracts for electrical mining equipment while here. He is a guest at the Fifth Avenue Hotel.

NORMAN G. KENAN.

MR. NORMAN G. KENAN, who was recently elected president of the Cincinnati Gas & Electric Company, is a man of most interesting career and personality, and may be said to have been connected with illuminating interests from the very beginning. He was born in Boston, Mass., December 28, 1849, and at the age of eight went with his parents to Cloverport, Ky., where his father engaged in the manufacture of oil from cannel coal. A little later the senior Kenan moved to Cincinnati and became connected as engineer with the Gas Company, dying of cholera in 1866. This sad event left the family without resources, but young Norman immediately proceeded to provide for his mother and her five other children by selling cigars in a restaurant. This he soon abandoned to become a conductor on one of the street car lines. Every spare moment of his time, however, was given to study and to night school, while his courtesy and steadiness attracted the attention of many of the passengers on his car. One of these was President Miller of the Gas Company, through whom he was given the position of time-keeper at the West End works with which his father had once been connected. He was rapidly promoted and in 1873 became chief clerk of both the West and East End works. During all this time he was studying gas manufacture with the object of becoming an expert, and so impressed the management of the company with his abilities that in 1884 he was made superintendent of the West End works. In 1887 he became general superintendent of all the works and three years later was appointed assistant to the president, at which time he had supervision of the construction of the first electric light plant erected by the old Gas Company. In 1892 Mr. Kenan was elected vice-president of the company and has now risen by sheer merit and force of character to the head of the concern, which is one of the largest gas and electric lighting systems in the whole country. Under Mr. Kenan's management the business of the company has increased far beyond the expectations of the directors, and the confidence of his associates in him is shown in the fact that when elected to the presidency he was given power to select his own successor as vice-president.

MR. WILLIAM CURRIE has resigned his position as engineer of the Chicago office of the Stanley Electric Mfg. Co. to look after his private interests at Montreal. Mr. Currie for many years was assistant to Mr. C. C. Chesney. His many friends will regret to hear of his leaving the electrical field to engage in private business.

MR. J. ALLEN HEANY, of York, Pa., to whose novel asbestos insulated wires we have lately drawn attention, wrote recently a strong letter to the newspapers on the Chicago theatre fire and in favor of better insulation, comparing with concrete and steel in the safety given to buildings against sudden and disastrous conflagration.

MESSRS. OTTO BLATHY, Max Dery and Prof. Charles Zipernowsky have been elected "members of honor" of the Hungarian Electrical Society of Buda Pest, in token of their distinguished services to electricity. The certificates of election were handed to them by a deputation of ten members. The honor followed the reading of a paper by Mr. Alex. Wolf on "A Chapter in the History of Electrotechnics in Hungary."

MR. H. S. WAITE, general manager of the Case Mfg. Company, of Columbus, Ohio, is now on a visit to New York. He reports that business is flourishing in his section and that the Case plant has sufficient orders in hand to keep it busily engaged for the next four or five months. Mr. Waite is making his headquarters at the local offices of the Case Company in the Singer Building. He expects to leave about the middle of next week.

DR. JULIO VINGUECHERE, a South American scientist and mining expert, has been in Schenectady to inspect some recent electrical machinery and appliances to be used in the government mines of Peru. The doctor has spent many years in the development of mines in the Cordilleras of the Andes and believes that the use of electrical machinery is the only true solution of the development of the wealth in the mines now unworked because of the cost of operation.

MR. EUGENIO DAVERI, for some ten years manager of the construction department of the Italian Edison Company, of Milan, has resigned and has taken up the agency of foreign manufacturers as selling representative. He will be glad to hear from American manufacturers of trolley cars, and electrical apparatus in general. He can be addressed care of the Societa Edison, 6. Via Lecco, Milan, Italy.

MR. CHARLES FENWICK, of Fenwick Freres & Company, of Paris, one of the largest handlers of American machine tools, etc., in Continental Europe, has sailed for the other side, after a brief sojourn in the States. He left behind him some fair-sized orders with the Brown & Sharpe Mfg. Company and with the Pratt & Whitney branch of the Niles-Bement-Pond Company, 136 Liberty Street, New York.

MR. C. G. Y. KING, M. E., member of the engineering staff of the Chicago Edison Company, is to lecture before the General Electric Agents, etc., in New York City, on February 17, on the "Erection of a 5000-k.w. Steam Turbine," with some 70 slides by way of illustration. Mr. King is a veteran and accomplished central station man.

MR. CHARLES J. GLIDDEN, the well-known telephonist and now equally widely known in the automobile field, lectured last week before the Automobile Club of America, on "Thirteen Thousand Nine Hundred and Seventy-five Miles Automobile Drive in Fifteen European Countries and Across the Arctic Circle." It was a great lecture, profusely illustrated by lantern slides. Mr. Glidden has kindly consented to repeat it for charitable purposes in New England and elsewhere.

MR. WILLIAM MACKENZIE, for several years traffic manager of the Mexican Gulf Railway and who is now interested in some water powers located in the vicinity of Mexico City, is now in New York for the purpose of making financial arrangements which will permit of the construction of an hydraulic plant capable of developing about 7000 horse-power and situated about 50 miles from the Mexican capital. He is at the Hotel Imperial and at Room 1406 Broad Exchange Building.

MR. OSCAR T. CROSBY, the electrical engineer and explorer, has returned to Paris from a trip to Central Asia, where he explored almost inaccessible parts of Turkestan and Thibet. On his way to Thibet Mr. Crosby skirted Afghanistan, visited Chinese Turkestan, and later, traversed Kashmir and the Karakorum caravan route, probably one of the most difficult used by human beings to India. It will be remembered that Mr. Crosby in 1900 explored by way of Abyssinia unknown regions of the upper Nile. He is expected in New York toward the end of this month.

MR. WALTER W. WHEATLY, general manager of the Street Railway Department of the Public Service Corporation and of the street railway companies controlled by that corporation in New Jersey has resigned, and resulting changes in the management have been announced by Thomas N. McCarter, president of the corporation. The resignation has been accepted, and took effect Feb. 1. The practical operation of the system hereafter will be under the personal direction of Albert H. Stanley as general superintendent. He has just come from Detroit, where he held a similar position. Mr. Wheatly has been doing splendid work, but the public needed a scapegoat, on account of its impatience over the necessarily slow welding together of the unrelated parts of the system. And then the record winter intensified the situation.

THE ENGINEERS' CLUB at its recent annual meeting gave marked recognition to the growing strength of electrical men in the club, already one of the foremost in New York City. Mr. J. C. Chamberlain, a well-known electrical engineer, was elected a trustee and made also chairman of the House Committee. Mr. M. G. Starrett, of the Interurban and Metropolitan Street Railway Companies, was elected a trustee to serve until 1907. Mr. T. C. Martin, already member of the board, was made second vice-president and put on the membership committee. The club's new president is Mr. W. H. Fletcher, a man of strong personality and qualities of leadership. The financial condition of the club is very sound and with a waiting list of nearly 200, many of whom have been up for over a year, there was a unanimous vote for the constitutional amendment raising the limit from 1,000 to 1,200.

MR. C. E. BROWN has resigned his position as electrical engineer for the Canadian General Electric Co., having been appointed by the Canadian Government as electrical engineer of the commission recently established to investigate the electro-thermic processes of manufacturing iron and steel in Europe. All who know Mr. Brown, and know of his work, feel that the Dominion Government is exceptionally fortunate in being represented by so thorough and practical a man. Mr. Brown is a native of Iowa and was graduated with honors from the University of that State. He later took up post-graduate work at Cornell University. After that he became connected with the General Electric Co., with which he was connected for four years as electrical engineer. Electrical manufacturing then took on great strides in Canada, and Mr. Brown went to Peterboro, Ontario, where he has been associated with the Canadian General Electric Co. for the last five years.

DR. J. L. BORSCH, of Philadelphia, has testified in a recent trolley personal damage suit that he has restored a man's sight by means of radium after every other means had failed. That the man has his sight again is a fact, as he was in the court room with apparently good vision and a prominent physician, who after treating him himself referred him to Dr. Borsch, testified to the man's condition before being treated by the radium expert. Dr. Borsch says: "In Sharpe's case, there were still remaining some normal cells—the man was not entirely blind, as stated—and these I stimulated into greater activity by use of the radium. Gradually I noticed a change in the man's condition and found that the stimulation had resulted in producing an amount of activity in the remaining cells not affected, equal or very near, at least, to the combined activity of good and bad before the injury. I applied this little twisted glass affair to the eye for about five minutes at a time, bandaging it very tightly. The radium used was not in excess of 20,000 activity."

PROF. W. S. GOLDSBOROUGH, of the Department of Electricity at the St. Louis Exposition, gave the New York Electrical Society last week a most admirable lecture on electricity at modern expositions and at the Louisiana Purchase Exposition in particular. The lecture was profusely accompanied by lantern slides, and to these the discourse was adjusted, the completeness of the series being shown by the fact that over 100 were thrown on the screen. Prof. Goldsborough brought out very clearly the fact that electricity lighting had made possible the modern world's fair with its large night attendance and its spectacular effects. At the same time, he showed that of later years the electric motor had effected changes in the daylight plan and had contributed largely to the increase in the number of "live" operating exhibits. Prof. Goldsborough, in passing, took occasion to pay a tribute to the memory of the late Luther Stieringer as a pioneer in exposition lighting. He touched also upon the subject of international electrical congresses, and in allusion to the work now being done under Prof. Elihu Thomson, an excellent portrait of whom he showed, said he believed that the St. Louis Congress would be one of the most important in the series. President Carty, in closing the meeting, suggested happily that President Loubet of France ought to be invited to open by cable the Exposition, and after a felicitous speech by Mr. C. O. Mailloux, the society voted its hearty approval of the idea.

EDUCATIONAL.

DRAFTING.—The General Electric Company has established a Drafting Room Apprenticeship Course, to which young men who are able to pass a satisfactory examination in arithmetic are eligible. The course is intended to fit applicants for drafting room positions. Further information can be obtained by application to Mr. J. W. Upp, engineer in charge of drafting room, General Electric Company, Schenectady, N. Y.

OBITUARY.

MR. A. G. BOWERS.—We regret to note the death of this well-known man, Mr. Alfred Graham Bowers was born at Port Huron on March 31, 1870. As a young man he entered the employ of the Bell Telephone Company, at Detroit, which position he subsequently left to enter the printing business at Montreal and while there he pursued the study of electricity. Returning to Port Huron, he entered the employ of Mr. D. J. Stevenson, an electrical contractor at Port Huron, where he gained considerable experience in general wiring and construction work. He was subsequently in the employ of Mr. E. C. Lombard, a construction contractor at Jackson, Mich.; was superintendent of the Whitehall, Mich., electric light plant. Leaving Whitehall he took up sales work and was successively identified with the Bryan-Marsh Electric Company as its Iowa and Minnesota representative, and the Ewing-Merkle Company of St. Louis, in the same territory. In the fall of 1903 he entered the employ of the Fort Wayne Electric Works as sales representative in Iowa, which position he held up to the time of his death. He died at Des Moines, Iowa, on Jan. 21, of pneumonia, after a few days' illness. In 1901 he married Miss Lillian Scoville, of Battle Creek, Mich., who survives him. His mother, Mrs. A. Bowers, and several married sisters live at Cass City, Mich. Mr. Bowers was widely known among the central station men and representatives of other electrical supply house in his territory, among whom he had many warm admirers, who will miss his genial and sincere friendship. Mr. Bowers was a member of the Knights of Maccabees and the United Commercial Travelers' Association. The funeral was held at Port Huron, Mich., Jan. 23.

MR. W. C. WHITNEY.—We note this week with deep regret the death, following an operation for appendicitis, of Mr. W. C. Whitney, formerly Secretary of the Navy under President Cleveland, and the great reorganizer and consolidator of the street railway system of New York City. Mr. Whitney, who was 64 years of age, came first into prominence as corporation counsel for New York City and soon rose to a prominence in Democratic counsels which he maintained to the time of his death. It was not until after his splendid work in creating the modern American navy that he turned his attention to traction, and then with the aid of Messrs. H. H. Vreeland and Daniel Lamont he soon built up the network which now constitutes the greatest electric street railway system in the world, under the names of the Metropolitan and Interurban Street Railway Companies. In this manner, while developing conduit work, he became interested in electricity in general, and had a large share in the promotion of electrical automobilism through the Electric Vehicle Company and its sub-companies. In this work he continued to take a deep interest to the last. A year or two ago he also became interested in the Stanley Electric Mfg. Company and is understood to have held a large ownership until its absorption by the General Electric Company. Of Mr. Whitney's fame as a sportsman and public spirited associate in many movements it is unnecessary to remind our readers. It is likely that his son, Mr. H. P. Whitney, will continue to represent his interests in the important field of work and play referred to above, including also his interests in the Consolidated Gas Company.

Trade Notes.

WHITEHEAD MACHINERY CO., of Davenport, Ia., notes its removal to the third floor of the Hagehoeck Building, West Second St., in that city.

MOORE ELECTRICAL CO., 52 Lawrence St., Newark, N. J., has issued a neat pamphlet in regard to its vacuum tube system of lighting. It is not illustrated.

ELECTRICAL SUPPLIES.—Mr. W. A. Hawkins, of Mt. Jackson, Va., has moved to Hagerstown, Md., with the object of opening a general electrical supply store, as well as to do house wiring, telephone work, etc.

SHEPHERD ENGINEERING COMPANY, of Franklin, Pa., has just opened a western office in the First National Bank Building, Chicago, of which Mr. L. J. Highland will be in charge, with the object of attending promptly to orders and inquiries for Shepherd engines in that part of the country.

QUEEN & COMPANY, INC., of Philadelphia, have issued a handsome and instructive circular celebrating the fifty years of their existence, 1853-1903. It gives a synopsis of the history of the house, illustrates some of its leading apparatus, etc., and gives views also of its laboratories, factories, etc.

THE WARD LEONARD ELECTRIC COMPANY reports a large increase in business in field rheostats during the last two weeks. It believes that the slightly dull season which seemed to have come over the electrical trade must have passed. They are about to issue new circulars covering theatre dimmers, speed controllers, etc.

HALLER MACHINE CO., of Chicago, Ill., 127-129 Fulton Street, has issued a handsome circular in regard to its metal letters for electric signs, complete electric signs, and other electrical specialties, novelties, etc. It gives full details and prices and should be seen by every one of our central station and isolated plant readers.

R. THOMAS & SONS CO., of East Liverpool, Ohio, has issued a neat price list and catalogue on high voltage transmission line porcelain insulators, all of which have been designed with great care and equal resultant success. The catalogue and list should be seen. It is a handsome publication and deals with meritorious appliances.

SMITH & HEMENWAY CO., of 296 Broadway, New York City, has completed arrangements with the Page-Storm Drop Forge Co. to handle its entire line of engineers' and drop forge wrenches. The latter concern makes a specialty of all kinds of drop forgings. The Smith & Hemenway Co. has ready a new catalogue on the subject and invites applications for it at once.

CHICAGO FUSE WIRE & MFG CO., of 358 Dearborn St., Chicago, etc., etc., has issued No. 15 of its admirable little series of catalogues and price lists. Its experience with tested fuse wire extends over 15 years, and its list now includes the latest ideas, practice and developments in that field. Special attention may be called to its "Union" fusible links, "Union" switch outlet boxes, etc.

FARWELL, OZMUN, KIRK & COMPANY, of St. Paul, Minn., one of the leading wholesale hardware firms of the northwest, have opened an electrical supply department. Mr. J. S. Webster, who has been for many years engaged in the design, sale and installation of apparatus while located in Minneapolis, has become manager of the new department and would like to have descriptive circulars and prices from all manufacturers of standard electrical supplies and specialties.

THE S. H. COUCH COMPANY, 156 Pearl Street, Boston, Mass., has issued a four-page circular, describing its "Workwell" Telephone. These telephones are put on the market at very moderate expense and the illustrations portray a good-looking pair of instruments. Included in the circular are the specifications of the instrument making good reading for people desiring telephones for communication between house and stable, or between office and shipping room, or between any two points.

PITTSBURGH TRANSFORMERS.—Mr. A. H. Mustard, 120 Liberty St., New York, sales agent for the Pittsburgh Transformer Company, recently sent out some interesting literature regarding these well known transformers. In one of the circulars it is pointed out that 85 per cent. of the people who bought Pittsburgh transformers five years ago are buying them to-day. Another circular gives illustrations of three styles of transformers, specifications of each being given. These transformers have acquired a standing due largely to their merit, but the efforts of the sales department have, of course, contributed largely to their wide use.

THE CALCULAGRAPH COMPANY has issued a little card for keeping accurate track of the regulation of the Calculagraph. This is arranged so that an entry is made on the card as to whether the Calculagraph runs fast or slow and as to the extent and affords a means for keeping tab so that the Calculagraph may be regulated exactly. Incidentally, the card is a good thing for a man to have who wishes to regulate his watch and know that it is running properly. The card, of course, merely affords an opportunity for making an entry of the variation of a watch so that the variation may be carefully noted.

WESCO SUPPLY CO.—The new price book just issued by The Wesco Supply Co., of St. Louis, covering its No. 50 Catalogue, has been sent out to all in the trade who has a No. 50 book. Anyone who has not received this catalogue can secure it by writing to the concern. In addition to the latest market prices on all articles shown in the above catalogue, the price book contains several lines of new goods, and a copy of the latest rules of the National Board of Underwriters. These rules will be found very useful as a ready reference, and the Wesco people have inserted them for the special convenience of their customers.

WIRE REELS.—Messrs. Eugene Conard & Sons, Elizabeth, N. J., manufacture reels of all sizes for wire and cable. These reels are made with special machinery of the firm's own design. The strength of reels depends much upon how the nails are clinched in the building up. This firm recognized the importance of this little detail and clinches each nail separately by hand, thus securing the strongest possible structure. The firm aims to produce the best reel possible, and many of its reels are being used by the larger wire concerns. It has ample facilities for getting out orders promptly, and can ship either by rail or water.

NATIONAL WIRE CORPORATION.—The New York offices of this important concern have been removed to Room 1103, Engineering Bldg., 114 Liberty St., with Mr. Richard C. Smith as New York sales agent, who says: "We shall be pleased to receive all inquiries at our new office, and will be prepared at all times to furnish information or to make quotations when desired. Our New Haven mills are now in full operation, producing a large variety of wire products, including wire rope, galvanized telephone and telegraph wire, wire strand, tinned and coppered market wire, bright and annealed market and stone wire, bright and coppered screw stock, tinned mattress wire, black, coppered and liquor drawn spiring wire, and a great variety of special and miscellaneous wires for the jobbing and manufacturing trade."

MR. CHARLES E. MILLER, the enterprising New York jobber of automobile and bicycle material, has leased the properties 316 and 320 North Broad St., Philadelphia, from Jan. 1. From this branch he will conduct both a wholesale and retail business. It is his intention to make elaborate improvements in this store, and make it the most attractive of its kind in the country. As there are large show windows in the front of these stores he will have an excellent opportunity to make a fine display, and he intends to treat Broad St. promenaders to an automobile show of the continuous performance order. The same energy and business acumen that have brought him such a large measure of prosperity, both in his main salesrooms at 97-101 Reade St., New York, and his retail branch at Thirty-eighth St. and Broadway, New York, will undoubtedly crown his Philadelphia enterprise with success.

THEATRE ATMOSPHERES.—The ventilation and heating of a theatre presents a problem not easily mastered by the ordinary heating engineer. In a crowded auditorium of this kind ventilation is the all-important question. It may be a simple matter to heat the building to a required temperature before the curtain rises, but to maintain a constant temperature and a pure atmosphere while the play progresses is not so easily accomplished. The heat given off from the bodies of the closely-seated audience is sufficient to raise the temperature in the house from 5 to 10 degrees during the performance. Fresh air to breathe must be supplied constantly to the occupants and the impure air must be removed. Evidently a system giving a forced circulation of air is necessary to meet those requirements. A good example of this system is the recent installation in the New Franklin Sq. Theatre, at Worcester, Mass. The heating and ventilating apparatus consists of an electrically-driven fan and heating coils, located in a corner of the basement. Fresh air is drawn from the outside and circulated through coils of steam pipes enclosed in a fire-proof casing and distributed through ducts by means of the fan to the desired parts of the theatre. There are plenum chambers under the orchestra floor and first balcony from which air is admitted through openings in the chair legs giving an even distribution throughout the house. The low velocity with which the air enters prevents annoyance from draughts. The foul air is exhausted through grills in the dome of the theatre and by means of an electric exhaust fan is discharged through the roof. The B. F. Sturtevant Company, of Boston, Mass., was the heating and ventilating engineer, and the apparatus installed is of its manufacture.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 26, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

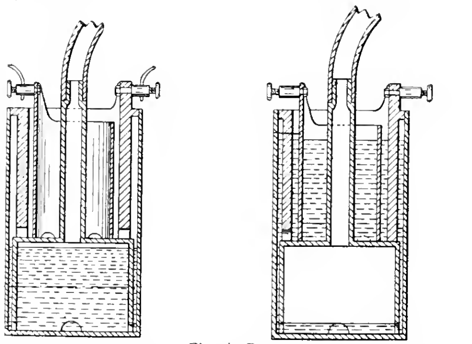
750,250. ELECTRIC BATTERY; Winfield S. Bryan, Cincinnati, Ohio. App. filed Sept. 28, 1903. An inverted cup connected by a tube with a source of air pressure, is located in the bottom of the cell and while the battery is not in use, the liquid of the cell is allowed to flow under the edges of the cup and fill it, thus covering the electrodes located above the cup; when the battery is to be put into use, air pressure drives the liquid out of the cup into the cell.

750,268. ELECTRIC SIGNALING APPARATUS; William E. Decrow, Boston, Mass. App. filed April 29, 1901. (See page 272.)

750,269. ELECTRIC SIGNALING APPARATUS; William E. Decrow, Boston, Mass. App. filed June 17, 1901. (See page 272.)

750,270. ELECTRIC SIGNALING APPARATUS; William E. Decrow, Boston, Mass. App. filed Sept. 27, 1901. (See page 272.)

750,288. RINGER; Anton M. Knudson, Chicago, Ill. App. filed June 6, 1902. (See page 272.)



750,250.—Electric Battery.

750,289. TELEGRAPH INSTRUMENT STAND; James W. Leech, Staunton, Va. App. filed Jan. 6, 1903. A stand for a telegraph instrument embodying a sounding box and reflecting board.

750,296. ELECTRIC RAILWAY SIGNAL; William V. Moak, Albany, N. Y. App. filed Dec. 8, 1902. Details.

750,309. ANNUNCIATOR; Lambert Schmidt, Weehawken, N. J. App. filed Aug. 28, 1901. The construction relates to the shutter-tripping mechanism.

750,352. OUTLET BUSHING FOR JUNCTION BOXES; Frederick W. Erickson, Boston, Mass. App. filed Oct. 5, 1903. A nut adapted to screw onto the end of the conduit carries a sheet metal flared rim for the end of the conduit.

750,361. ELECTROMETALLURGY OF IRON OR STEEL; Henri Harmet, St. Etienne, France. App. filed Sept. 30, 1901. (See page 274.)

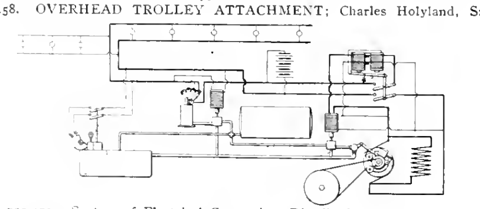
750,368. TROLLEY FOR ELECTRIC RAILWAY CARS; Charles J. Johnson, St. Louis, Mo. App. filed May 14, 1903. Details.

750,421. ELECTRIC BRAKE; George C. Anthon, Medford, Mass. App. filed Nov. 30, 1901. A liquid lock and release for the brake and means for controlling the same; also certain improvements in electro-magnetic clutches by which a brake winding drum is brought into frictional engagement with a driven axle.

750,422. ELECTRIC BRAKE; George C. Anthon, Medford, Mass. App. filed April 11, 1902. The brakes are actuated by current from a storage battey, the battery being charged by the line current, with provision also for operating the brakes from the line.

750,454. SYSTEM OF ELECTRICAL DISTRIBUTION; Josef H. Hallberg, New York, N. Y. App. filed Oct. 16, 1903. As a means for balancing the current in individual circuits of a multi-voltage system, a pair of motors having their armatures driven at the same speed and connected to supply the required voltages, and the field magnet of the motors connected so that the field of one motor will receive current from the circuit in which the armature of the opposite motor is included.

750,458. OVERHEAD TROLLEY ATTACHMENT; Charles Holyland, Sr.,



750,471.—System of Electrical Generation, Distribution and Control.

Pittsburg, Pa. App. filed June 6, 1903. Details of a device to retain the wheel on the wire.

750,471. SYSTEM OF ELECTRICAL GENERATION, DISTRIBUTION AND CONTROL; Lamar Lyndon, New York, N. Y., and Elmer A. Sperry, Cleveland, Ohio. App. filed Jan. 17, 1903. Regulating mechanism for a system of lighting in which the generator is driven from the car axle; the regulating being accomplished through a fluid actuated belt-tightener.

750,492. ELECTRIC CLOCK; Fred Schmidt, Oak Station, Pa. App. filed May 9, 1903. Details.

750,497. SYSTEM OF ELECTRICAL GENERATION, DISTRIBUTION AND CONTROL; Elmer A. Sperry, Cleveland, Ohio. App. filed Dec. 5, 1902. A modification of patent 750,471.

750,500. SYSTEM OF ELECTRICAL GENERATION, DISTRIBUTION AND CONTROL; Elmer A. Sperry, Cleveland, Ohio. App. filed July 1, 1903. Relates to the preceding system.

750,509. ELECTRICAL CONDUCTOR; William H. Wherry, Cleveland, Ohio. App. filed Nov. 3, 1902. The bond heads are welded to the rails.

750,510. PROCESS OF FORMING ELECTRICAL RAIL BONDS DIRECTLY IN PLACE ON THE RAILS; William H. Wherry, Cleveland, Ohio. App. filed Jan. 22, 1903. The process consists in applying heat to the head of the bond while it is in contact with the rail, until the latter is melted and becomes alloyed with the bond.

750,522. APPARATUS FOR BONDING RAILS; William B. Cleveland, Cleveland, Ohio. App. filed Oct. 30, 1902. A sheet metal sleeve embraces the middle portion of the bond to protect it when confined inside of the fish-plate.

750,525. TRANSFORMER; Augustine R. Everest, Lynn, Mass. App. filed Aug. 11, 1902. A transformer core made of two bowed members hinged together at one end and having engaging extensions at the other end, the coils being slipped over the members when they are open.

750,543. HEAT ALARM; Howard F. Jones, Wilson, N. C. App. filed April 13, 1903. Details.

750,549. SYSTEM OF ELECTRICAL GENERATION, DISTRIBUTION AND CONTROL; Lamar Lyndon, New York, N. Y. App. filed Jan. 22, 1903. In a train lighting system the electro-magnetic device by which the speed of the generator is controlled, is actuated by current from the battery, so that as the voltage of the battery rises in charging, the speed of the dynamo is reduced.

750,550. SYSTEM OF ELECTRICAL GENERATION, DISTRIBUTION AND CONTROL; Lamar Lyndon, New York, N. Y. App. filed July 18, 1903. Relates to the regulating devices in a train lighting system.

750,563. PROCESS OF COVERING WIRE; James C. Anderson, Jersey City, N. J. App. filed April 30, 1903. Copper ribbon is covered by making an elongated envelope of paper, then covering the envelope, inserting the ribbon and closing the envelope.

750,584. PROCESS OF ADMINISTERING ELECTRICAL VIBRATIONS; Fred H. Brown, Los Angeles, Cal. App. filed Aug. 25, 1902. Electrical impulses whose periods of vibrations are synchronous with musical vibrations, are created by causing musical sounds to vary the resistance of an electric circuit; an induced current created therefrom is administered therapeutically.

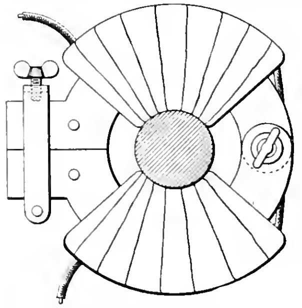
750,594. MAGNET; Henry F. Campbell, Boston, Mass. App. filed May 16, 1901. A magnet comprising parallel horseshoe-shaped bars arranged to have an air space between them and a pole piece adjustably mounted upon the lower ends of the bars.

750,646. COMBINED ELECTRICAL BATTERY RECEPTACLE AND BELL SUPPORT; William A. Harvey, Scranton, Pa. App. filed Sept. 9, 1903. Details.

750,689. PLUG FOR TELEPHONE-SWITCHBOARDS; Frank D. Pearne, Chicago, Ill. App. filed April 20, 1903. (See page 272.)

750,704. TELEPHONE SWITCHING AND SIGNALING APPARATUS; Malcolm C. Rorty, Dedham, Mass. App. filed Jan. 3, 1902. (See page 272.)

750,720. INCANDESCENT LAMP; Walter A. Springall, San Antonio, Tex. App. filed June 25, 1903. A multi-filament lamp having contacts in its



750,525.—Transformer.

neck by means of which the filaments can be successively thrown into circuit by twisting the neck in its socket.

750,722. INSULATOR; Louis Steinberger, New York, N. Y. App. filed May 25, 1903. A knob of insulating material covered by a metal casing and having an opening through which the conductor is to be threaded.

750,723. BINDING POST; Louis Steinberger, New York, N. Y. App. filed June 22, 1903. The post has two threaded portions succeeding each other and of different diameters, each one carrying its own wire clamping devices.

750,733. TROLLEY POLE; John J. Tartt, Los Angeles, Cal. App. filed March 30, 1903. An arm carrying the wheel is pivoted to the upper end of the pole and actuated by its own spring, the construction being such that vibrations of the pole will not be communicated to the arm.

750,753. ELECTRIC FURNACE; Rámon Chavarria Contardo, Sèvres, France. App. filed Aug. 24, 1900. (See page 274.)

750,765. ELECTRIC MOTOR; Thaddeus W. Heermans, Chicago, Ill. App. filed Dec. 4, 1899. Both the field magnet and armature are rotating parts, to each of which a pulley is attached and a speed-controlling device is interposed in such a manner that as the speed of one part rises, the other falls, without varying the power of the motor.

750,769. TELEPHONE-SERVICE APPARATUS; Uriah S. Jackson, Ossipee, N. H. App. filed May 31, 1902. (See page 272.)

750,770. TELEPHONE-SERVICE APPARATUS; Uriah S. Jackson, Boston, Mass. App. filed April 22, 1903. (See page 272.)

750,777. APPARATUS FOR SELECTIVE SIGNALING; Kenneth Moodie and John S. Small, Chicago, Ill. App. filed Sept. 13, 1902. A number of pairs of helices, each comprising a main circuit helix and an operating circuit helix, means for operatively neutralizing the effect of any main circuit helix by sending a current over the operating circuit, certain of the helices being relatively so arranged and so energized as not to be neutralized by an operating current which will result in neutralizing another of the helices.

750,781. SAFETY DEVICE FOR RAILWAY SERVICE; Edmund B. Powers, New York, N. Y. App. filed March 5, 1903. A projection from the locomotive is struck by an arm at the roadside and moved a certain distance to actuate a certain signal by the particular location of the arm at the roadside.

12,195. ELECTRICAL ACCUMULATOR; Chaimsonovitz Prosper Elieson and Vladimir de Bobinsky, Paris. France. App. filed Oct. 26, 1903. (See page 272.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

Vol. XLIII. NEW YORK, SATURDAY, FEBRUARY 13, 1904. No. 7.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

Telephone Call: 7605 Cortlandt. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office - - - - - - 1139 Monadnock Block.
Philadelphia Office - - - - - - 929 Chestnut Street.
European Office, Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, FEBRUARY 13, 1904.

CONTENTS.

The Institute Dinner.

The Institute annual dinner will occur just after our issue has gone to press, and we must reserve our report until next week. We are glad to know that it promises to be unusually well attended, and a brilliant and memorable success, worthy the work put upon it, and the anniversaries it celebrates. We are glad to be able to extend our congratulations to Mr. Edison and the Institute upon the founding of the first electrical medal in this country associated with his name, and hope the medal will be won by many worthy recipients who will also come in due time to make their part and mark in the electrical arts.

Manufacturing Competition.

One of the most important recent events in electro-industrial development is the new departure of the Allis-Chalmers Company, one of the great steam engineering manufacturers of the country, to whose purpose of becoming also a leading electrical manufacturer, we give publicity this week. The corporation has great resources, has recently made notable affiliations, and now has enlisted for its electrical staff some well-known men, whose names we mention. This is a move which will be watched with deep interest and may be fraught with many consequences as to the future of the art, now broadening and widening in every direction.

War in the East.

Now that war has unfortunately broken out in the Far East, it will be interesting to see what use Russia and Japan make of the modern resources of electricity as applied to warfare, both on land and on sea. The Transvaal war and the Spanish war were both rather disappointing as to the use of new devices, but we think the present struggle may furnish some lessons. The Russians have engineers with a distinct leaning to electricity, while the brave and energetic Japanese "miss no trick," in what is new and useful, whether for war or peace.

An Interesting Bit of Hydraulics.

A rather unusual variation of Eastern hydraulic practice is that reported on page 305, this week, on the Bull's Bridge power plant. This new enterprise on the Housatonic reminds one in certain ways of current Western practice, yet varies from it in some important particulars. The hydraulic developments here in the East have been evolved from the early work on the large New England rivers by a process that has been upon the whole determined by provincial canons of practice as thoroughly as has been the speech of the Yankees who have undertaken the work. Lowell, Holyoke and similar cities have furnished the impetus for the investment and the work has gone on by the sole light of their experience. The articles of the Eastern hydraulic creed may not number quite thirty-nine, but their fixity puts to shame their theological prototype. A stream with a moderate fall and plenty of water, a stone dam built for time and eternity, regardless of expense, a hewn masonry canal and tail race, vertical shaft turbines with plenty of gearing, which the owners swear wastes no power at all—and the hydraulic engineer was content with the work of his hands. There have been schismatics and heretics even in New England, however—wretches who had the temerity under stress of hard times to put in crib dams that would only last a generation or two, and backsliders who tried to wreck the foundations of the faith by objections to bevel gearing; but in the main Eastern hydraulic plants have seldom wavered in the faith save when tempted by evil-minded electricians.

In the West the pioneer in hydraulic work was the mining and irrigating engineer, bringing down to the placer diggings and to the broad acres of the valleys the melted snows of the Sierras, carrying the clear little stream a score—yes, a hundred of miles, if need be—in ditches and flumes and tunnels and inverted syphons, until he could drop it a sheer eighth of a mile or so down to the gravel banks or the sage brush deserts that turned to gardens at its touch. It was a different school from that of the East with very different lessons to be learned—but learned they were, and thoroughly. Now, here in the East we are just beginning to appreciate the situation, and as the larger powers on the older streams are taken up, to cast about for powers anywhere, with a willingness to develop them according to their needs, with little respect for tradition. And such powers as this at Bull's Bridge are the first fruits of this broader outlook. In the arrangement of the works with a long canal ending in steel pipes plunging right down upon the wheels, the situation is typically Western, even though the fall is only a beggarly hundred and twenty-five feet or so. The dam, however, is much more of a structure than is usual in Western plants and the canal follows Yankee patterns in many respects. It is something, however, to note that the dam is of rubble and concrete, a construction which is distinctly a compromise between progress and precedent. We believe in good construction, but we have here in the East much to learn as to methods of maximum economy in hydraulics. Each year is likely to see new finds among the New England and Appalachian hills and more cases for the adroit adaptation of Western methods of practice. There are a good many falls of surprisingly great head to be utilized by those far-sighted enough to pre-empt them. Most of them are relatively small, but in the present condition of electrical power transmission can be profitably developed.

The Series Wound Alternating Motor.

The specification of Mr. Lamme's alternating railway motor, printed elsewhere in this issue, is interesting as showing an entire absence of sensational features. The success which Mr. Lamme has reached is in the line of downright skill in designing, the union of a firm grasp on the practical requirements of the case with great technical facility at suiting means to ends. The motor as described is a simple series-wound structure with an immensely powerful armature, high-resistance commutator leads, and pole faces perforated longitudinally to break up cross-induction. To simplify the commutation the frequency is low, the voltage is kept moderate and the poles are fairly numerous to bring the rotative speed to the best working point as regards the armature alternations. Mr. Lamme has apparently found that first-class working conditions are attained only within rather narrow limits in the design, and in his patent certain approximate conditions of design form an essential part of the claims. We shall be particularly interested to see how far these somewhat stringent conditions may, in practice, affect the performance of the machine on direct-current circuits. One of the conspicuous advantages of the series-wound alternating motor is the fact that at least in theory the machine can be successfully operated on direct-current circuits, and so can be made available for the existing urban connections of interurban roads. If, however, the design from the standpoint of alternating current operation is rather closely limited, will the motor meet the full practical requirements of tramway work on the usual direct-current systems? This is, of course, a question of fact not to be answered offhand or from an inspection of the patent specification. It is safe to say, however, from the judgment displayed in the alternating-current design, that if a successful compromise is practicable, Mr. Lamme is fully competent to work it out.

Graphics in Power-House Location.

It is a well-known proposition in the theory of electric power transmission that the electrical center of a district is its center of gravity. That is to say, if a massless plane map of the district be prepared, and at each point of load a corresponding mass be located, at the rate of say one milligramme per ampere to be supplied, then the center of gravity of all the masses, or the position on the map at which the sum total of the masses would be equivalent to the total distribution; or, again, the point on which the map, as a rigid plane, would float horizontally, if rested on the point of a vertical needle, is the center of distribution of the system for minimum copper in radial distributing conductors, arranged for uniform current density, and for any given drop of pressure in transmission. A power house should theoretically be located at the electrical center of gravity for the greatest economy of distribution. Of course, the proposition applies to an ideal case, in which land has the same value at all parts of the district, and where no natural obstructions prevent a power house from being erected; where rights of way are all alike, and where the designing engineer can lay out a distribution system as the Russian Czar is said to have laid out the Moscow-St. Petersburg Railway—with a map, a straight-edge and a pencil. It is doubtful whether such ideal conditions of electric power house location exist even beyond the skies. They never have been reported to occur on this earth. The power house can never fall on the exact center of gravity of the system. Moreover, the distribution lines are always subject to some conditions of dissymmetry. Again, the prospective loads are never predeterminable with mathematical accuracy. They are always open to a certain range of doubt, and estimation must take the place of computation to a greater or less degree. Consequently, the center-of-distribution law has about as many restrictions, qualifications and reservations, in practice, as the Kelvin law of the most economical size of conductor to transmit a given power. In theory, these laws are rigid and adamantine. In practice they are made so tortuous and flexible that their own authors would sometimes never recognize them. Nevertheless, the engineer should be familiar with these propositions. He should instinctively do obeisance to the law of the electrical distribution center, even when his mind is devoted to the numerous details of land value, water supply, coal supply, rights of way and wrongs of way.

If, however, the center-of-gravity law is powerless, in practice, to assign the most economical center of distribution from the business man's standpoint, it is at least capable of declaring when the center of distribution ought not to be located from the conductor cost standpoint. It is well, at least, to be able to determine, as closely as the load estimates will permit, where the center of distribution lies, in order to compare the location of the economy council with the location of the economy of conductor, the council being composed of representatives of land, fuel, transport, property rights and president's proclivities, along with Mr. Copper Conductor. The ordinary method of finding the center of gravity of a district is to mark off the loads on the map, then to project those loads orthogonally on any pair of co-ordinate axes, such as the edges of the map, to compute the center of gravity of these loads, on each edge separately, and to mark off the center on the map at the intersection of the co-ordinates of the centers of gravity on the edges. This process requires two arithmetical processes to be pursued, for determining the centers of gravity on the two edges respectively. The article by Mr. S. Diamant on page 311 offers an ingenious method of solution for these two arithmetical problems without resorting to arithmetic; that is, by purely graphical methods. To some persons graphical methods are specially welcome. Isaac Newton's genius showed itself in graphics most particularly. Other persons prefer arithmetic to the pencil and protractor. But whichever method may be preferred, the graphical problem will always have interest. Mr. Diamant projects his loads upon the co-ordinate axes in the usual way, and then makes a pair of auxiliary diagrams. These diagrams lead to certain angular relations between lines definitely related to the lines of load. By working with these angles on the edges of the map, the two centers of gravity are arrived at without computation. Whether this geometrical solution is known in mechanical graphics we are not informed; but the geometrical proposition seems to be new in electric technology.

RADIATIONS EMITTED BY A RIGHI VIBRATOR.

In the last number of the *Physical Review* an interesting series of measurements is reported by Messrs. Willard and Woodman on the radiations emitted by a Righi vibrator. A Righi vibrator consists essentially of four metal balls in a line, with three spark-gaps between them. The middle spark-gap is usually in oil. The balls are ordinarily small, like large-sized marbles, and the waves that such a vibrator emits when the extreme balls are suddenly electrified or discharged, are about as short as can be conveniently produced. Sometimes the inside pair of balls are of larger diameter than the outside pair, and sometimes only three balls are used, one big one in the middle and two little ones, at opposite ends of a diameter. There is a great difference of opinion as to the nature of the waves emitted when the electric system is struck. Some contend that the system emits all wave lengths, in a continuous spectrum, and that the particular waves which affect the resonator are selectively determined by the dimensions of the latter. Others believe that the vibrator emits waves of definite length—that is to say, of a length which has a definite geometrical relation to the size of the vibrator—but that, owing to the highly damped nature of the vibrations, or their rapid diminution and decay, the wave lengths appear to cover a wide range. One school supports the theory of a continuous spectrum; the other supports the theory of a simple spectrum with a line or lines like a gas spectrum.

When the vibrator attains a considerable length, as in the antennæ of wireless telegraphy, the theory of wireless telegraphy has long pointed to the existence of a fundamental wave, of four times the height of the mast, or twice the length of the antenna with its "image" below the ground. Upon this fundamental should exist an indefinite number of harmonics like those of an excited musical string. The number and prominence of the harmonics depend upon the particular detail conditions of excitation. In general, the bulk of the energy is carried by the fundamental waves. If Righi vibrator radiations resemble wireless antenna vibrations, then the line spectrum theory is favored rather than the continuous spectrum theory, assuming that there will be a plurality of lines, in harmonic or simple multiple relationship. The Righi vibrator is, however, not the simplest type of vibrator, and it seems possible for some complications to exist in its vibratory system. The measurements of Messrs. Willard and Woodman show that the waves emitted had pronounced fundamental wave lengths and also distinct harmonics. At the same time the measurements show that the dimensions of the resonator materially affect the received energy. So rapid is the damping of the waves emitted by the vibrator that the waves may almost be regarded as single impulses, with an insignificant trail. This simple impulse, striking the resonator, sets the latter in vibration according to its own frequency and wave length. Consequently, the tuning of the vibrator to the resonator has much less effect than if the resonator emitted a continuous train of waves.

THE SPIRIT OF TECHNICAL EDUCATION.

Some time since, in commenting on President Butler's proposition for a two-year college course, we expressed the opinion that so far as success in technical callings was concerned, education ought to be broadened rather than narrowed. So far as the mere acquisition of facts is concerned, systematic perusal of a modern technical journal will furnish more raw material than the average course of instruction in a technical school, but we would be the last to insinuate that the former renders the latter unnecessary. What the successful engineer wants is power and facility in using the raw material that he finds at hand, and this can be acquired only by a wide and thorough intellectual training. Its scope and character is of far less importance than its thoroughness. We do not wish to make invidious comparisons between institutions, but we know of none which have furnished a large number of brilliant engineers in various departments compared with the total number of graduates than the United States Military and Naval Academies. These men were trained not in the so-called practical details of modern engineering, but in the art of war, but so trained that their mental and physical powers were under full command for what they might be worth. It is the foundations which count, and the wider and deeper these are laid the better. Hence, we regret any tendency to scamp the preliminary work of building an education and character. An engineer needs them both to be fully equipped for his part in the world's work. We in America have come in these latter days to the parting of the ways in technical education. We have swept rapidly along, making tremendous material progress, and gaining a swift adaptability in grasping the ideas which had been accumulated by many hands in unpractical and unapplied research. Now, the choice lies between lending a hand in this very research and scurrying about in the hope of getting some one to do the work for us.

Scientific education had in earlier years a hard battle for existence. It was crowded into corners and shoved into alleyways by the mental luggage of centuries past. To grow, indeed to live at all, it had to take the aggressive, to play the iconoclast, and to push aside the dust-covered impedimenta that were in the way. All this was well, but with the rapid accession of material results has come a certain contempt for the eternal house of learning in which it must forever dwell. The result has been that American technical education has laid too much stress upon the acquisition of bare facts, a knowledge as dead and unfruitful of intellectual growth as a defunct language. For these facts, however important in themselves, are the fruits of others' sowing, and the acquisition of them merely the diligence of the unthinking gleaner. So long as the pickings are good, the gleaner flourishes, and in course of his hum-drum task he may sometimes gain the skill of the husbandman; but it is in spite of his labor not because of it. Permanent supremacy comes only with a deeper kind of culture, and toward that the efforts of the coming generation must be directed. We are moved to this defense of the foundations of specialized knowledge by the recent announcement that three distinguished professors in Columbia University have offered their resignations in protest against the brushing aside of the culture courses which they represent. We do not know either the [illegible] affected or the full merits of the issue which [illegible] this we do know, that when general culture [illegible] rgraduate instruction, post-graduate instruction [illegible] the loser. In this world of hard work a man to [illegible] success must be able to do some one thing better than [illegible] know one thing more thoroughly; [illegible] to make [illegible] worth the knowing and the doing and to give that success [illegible] he must have learned the relation of both to [illegible]

Entrance of Allis-Chalmers Into Electrical Field.

One of the most important and far-reaching events of recent years in the field of industrial electricity is the entrance into it of the Allis-Chalmers Company. With regard to this action on the part of this well-known concern, respecting which rumors have been in circulation so long, no further doubt appears to exist, and thus one of the most formidable oppositions which the existing great manufacturers have had to encounter takes shape and organized form. The creation of this new competition would appear to have been inevitable from the standpoint of the Allis-Chalmers people, and the present movement may be said to date back to the entrance of the General Electric Company into the steam turbine field, and to the action of that important concern in selling its dynamos and steam turbine units as a complete generating plant to the entire exclusion of the reciprocating engine with which the fame and reputation of the Allis-Chalmers Company have been so closely associated in the past. It is understood that the Allis-Chalmers Company expressed to the General Electric Company their willingness to undertake in its behalf the manufacture of the steam turbine in large shops already well equipped for such work, leaving to the General Electric Company the manufacture of the electrical part of the combination; but these proposals, if made, were evidently not accepted. Finding themselves thus cut off by the General Electric and Westinghouse production of steam turbines as well as generators, from a very large portion of the work which had constituted no slight share of its business, the Allis-Chalmers Company have determined to redress the balance of things by entering the electrical field for the production of heavy machinery, believing that with unsurpassed mechanical experience, with all the heavy apparatus free from patent litigation, and with the command of some of the best electrical engineering talent in the country, and with energy and good judgment, it might well make itself in a short time a very formidable factor.

We understand, therefore, that the Allis-Chalmers Company are to take up immediately the manufacture of heavy electrical generators for the largest class of work and are at once entering that field. In addition to this, and supplementing their well-known reciprocating engines, they are, after two years of very careful research, also prepared to supply a steam turbine which is in efficiency equal to the very best known in Europe. They have also, as noted recently in these columns, taken up the manufacture of one of the largest and best-known types of gas engine—the Nürnberg—and have now secured from the famous Swiss firm of Escher, Wyss & Company, who designed the Niagara turbines, the exclusive rights for the manufacture of their hydraulic turbine, of whose experience and plans they will derive the full benefit.

One of the first steps in connection with the new departure has been the creation of an electrical department, in regard to which work is now going forward. At the head of the engineering staff will be Mr. John F. Kelly, so long and so favorably known in connection with the Stanley interests. He will be the active engineer in the company so far as electrical matters are concerned, as its electrical director, but associated with him in an advisory and consulting capacity will be Mr. William Stanley, Jr. It will be readily recognized that in these two gentlemen the company has acquired the services of some of the very best talent now available.

A great many details with regard to this momentous action are not yet ready for publication, but we understand that Mr. Kelly has been busy both at the company's works at Scranton and at their Western shops in making plans which will give immediate effect to the campaign of development along electrical lines, which the executive officers of the company have carefully laid down. We expect in a short time to be able to give some further details in regard to this matter.

Warships and Wireless Telegraphy.

A Washington dispatch states that a series of tests of four systems of wireless telegraphy will soon be made by warships in the vicinity of New York. The progress of wireless telegraphy in the navy recently is considered to have been very satisfactory. In one case the flagship *Kearsarge* and the *Minneapolis* communicated with each other by the wireless method at a distance of sixty miles.

The Pupin System Validated in Germany.

Dr. Michael I. Pupin, who recently went abroad to attend the final argument on the opposition to the granting of a German patent upon his loaded conductor, reports by cable a sweeping victory. The case has attracted wide attention. The patent will issue to the Siemens & Halske Company. The opposition was entered by several rival manufacturers of cables and by the postal administration of Germany, which claimed to have anticipated the invention with certain experiments with loaded conductors.

It is interesting to note the thoroughness with which the invention has been investigated by the German Patent Office. The experimental tests which formed a part of this investigation are reported very fully in Electrical World and Engineer, December 27, 1902. They demonstrate the correctness of Prof. Pupin's theoretical deductions as to improvement in transmission resulting from introduction of the coils or loads into the conductor, and the essential conditions of distribution of the coils with respect to the wave length. The prior art was exhaustively collected and considered by the German examiners. The granting of the patent is, among other things, their answer to Heaviside's claim, put forth in the "Encyclopædia Britannica," that he and not Prof. Pupin made this invention. In his article on "Telegraphy" Heaviside says ("Encyclopædia Britannica," Vol. XXIII, p. 218):

"Telephone wires in air, for long-distance telephony, should have L as large as possible. . . . The difference between $L = 2$ and $L = 20$ or 30, which is produced by separating the wires, is enormous, and largely multiplies the distance over which telephonic waves can be carried.

"But it is the improvement of signaling through cables that is most important, if it can be done. . . . The writer invented a way of carrying out the principle other than uniformly, and recommended it for trial; viz.: by the insertion of inductance coils in the main circuit at regular intervals, say one per mile, according to circumstances. The time constants of these coils should be as large as possible, so that the average inductance may be largely increased without a large increase in the average resistance per mile. The action of the coils is similar to that of small detached loads placed upon a string to give it inertia, and enable it to carry waves further. If we wish to imitate a curve containing bends of various sizes by means of dots, it is obviously necessary to have several dots in every bend. So in the substitution of detached inductances for uniform inductance, we need to have several coils in every bend of the electrical wave. It is easy to say that so many coils will be wanted in such a length, in telephony, for example, if we can fix upon the shortest wave length, by using the known formula for wave length. One could do that without being considered to make a new discovery. But this does not answer the question how few the coils may be for telephony through a cable. Theoretically, we want an infinite number, i. e., uniform inductances. We must sacrifice something. The shortest telephonic wave length necessary to be considered is a doubtful element, and there are unmentioned interferences to be allowed for. Hence, experiment alone can decide how few the coils need be for telephony through a distance far exceeding that possible without the coils. Nothing particular has been done in Great Britain to carry out the writer's invention, but in America some progress has been made by Dr. Pupin, who has described an experiment supporting its practicability; the length telephoned through was increased five times by inserting the coils."

Heaviside's suggestions, upon which he places so much reliance, are interesting. But on the whole they are surpassed in importance, as they were preceded in time, by the researches of the late A. Vaschy,[1] an engineer of great eminence, connected with the telegraphic and telephonic service of the French Government.

Both Vaschy[2] and Heaviside[3] illustrated the beneficial effect of high inductance by the analogy of the mass of vibrating strings. Neither seems, however, to have noted the bearing of the Lagrangean problem of the loaded string upon the problem of the loaded conductor, Heaviside's suggestion to the contrary in the "Encyclopædia Britannica" notwithstanding. Prof. Pupin was the first to point out this analogy, and he first extended Lagrange's famous solution to cover a case involving forced oscillations or dissipative resistances.

In disposing of his foreign rights to the Siemens & Halske Company, Dr. Pupin considers that he has placed them where no exploitation would be attempted excepting strictly in accordance with the highest commercial standards. The company deserves congratulation, as well as Prof. Pupin, as the great and recognized ability of its engineers have contributed largely to the final outcome of this long contest.

[1] Annalles Telegraphiques, 1884, 1888, 1889.
[2] La Lumiene Electrique, 1887.
[3] Electromagnetic Theory, Vol. 1, p. 215.

High-Pressure Power on the Housatonic.

ONOTA and Pontoosuc Lakes, in Pittsfield, Mass., are the head waters of the Housatonic River, which, after crossing the State of Connecticut, flows into Long Island Sound a few miles east of Bridgeport. In its course of 123 miles the river drops 983 ft., between the lakes and tidewater, and affords numerous opportunities for the development of water power.

Over much of its course the Housatonic has carved out for itself a narrow valley whose rocky sides rise abruptly from almost the water's edge and tower hundreds of feet above its surface. Such a combination of natural features affords excellent opportunity for the development of water power under high pressures. Years ago Nicholas Staub, of New Milford, Conn., a town in that part of the Housatonic valley just considered, saw that a great water power might be developed there, and secured a charter from the State Legislature that granted important rights for this purpose, in 1893. After years of negotiation this charter passed into other hands, capital was interested, and in the spring of 1902 work on the great power development at Bull's Bridge, that is now to be described, was begun by the New Milford Power Company.

Bull's Bridge is the site of a highway crossing over the Housatonic River in the town of Kent, and is in that part of the valley where the river has a continuous rapid descent with steep, rocky hills close on either side. To reach the bridge a drive of several miles from the railway depot in Kent is necessary. Near the bridge the valley narrows and the river has cut its way down into solid rock. Below the bridge the river makes a turn of nearly 90°, and then, after flowing nearly straight for about a mile, takes another turn that brings its general direction back to within a small angle of its former course. At a short distance above the bridge a dam has been built across the river, and a canal starting from one end of this dam skirts the hillside for a distance of about two miles, and then terminates in a forebay, where the water stands about 110 ft. above the surface of the river below at the second bend above mentioned. From this forebay a steel pipe carries the water down the steep hillside to the power station on the river bank. This type of water power development, comprising a rather long canal, a moderate volume of water and a gradual fall in a river concentrated at a single point, so as to give a head of one to several hundred feet, is quite common in California, but has seldom been attempted in New England. There is reason to think, however, that water power plants of this sort will yet come to be of importance in the east.

At the point selected for the main dam on the Housatonic the bed of the river narrows down to a width of approximately 80 ft. between high ledges of solid rock, though the width just back of the dam is fully twice this distance. In this admirable situation a solid concrete dam has been laid between the ledges that form the banks of the river and sunk into the natural rock of its bed. This dam is curved in form with a radius of 88.5 ft. at the toe, 104.6 ft. at the crest and 110 ft. at the back or upstream side, the common center of the arcs being near the middle of the river down stream.

At its base the width of the dam is 34.5 ft., and 8 ft. of this width in the part directly below the crest is recessed to a depth of 2 ft. into the solid ledge of the river bed. The toe of the dam is sunk about 3 ft. below the surface of this same ledge. In height from the lowest part of its bed to its crest the dam measures 24 ft., and at the level of the top back edge, which is 1.5 ft. below the crest, the thickness of the dam is 9.5 ft. From bank to bank at its back face the arc of the dam is about 97°, and the toe of the dam is about 80 ft. long. This dam raises the river level and causes it to overflow its banks for a distance of nearly four miles up stream. This raise in the river throws its water into the bed of a small stream called Spooner's Run-Around, as this bed comes close to that of the Housatonic River at a point several hundred feet above the main dam. A few hundred feet below the main dam the bed of the run-around again joins the river. To prevent the escape of water by way of this run-around, save when the river is nearly up to the top of the main dam, a weir dam has been thrown across the lower end of the run-around. This auxiliary dam is 150 ft. long at its crest, which is a straight line, is 10 ft. wide at the crest level, and 25.5 ft. wide at its base.

In elevation the crest of the dam at the head of the run-around is two feet less than that of the main dam across the Housatonic River, so that ordinarily water will flow over the smaller dam before the river reaches the top of the main dam. Flashboards are provided, however, for the smaller dam, which raise its crest line to the same level as that of the larger dam, when desired.

Fig. 1.—Water in the Deep Cut of the Canal.

The main dam is built of large stones and cement concrete, the stones being so placed that there are at least six inches of concrete between them. On both the face and back of this dam the layer of concrete is from one to two feet thick outside of the large stones that go to make up its core. For a distance of about six feet below its crest the main dam is entirely of concrete and the same is true for about seven feet of its width at the toe. From this it will be seen that this dam is a continuous mass of masonry throughout.

Another type of construction has been followed in the smaller dam at the head of the run-around, which has a vertical layer of concrete two feet thick on its up stream face, next to this a rubble wall three feet thick, and then a rock-filled interior, the whole being covered with a layer of cement concrete. This layer of concrete is about one foot thick over the top and down stream face of the small dam and extends some five feet beyond the rock filling at the toe. To provide for the escape of any water that may find its way into the rock filling of this dam, where no mortar or concrete was used between the stones, one or more iron pipes have been set into the concrete covering of the dam near its toe. A short distance below the main dam there is a natural fall over a ledge of rock in the bed of the Housatonic River, and near the foot of this fall the elevation of the water surface is about 44 ft. below the crest of the main dam. The remainder of the fall between the surface of the water in the forebay and the tail water at the power station is obtained through the gradual drop of the river bed. It is estimated that the operation of the power station at full load during a period of twelve hours will lower the pond created by the main dam only one foot in water level.

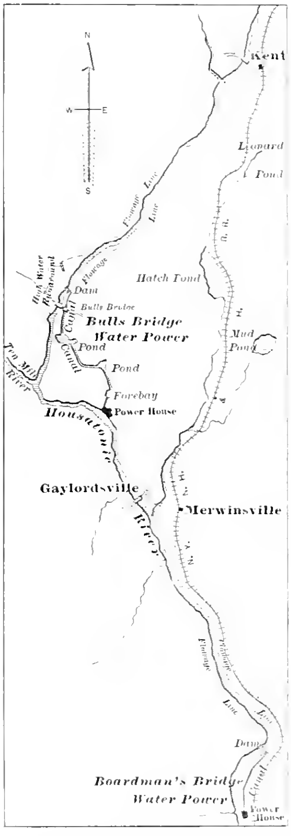


FIG. 2.—MAP OF BULL'S BRIDGE AND BOARDMAN'S BRIDGE WATER POWERS.

Before work could be commenced on the main dam the section of the canal nearest to it was blasted out of the solid ledge, and a cofferdam was built across the Housatonic at a point a little above the site of the dam so as to force the entire flow of the river into the canal. After flowing about 600 ft. in this rock section of the canal the river returned to its natural bed through waste gates. The cofferdam employed to divert the river into this canal was of a construction rather novel in the East, though it has long done effective work in the West, especially along the Mississippi River, where it has been necessary to resist the eroding tendency of the Father of Waters. In this construction the cofferdam is made up of small saplings or brush made into fascines, as they are called, placed with tops up stream, and in alternate layers with heavy stones. Over the completed mass of brush and stone an outside layer of earth is placed. The cofferdam built in this way near Bull's Bridge resisted several floods on the Housatonic when the water went over the top of the dam for days together. The only apparent effect of this flow of water was to wash a few inches of earth from the top of the brush and stone. The rock section of the canal just mentioned begins about 30 ft. from the east end of the main dam, and is separated from it by a high ledge, as may be seen from one of the photographs. This first rock section of the canal is about 600 ft. long from the river to the point where the entrance gates and waste gates are located. At its river end the stone floor of the canal is 17 ft. below the crest of the main dam, and 15 ft. below the crest of the weir dam at the head of the run-around, so that water will flow through this part of the canal with a depth of 15 ft. In cross section this portion of the canal is 25 ft. wide and has a depth of not less than 17 ft. with vertical sides, though the depth is much greater than this in some parts of the cut. The cross section of water flowing through this rock cut will be 375 sq. ft. when the flowage line is up to the top of the small dam at the run-around.

At about 600 ft. from its river end the canal widens out into an entrance chamber, and here the flush, waste and entrance gates are located. The waste gates, of which there are two, are located at the down-stream end of a spillway on the side of the canal next to the river. This spillway is about 150 ft. long and its elevation is the same as that of the crest of the main dam. Each of the two waste gates is built up with 9-in. square hard pine timbers bolted together, and closes an arched opening 10 ft. wide and 8 ft. high in a concrete pier that carries vertical guides of heavy timber. Each gate is divided into two equal parts horizontally, so that one-half can be raised without raising the other. At each of these waste gates the elevation of the arch floor is about 2.3 ft. less than that of the canal floor. The concrete pier that carries these two waste gates has its top 28 ft. above the floor of the arched openings in its base, and 10 ft. above the crest of the main dam. Next to the waste gates comes the flush gate, which is 16 ft. wide, and has its top edge at the same elevation when in normal position as the top of the main dam. The floor of the opening closed by this gate is 2.5 ft. below the crest of the main dam, so that by lowering this gate an opening from nothing up to $16 \times 2.5 = 40$ sq. ft. may be provided for water that is just up to the crest of this dam.

The Housatonic River is subject to severe freshets, owing to the rapid descent of its bed and the precipitous nature of the territory through which it flows. To provide for these freshets the large capacity of spillways, flush gates and waste gates has been made. When the river is only moderately full its entire flow is intended to pass into the rock cut of the canal which has an area in cross section of 375 sq. ft. up to the normal flowage line, which is on a level with the top of the smaller dam, but is two feet below the top of the main dam. When the river has risen to just the crest of the main dam, the cross section of water discharged over the smaller dam will be $2 \times 150 = 300$ sq. ft. Opening the flush gate adds $2.5 \times 16 = 40$ sq. ft. to this discharge area, and full opening of both the waste gates gives $8 \times 10 \times 2 = 160$ sq. ft. more. The total of these discharge sections amounts to 500 sq. ft., to which must be added $24.4 \times 2 = 48.8$ sq. ft. to account for the rise of 2 ft. in the flowage line of the canal. It thus appears that the total cross section of discharge in time of freshet may be $548.8 + 375.0 = 923.8$ sq. ft., or nearly 2.6 times the normal canal area of discharge, before any water goes over the main dam. As the freshet water rises above the crest of the main dam, the length of the discharge line, over and above the openings at the discharge gates, becomes 150 ft. for the smaller dam, plus about 200 ft. over the main dam, plus the 200 ft. of spillway at the side of the canal next to the waste, plus the 16 ft. at the flush gate, a total of 566 ft.

FIG. 3.—ENTRANCE GATES IN FRONT, FLUSH AND WASTE GATES AT RIGHT.

The canal entrance gates set squarely across the entrance chamber next to but at nearly a right angle with the plane of the flush and waste gates. Four entrance gates, each of heavy timber, moving in wooden guides, are provided, and like the former gates are provided with hand-operated raising and lowering gear.

Certain portions of the canal below the entrance gates are provided with spillways on the side toward the river, so that their total length along the canal amounts to about 1,000 ft. In some parts of its course of about two miles the canal is built entirely in earth, and in such cases the area of cross section up to the normal flowage line is 450 sq. ft. The normal depth of water in this cross section is 14.6 ft., the width of the bottom of the canal is 8.9 ft., and the side slopes are 1½ to 1. These slopes are paved with heavy stones to a depth of 2 ft., and this paving runs up to an elevation 2 ft. above the crest of the main dam. As the canal for much of its

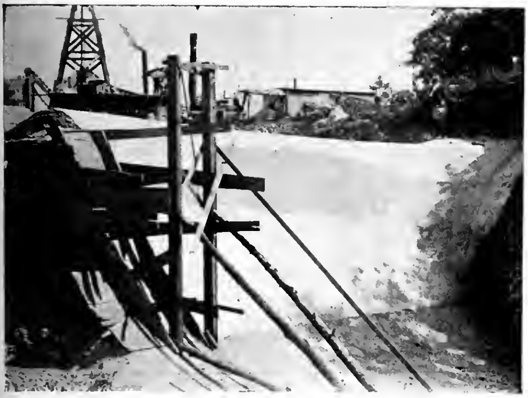


FIG. 4.—SECTION OF DAM, BULL'S BRIDGE.

length runs on a side hill, a cut on one of its sides and a fill on the other was necessary in some of its sections, and the same section is often partly in rock and partly in earth. At two points in its course the canal encounters comparatively low ground, and in these places it widens out into ponds with dikes to prevent the return of its water to the river. These ponds add somewhat to the storage capacity above the main dam.

At the forebay on the hill above the power station the canal

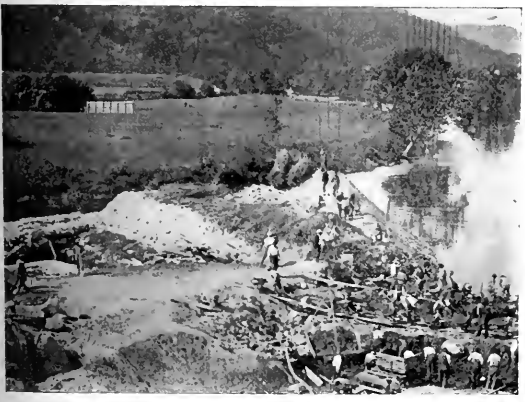


FIG. 5.—BRUSH AND STONE COFFERDAM, BULL'S BRIDGE.

widens into an entrance chamber that is 60 ft. broad at the racks. These racks are about 20 ft. high and have a slope that amounts to 4 ft. in horizontal projection. About 21.5 ft. in front of these racks and separated from them by a heavy framework are the gates that close the ends of the steel pipes which run down to the power house. Each gate is built of hard pine timbers and is in two horizontal sections that can be moved independently. Concrete forms the floor of the entrance chamber, and the head and wing walls of concrete on three sides of this chamber are 7.5 ft. across on top at their thickest points. Where the base of the head wall joins its concrete foundation its thickness is about 18 ft. The top of these walls is two feet higher than the crest of the main dam. Hand-operated gearing for moving the gates is located on top of the head wall. In this wall provision has been made for two steel pipes to convey water down to the power house, one of these to be of 8 ft. and the other pipe of 13 ft. diameter.

The 13-ft. pipe is already in position, and the 8-ft. pipe will not be erected until some future time. This 13-ft. pipe, after reaching the power house, runs along outside of its river front, and connects with seven smaller pipes that pass through the wall and to the water wheels inside. At the end of this horizontal section of the main pipe, which shrinks in diameter as pipes for the wheels are taken off, it turns into a vertical position and extends to an elevation equal to that of the crest of the main dam. The standpipe thus formed acts to relieve any undue pressure such as might be caused by the hydraulic ram action following the shutting of some of the wheels too quickly.

Inside the power house are six main generators and two exciters, each direct-connected to its own set of horizontal wheels. Energy from the six alternators will be raised to a pressure of about 30,000 volts, and then transmitted to Waterbury, New Britain and other cities of Connecticut, there to be used by electric lighting and railway systems.

All the above hydraulic work has been designed and constructed under Mr. W. S. Morton, chief engineer of the New Milford Power Company. The president of this company is Mr. Robert N. King, who has previously developed large water powers for electrical transmission on the Apple River, in Wisconsin, and on the Hudson River, at Mechanicville, N. Y. Mr. King and Mr. Morton have been associated in some of this earlier electrical work.

Melting Out Frozen Water Pipes Electrically.

During the recent intense weather the method of thawing out frozen water pipes electrically was undertaken successfully at Altoona, Pa. Mr. E. B. Greene, the well-known superintendent of the Edison Electric Illuminating Company of that city, who has been conducting this still novel and interesting work, writes us as follows concerning practical results:

We use for this purpose alternating current of low voltage, the maximum voltage not being over 50. The method of doing this, as you know, originated with Messrs. Jackson & Wood about the year 1900, so you will appreciate that it is not new with us. We use a 25-kw transformer wound for 50 volts, using an amperemeter to know what quantity of current we are using, and reduce the voltage with a water rheostat, using common table salt to impart the necessary conductivity.

The transformer, water rheostat and instruments are assembled in a box which is hauled out to the place desired to use, when the transformer is connected up to run as in ordinary methods of lighting, using the water rheostat on the primary side of the transformer (as this requires a very much smaller vessel for the water rheostat). The secondary, or low-voltage cables, are connected directly to the spigot or to the pipe inside the building, the other one being connected to a fire plug, or, if more convenient, to the pipe in an adjoining house, which then completes the circuit on the iron pipe for the low potential.

We have thawed 250 ft. of one-inch iron pipe in twenty minutes actual time of current on, using between 18 and 20 kw. In smaller services, say ¾-in., and on 30 or 40 ft., we have thawed out in from five to eight minutes, using about 11 to 15 kw. The apparatus is very small and it is quite a convenience to people to have water, when their pipes are frozen, in two or three hours after asking to have the apparatus connected up. There is, of course, very little business in the sale of current in connection with the above, but the advertisement we get from being able to help out people who don't have water we think will repay us amply for the trouble and the expense entailed.

As you, no doubt, can see from the above the cost of sending out the transformer, the time of the men connecting up and disconnecting, and the draying charges would leave very small margin unless you would charge an excessive price, which we don't believe it pays us to do. The cost varies very much. The cheapest job, which was near by the station, was $2.50; the most expensive one was $9.50; yet the amount of current used is a very small amount as compared with the charges for labor and drayage.

The Frequency Changers at Montreal.

By B. A. Behrend.

THE City of Montreal, Quebec, obtains electric energy for power and lighting from three plants, which have three different frequencies. The Chambly power plant supplies alternating current at 66 cycles, the Lachine Hydraulic Land & Power Company generates alternating current at 60 cycles, and the Shawinigan Water & Power Company generates alternating current at 30 cycles. Since the consolidation of these three plants a compromise frequency of 63 cycles has been adopted.

At Shawinigan Falls there are installed two 3,750-kw generators operating at 180 revolutions and 30 cycles and generating 2,300 volts of two-phase current. By means of transformers the two-phase current is changed to three-phase current of 55,000 volts, which is transmitted from Shawinigan to Maisonneuve, a distance of 85 miles. In the sub-station at Maisonneuve, a suburb of Montreal, the 30-cycle, three-phase current is stepped down from 44,000 volts to 2,300 volts. The long-distance line between Shawinigan Falls and Maisonneuve is the longest line east of the Rocky Mountains, and it is operated at the high potential of 55,000 volts at the generating end and 44,000 volts at the receiving end. The line is made of aluminum cable consisting of seven strands No. 6 B. & S. gauge. The wires are mounted on porcelain insulators, the distance between wires being 60 inches. The porcelain insulators are supported by locust pins. The wires are arranged in equilateral triangle. Fig. 1 is a picture of the sub-station in which are installed five 1,066-kw frequency changers designed and built by the Bullock Electric Manufacturing Company, of Cincinnati. The incoming line is clearly shown in the background of the picture. The three-phase, high-potential current is reduced by three Westinghouse transformers from 44,000 volts to 2,300 volts. The five groups of frequency changers which are clearly shown in Fig. 2, change the current from 2,300 volts three-phase 30 cycles to 2,300 volts three-phase 60 cycles. As the picture shows, the frequency changers are set in a row with their shafts parallel. The machine on the left is the 30-cycle motor; the machine to the right is the 60-cycle generator; the exciter which is shown on the right-hand side of the set serves as starting motor and also excites the two alternators. The rating of each set is 1,068 kw at 2,300 volts 60 cycles, 100 per cent. power factor, or 800 kw at 75 per cent. power factor. The speed of the frequency changers is 450 revolutions, the motor being

FIG. 1.—SUB-STATION AT MAISONNEUVE.

FIG. 2.—FIVE FREQUENCY CHANGERS AT MONTREAL.

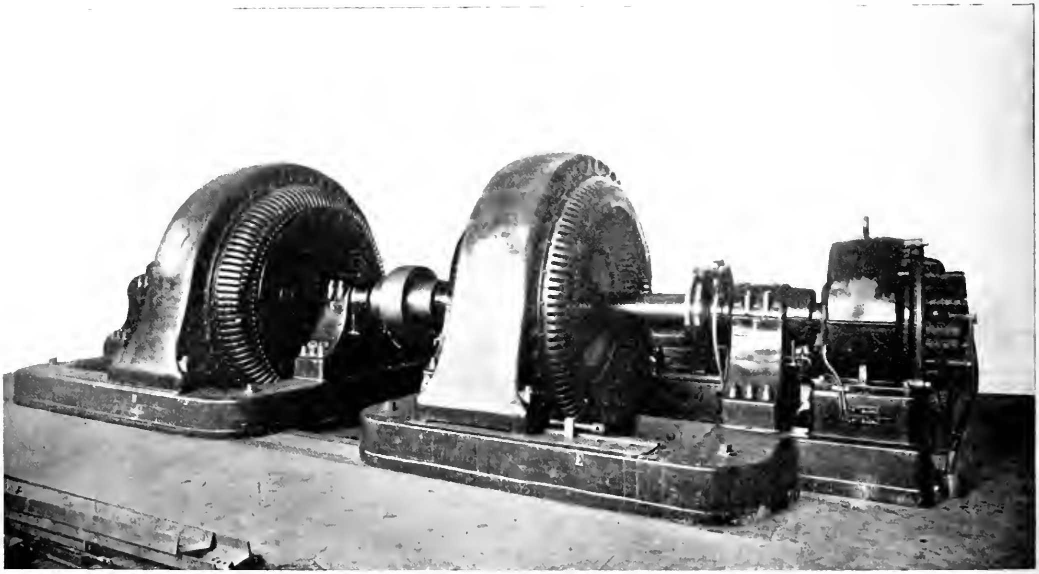


FIG. 3.—ONE OF THE 1065-KW. FREQUENCY-CHANGER UNITS.

an 8-pole machine, the generator a 16-pole machine. Fig. 3 shows one of the sets. The stationary armatures can be moved parallel to the shaft so as to expose the armature and fields for inspection

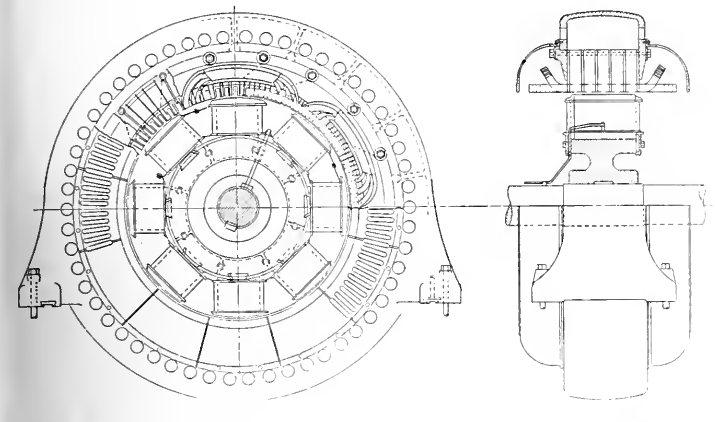


FIG. 5.—1100-KW., 2,300-VOLT, THREE-PHASE, 30-CYCLE SYNCHRONOUS MOTOR.

and repairs. The machines are mounted on I-beams, as shown in Fig. 4, which is an outline drawing of the general arrangement of the machines. Some of the constructional features of the motors and generators are shown in the assembly drawings, Figs. 5 and 6.

it was deemed advisable to use large exciters in order to facilitate the starting of these sets, as at the moment of starting the current taken is quite considerable. A 30-cycle induction motor direct-connected to a 80-kw direct-current generator is used for the starting of the frequency changers.

The operation in multiple of frequency changers is of considerable interest. Imagine a frequency changer to be in operation and a second frequency changed is to be connected in parallel with the first. Imagine that the first set is carrying full load and that the second set is to divide the load with it. The motor can be synchronized in the usual manner by adjusting the field current so that the potential difference between the bus-bars and the synchronous motor vanishes. If the generator is synchronized in the same way it is not possible to put a load on the machine. If the field current of the generator is diminished or increased the load of the frequency changer remains unaltered and the effect of changing the excitation results only in an increase of the cross currents between the two sets. Now then, in order to make the second frequency changer divide the load with the first, it becomes essential to abandon the usual way of paralleling. The following reasoning will at once give us a solution of the problem. Let us assume that both sets are in operation and are dividing the load equally. The saturation curves of the machines being the same, it is

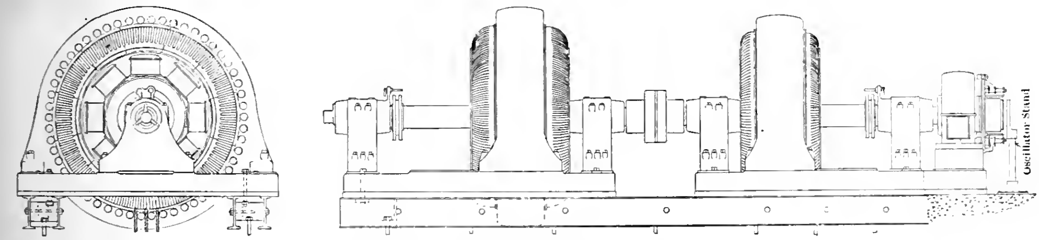


FIG. 4.—OUTLINE OF 1065-KW. FREQUENCY CHANGERS.

On account of the high peripheral speed of 8,000 ft. per minute of the revolving fields, the mechanical construction of the rotating parts has to be made solid and reliable. The rotor spiders are made of cast steel with dove-tailed slots milled into them. The pole pieces are held by means of wedges in these slots. The spider is designed with a central web, which is the best construction for high-speed rotating wheels. These machines were tested at the shops of the Bullock Company at a surface speed of 12,000 ft. per minute.

The high combined efficiency of the sets is shown in the curves represented in Figs. 7 and 8. Fig. 7 shows the combined efficiency for 100 per cent. power factor on both machines for an output of 800 kw at the generator end, while Fig. 8 shows the combined efficiency for an output of 1,066 kw, 100 per cent. power factor on both machines. The combined efficiency includes all the losses of the motor and generator and the bearing friction and windage of the set. At an output of 800 kw at 100 per cent. power factor the combined efficiency of the set is 89.2 per cent., and at an output of 1,065 kw at 100 per cent. power factor the combined efficiency of each set reaches the extraordinarily favorable value of 91 per cent.

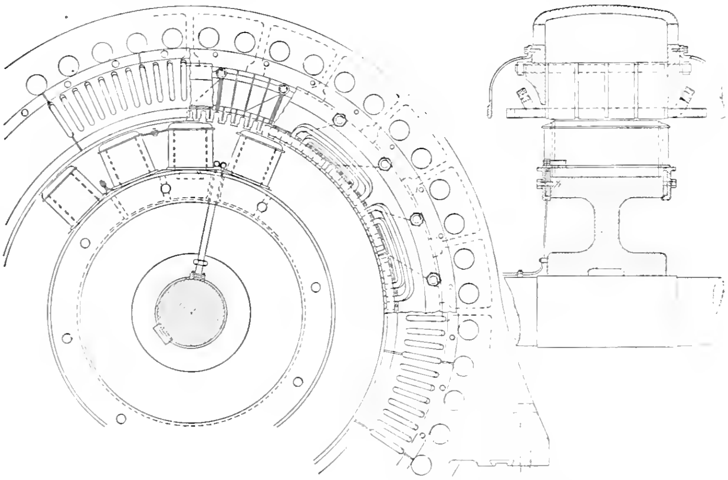


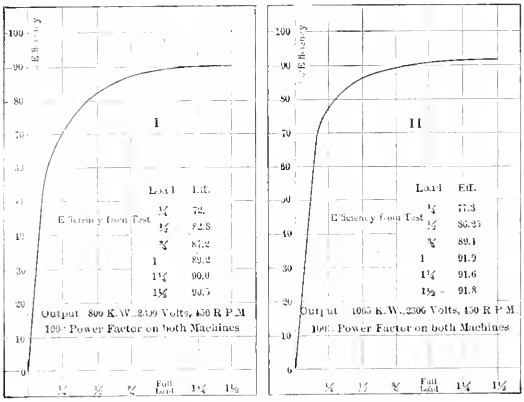
FIG. 6.—1065-KW., 2,300-VOLT, THREE-PHASE, 60-CYCLE GENERATOR.

The frequency changers are started from the exciters. The exciters are good for 75 kw at 120 volts. Although the excitation of each machine does not exceed 18 kw under any conditions of load,

clear that the exciting currents of the machines must also be the same if the load be distributed uniformly between them. As juggling the field currents after the machine has been thrown in parallel has no other effect than to increase the cross currents, it is at once evident that the field currents have to be adjusted properly before the machines are thrown in parallel. Hence, assume the first set in operation with

125 amp. excitation on the fields of the generator. If we wish to throw the second set in parallel with the first set, we first synchronize the motor of the second set and then make the excitation of the generator of the second set 125 amp. The bus-bar voltage on which the first set is operating is 2,300 volts; the second set has the same excitation and the terminal voltage of its generator is, therefore, greater than the bus-bar voltage on which the machine is to operate. Assume the drop of the machine at this load to be 12 per cent., then the generator of the second set at 125 amp. excitation on its fields will generate 2,580 volts. The switches must be closed between the two machines at these unequal voltages and the two sets will pull each other in parallel with the load distributed equally between them.

The aggregate power of the frequency changers in this sub-



FIGS. 7 AND 8.—CURVES OF COMBINED EFFICIENCY.

station amounts to 11,000 kw, of which, of course, only one-half is utilized on account of the changing from 30 cycles to 60 cycles. The plant has been in operation since February, 1903.

The unique character of this plant operating on a system which Mr. Alton D. Adams has recently called in these columns, "the greatest center of transmitted power," will justify my supplementing Mr. Adams' article. (*) The line between Shawinigan Falls and Montreal was designed by Mr. Ralph D. Mershon, and the substation by Mr. Wallace C. Johnson, chief engineer of the Shawinigan Water & Power plant.

Doherty Medal Competition.

Mr. Ernest H. Davis, secretary of the National Electric Light Association, has issued the following important notice:

I beg to call your attention to the following extract from Mr. Henry L. Doherty's presidential address at the Cincinnati convention: "We must give underground construction more consideration than heretofore. We had hoped at this meeting to have a text paper on this subject, but were unable to obtain assistance. What we want is a paper so complete and detailed that it will enable any central station man who is forced to put his wires underground to undertake the work simply by the guidance of this paper; and, with the consent of your executive committee, I recommend that we make this a feature of our next convention, and with your further consent I will award a gold medal, properly inscribed, to the contributor offering us the most complete and comprehensive paper on underground construction, for either alternating or direct-current plants, or a combination of both; the selection of the best paper to be made by a suitable committee to be appointed by the incoming president."

Mr. Doherty's generous offer of a gold medal was accepted by the Association, with the condition that not less than five papers be contributed, but for certain reasons it was decided to postpone the competition until this year. The competition is now open to all wishing to contribute a paper on "Underground Construction." Papers must be received at the office of the Association not later than April 21. Three copies of each paper are requested.

* Alton D. Adams, "Montreal, The Greatest Centre of Transmitted Power," Dec. 5, Dec. 12, Dec. 19 and Dec. 26, 1903.

Radioactivity and Radiation.

By J. B. Whitehead, Ph.D.

In an article with the above title which appeared in your issue of January 23, Dr. Louis Bell sounds a general warning against the too hasty interpretation of experiment and consequent construction of theory, and in particular he suggests that the new but generally accepted theory of ionization and its bearing on the phenomena of radioactivity, may perhaps require modification in the light of certain other kindred observations of Blondlot and Sanford. The condemnation of the tendency to jump to conclusions, and of the thirst for sensational deductions will receive general concurrence, but the illustration cited seems hardly a case in point.

If there are two pieces of work in the recent literature of experimental physics the results of which are to be doubted, they are that of Blondlot on the N-rays and that described by F. Sanford in the *Physical Review* of December, 1903, on a so-called new type of radiation.

The name of Blondlot is sufficient to attract attention and respect to any of his work, and his claim to have discovered a new type of "ray" was received with widespread interest. Physicists in all countries immediately began experiments, and further investigations by Blondlot were awaited with impatience. As time passed, however, and other experimenters failed in attempts to repeat Blondlot's observations, an element of doubt arose throwing a haze of uncertainty over the whole work. There need only be mentioned among the many questioning the existence of the N-rays, the names of Rubens, Wood and Lummer. In fact, the last-named has shown that many of Blondlot's observations can be explained as being largely due to physiological causes. These observations were frequently on the variation of the intensity of illumination of bits of paper, metal, or of a spark in a dark room. Now, it is common knowledge that if one looks steadily at a star on a dark night, by shifting the eye a little to one side the star appears to change in intensity. Lummer has shown that variations such as those observed by Blondlot may be largely due to such subjective causes, and he points out that a measuring instrument other than the eye must be used before observations of precision can be had. Those of Blondlot's results which are most conclusive and least subject to Lummer's criticism are the ones referring to the condensation of the rays to foci by lenses, thus giving a means of determining their wave length. Apparently, however, all attempts to repeat the original observations have failed, so that until new evidence appears we must reserve judgment here also. Prof. Wood, of Johns Hopkins University, has attempted to repeat many of Blondlot's experiments without success.

From the account in the *Physical Review*, the work of Sanford appears so crude, so wanting in description and data, and so subject to criticism generally that it is difficult to understand how it can be accepted in evidence of anything new. There is hardly an observation which he describes that cannot be explained by the ordinary phenomena of ionization and Röntgen rays, primary or secondary. The observations on reflection and polarization require repetition and fuller description, before they can attract serious attention. The secondary Röntgen radiation which would seem to account for some of Sanford's observations were observed by Perrin in 1897, and their properties have been investigated by Sagnac, Townsend, Thomson and others.

From these facts it seems hardly possible as yet that we have failed to take into sufficient account these new types of radiation in the rapid development of our theories of ionization and radioactivity; theories, the basis of which rest on experiments as conclusive and reliable as they are beautiful.

"Good in Everything."

A special cable dispatch from Paris of January 30 to a New York daily paper says: "A French scientist, with the English sounding cognomen of Griffiths, has discovered evidence of radioactivity in the petals of several odoriferous flowers. When geraniums and sunflowers are placed near selenium with which an electric current has been interrupted the metal at once displays signs of strange activity and becomes an electric conductor. Dr. Blondlot this week explained to the Academy of Medicine of Paris the peculiar properties of these rays.

Application of Graphics to Power House Location.

By SIDNEY DIAMANT.

IN locating the electrical centroid of an area, over which concentrated loads exist the relative position of which is known, the method described by Dr. Bell has been generally employed. The scheme described in this article occurred to the writer in his desire to develop a method which would eliminate the possible confusion resulting from working directly on the area under consideration.

Given the position and the intensity of the loads, either absolute or relative, the problem is to locate the electrical centroid. As shown in the diagram, the position of a number of loads is located and their relative intensities are represented by the numbers 1, 3, 4 and 6, for example. Draw two axces, *O X* and *O Y*, at right angles with each other. (It has been observed by actual trial that the axces may make any angle with each other and that these axces may pass among the loads if it be more convenient for plotting because of limited space). Project these loads on the axces and continue, for a short length, the lines from these projections perpendicular to the axces. It is then desired to locate the position of two lines or neutral axces on which lies the centroid. The simultaneous position of the centroid on these two axces is at their intersection and locates the true centroid of the various loads.

To locate the neutral axis which is perpendicular to *O Y*, draw a line, *a-e*, parallel to the lines of action of the horizontal load components and on this line lay off successively to scale the different load values, *a-b*, *b-c*, *c-d* and *d-e*, following in the same direction. From the center of this line draw *s'-s* perpendicular to *a-e* and make *s'-s* equal to *a-s'* to conveniently limit the extent of the layout. Draw from the point *s* the component forces, *s-a*, *s-b*, *s-c*, *etc.* This merely enables a combination of the forces in such a way as to effect a neutralization of a component of one load by a component of another. The forces are decomposed as follows:

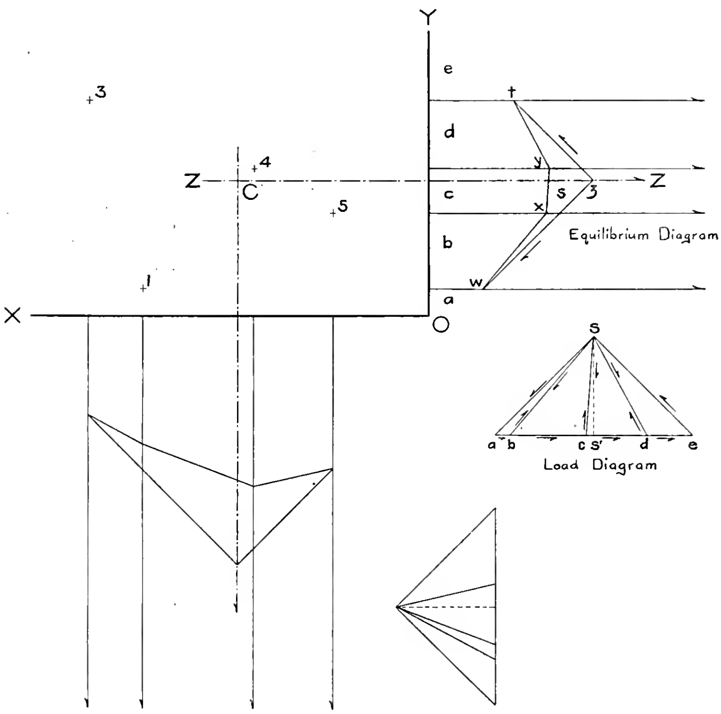
FORCES.	COMPONENTS. Load diagram.	Equilibrium or directional diagram.
(*a-b*)	*b-s* / *s-a*	*w-x* / *z-w*
(*b-c*)	*c-s* / *s-b*	*x-y* / *x-w*
(*c-d*)	*d-s* / *s-c*	*y-t* / *y-x*
(*d-e*)	*e-s* / *s-d*	*z-t* / *t-y*

The letters denote the direction and path of the components; as *a-b* denotes direction from *a* tob and along the path *a-b*. Since the forces *a-b* and *b-c* have a common component, *b-s* and *s-b*, along the same path, but in opposite directions, *b-s* component of *a-b* neutralizes *s-b* component of *b-c*. Likewise, *c-s* component of *b-c* neutralizes *s-c* component of *c-d; d-s* component of *c-d* neutralizes *s-d* component of *d-e*, so that these components are of opposite sign in the equation of forces and components. Therefore, the sum of the loads, *a-b*, *b-c*, *c-d* and *d-e* is held in equilibrium by the sum of the force components, *s-a* and *e-s*, since the equal and opposite components cancel each other. Thus the total load has *s-a* and *e-s* as load components.

Next, as to the construction of equilibrium diagram: In naming the forces the graphic notation usually employed will be made use of so that a line which separates spaces *a* and *b* indicates the direction of a force, *a-b*. From a convenient point, *w*, on the force directional line, *a-b*, which is a continuation of a line connecting the actual position of the load and its projection on the *O Y* axis, draw the indefinite line, *w-x* (the subscript letter is not shown in the sketch, but is the indefinite end of the line on which is the letter itself, without the subscript, ocupying a definite position) parallel to the force component, *b-s*, of the load diagram. The point, *x*, is at the intersection of the indefinite line, $w\text{-}x_i$ with the next force directional line, *b-c*.

Then from *x* draw the indefinite line, $x\text{-}y_i$ parallel to the force component, *c-s*, of the load diagram and the intersection of this line with the next force directional line, *c-d*, determines the point, *y*. From *y* draw the indefinite line, $y\text{-}t_i$ parallel to the force component, *d-s*, of the load diagram. Then the intersection of this line with the next force directional line, *d-e*, gives the point, *t*. From *w* and *t* draw the indefinite lines, $w\text{-}z_i$ and $w\text{-}t_i$ respectively, parallel to the load components, *s-a* and *e-s*. Then *z*, the intersection of these two lines, is the point through which passes the resultant of the force components perpendicular to the *O Y* axis.

Because all the load components perpendicular to the *O Y* axis act in directions parallel to one another, the resultant, *Z-Z*, acts in a line parallel to the lines of action of the load components. Since the centroid is the point through which passes the resultant of all the loads, the centroid of the loads is on a line, *Z-Z*, perpendicular to the *O Y* axis on which the loads are projected. If about this line moments be considered due to the loads acting about their respective lever arms, the algebraic sum of the moments will equal zero. Likewise, a similar demonstration will be true of the projected positions of the loads on the *O X* axis, and the position of a second line, on which is the centroid of all the loads, may be determined. The intersection of these two neutral axes indicates the definite position of the centroid of all the loads in their true positions. If, now, any line be drawn through *C*, the sum of all the products of all the loads on one side of this line multiplied by their respective lever arms equals the sum of the products of all the loads on the other side of the line multiplied by their respective lever arms.



APPLICATION OF GRAPHICS TO POWER HOUSE LOCATION.

The result obtained by this method agrees with that obtained analytically by the following equations:

$$L_x = \frac{A\ 1_{ax} + B\ 1_{bx} + C\ 1_{cx} + D\ 1_{dx}}{A + B + C + D}$$

$$L_y = \frac{A\ 1_{ay} + B\ 1_{by} + C\ 1_{cy} + D\ 1_{dy}}{A + B + C + D}$$

wherein L_x = abscissa of centroid and L_y ordinate of centroid, with respect to the selected pair of axes. A, B, C and D are the respective loads and l_{ax} = distance of load A from Y axis, l_{ay} = distance of load A from X axis.

A power house or a general distributing center located at the centroid will result in the most economic condition of distribution.

British Lamme Single-Phase Railway Motor Patent.

The current issue of the London *Electrician* contains a reprint of the specifications of a British patent granted to B. G. Lamme on "Improvements in Electric Motors," which contains a lengthy discussion of the principles of the railway motor associated with the inventor's name. Owing to the interest of this discussion we reprint in full the specifications, including the drawings.

My invention relates to electric motors, and has for its object to construct an improved series-wound motor for use with single-phase alternating currents. Hitherto alternating currents have been applied to operate series-wound motors, but considerable difficulties have arisen in the form of undue heating, excessive sparking of the brushes and low efficiency, together with want of due regulation. According to my invention, I overcome these defects, not by merely modifying the arrangement of parts of the ordinary series-wound motor, but by providing that certain definite proportions and relations shall subsist between such parts, together with various novel features in the construction of the motor. Since the self-induction of the field magnets and the counter e.m.f. set up by the armature are both dependent on the strength of field, a relation subsists between them which is proportional to the speed of rotation of the armature, the relative ampere-turns and the frequency. A higher speed, a low frequency and few turns on the field magnets compared with those on the armature, will give a lower ratio of the field self-induction to the armature counter e.m.f. Both the field strength and the armature magnetic lines of force increase with the current supplied to the motor, and if saturation is not approached each of these will increase directly as the current, and, therefore, the torque which is produced by them jointly will increase as the square of the current, which would be a highly advantageous condition for electric traction work. Increase in strength of field, however, is accompanied by augmented self-induction which, when working with alternating currents, must be reckoned with. Inasmuch as the resultant of all the e.m.f's is equal to the applied e.m.f., increase in self-induction would result in a fall of speed, and if the self-induction of the motor becomes relatively high, the speed will fall very rapidly, and zero will be reached when the self-induction is equal to the applied e.m.f. Conversely, if the strength of the field is kept constant its self-induction will be constant, and, consequently, the armature speed will not fall unless its own induction be very high.

In the two cases above stated the first is that in which the strength of field is approximately proportional to the strength of the current, and in the second case the field magnetic strength is constant. As previously pointed out, the first case provides favorable conditions for electric traction; but it is limited by the fact that the maximum torque which can be developed may be insufficient for maximum requirements. In the second case the torque is not so limited, but on the other hand the general characteristics of the motor may not be suited to given conditions of working. It is, therefore, advantageous to so proportion the motor as to combine the two cases and thus secure conditions through a certain range of working, in which the field strength is approximately proportional to the current, and have the motor capable of developing the required torque. It has been pointed out that the limitation in the torque developed when the field magnetic strength increases in proportion to the current, is due to the rapidly-increasing self-induction of the field as the current is increased, so that the self-induction soon becomes nearly equal to the applied e.m.f. It is desirable, therefore, to provide means for limiting the self-induction so that it does not normally absorb an undue proportion of the applied e.m.f., and when a heavy torque is required, the self-induction of the field shall not limit the current, but shall permit a sufficient current to flow to produce the required torque. As the cross-induction of the armature through the poles acts with the self-induction of the field in limiting the flow of current, it is desirable that this should also be kept within proper limits. It follows, therefore, that the self-induction of the motor, as a whole, in normal working, should be relatively small with relation to the applied e.m.f., and should also have a limiting value which is less than the applied e.m.f., even when the motor is operating under maximum conditions of torque. The relations between the field self-induction and the armature counter e.m.f. may be expressed as follows: Self-induction of field = alternations × field turns in series × induction per pole × constant. The counter e.m.f. of the armature = revolutions × the number of armature wires × induction per pole × constant. The constants used are dependent upon the characteristics of the supply circuit and upon the units in which the different terms are expressed; their values are determined in any given case, according to well-established laws, and the armature winding is assumed to be of the usual parallel type.

$$\frac{\textit{Field self-induction}}{\textit{Armature c.e.m.f.}} =$$

$$\frac{\textit{Line alternations} \times \textit{field turns in series} \times \textit{induction per pole}}{\textit{Revolutions} \times \textit{amature wires} \times \textit{induction per pole}} \times \textit{const.}$$

since armature wires = 2 × poles × armature-turns in series,

$$\frac{\textit{Field self-induction}}{\textit{Armature c.e.m.f.}} =$$

$$\frac{\textit{Line alternations}}{\textit{Poles} \times \textit{revolutions}} \times \frac{\textit{field ampere-turns}}{\textit{armature ampere-turns}} \times \frac{\textit{constant}}{2}.$$

In a direct-current motor the armature alternations are equal to the product of the revolutions multiplied by the number of poles, and, since this relation may be assumed to obtain in a series alternating-current motor the foregoing formula may be further simplified by substituting the term "armature alternations" for the term "poles × revolutions." It has been pointed out that the self-induction of the motor should be relatively low as compared with the applied e.m.f., since the resultant of the self-induction of the motor and the counter e.m.f. is approximately equal to the applied e.m.f., and it follows that the self-induction should be low in proportion to the counter e.m.f. of the armature in normal working. The relation between the two is expressed in the foregoing formula, and it is now apparent what relations must hold between the elements of the motor itself and between the motor and the external conditions.

In order that the ratio between the field self-induction and the counter e.m.f. of the armature may be low, it is clear that there must be a small number of line alternations, a large number of poles and a high speed, and a small number of field ampere-turns and a relatively large number of armature ampere-turns. The absolute values and the ratios between these several elements which are admissible and suitable for practical design and operation will now be considered. The ratio of field ampere-turns to the armature ampere-turns has, generally, a minimum value which is fixed by the proper operation of the motor itself. If the field ampere-turns are too small as compared with the armature ampere-turns, the magnetic field will be distorted and good commutation will be difficult. The minimum ratio of field ampere-turns to armature ampere-turns is dependent upon many factors in the design, but, in general, it may be said that this ratio should be greater than 0.5 and may sometimes be as high as 0.75.

Therefore, when definite limits have been assigned to two of the ratios in the last equation—namely, the ratio of field self-induction to armature counter e.m.f., and the ratio of field ampere-turns to armature ampere-turns then there is also a definite limit fixed for the remaining term in the equation, i. e., a definite relation between the alternations in the supply circuit, the number of poles of the motor, and its rate of revolution, or, in other words, between the line alternations and the armature alternations. It may be noted that an average working value for the last-mentioned ratio is approximately 0.625, and it has been found that the expression $\frac{\textit{constant}}{2}$ in the foregoing formula closely approximates the reciprocal of 0.625, i. e., 1.6. It follows, therefore, that the last two ratios of the formula cancel out, leaving only the ratios of field self-induction to armature counter e.m.f. and line alternations to armature alternations, for which definite limits are fixed, as hereinbefore pointed out. With a given number of revolutions, the number of poles must be directly proportional to the alternations in the supply circuit. Thus, for instance, if an eight-pole, 700-revolution motor of a certain capacity is required for 2,000 alternations per minute, 3,000 alternations per minute will require a 12-pole motor at 700 r.p.m.

The foregoing considerations indicate the conditions required for securing a relatively low self-induction of the field of the motor. It has been stated that a limiting value of the self-induction of the motor can be secured by suitably proportioning certain parts of the motor. A method of doing this will now be described. The field self-induction and the armature self-induction may both be limited by special construction of the pole pieces. For instance, slots or holes may be cut in the body of each of the field pole pieces from end to end transversely to the direction of rotation, the amount of iron left at the back of the slots being that which is required for the desired induction. The teeth or narrow portions between the slots or holes are of such cross-section that the desired induction through them may be obtained. The slots or holes may be closed, or nearly closed, at the pole faces, and usually this is preferred, as open slots increase the magnetizing power required in the field winding which, in turn, necessitates more field turns, and results in greater field self-induction. The cross-section of iron in the poles is preferably such that but little magnetizing power is absorbed in addition to that required for the air-gap until the current exceeds the normal rated amperes of the motor. Beyond this normal current the teeth between the pole slots rapidly approach saturation. In order to secure this result, the parts in which the cross-section of the magnetic circuit is reduced should be of comparatively short length, but should, of course, be worked at a high induction. It is not necessary or desirable to subject the whole yoke to a high induction, as the desired results can be obtained by having a short length of small cross-section; whereas, if the whole yoke be subjected to a high induction, the losses due to reversals in the core will be objectionably large, and also the magnetic leakage into the surrounding frame and through the field windings will be objectionable.

The self-induction of the armature which results from a cross-induction through the poles, in which the magnetic lines enter at one edge or side of the pole and pass through the core to the opposite edge or side, is also reduced and limited by the arrangement of slots or holes which has been described and which would not be obtained in the same degree if the whole yoke were saturated, provided the field cores in the two cases required the same number of ampere-turns in the field for magnetizing them. The cross-induction of the armature is due to the magnetic flux which passes through the field poles, the path for any given pole being through the teeth at one side, then across the slots and also across the pole back of the slots and then along the teeth at the other side of the pole and back to the armature. The smaller the section of the teeth and the more highly they are saturated, the less will be the cross-induction with a given current in the armature. As it is desired to have the induction in these teeth quite high, it is, as above pointed out, desirable to have the teeth as small as possible, and, therefore, the magnetic reluctance of the field circuit is concentrated near the pole face instead of being distributed through the whole yoke. The total useful flux through the armature and field sets up no effective e.m.f. of self-induction in the armature windings, as it will add to the counter e.m.f. at one part and subtract at another part of such winding. But the e.m.f. set up by the cross-induction does not neutralize itself in the same way, and thus becomes an e.m.f. of the same character as that set up in the field windings. The cross-flux from the armature may be further limited by the suitable interposition of a secondary circuit, if desired. For example, if a slot at the middle of the pole contain a conducting plate or closed coil, it will oppose the magnetic flow which would tend to cross the slot. If the ends of a conductor placed through the middle slot be connected with the outer frame of the machine at each end, or if the conductor be closed around the outside of the yoke, then the secondary circuit thus formed will oppose the flow of the cross-induction which tends to pass through the section of iron back of the slots.

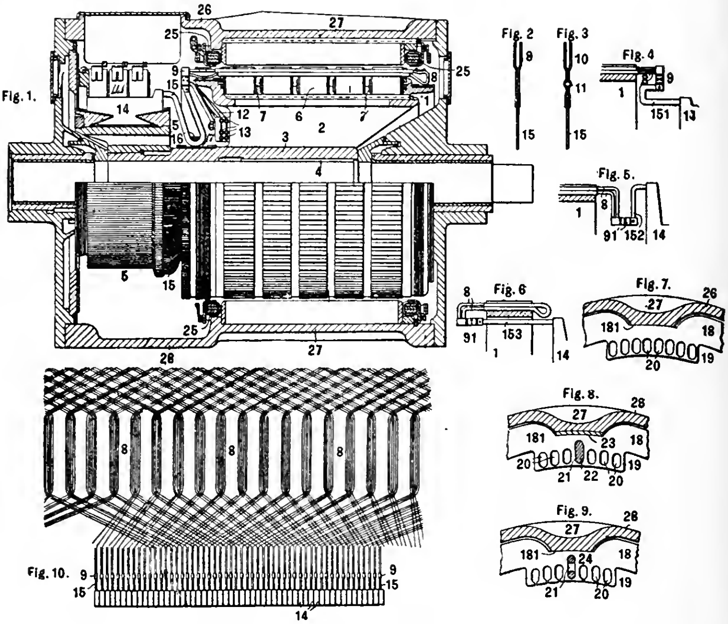
The armature winding of the motor is of the closed coil type and is closed upon itself before being connected to the commutator, relatively high resistance leads being inserted between the winding and the respective commutator bars. As the magnetic field of the motor is alternating, any short-circuited turn through which the magnetic flux from a field pole passes will have a secondary current set up in it. By the well-known laws of the transformer the ampere-turns in such short-circuited secondary will approximate the ampere-turns in the primary winding, which is, in this case, the field magnet winding. Certain coils of the armature winding are short-circuited through the brushes when the adjacent commutator bars to which the ends of the coils are connected are bridged by the brushes, and when the latter are located in neutral positions or without lead, the short-circuited turns surround the paths of the magnetic flux and are, therefore, good secondary circuits in which relatively large secondary currents are set up by induction. This is the principal cause of the excessive sparking in series motors of ordinary construction, when it is attempted to operate them upon an alternating-current circuit. In order to obviate destructive sparking, the current in the short-circuited turns of the armature coil should be limited to an amount materially less than what would normally flow. I have found that by inserting a definite amount of resistance in each of the leads between the closed winding and the commutator bars, it is possible to so limit the secondary current due to the alternating field flux as to prevent injurious sparking. The working currents in the armature winding will not pass through these resistances except at the bars in contact with the brushes, because the armature winding is closed on itself inside or beyond the resistance leads. Consequently, the loss in the winding due to the introduction of the resistance can be relatively small, and when the armature is rotating this loss is distributed successively through all the resistances, thus making the average loss per resistance lead very small. Various ways of introducing such a resistance will be described in connection with the accompanying drawings.

With a given current in the motor, the turn of each armature coil which is short-circuited by a brush will tend to have the same e.m.f. set up in it irrespective of the e.m.f. applied to the motor. Therefore, the resistance in the leads may be such that the short-circuited current developed will be limited in amount, and, generally speaking, with full-load current in the motor; the resistance should be such that the short-circuited current will not exceed, say, twice the value of the full-load current. The resistance in each short-circuit will include the resistance of the turn itself plus the resistance of two of the leads, plus also the resistance of the brush holders and brushes. As will appear from what has already been stated, the conditions for suitably low self-induction and for a proper ratio of field ampere-turns to armature ampere-turns practically determine the number of poles the motor should have with a given rate of alternation and speed. This motor will require a relatively larger number of poles as compared with direct-current motors of corresponding size. Moreover, the conditions of good commutation are that the armature circuits of the motor be connected in parallel, and that the number of turns between consecutive armature bars be small. It follows, therefore, that the voltage of the motor is definitely limited, and it is found that the actual voltage is low relative to that for which direct-current motors may be wound—such, for example, as motors employed in ordinary electric traction. While this characteristic would be a serious limitation in connection with the distribution of energy for direct-current traction motors, it is of minor consequence in connection with alternating-current motors, since transformers may be interposed between the supply circuit and the motors, which may be designed to receive practically any voltage from the line and to deliver any desired voltage to the motors. In service, a motor may require either a constant voltage or a variable voltage. For variable speed work the variable voltage is usually desired. A variable voltage may be obtained by the introduction of resistance or self-induction into the circuit or, preferably, by means of a transformer in which the rate of transformation is suitably changed. The several elements which are involved are the motor, the controller, the supply circuit and the transformer. The motor, as has been pointed out, has inherent limitations as to the voltage for which it can be wound, which are independent of the transformers, the controller and the voltage of the supply circuit. The current and the voltage which can be most advantageously handled by the controller may be entirely different from those of the motor. For example, it may be advantageous to design the controller for one-third of the current and three times the voltage which are required by the motor. The line voltage may, in turn, be entirely too high to be introduced directly into the controller or the motor. It follows, therefore, that the voltage of the motor, the voltage of the controller and the voltage of the supply circuit, and their respective currents, which may be most advantageously utilized, may be widely different. It is possible, however, by means of one or more transformers, to operate a motor adapted to any voltage by a controller adapted to any voltage from a supply circuit of any voltage. A convenient method of control consists in connecting a main transformer across the supply circuit, its secondary being included with the motor circuit but having included in series the secondary of a series transformer, the primary of which derives current either directly or indirectly from the main circuit and is capable of adding to or subtracting from the e.m.f. developed in the secondary of the main transformer.

This invention is applicable in cases where frequent starting is required, as, for instance, in electric traction systems. It is now the common practice in operating electric cars to have two or more electric motors upon each car, and for the purpose of securing varying speeds means are usually employed for connecting the motors either in series or in parallel, and for introducing more or less ohmic resistance into the circuits of the motors. With single-phase motors constructed according to my invention, it is possible to dispense with practically all ohmic resistances for regulating purposes, and it is not necessary to connect the motors successively in series and in parallel for the purposes of regulation, but the motors may be permanently connected either in parallel or in series and all the benefits of the usual series parallel control, as employed with direct-current motors, may be obtained by varying the e.m.f. applied to the alternating-current motors. In some instances it may be desired to connect the motors permanently in series—for instance, in cases where the reduced current will be more suitable for the controllers, or where the increased voltage presents advantages such as would be secured if this voltage were equal to that of the supply circuit. The method of control by means of variable ratio of transformation in the transformer is one which provides a very much higher degree of economy in starting and at lower speeds than is obtained in the usual method of operating direct-current motors where the voltage is reduced by means of rheostats, either with or without the series parallel method of control. In electric traction work, in which starting is frequent, a very large per cent. of the power delivered to the car may be lost in rheostats, thus greatly reducing the efficiency and increasing the cost of operation. It is to be understood, however, that the rheostatic method of control may be used with the form of alternating-current motors herein described, if desired, but usually the advantages of operating by means of transformers with variable e.m.f. ratio without rheostats are very great. The voltage delivered by the transformers is that required by the motor, so that there are practically no losses except those inherent in the transformers and motors, both of which are capable of being so designed as to have high efficiency. With this system full load torque or several times full load torque at starting may be developed with a very small amount of energy from the supply circuit. It also follows that with a given torque developed by the motors, the power taken from the circuit is substantially proportional to the speed of the motors, which is not the case with direct-current motors.

In the accompanying drawings, Fig. 1 is a view, partially in side elevation and partially in longitudinal section, of a motor constructed in acordance with my invention. Figs. 2 and 3 are detail sectional views of two of the combined resistance leads and connectors between the armature conductors and the commutator segments. Figs. 4, 5 and 6 are detail views illustrating modified arrangements of resistance leads for connecting the armature conductors with the commutator segments. Figs. 7, 8 and 9 are detail views of different forms of field magnet core construction. Fig. 10 is a diagrammatic development of a portion of the armature winding and connections between the same and the commutator segments. As here shown, the armature, 1, comprises a skeleton openwork frame or spider, 2, the hub, 3, of which is in the form of a sleeve mounted upon and suitably keyed to a shaft, 4, this sleeve being extended at one end to receive a commutator cylinder, 5, which is also suitably keyed to it. The core, 6, of the armature is built up in the usual manner of thin plates or laminæ, properly spaced apart at intervals by ventilating spaces, 7, and provided with slots which, in the present case, are 72 in number, in which are mounted the insulated conductors, 8, constituting the coils of the armature winding. These coils or conductors, as shown, are of strap copper, the turns of which are located side by side in the slots, forming three separate coils, which span the core from the first to the ninth slot, and so on around the core. The coils are properly joined together at one end of the armature by means of suitable connectors, 9 and 10, so as to form a closed parallel winding. The connectors, 10, are provided with sockets, 11, in which are fastened the outer ends of suitable connecting wires or strips, 12, the inner ends of which are connected to balancing rings, 13, in a well-known manner.

For the purpose of reducing the secondary currents that are generated by the alternating magnetic field in the coils which are short-circuited at the brushes to substantially non-sparking limits, I join the connectors, 9 and 10, to the several commutator bars, 14, by means of relatively high resistance leads, 15, there being in the present case



FIGS. 1—10.—SINGLE-PHASE RAILWAY MOTOR PATENT.

216 commutator bars and the same number of leads. As employed by me, these leads are in the form of strips of German silver, and their dimensions are actually determined, in view of the specific resistance of the material, so as to reduce the secondary current, above referred to, to the desired limits, and the form and arrangement of the leads are also such as to be properly accommodated by the space available and so as to be properly ventilated and securely supported independently of each other. The commutator brushes, 141, are arranged in sets in the holders or arms, and, in the present instance, the arms or holders are eight in number. The brushes and arms may be of usual material and construction and connected in the usual manner to properly co-operate with the commutator cylinder and the supply circuit. As indicated in Fig. 1, the leads, 15, are bent into substantially the form of U-shaped loops, the inner ends of which are held in place by means of a suitable winding, 16, an insulating band, 17, being interposed between the leads and the sleeve, 3, of the armature spider. As illustrated in Fig. 4, the resistance leads, 151, are shown as having a substantially U-shaped form, one arm of which extends beyond the other for connection to the commutator bar and the two arms of which are approximately parallel at the armature axis. In Fig. 5 the resistance leads, 152, are shown as having each a main

body position substantially perpendicular to the armature axis and an outer end which extends approximately at right angles to the body portion for connection to the commutator bar. In this case the end of the armature conductors project inwardly, approximately parallel to the body portions of the leads, for connection to the connectors, 91, which are also substantially at right angles to the body portions of the resistance leads. In Fig. 6 the resistance leads, 153, are connected to the ends of the armature conductors, at the end opposite the commutator, and project through the spider to the commutator and, substantially parallel to the axis of the armature. Other forms and arrangements of resistance leads may, perhaps, be devised which will be adapted for the purpose. These, I have shown, are such as I have been able to devise to most satisfactorily provide the necessary resistance and, at the same time, be economically and safely disposed in the available space in the motor.

As has already been pointed out, the number of field magnet poles of the motor must be directly proportional to the rate of current alternation in the supply circuit, and other conditions, which have been heretofore pointed out in detail, render it desirable, and, in fact, necessary, for successful operation that the rate of line alternations shall be low, and that the rate of armature alternations shall be relatively high. The motor here illustrated and described was designed for a frequency of 2,000 line alternations per minute, and the motor which is adapted to this number of alternations and the other conditions has eight field magnet poles. The field magnet core, 18, is in the form of a hollow cylinder and is built up of thin plates or laminæ, the laminated construction being necessary by reason of the fact that the magnetic flux, due to the field magnet winding, is alternating.

The polar projections or pole pieces, 19, are provided with holes or perforations, 20, extending through the same, transversely to the direction of armature rotation, and located in close proximity to the ends of the polar projections or pole pieces, and the depth of the body portion of the core is reduced at the rear of each polar projection, as shown at 181, in Figs. 7, 8 and 9, in order to aid in reducing the cross-magnetization and, consequently, the armature self-induction. The slots, 20, are made comparatively shallow in order to keep the iron loss low and at the same time to insure the desired saturation of the adjacent iron when the current materially exceeds the rated amperes of the motor. These slots may be entirely closed at the pole faces, as indicated in Figs. 7 and 8, or they may have narrow openings, as shown in Fig. 9, but in every case where open slots are employed the openings should be small. As shown in Fig. 7, there are eight of the holes, 20, which, as above stated, are of such dimensions and so spaced as to provide a cross-section of metal between them which will become quickly saturated when the current in the field magnet windings materially exceeds the rated amperes for which the motor is designed. In Fig. 8 are shown six holes, 20, and at approximately the middle of the pole piece is a hole, 21, which is of materially greater depth than the holes, 20. In this hole, 21, is located a bar or plate, 22, of copper or other good conducting material, for the purpose of serving as a closed secondary circuit to reduce the armature self-induction due to the cross-magnetization. In Fig. 8 is shown a plate, 23, of copper or other good conducting material, which also acts as a secondary closed circuit to oppose any cross-magnetizing flux which tends to pass outside of the core, 18, of the field magnet. In Fig. 9 the construction is the same as that shown in Fig. 8, except that a single turn, 24, of wire constituting a closed coil is placed in the middle slot, 21, instead of the bar or plate, 22, and the plate, 23, is omitted. Other forms of conductors suitably disposed to act as secondaries and thus oppose the cross-magnetizing flux might be employed, if desired, those shown being set forth merely as examples that I have found well adapted for the purpose. The field magnet winding, 25, is here shown as comprising eight coils of strap copper, bent edgewise and connected in series and so insulated and supported as to perform the functions desired, and, at the same time, be effectively insulated and occupy a minimum amount of space. In the present case the winding comprises 20 turns, one-half of the coils having three turns and the other half having two turns, and the coils of the two sets are alternately disposed around the core. A greater number of turns may be employed, if desired, provided they are so connected that the number of turns in series does not materially exceed that specified above.

The field magnet core and coils are mounted in a casing, 26, which is provided with extensions at its ends to enclose also the armature and commutator. As shown, this casing projects inwardly, at the backs of the pole pieces, to constitute supports for the core, 18, and is correspondingly hollowed out as regards its exterior, as indicated at 27, so as to lessen the weight of the structure. This form may be varied from what is shown, if desired, and the points of support between the core and the casing may be otherwise located. The casing may also be made of openwork skeleton construction, if desired, since its office is mainly that of a support for the field magnet.

Various methods of controlling motors, constructed in accordance with this invention, may be employed, it being preferable, as above stated, to vary the e.m.f. applied to the motors. For this purpose a transformer may be interposed between the motor and the supply mains, and the e.m.f. of the secondary may be varied by varying the number of windings of the primary or secondary, or varying their magnetic relationship in a manner well known in the art. Either a two-coil transformer or an autotransformer may be employed. Another very convenient means consists in the employment of a three-coil transformer, the third coil of which is connected with the primary coil of a second transformer, the secondary coil of which is in series with the secondary coil of the main transformer, as above described. Rheostats or similar adjusting means may obviously be employed in addition to or instead of the means for varying the voltage. It will be understood, however, that the invention is not limited to the method of control or restricted to any precise method.

The claims of the patent are as follows:

1. A single-phase, alternating-current, series-wound motor, in which the ratio of the field magnet self-induction to the armature counter e.m.f. is approximately equal to the ratio of the line alternations to armature alternations, substantially as described.

2. A single-phase, alternating-current, series-wound motor having a closed-coil, parallel-wound armature with relatively high resistance leads connecting the armature coils with the several commutator bars, and a field magnet the poles of which have slots transverse to the direction of rotation of the armature and with or without a closed conductor inserted in one of the slots and extending through approximately the central portion of the pole, substantially as described.

3. For use with single-phase alternating electric currents, a series-wound motor having the ratio of the number of its field poles to the number of current alternations per minute approximately as 1 to 250, and having a ratio of field ampere-turns to armature ampere-turns approximately as 20 to 27.

4. Electric motors for use with single-phase, alternating currents constructed substantially as described with reference to the accompanying drawings.

Extensive Train Lighting.

President Mellen, of the New York, New Haven & Hartford Railroad Company, has issued orders to the traffic department to equip a vestibuled train with an electric lighting plant, with generators on the car axles. It is stated to be President Mellen's intention to replace gas with electricity all over the line, and this progressive plan is to be put into operation at once.

A Manacled Inventor.

A most extraordinary and almost incredible yarn comes to us from New England, about Henry K. Goodwin, alleged to be held in bondage by the machinations of the Bell telephone interests. A bill is up in the legislature which, if passed, would result in the release of Henry K. Goodwin, now in Charlestown State Prison, who was convicted of the murder of Albert D. Swan, of Lawrence, in 1885. In the process of the hearing Senator Callender, of Boston, astonished the committee and the spectators by asking Lawyer Rowley, who represented Goodwin: "Haven't the electrical corporations in this State opposed Goodwin's pardon?" Mr. Rowley replied: "In my opinion the electrical corporations have done everything in their power to prevent the pardon of Goodwin. And there is in existence correspondence which will show it." "Didn't Goodwin invent a switchboard which is substantially the one now in use by the Bell Telephone and New England Telephone Companies?" demanded Senator Callender, and Mr. Rowley answered: "I understand that to be the case." It would be very interesting to know what kind of a board Goodwin invented, if he ever did invent one.

Discussion on A. I. E. E. Papers on the Single-Phase Railway Motor.

Owing to the great interest of the subject, we supplement our report last week of the January meeting of the American Institute of Electrical Engineers with the discussion in full by Messrs. Lamme, Steinmetz and Armstrong, and the non-mathematical part of the remarks of Prof. A. S. McAllister.

LAMME DISCUSSION.

In the paper presented before the American Institute in September, 1902, I called attention to the fact that there were but two types of single-phase, alternating-current motors having suitable characteristics for railway service, viz.: that called the "series type," and the "repulsion type." Both of these motors have armatures like direct-current motors with commutators and brush holders. Attention was called to the fact that both motors have suitable characteristics for railway service, as both automatically give variable speed characteristics with changes in load. That paper primarily described a single-phase railway system, and the motor formed but an element in the general system. It was a very general opinion at that time that the success of the commutator type of motor for large sizes as doubtful, and the sparking feature was considered a fundamental source of trouble. It was generally conceded that if a motor with series characteristics could be made to operate successfully, it would be a great step in advance in the railway field. Since that time single-phase railway systems have been more fully developed. Practically no departures from the general system then indicated have been furnished, and the types of motors developed have been along the lines of the two motors indicated in that paper.

Up to the present time the only suitable motors suggested for this work have been of the commutator type, and have been those having series characteristics. I have suggested that all these motors can be considered broadly under the one class of series motors, as they all have the series characteristics of the direct-current series motor. I further suggested that they can be subdivided into the "straight series" type and the "transformer series" type. The transformer series could also be arranged in two classes, viz.: one in which the armature or field is supplied by an external transformer, and one in which the transformer is placed in the motor itself; this latter is the repulsion type of motor.

Figs. 1, 2 and 3 illustrate the three classes, Fig. 1 being the straight

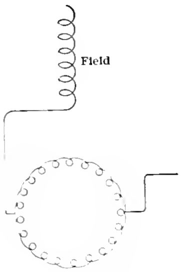


FIG. 1.

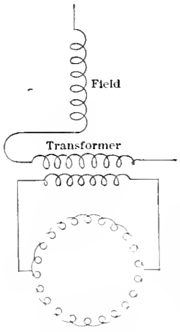


FIG. 2.

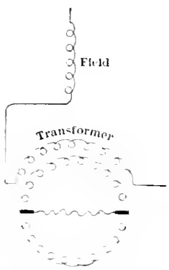


FIG. 3.

series, Fig. 2 the transformer series and Fig. 3 the repulsion motor. Fig. 2 would be considered as a true series motor, although the armature and field are not directly in series, and yet most of the characteristics described as belonging in the repulsion motor apply directly to the transformer motor shown in the figure. Comparing the relations of these motors, viz.: the straight series and the repulsion motor, we will first take up the straight series.

In this motor, if properly designed, two voltages can be considered, viz.: that across the field circuit, and that across the armature circuit. The armature voltage can be made practically non-inductive so that the input of the armature will represent practically true energy. The voltage across the field is practically at right angles to the armature voltage, and represents very closely the wattless component supplied by the motor. The resultant of these two voltages will then be the line voltage. The power factor of the motor when running is represented principally by the voltage across the armature winding being increased slightly by the losses in the field core and winding. Therefore, for high power factors it is important that the voltage across the armature circuit be made as high as possible, relative to the applied voltage, and that across the field as low as possible.

There are three ways in which to increase the voltage across the armature, viz.: by increase in speed, by increase in the number of wires in series in the armature, and increase in induction through the armature. By increase in speed and increase of the wires in series, the armature voltage will be increased without affecting the field voltage, and therefore the ratio of the armature voltage to the line voltage is increased. Increasing the induction in the armature also increases the induction in the magnetizing coil in the field, and the voltages of both are increased. Therefore, this increase does not improve the power factor of the machine.

Instead of increasing the armature voltage, the voltage across the field winding may be decreased for improving the power factor. This can be decreased in two ways, viz.: by reducing the turns in the field coil or by reducing induction through the coil. Reducing the induction through the field reduces the induction in the armature winding also, and therefore represents no gain; and, therefore, reduction in field turns is the feasible means of reducing the field voltage. Reduction in field turns can be accomplished in two ways, viz.: by decreasing the effective length of air-gap in the motor, and by increasing the cross-section of gap. By making the gap very small the voltage across the field could be made very small compared with the line voltage, and extremely high power factors could be obtained, whether the motor is of the straight series or repulsion type. Also by increasing the section of the air-gap the turns of the field can be decreased with a given total induction through the coil, and the power factor can thus be very considerably increased. The first method, viz.: decrease in gap, is limited by practical conditions, which have been determined from long experience with direct-current work. It should be borne in mind when published descriptions of such motors are given that the results, as regards power factor, generally depend upon data which is not given in the description, such as the magnetic dimensions of the armature and field, the length of gap, etc. Therefore, a machine may be described as showing an extremely high power factor, which may in practice not be a commercial machine, from the standpoint of American railway experience. Increasing the section of air-gap without decreasing the length of gap also improves the power factor, but makes a larger and heavier machine, as a rule.

Both these modifications reduce the ampere-turns in the field. The direction of the improvement in the armature was shown to be in increased armature ampere-turns with a given speed. It therefore follows that almost any result desired can be obtained as regards power factor by increasing the armature ampere-turns and decreasing the field, or exciting ampere-turns. I will refer to this point in considering the repulsion motor.

It should be noted that in all these motors there should be but little saturation in the magnetic circuit, and but few ampere-turns expended in saturation of the iron under normal conditions. This consequent low saturation in such motors leads to certain characteristics in the torque curves which have been cited this evening, as an indication of superiority of the alternating-current motors over direct-current motors, namely, a torque increasing approximately as the square of the current. In fact, this superiority of torque should be charged to the non-saturated condition of the motor rather than the alternating-current principle. If direct-current motors were worked normally at as low induction as the alternating-current motor, then the direct-current motor would show better torque characteristics, which would be comparable with the alternating motor. This claim for a better torque in the alternating motor compared with the direct seems to be a case of making a virtue of a necessity.

It is evident from what has been said that the power factor of the straight series motor can be made anything desired, it being a question of proportion between armature and field, length of air-gap, amount of material used, etc. In practice a compromise would naturally be made among the various characteristics, and a slight reduction in power factor is probably of less importance than a corresponding reduction in size and weight. Also large clearance is probably of more importance than an extremely high power factor at normal load. In practice it will be found that such motors are made with armatures with a large number of ampere-turns compared with the fields in order to obtain comparatively high power factors with large air-gaps. The number of poles need not be made such that the produce of the poles by the normal speed represents the frequency of the supply circuit. Good series motors can be made, and have been made, in which the number of poles were very much larger or much smaller than represented by this relation.

Taking up next the transformer type of motors, Fig. 2 represents one type of these. In this the field is in series with the primary of the transformer, the secondary of which is connected to the terminals of the motor. I would call this a true series motor, although it is not a straight series motor. In this motor the voltage across the armature can be made practically non-inductive and the voltage across the primary of the transformer will be practically non-inductive. The voltage across the field winding will have practically 90° phase relation to that across the primary of the transformer, and the magnetic field set up by the field winding will have a 90° relation in time, to the magnetic field in the transformer, as in the repulsion motor. In this motor the voltage across the transformer will be highest at light loads and will decrease with load until zero speed is reached. At start there is lowest induction in the transformer and highest induction in the field winding. Such a motor will have speed torque characteristics very similar to those of a straight series motor, except as affected by the actions taking place in the transformer itself. If the transformer possesses no reactance, then at start the current in the armature should be the same as if connected as straight series motor, and the conditions of torque at start should be the same. If the transformer possesses reactance, then at start the current in the armature will not be quite equal to the current which the armature will receive if coupled as a straight series motor, assuming the transformer to have a 1 to 1 ratio. Neither will the armature current be exactly in phase with the field current; therefore, the starting torque of a motor connected in this way will be slightly less than the torque of the same motor if connected in straight series. This is on the assumption that the transformer is one proportioned for small reactance; but if the primary and secondary windings of the transformer should be on separate cores with air-gap between, then the reactances of the windings are considerably greater than in the above case. Therefore, we should expect a motor with such a transfer would give still lower torque than the straight series with the same current supplied from the line.

In a repulsion motor the transformer is combined with the motor itself and the primary and secondary windings are upon different cores with an air-gap between. The starting conditions of such a motor as indicated above should be poorer than the straight series motor, or for the same starting torque somewhat greater apparent energy should be required. It stands to reason that applying the current directly to the armature winding should give greater ampere-turns and better phase relations than generating this current in a secondary circuit, and not under ideal transformer conditions. The tests which I have made, as well as the results shown in the curves of the papers given to-night, indicate this. It is to be noted that the torque curve is not the same shape near the zero speed point as the torque curve of the series motor.

Series motors and repulsion motors may be indicated in the simple form shown in Figs. 4 and 5. In the diagrams of the repulsion motor (Fig. 5), two field poles, *F F*, are shown, and two transformer poles, *T T*. To obtain high power factors on such a motor the ampere-

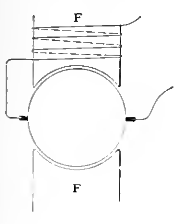


FIG. 4.

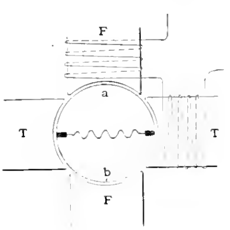


FIG. 5.

turns in *T* must be much greater than in *F*, which means that the ampere-turns in the secondary or armature are much greater than in the exciting field, as in the series motor. The high power factor obtained with these motors is, therefore, due principally to the small ampere-turns in the field and the small voltage across the field.

With brushes set at an angle of 16°, for instance, from the primary or resultant field, the ratio of armature to exciting field turns would be almost 5 to 1, a ratio which will also permit of extremely high power factors in well designed straight series motors over wide ranges of speed. To this feature should be credited the good power factors claimed for the repulsion motor. In either the series or repulsion type of motor, high power factors, especially at low speeds, are directly dependent upon this fact of high ratio of armature to field, and with a high ratio, high power factors should be obtained without crediting the result to leading currents in the armature. In the diagram of the repulsion motor the line current indicated flows through to the field winding and the transformer winding. The primary current sets up a magnetic field in the exciting windings in phase with the line current. If it also set up a field in the transformer in phase with the line current, then the e.m.f. generated in the armature winding due to rotation would have a 90° relation to the e.m.f. set up by the transformer, and a correcting or magnetizing current would flow. This flow is in such direction that it corrects the relation between the two voltages in the armature by shifting the transformer magnetism one-quarter phase later than the exciting field magnetism. This armature corrective current thus may be considered as magnetizing the transformer, making the primary input to the transformer practically non-inductive, but this magnetizing or correcting current may be considered as flowing in a circuit at right angles to the field magnetic circuit, and having practically no effect on the field circuit. Therefore, as a rough approximation, the exciting field may be considered to represent the wattless component of the input, and the transformer field the energy component, as in the series motor.

As to the statement that the magnetizing current in the armature reduces the wattless component of the exciting field, I do not accept it broadly. If this component is reduced, then another component of practically equal value is introduced somewhere else, for the power factors obtained with such motors can be accounted for by the high ampere-turns in the armature winding, compared with the field or exciting ampere-turns. If the armature current improves the power factor by diminishing the magnetizing or exciting field, then the curves in curve sheets 1 and 4 of Mr. Slichter's paper should show it. I have gone over both sets of curves calculating

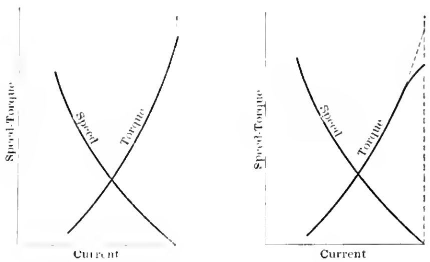


FIG. 6.—SPEED-TORQUE CURVES.

the wattless components from the power factors. From this and other data in these curves I find that beginning near synchronous speed the wattless component in the motor goes up slightly faster than would be represented by the field excitation, assuming it to be entirely wattless. Therefore, according to these curves, the power factor at lower speeds are not quite as good as would be obtained by a field entirely inductive and the armature entirely non-inductive, in a straight series motor. These calculations are rather approximate, as the curves do not check at all well with each other. For instance, the output of the motors is represented by the input multiplied by the power factor and the efficiency. The output is also represented by the product of speed by torque. These two results do not check at all well in either set of curves, there being discrepancies as high as 10 per cent. In curve sheet No. 4, for instance, either the torque or the speed is too high for the lower speeds. Checking back on this curve, using either the speed and torque or the power factor and efficiency for determining the output, I find that the wattless component in the motor at 190 revolutions is approximately 20 per cent. higher than it would be if the field excitation alone were wattless, assuming at 440 revolutions the wattless component is represented purely by field excitation; that is, from 440 to 190 revolutions the wattless component is increased 20 per cent. over that which would be represented by field excitation alone. This indicates that not only should the field excitation be considered as practically wattless, but that in addition there is a wattless component due to reactance in the armature widings, etc.

The armature current can be split into two components, one of which is partly magnetizing and represents no torque. The other component is in phase with the field magnetism and, therefore, represents torque. The magnetizing or wattless element may be comparatively small, as the number of turns in the armature is relatively large, but the armature thus carries at times a slightly larger current than the straight series motor.

A further inspection of the diagram (Fig. 5) indicates how the power factor of the motor can be made very high at synchronous speed. At all speeds the voltage generated in the armature due to rotation in the field *F*, is practically equal to the voltage generated by the transformer *T*, thus making zero voltage across the terminals. But also at synchronous speed the voltage generated by the exciting field acting as a transformer, between the points *a b* will be practically equal to the voltage generated in the winding by rotation of the winding in the transformer field. Therefore, across *a b* the voltage is practically zero with these conditions, but the frequency remains the same as that in the field. If now the magnetizing current be supplied across the points *a b*, then the required ampere-turns for magnetizing the motor can be supplied at practically zero voltage, and the turns of the external magnetizing field can be omitted. Therefore, under this condition the wattless component is practically zero and the power factor becomes practically 100 per cent. This is the method of excitation used on certain European single-phase motors in which high power factors are claimed for full-load running. But this method of excitation does not improve conditions at start as the same excitation will be required at standstill, whether the excitation be supplied to the armature or to the field. Therefore, this method of excitation does not help the motor at that condition of load which is the severest on the generating and transmission system. It has the advantage of omitting the field exciting winding, but has the great disadvantage of requiring a double set of brushes on the commutator with but half the distance between the brushes found in the straight series or the ordinary repulsion motor. I do not believe that such methods of compensation are of sufficient advantage to overcome the complications attendant upon them.

At zero speed both the straight series and the repulsion motors will show low power factors and with equal losses in the motors the repulsion should have slightly lower power factor than the series. This question of power factor at start is largely a question of internal losses in the motor at rest, and the repulsion motor in individual cases may show higher than the series motor, because it may be designed with higher internal losses. The real measure of effectiveness is not the power factor at start, but the apparent input or kilovolt amperes at start required for a given starting torque. With equally good designs of motors, my experience is that the kilovolt amperes will be found to be considerably less with the straight series than with the repulsion motor, due to the fact that the current is fed directly into the armature and not by transformer action, and, therefore, the conditions of phase relation and amount of current in the armature winding are more favorable. Therefore, it follows that in order to have the same kilovolt ampere input for the same starting torque, the repulsion motor should have a smaller length of air-gap than the corresponding straight series motor, or should have a greater section of air-gap, which means greater weight of motor. This is one of the conditions which has led me to the advocacy of the series motor rather than the repulsion motor, as I have considered this condition of starting of more importance than running, although I am satisfied that many of the running conditions of a well-designed series motor will be found in practice to be superior to those of an equally well designed repulsion motor.

Referring again to Fig. 5, it will be noted that two fields are set up in such a motor, and that at synchronous speed these two fields are equal. In the straight series motor there is but one field set up, the other being omitted. It is evident that the straight series motor with the current supplied directly to the brushes can have a smaller section in certain parts of the magnetic circuit than is required for the repulsion motor, and that, therefore, the weight of material would be less, and the external dimensions can be less. Therefore, it follows that for equally good designs and same frequency, the straight series motor should be more compact and should weigh less than the repulsion motor. It is reasonable to expect this, as the repulsion motor contains a transformer in addition to the other parts found in the straight series motor. Furthermore, the transformer found in such a motor is one with an air-gap and with the windings on two separate elements, and, therefore, cannot be as well proportioned as a separate transformer could be. Also, there is a transformer for each motor, and in a four-motor railway equipment, for instance, there would be four transformers of smaller size against one larger transformer used with the series motor, this larger transformer having a closed magnetic circuit, and of a highly efficient design compared with the transformers in the motors themselves.

A further point should be taken up in the comparison of these motors, viz.: the current in the coil short-circuited by the brushes. This coil is a secondary to the field and the current in it is necessarily greatest at the period of strongest field. Therefore, this current will be greatest at the time of starting. If the repulsion motor and the straight series motor have the same field strength at start, then the short-circuited current should be the same in each. But as the current is fed into the armature in the repulsion motor through transformer action, it will be found as a rule that the starting field strength of such a motor is slightly greater and the starting armature strength slightly less for a given torque than is found in the straight series motor having same ratio of armature to field windings. Therefore, the short-circuit current at start will be somewhat larger for the repulsion motor than the corresponding staight series motor. This short-circuit current may be somewhat less near full speed than in the straight series motor, but it is not the full speed condition which is the serious one. The short-circuit current at start is one of the most serious conditions which confronts us in alternating-current motors, and is also of great importance where there is any considerable operation on low speeds, and I have advocated a type which I consider gives the easiest condition in this regard. This short-circuiting cannot be entirely

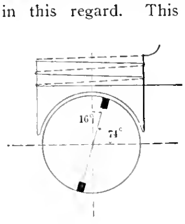


FIG. 7.

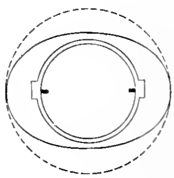


FIG. 8.

avoided in any of the motors brought out without adopting abnormal and questionable constructions, although devices like narrow brushes, sandwich windings, etc., have been proposed. In certain foreign motors the brushes used are so narrow that they cover practically the width of one commutator bar. As such motors are generally built with a very large number of bars, the brushes used are extremely narrow, being approximately 0.2 in. thick at the tip. This will undoubtedly lessen the short-circuiting, but I consider that it is simply transferring trouble to another point, and not avoiding it. A brush 0.2 in. thick is not a practicable one for commercial railway service. At higher speeds, with only a moderately rough commutator, such brushes will be liable to chip and break. I have had experience with ¼-in. brushes on such high-speed commutators and speak from experience. Further, I do not believe that the brush on a street car motor should be so narrow that it bridges but one commutator bar. A brush should bridge at least two bars to give good smooth brush operation. I have made a practice of using ½-in. brushes on motors of say 100 hp.

The sandwich winding, which consists of two or more windings side by side, will prevent short-circuiting at the brushes, but is another case of transferring trouble to another point. It has been found in practice that it is difficult to run a sandwich winding without trouble at the commutator with direct current without a tendency to blackening and pitting of the commutator and I consider that with alternating current this tendency to pitting and burning of the bars would be equally great.

As a rule, I have found little difference between the operation of repulsion and straight series motors as regards sparking, except that the repulsion motors generally have greater current in the short-circuited coil near zero speed, and, therefore, show greater tendency to heat and spark. At or near synchronous speed there appears to be very little difference in the commutation, although I have never given the repulsion motor the test of long-continued service that I have given the series motor. The series motors with which I have worked have never shown any tendency to give trouble on the commutator, and on the exhibition car equipped with four 100-hp motors, the commutators have never been sandpapered since the equipment has been put into service. This exhibition car is used principally for showing the accelerating properties of the motors. I have, therefore, no hesitancy in saying that the straight series motor will prove to be equal to the direct-current motor as regards action at the commutator. Wide brushes are used, such as have been used in street railway motors.

It is well known that with large direct-current motors, especially where operated at very high speeds, there is a tendency to flash across the commutator, or to the frame of the motor if the field circuit be opened for a period long enough to allow magnetism to drop to zero, and then the field be closed again. In this case there is a rush of current before the field has had time to build up, and this rush of current, together with field distortion, may cause serious flashing. In the alternating-current motor, whether of the straight series or the repulsion type, this tendency should be entirely absent. In the straight series motor the magnetism falls to zero once in each alternation, and, therefore, if this tendency to flash existed it would occur continually. The lamination of the magnetic structure and the proportions of the machines which permits it to operate successfully on alternating current tend at once to cure this trouble from flashing found in direct-current motors. Furthermore, a properly designed straight series motor can be short-circuited across the brushes without injury to the motor, and can continue to operate in this way. Therefore, if the machine can be short-circuited in this way, there is no tendency to maintain an arc if suddenly short-circuited.

Returning to the subject of power factors, it should be noted that high power factors are very frequently found in motors of low or only mderately good efficiency. This low efficiency, to a slight extent, explains the high power factor in some motors, both polyphase and single-phase. Low efficiency means higher true energy expended, and with a given wattless component it means higher power factor. It is the old problem of increasing the power factor by wasting energy in a circuit instead of reducing the wattless component. The power factor of any alternating motor can be very considerably increased by putting resistance in series with it. Instead of this resistance the internal losses of the motor may be made higher, which will accomplish the same results. The motor will, therefore, appear to have a higher power factor than it really deserves, if efficiency of the motor is taken into account. If, for instance, the efficiency at 300 revolutions shown in Mr. Slichter's curve sheet 4 would be made as high as on direct-current motors, then the power factors with the same magnetizing and other conditions would have been approximately 4 per cent. lower. This lower power factor would not have made any harder condition on the supply circuit, but actually would have made a somewhat easier condition, as the supply system would have furnished about 8 per cent. less kilovolt amperes. For lower speeds this difference in power factor will be greater, and less for higher speeds. A high power factor at start, obtained by the use of resistance in series with the motor by high internal losses which do not represent torque, is, therefore, a detrimental condition rather than a good one, as it means increased kilovolt ampere expenditure for a given torque. This is merely given as an illustration showing that power factor in itself is not a true indication of conditions, but must be accompanied by other data. I do not give this as a criticism of these motors, but as a general condition found to a greater or less extent in all alternating motors.

STEINMETZ DISCUSSION.

In opening his discussion Mr. C. P. Steinmetz said he was pleased to agree with Mr. Lamme in considering the relative position of the repulsion motor, the plain alternating-current series motor, and the alternating-series motor fed by a transformer; and that he was pleased to see that Mr. Lamme has come to the same conclusion to which he and Mr. Eickemeyer had come in this early work; that is, that the only way to make an alternating-current series motor to operate at reasonably satisfactory power factor was to combine as high armature reaction as possible with as low field excitation as possible, then increasing the ratio of armature magnetism to the field, thus eliminating the current you cannot use; otherwise one will strike a standstill. As to assuming that the alternating current is non-inductive, no electrical engineer has yet designed a circuit traversed by alternating current which is really non-inductive. In the early work of Mr. Eickemeyer careful investigation was made on this subject by having the motor designed so that the relationship between the armature magnetic force and the field magnetic force could be varied, and it was found with that particular motor, using ratios somewhere between 3½ and 4, that is, where the armature reaction was between 3½ and 4 times greater than the field action, the best condition was reached. That is to say, if the total induction increases the armature reaction beyond that we lose more by increasing the induction of the field. With a short-circuit surrounding the armature, this point was reached at the lower value of armature reaction. However, that work was done at very high frequencies; that is, with motors where the polarity pitch was much less than they must be with the present frequencies, and undoubtedly with a change from these high frequencies of the early days to the frequencies considered here, which are about a quarter or less than those old frequencies, we can go to a further extent in this direction. However, attention is called to the fact that there is an ultimate limit between the ratio of armature reaction and the field excitation; otherwise you could say you could, by making the armatures 100 times as strong as the field, get any unit of power factor practicable; but you reach a maximum point and you cannot go beyond that without losing again.

The fact is that the repulsion motor has inherently such a high power factor that even with a considerable air-gap an air-gap which is impossible with the ordinary induction motor we can run to magnetic saturation and with large starting current; this magnetic saturation is approached and passed in part of the magnetic structures, in the base of the field and armature, and that causes the falling off, as we observe in the direct-current motor. It is not feasible to go to anywhere near such saturation as in the direct-current motor, but while we approach saturation, it is not necessary, but means a small motor.

Regarding the relative proportions and material of the repulsion motor and the alternating-current series motor, Mr. Steinmetz agreed with Mr. Lamme as far as his conclusion goes; that is, by using one and the same motor, the alternating-current series motor, first as a series motor and then as a repulsion motor—and experimental investigations have been made in that direction—by using a repulsion motor and running it as an alternating-current series motor led to exactly the opposite result, that the series motor is decidedly larger in weight and lower in efficiency. The explanation is simple. One reason why that the armature is not absolutely non-inductive, and the result is that if you calculate the power factor from the inductance of the field, assuming the armature is non-inductive, you get a higher power factor than exists in reality, because there is a self-inductance in the current of the primary and secondary, and self-inductance in the armature. While small, it is still there. You will find it in all alternating-current systems. Both observations are, no doubt, right, but in the repulsion motor by using this transformer we derive a high power factor at relatively low speeds and thereby are permitted to apply the standard induction motor design; that is, the distributed winding—the primary winding or field winding being distributed around a circumference—the secondary winding meaning low inductance winding. The induction motor has been made a commercial apparatus only by going to the distributed winding, but induction motors are still built and operated with definite polar projections, but they are inherently lower in power factor than motors with the distributed winding. By applying the same principle to the repulsion motor, we get thereby a considerable decrease in the self-inductance of the circuits and thereby are permitted to get close to saturation, in turn reducing the size and weight. Such a winding, however, for a plain series motor is not satisfactory, because in the series motor, as the original investigations of ten years ago showed, it is essential to have a definite polar projection to get good power factor, so that the motors considered, while they are a development of the same type, are of an entirely different mechanical structure. A motor which is a good series motor will make a very poor repulsion motor; the repulsion motor is larger, heavier, and more efficient. You cannot take one and the same motor and run it first as one and then as the other and draw general conclusions, because the transformer feature introduced requires redesigning and nullifies comparisons based on one particular design.

Mr. Steinmetz said that comparing the present alternating-current motor of the plain series or repulsion type with the highly developed direct-current motor, we find a somewhat lower efficiency in the alternating-current motor, and it has somewhat larger weight. His personal opinion is that the difference is altogether less than should be anticipated, considering the short time of the development of the one and the longer time of the development of the other. The two types are not directly comparable. Take, for instance, the question of weight. In the direct-current motor we must have definite polarity, which requires a larger radial depth and a distributing winding of the repulsion motor, hence the outer turn of the field structure would be impossible in the repulsion motor and with the same external diameter there must be larger diameter in the repulsion motor. This throws out a direct comparison. As to the question regarding the relative efficiency, the internal proportioning of the motor is different. In the modern direct-current series motor the field is much stronger than the armature; in the repulsion motor we have realized a condition where the armature is stronger than the field. That would mean to correspond to the direct-current series motor in which we quadrupled the output of the armature, having four times as many turns. That would throw out of proportion any comparison to give the relative efficiencies; so, while the alternating-current motor has the additional losses of the hystereses and eddy currents, the proportions are changed and we cannot say that it means inherently low efficiency any more than we can say that the polyphase induction motor means a lower efficiency than the direct-shunt motor. We know that this is not the case, but that the polyphase induction motor has the same efficiency as the direct-current shunt motor on a general average. While at present for some years to come the alternating-current railway motor, as a new type of apparatus, will be handicapped by somewhat lower efficiency and somewhat greater weight, he does not consider this as inherent to the motor, but rather as more or less the result of a shorter development and does not consider it impossible that they should come to equality with, or even in some cases superiority to, the direct-current motor; but that is merely guessing at the future. All that he can say is that he does not see any inherent reason why the alternating-current motor should be heavier or less efficient than the direct-current motor. As to reversing, there are different ways of doing the same thing. We can change the point of entrance of the current in the primary wire without changing the brushes. We can feed into the primary winding at several different points in the repulsion motor and get the advantage of not shifting the brushes. As to whether it takes more copper in the repulsion than in the series motor, the repulsion motor takes more copper and less iron than the direct-current series motor takes, because the proportion of armature to fields are reversed as to the alternating-current series motor. He did not want to state positively, because he had not gone over the fields of the alternating-current series motor with sufficient care, or tested the ordinary current series motor with modern frequency; but his impression is it would be about the same as the direct-current motor. The plain series motor will have a smaller armature diameter than the repulsion motor, probably larger external diameter, more iron and less copper, but in general he does not expect there will be any inherent difference between the two types.

ARMSTRONG DISCUSSION.

In reply to questions by Mr. Ralph D. Mershon, Mr. A. H. Armstrong said that as to designing a repulsion motor that at the same time will operate as a good direct-current motor, one can make a repulsion motor to operate on direct current good enough to help through a town along right of way, but cannot make a good repulsion motor and a good direct-current motor in the same structure, any more than one can make a good series motor both alternating and direct. One feature or the other has to be sacrificed, and the preponderance of interest will determine which. As to the potential of the motors, a good repulsion motor can be wound for two or three thousand volts on the field without the use of transformers; the exact voltage is open to experimenting. Nothing is known about the effect of constant jarring and crystallization of insulation at high potentials on a railway car. Control can be either by a compensator or resistance or some method like that, with a good potential in starting—there are a number of methods. Such control would hardly be used at high potentials in service calling for frequent stops. If you stop once in five miles the slight difference in efficiency in starting would have no effect on the general efficiency of the system as a whole. You would gain one or two per cent. in the average of the car or train, which would not compensate for the complication. One can consider two or three thousand volts entirely feasible on the field of the motor without any intervening machinery. That, however, is open to experimentation and development. So far as the motor goes, it can be wound to that potential, but whether that motor would successfully withstand the shocks of railway service is a matter to be found out.

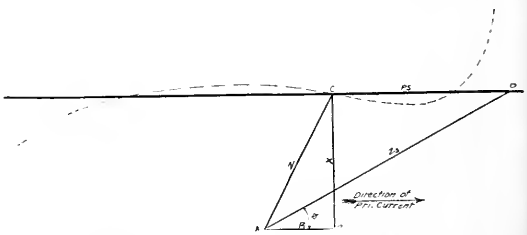
As to the weight of alternating-current motors and direct-current motors, that is an open question. The question of the capacity of direct-current motors has been very carefully worked out by the different engineering companies during the last two or three years, much time and labor has been spent in determining their exact capacities for a given piece of work, standards have been adopted and the matter has been worked down to a fine point with relation to direct-current motors; and to attempt to compare a piece of apparatus not yet in commercial service with a standard piece of apparatus developed for fourteen years, is hardly fair, and it is almost impossible to give a definite answer to the question. It can be said roughly that the motor will weigh somewhat more than the direct-current motor, but just how much added weight there will be we do not know. As to the weight of the rest of the equipment, that would depend on the method of control. If you use a high-potential motor, 3,000 volts direct on the field, your control should not weigh very much more. If you use a low potential and install a transformer of 100-kw capacity in the car, you have the added weight of the transformer in addition to the translating apparatus.

In reply to a question as to how large an alternating-current motor we can get for a 33 or 36-in. wheel, Mr. Slichter said that a 100-hp motor could be placed there, but he could not say a larger motor could not be. Mr. Lamme said his company was building 150-hp motors which will go in on 33-in. wheels closely, easily on 36-in. wheels. They have determined that they cannot put 200-hp motors on 36-in. wheels. That is one limit.

MCALLISTER DISCUSSION.

In introducing his remarks Prof. A. S. McAllister, of Cornell University, said that in the papers presented mention is made of the fact that the repulsion motor, when driven against its torque, acts as a generator, and that when the negative speed becomes of a value such that its product with the torque exceeds the internal losses of the motor, the machine will feed energy back to the line. The analytical equations given by Mr. Steinmetz furnish an explanation of the cause for this action on the part of the machine. The equations used may be represented graphically by a simple diagram, which allows of a more ready interpretation than do the equations.

The diagram referred to is given in Fig. 1, where X (the distance BC) represents the combined local (stationary) reaction of both the primary and secondary circuits, the latter being reduced to primary terms. The scale is ohms or volts for one ampere. The heavy line is the assumed locus and the broken line the observed locus. R (the distance AB) is the equivalent stationary resistance effect of both circuits of the motor. Then Z (AC) represents the stationary impedance of the motor, and the cosine of the angle CAB



IMPEDANCE (E. M. F.) LOCUS OF REPULSION MOTOR.

is the power factor at starting. When the motor operates at a speed S, the power component of the apparent motor impedance is increased by a certain value PS $(CD$ in Fig. 1$)$: P being a coefficient depending upon the relative strength of the field which causes the generation of e.m.f. in the armature conductors at speed S, and hence depends upon the position of the brushes. P is here, as in the equations, assumed constant and the e.m.f. for each primary ampere due to PS is assumed to be in phase with the current supplied.

Fig. 1 shows: $PS = R$, the apparent impedance of the motor becomes X; the current is $\frac{E}{X}$ and represents no energy flowing either to or from the motor; that is, the machine is operating as a generator and supplying its own losses. A further increase of negative speed causes the power component of the apparent motor impedance to become negative, indicating that energy is flowing from the machine. This action of the machine was illustrated by curves which were the results of tests of a certain repulsion motor, while other curves gave the calculated performance of the same motor, proper substitution having been made in the equations. Referring to the theory of the repulsion motor, Mr. Steinmetz states that the current which flows locally in the circuit formed by the brush and an active coil tends to a reduction of the power factor at high speeds; which statement Prof. McAllister said may be taken as an explanation of the fact that the power factor observed in the case of high speeds is much below that calculated, as shown by the curves just referred to. The neglect of the counter torque due to the local current flowing in the coil under the brush leads also to error in assuming that the repulsion motor tends to increase indefinitely the speed of its rotor as the applied e.m.f. is increased or as the load is decreased, since in reality experiment shows that the rotor tends to reach a certain speed above which, if it be driven mechanically, it acts as a brake.

Prof. McAllister then deduced certain equations, and said that the discrepancies between the assumptions made and the physical facts involved will be evident from a study of the formation of these equations, which become identical with the approximate equations of Mr. Steinmetz if for each value used above there be substituted given equivalents.

Modern Methods of Operating Machine Tools Electrically.

Before the Engineering Society of Columbia University on Tuesday, February 2, Mr. Putnam A. Bates, an engineering graduate of the University, and well known as connected prominently with the management of the Crocker-Wheeler Company, gave an interesting lecture on "Modern Methods of Operating Machine Tools Electrically." The lecturer was appropriately introduced by the president of the Society, Mr. Gustav Wittig, and at the close the members expressed themselves as greatly pleased, passing a vote of thanks to Mr. Bates. The general text of the lecture follows:

It is particularly gratifying to the electrical engineer of to-day to note the fact that through the handiwork of his profession in making the use of electricity possible in commercial arts, its adoption has not only become very general, but is looked upon practically as a necessity. The great flexibility, comparatively low cost of installation and economical distribution of electric power, have given it a firm standing in general machine shop equipment. The question, therefore, of whether or not in machine shops power shall be distributed by means of electricity, is to-day hardly considered, as the advantages obtained by this method have been so successfully proven that there is little room left for doubt. Hence, the subject which is given attention is what method of electric distribution shall be adopted and in what manner shall the electric motors be arranged with respect to the work which they have to accomplish.

In considering the subject of individual drive, some have said "that while considered alone and for the individual tool, this method is ideal, yet the objection will occur that the enormous multiplication of small motors means increased complication and greatly increased cost, and that if this method is employed it should be limited to tools requiring from 5 to 10 hp and upwards, and that group drive should be used where the tools require less than these amounts."

If the saving in the coal bill due to the decreased losses in transmission obtained by individual drive throughout a machine shop or factory, only is to be considered, the objection above referred to might in a measure be correct, but as a matter of fact the coal bill in a year amounts to such a small percentage of the total operating expenses of any manufacturing establishment that a small variation in this one way or the other hardly merits more than passing consideration.

The element in our factory costs which requires our most careful consideration is that of the labor cost involved in turning out a given piece of work. A very small percentage of decrease in our total labor bill will, as a rule, justify a greatly increased first cost, provided that cost will directly bring about the reduction of labor. Besides eliminating the disadvantages of line shafting, belting and the inflexibility of location, the individual drive of machine tools by electric motors increases the efficiency and output of machine shops. It is not necessary, therefore, to lay down any specific line of demarkation as to the size of the tool on which it would be advisable to apply an individual motor, but rather to consider in the case of each particular tool the class of work which is to be done and the character of the shop in which the system is to be installed. It can then be determined as to whether the increased facilities which the individual motor-driven tool affords, will not offset the objection claimed against the individual method of tool drive, which is "greater first cost." These increased facilities lie in the direction of variable speeds, under instant control, over any range, with every speed constant regardless of the load, the ability to maintain high cutting speeds due to superior facilities for manipulation and the absence of shut-downs from belt troubles.

If we fail to find that the advantages just mentioned offset the only objection claimed, before dismissing the problem there must be credited against the first cost of the individually-driven tool the cost of countershafts, hangers and belts, also the cost of the increased power to overcome friction losses due to the shafts getting out of line and the tool operator's time lost in lacing and repairing the belts, to say nothing of the unhandy methods which are required for the starting and stopping, and shifting from one speed to another. Upon giving all of these points careful consideration, we will find that the first cost of the individually equipped shop is not much if any greater than one arranged for group drive. Particularly is this so in the face of the advantages obtained by the former method of drive.

The practice of using portable tools and bringing the tools to the work rather than the work to the tools, which is becoming so popular to-day is only a further development of the individually-driven motor tool idea. The portable tool, which cannot be operated unless it is driven by an individual electric motor, serves as an excellent example of what we should endeavor to accomplish in our efforts to make all our machine tools as simple and useful as possible. They should not be so arranged that they must always be in one particular location in a shop, for it may be desirable to use this portion of the shop, as time goes on, for other purposes, or possibly it will become necessary to crowd in additional machines of the same type as those already in use, and it is not every shop that is so arranged as to permit of the installation of additional tools without necessitating very awkward connections to the line shafting.

If the tools are all individually driven, this difficulty does not exist. While the individual method of electric drive provides a material reduction in the cost of power, this factor is not its greatest recommendation, the greatest benefit being derived from the elasticity which is obtained only by the adoption of this method. With individually-driven tools there is no longer any necessity for the rigidity of arrangement which obtains with shafting and belting, so that if it becomes necessary to rearrange the plant at any time, the expense is reduced to a minimum.

The valuable light which possibly the shop or factory building has been constructed especially to provide, can only be maintained by avoiding the adoption of any equipment requiring overhead construction which must necessarily prove a hindrance in this regard. A study of the evolution of the introduction of electricity into industrial plants, first for lights, second for cranes and elevators, third for constant-speed motors for group drive and lastly variable-speed motors individually connected to the tools, indicates clearly that the group method can hardly be compared with individual drive so far as advantages are concerned, or it would not have been necessary for manufacturers to spend their energies in developing the ingenious applications of individual motor-driven tool equipments, which have been offered to the market during, we may say, the past year or so.

While the driving of groups of tools by means of constant-speed belted motors permits of the elimination of very heavy belting and long line shafts, and in this regard is an advance towards the ultimate end—electric drive of individual machines—it does not and cannot offer that which is by far the most important feature of electric drive; i. e., the possibility of placing the speed control of the driven tool at the immediate will of the operator.

With these preliminary remarks as to general problems governing questions which have to be determined before a purchaser can properly select the electric system which is best suited for his own plant, I will pass now to a description of a particular system of electric drive which gives certain positive advantages due to its methods of variable-speed control. The system described is one designed and perfected by the Crocker-Wheeler Company, of Ampere, N. J.

The ordinary belt-driven tool usually has a speed range obtained by mechanical means, of from 20:1 to 50:1, with increased speed steps of about 30 to 50 per cent. The Crocker-Wheeler system for the multiple voltage operation of machine shops not only extends the speed range, but also reduces the speed increment per step to about 10 per cent., which has been found by experience to be as small an amount as would be desirable to use. This system is a method of electric power distribution at different voltages, which enables standard motors to be operated at various speeds by changing the potential of the current at the motor terminals. The generating plant supplies the highest voltage of the system. This voltage may be termed the primary and is divided by a three-unit balancing transformer into three unvarying voltages of unequal value, which are maintained between the wires of a four-wire circuit, various connections of which offer six different and distinct voltages.

The principle of which this system of speed control is based is that in a separately excited shunt motor the speed of the armature is proportional to the voltage supplied to its terminals. If this voltage remains constant the speed will remain constant even with varying load. It is the function of the balancer to maintain these voltages constant and to accommodate the unbalance of currents between the four wires of the distribution circuit. As the conditions of machine tool operation will result in the various motors of the system being nearly equally distributed on the circuits, the unbalanced currents will be but a small percentage of the total current taken by all the motors. The intermediate wires of the system are extended to the variable-speed motors only, the constant-speed and crane motors and the lighting being supplied in the usual manner from the outside wires at the generator voltage.

Those motors requiring variable speed are connected to the four-wire circuit by means of a controller of the drum type adapted for mounting on the tool in a place convenient to the operator. The action of this controller is such that as the drum revolves the armature terminals of the motor are connected in the proper sequence to the six circuits afforded by this system, and the travel of the drum from one position to the next is so quickened by the action of a spring that contacts are made and broken at a high rate of speed, preventing the formation of arcs and eliminating the possibility of the drum stopping between contacts. This gives six fundamental motor speeds, which are subjected to a further refinement by varying the motor's field strength sufficiently to cover the gaps between them.

The speed range obtained on the voltage points alone is 6:1, being proportional to the ratio of maximum to minimum voltages. The addition of field resistance points above the highest voltage points extends the total range of the controller to a value of 10:1. For exceptional cases the range may be increased to a maximum of 12:1, the proper range in any case being determined by the character of the machine and the work which it performs. The Crocker-Wheeler system as outlined has certain positive advantages of which the most important are the following: 1, variable speed, under instant control, over any range; 2, every speed constant regardless of the load; 3, controllers simple and convenient of attachment; 4, the horse-power of the motor but slightly in excess of that required by the tool; 5, output of machine tools much greater than when they are belt-driven; 6, easy of adaptation to existing shops with a two-wire system of electric power distribution; 7, employment of standard motors; 8, ability to maintain high cutting speeds due to superior facilities for manipulation.

Motors used in an ordinary shop equipment may be divided into Classes A, B, C or D, according to the nature of their duty. Class A is the constant-speed motors such as drive groups of small tools by shafting, this class being kept as small as possible consistent with best judgment based on a careful study of all of the advantages which should be credited to the individual drive idea in comparison with the one disadvantage which may or may not exist, that of a possible slight increase in first cost. In many cases, however, even this one disadvantage may be lost sight of in the face of the advantages which are to be obtained through flexibility of location and ease of manipulation. Class B, controllable-speed motors, generally of the series-wound type, as used on cranes. The duties which the motors in both of these classes have to perform is such that their demand for current is intermittent and often excessive, consequently they are best suited for connection to the outside mains and such speed regulation as they may require can be obtained by rheostatic control.

The other two classes, C and D, are controllable-speed motors for the drive of individual tools where the speed should be maintained constant at any one of a number of fixed values. Class C covers driving pressure blowers, punch presses, planers, etc., which demand approximately constant torque at all speeds, the horse-power diminishing with the speed. This characteristic of the tool being identical with the power characteristic of the motor on this system, the normal horse-power of the motor need not be greater than the maximum demanded by the tool.

Class D covers those motors operating lathes, boring mills, etc., where the torque increases as the speed diminishes. If the range required by these tools is to be obtained by using a motor through its maximum range, the motor would be very large and unnecessarily expensive. For this class a speed range of approximately 3:1 has been selected as a basis for the determination of the most suitable sizes of motors with respect to the duty which they have to perform. A motor, therefore, to give a constant horse-power throughout this range, must have a normal rating of about twice the horse-power required by the tool. This range, however, may be extended to cover the entire range required by the tool by using one or more additional gear runs. The method is an advantageous compromise between the use of an excessively large motor with no gears and a constant-speed motor with many gears.

The extreme facility of manipulation which this system affords enables the machinist to push his tool to the highest limit of cutting speed, thereby giving large increases in output. Results show that as much as 20 per cent. increase in output over a belt-driven tool may be obtained by this system of motor drive. As by actual test in commercial plants, it has been demonstrated that 2¼ per cent. increase is sufficient to warrant the outlay necessary for individual drive, the possibility of large saving in operating expenses through the adoption of this system is at once apparent.

Local Meetings of the American Electrochemical Society.

The first meeting of the New York Section of the American Electrochemical Society was held on January 26 in the Chemists' Club, New York City, the attendance being nearly 60 in spite of most disagreeable weather. The first meeting of the Philadelphia Section was held on February 5 in the Engineers' Club, of Philadelphia, the attendance being 11. As far as the papers presented were concerned, both meetings were a full success and the discussion which followed the reading of the papers was in both cases animated.

The meeting of the New York Section was opened by the chairman, Prof. Charles A. Doremus, who dealt with the success of the Society and explained why New York City should have a local section. Mr. A. von Isakovics acted as secretary.

In a paper on "The Commercial Electrolysis of Water," Prof. J. W. Richards gave a review of the various commercial systems for producing hydrogen and oxygen by the electrolysis of water. A solution of caustic soda, with iron electrodes, seems now to be generally used. To keep the products of electrolysis—oxygen and hydrogen—separate from each other is the main technical problem in the design of the cell. This is universally done by means of a diaphragm, but according to the nature of the diaphragm the following three classes may be distinguished: First, non-conducting porous diaphragms filling the whole cross-section of the cell, as in the cell of Schmidt; second, solid partial partitions of a non-conducting material, as in the cell of Schoop; third, metallic partial partitions, as in the cell of Schuckert. In the latter case the metallic partition does not conduct the current, since otherwise hydrogen and oxygen would be evolved at its two sides. This is at least the case as long as the e.m.f. at the terminals of the cell is kept low. Such partial metallic diaphragms are, of course, preferable to glass on account of durability.

In a paper entitled "Thermochemistry of Electrolytic Dissociation," Mr. C. J. Reed attacked a previous paper of Dr. J. W. Richards on the same subject and claimed that his calculation of the neutralization heat was essentially based on the assumption of complete dissociation, which contradicts his other views. Dr. Richards' method of calculating the formation heats, on the principle that it is an additive property, is claimed by Mr. Reed to be incorect in many cases. In the discussion which followed, Dr. Richards maintained his original position concerning the calculation of the neutralization heat and stated that the rule of Hess for calculating formation heats applies essentially to very dilute solutions. It is, of course, well known that this consideration does not apply to the case of insoluble salts.

In a paper on "Ferro Alloys," Mr. A. J. Rossi gave an account of his researches on the manufacture of ferro alloys in the electric furnace and discussed especially his method of reduction by means of aluminum. It is in principle similar to Goldschmidt's aluminothermic method, but while the latter uses aluminum in powdered form, Rossi applies the aluminum in waffles, ingots, scrap or the like, which are charged in the electric furnace. When the current is started, the aluminum melts in a very few minutes, and into this molten bath he then shovels the metallic oxides to be reduced. As applied to ferro-titanium, for instance, the method consists in charging in the bath of aluminum titaniferous iron ores, i. e., titanic oxide associated with iron oxide. Iron is reduced first, forming a bath in which the titanium reduced by the aluminum in its turn dissolves, yielding the ferro-titanium. Mr. Rossi exhibited a very interesting collection of ferro metals, which he had produced in the electric furnace, including ferro-titanium, ferro-tungsten, ferro-molybdenum, ferro-chrome, ferro-silicon, ferro-manganese, copper-titanium with accompanying slags.

A note by Mr. I. J. Moltkehansen referred to an observation which he had made in electrolyzing a concentrated silver nitrate solution with two platinum wires as electrodes. He obtained two deposits of similar appearance at both electrodes. Mr. Reed suggested that the anodic deposit might have been silver peroxide.

The meeting of the Philadelphia Section was called to order by Mr. Carl Hering as chairman, Dr. S. S. Sadtler acting as secretary. A paper on "Composition and Reduction of Voltages" was presented by Dr. J. W. Richards. It relates to the calculation of the e.m.f. in the case when two or more different chemical actions are simultaneously going on. For instance, if a solution of a mixture of copper sulphate and sulphuric acid is electrolyzed between copper electrodes, the question is what must be the voltages at the terminals of the cell. If a certain number of coulombs is consumed in depositing copper, while the balance of the coulombs evolves hydrogen, the energy of both reactions can easily be calculated. (The energy required for depositing copper is, of course, zero as long as the Joulean heat is neglected.) By dividing the total energy required for all the different reactions which go on by the total number of coulombs passing through the cell one gets what Dr. Richards calls the composite voltage. Some numerical examples were given by the author.

In a paper entitled "Formation of Hypochlorites," Dr. S. S. Sadtler discussed some experiments concerning the influence of the composition of a solution and the material of the electrodes on the formation of hypochlorite. The electrolyte was a salt solution containing an alkali and the results were given for different concentrations. He found peroxide of lead electrodes to be the best for his purpose.

In a paper entitled "Theory of Electromotive Forces," Dr. R. Gahl applied in an interesting manner the theory of electrons to the calculation of e.m.f's. The result which he finally reaches is the well-known formula of Nernst for the e.m.f. of a galvanic cell, but Gahl's method is novel in so far as he bases his considerations on the chemical equilibrium between charged ions, discharged atoms and electrons. For instance, in the case of the monovalent sodium ions he considers the chemical equilibrium between the charged sodium ion, the discharged sodium atom and the positive electron.

A brief note by Mr. E. W. Smith maintained that what is generally called overvoltage must be assumed to be contained in the second term of the Gibbs-Helmholtz equation which contains the temperature coefficient. Dr. Gahl doubted the correctness of this assumption since the Gibbs-Helmholtz equation assumes the discharge of the cell to be absolutely reversible, and the reversibility is doubtful for those processes which are concerned in what is generally called overvoltage.

Canadian Niagara Falls Power Development

In a report to the stock and bondholders of the Electrical Development Company, of Ontario, Limited, which has been printed in pamphlet form with a number of illustrations, an account is given of the present status of the work on the power plant being erected on the Canadian side of Niagara Falls, and which, when completed, will generate power for transmission to Toronto.

Vice-President and General Manager Frederic Nicholls gives an account of the organization of the enterprise and the general progress of the work. From this we learn that on January 29, 1903, an agreement was entered into between the Queen Victoria Niagara Falls Park Commissioners and Messrs. Mackenzie, Pellatt and Nicholls, granting rights to take water from the Niagara River at Tempest Point, for the purpose of generating electricity to the extent of 125,000 electrical hp. On the 18th of February, 1903, the Electrical Development Company, of Ontario, Limited, was incorporated under the authority of the Legislature of Ontario, with a capital stock of $6,000,000. At a meeting of shareholders of the company, held on March 21, 1903, the agreement made between Messrs. Mackenzie, Pellatt and Nicholls and the Queen Victoria Niagara Falls Park Commissioners, was acquired by the company.

Since that date no time has been lost in expediting operations in order that the enterprise may be income-producing at the earliest possible period. Contracts have been awarded for cofferdam, tail-race tunnel, wheel pits and electric generators, and preliminary plans have been completed for the construction of the power house. Contracts for the water wheels and head gates have yet to be let, but the engineering data for all of this work is about completed, and tenders will be called for at an early date.

The Toronto & Niagara Power Company, having the charter right to expropriate lands, has been equally active in securing a private right of way between Toronto and Niagara Falls, on which the pole line for the transmission of energy will be constructed. About 85 per cent. of the right of way, having a minimum width of 80 feet, has been purchased to date. The right of way has been located in such manner that in addition to the pole line provision is made for a double-track railway, should future developments warrant its use for such an enterprise.

With a view to providing manufacturing sites for those who may become purchasers from the company of power for industrial or electrochemical uses, some 530 acres of land have been purchased fronting on the Chippewa River, situate about two miles from the town of Niagara Falls, three miles from the confluence of the Chippewa and Niagara Rivers, and about 3½ miles from the point at which the Chippewa River has entrance into the Welland Canal. These lands have a river frontage of over 1½ miles. The purchase price averaged about $70,000 per acre. It is stated that the wisdom of this early purchase is evidenced by the fact that similar lands in the vicinity are now held at a great advance over this figure, caused no doubt by activity due to the development at Niagara Falls now under way.

Installment payments on the company's bonds have been promptly met and receipts have, up to the present, been in advance of expenditures. The cash balance at the credit of the company, in the hands of the National Trust Company, trustees for the bondholders, amounts at present to about $1,000,000. As all the works of the company are being pressed forward to completion simultaneously, progress payments will be required more rapidly in the future, but calls have been so arranged that ample funds will be available to meet all expenditures as the work progresses.

Mr. F. S. Pearson, consulting engineer to the company, gives a report of progress on the construction of your power plant at Niagara Falls.

At the time this work was commenced it was recognized by all those conversant with the plans that the greatest difficulties the company would have to encounter would be in the installation of the cofferdam and the commencement of the work on the main tail-race tunnels. It was considered by many that it would be impossible to carry out the work as outlined on the original plans. Both of these serious problems have been solved in a very satisfactory manner and without serious expense or delay.

It was assumed in the original estimates that the depth of the water would be about 8 ft. as a maximum on the line of the cofferdam, and in view of the fact that this dam was to be located in the midst of the rapids of the Niagara River it was expected that it would be a difficult operation to build a structure that would withstand the excessively rapid current. As the work on the cofferdam proceeded and it became possible to ascertain the depth of the river, it was found that there was 26 ft. of water, but even with this extraordinary depth and the rapid current, the work on the dam has proceeded continuously and at a rapid rate when the difficulties of construction are considered. The most serious part of this work is now completed and there remains only a short spur to connect with the shore in shallow and still water. The dam as constructed is thoroughly stable and secure, as one cannot feel a tremor in any portion of the work and it is evident that the dam is well designed for the purpose intended.

A long section of this dam was constructed over a portion of the river bed covered with very large boulders, on which it was necessary to place the cofferdam, fitted to the boulders as well as was possible under the conditions. Naturally a cofferdam built on such a sub-stratum would show great leakage, and it will require considerable work and time to stop the flow of water under the dam. An inspection of the work at the present time shows that very little water is leaking under the dam, even between these boulders, and there is no reason why the greater portion of these leaks should not be stopped. At the present time the amount of water coming through under the dam is not sufficient to seriously interfere with the construction of the work, as it could be handled by flumes and canals, if necessary. The larger portion of these leaks, however, will be stopped in the next few months, and before the forebay construction is commenced. It can be safely stated that this cofferdam represents as great an undertaking in this line of work as has probably ever been designed or constructed.

The plan for the tail-race tunnel requires a portal under the falls. There have been various theories regarding the condition under the falls, as there are, at times, noticeable explosions, apparently due to compressed air, and it was confidently predicted by engineers conversant with Niagara Falls and the work thereabout that it would be impossible to open a tunnel portal at the point selected on the plan. In order to reach the line of the main tunnel a subsidiary tunnel of about 650 ft. in length was required, and to ascertain the conditions under the falls, as well as to provide for dumping the debris of excavation, an opening was planned about midway of this tunnel. It was anticipated that some trouble might be caused by the water when this opening was made, and the anticipations were more than borne out by the facts, as long before an opening was effected the subsidiary tunnel was flooded with water, which leaked through cracks at the face of the cliff. For several weeks the contractor had a great deal of trouble in overcoming this difficulty, but finally, after persistent and very creditable work, an opening was effected, which has completely drained the tunnel, and also proven that it is perfectly feasible to place the terminal of the main tail-race tunnel at any point desired.

The character of the rock encountered in the subsidiary tunnel is a solid shale, thoroughly tight, and there is not water enough in the tunnel to supply the air drills. In most places the rock is absolutely dry. This is an indication that there will be no trouble in driving the main tail-race tunnel, especially in view of the fact that there is now an opening from the subsidiary tunnel which would drain any volume of water which might come in through a fissure in the rock.

With this opening under the falls assured, and the cofferdam practically completed, the two greatest difficulties in connection with this work have been surmounted. The progress of the subsidiary tunnel (something like 14 ft. per day) is an indication of the progress the contractor should make on the main tunnel. The contractor for the wheel pit is erecting a large and efficient plant for the construction of this pit, and it is evident that he proposes to push this work in every possible way.

On account of the magnitude of the installation and the immense volume of water required for its operation under maximum conditions of load, there has been a question in the minds of the engineers as to the volume of water readily available for the work. This question arose from the assumption that the maximum depth of the water in front of the forebay was only about 8 ft. Plans were under consideration contemplating the excavation of a deep channel in the river beyond the cofferdam limits to provide for a sufficient volume of water. Now that the cofferdam is installed, and the great depth of 26 ft. of water has been found, all questions regarding the supply of water have been set at rest, as it is evident that the amount of water available is several times in excess of that required. While the great depth of the channel has made the construction of the cofferdam much more expensive, it avoids a large expenditure in excavation and absolutely assures the company as regards its water supply, thus compensating for the greater cost.

The plans for the work in general are being completed and contracts have already been placed for the wheel pit, tail-race tunnel and generators. The plans and specifications for the water wheels and iron work about the power station and pole line will soon be ready, so that the contracts for these can be placed within a short time.

The location of this plant is very advantageous and when completed it will be equal in all respects to any that have been proposed or constructed at Niagara Falls. On account of its advantageous location the cost per horse-power will be exceptionally low. With a transmission line to Toronto of capacity sufficient to deliver 30,000 hp, the total cost per delivered horse-power at Toronto will be as low, if not lower, than that for any other plant of a similar nature that has been constructed. The company should also build up a large business in the vicinity of Niagara Falls and along its transmission line, and with the low initial cost the financial success of the company seems assured, as on account of the low cost of its power it should be in a position at all times to meet competition with other concerns and at prices which will realize a good net income.

Mr. W. T. Jennings, chief engineer of right of way, reports that the total distance between the generating station and Toronto is 75½ miles. The location has been selected with a view to the utilization of the right of way lands not only for electric power transmission lines, but for railway purposes, and in this respect it may be noted that the country traversed does not present serious engineering difficulties. Considering the advantages which may thus be obtained for very rapid rail transit, by electric power, between the Niagara River frontier and Toronto, the small additional distance over air lines between fixed points is inappreciable from an electrical transmission point of view, while for the railway of the future, with a train service rated at 100 miles per hour or more, it is obvious that the best alignment and gradients the country can economically afford are necessary.

A private right of way has been largely secured through the districts traversed, on a minimum basis of 80 ft. in width (with enlargements where necessary), to provide for pole transmission lines and for a double-track railway, while where forest land is passed through the right to cut down trees, etc., has been secured for such extra distances as may be advisable to insure freedom from accident, interruption to electric transmission or to train service. Tenders for fencing the entire right of way have been invited.

Electrical Engineering at Union University

During the winter term of 1904, non-students of Union University are admitted as special students in the following courses of lectures given by or under the auspices of the Department of Electrical Engineering: Post-graduate lectures in electrical engineering, by Chas. P. Steinmetz, professor of electrical engineering; general lectures in electrical engineering, by specialists of the General Electric Company and Dr. Steinmetz; engineering mathematics, by Dr. C. P. Steinmetz; electrochemistry, by C. A. Ernst, Ph.D., assistant director of Electrochemical Research Laboratory of the General Electric Company.

An indication of the excellent work being done at Union is given by the following list of lectures by specialists delivered during the fall term: "Introductory," by C. P. Steinmetz; "Magnetism and Induced Electricity," by R. Neil Williams; "Historical Development," by W. S. Andrews; "Direct-Current Machine Action and Application," by H. F. T. Erben; "Direct-Current Machine Calculation and Design," by W. F. Dawson; "Boosters and Variable-Speed Motors," by H. Bickerstaff; "Electrical Calculation of Alternating-Current Generators and Synchronous Motors," by W. J. Foster; "Electrical Calculation of Induction Motors," by A. E. Averett; "Mechanical Design of Generators and Synchronous Motors," by H. G. Reist; "Mechanical Design of Induction Motors," by H. G. Reist; "General Transformer, Boosters, Frequency Converters, etc.", by C. P. Steinmetz; "Alternating-Current Transformer," by W. S. Moody; "Potential Regulators," by E. F. Gehrkens; "Constant-Current Transformers," by M. O. Troy; "Reactors," by J. J. Frank; "Technical German," by R. Neil Williams.

New Telephone Patents.

THE MERCURY VAPOR COLUMN AS A TELEPHONE REPEATER.

Probably almost every electrical man is aware of the multitudinous attempts to solve the problem of the telephone repeater and many will recall the Glidden offer of several years ago of one million dollars for a practical apparatus of this type. The earlier suggested repeaters were all of the same kind, being a mechanical combination of telephone and microphone, with either the same or interconnected diaphragms. Such instruments appear all right in principle and in the laboratory they will repeat with more or less success. When, however, the current undulations to be repeated are received over a reasonably long line, approaching the requirements of practice, the received energy is so small, having been dissipated and attenuated from many causes, that its value on the far side of the repeater is almost always less than were the repeater entirely removed from the circuit. This result may be traced to the large mass of microphone parts which must be set into instantaneous motion, coupled with the fact that any sluggishness in their response means almost an entire loss of clearness.

The first step in the right direction and a very promising one was made some few years since in the repeater of Mr. Erdman, which abandoned any solid connection between the receiving and transmitting parts, substituting therefor a pneumatic connection. In brief, the receiving magnet was made to control the outlet of a

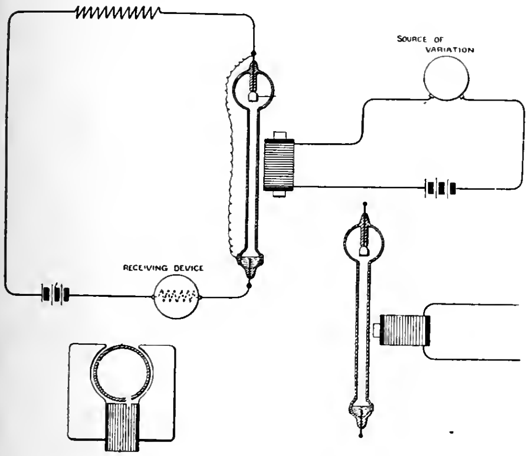


FIG. 1.—HEWITT VAPOR TUBE TELEPHONE REPEATER.

fine tube through which air was flowing at high velocity supplied from a receiver. Near the valve end the tube communicated with a chamber closed by a diaphragm which was connected to the microphone. By carefully balancing the valve of the receiving part and properly designing it, a very small received energy could be made to produce an enormous effect upon the repeating microphone; but this speed of response was too low and this repeater failed, because it muffled the speech. It therefore becomes apparent that some electrical or equally instantaneous means of associating the receiving and transmitter circuits must be found and this an association by which the energy of transmission is increased if a successful repeater is to be devised. Such means form the subject of a patent granted to Peter Cooper Hewitt and noticed briefly last week. According to the specifications, a mercury vapor column which seems to be lending itself to so many useful ends, is found to be very sensitive to a magnetic flux intersecting it, any variation in such flux causing its apparent resistance to change considerably. Now, it may be readily understood that if such a column can be made to maintain a constant resistance when supplied from a constant source of potential, then if it be placed in series with a telephone, no sound will be heard. Let, however, a receiver magnet, through the coils of which an undulatory voice current is flowing, be brought up to the column, and there will at once occur a disturbance in the first telephone due to direct resistance variations of the column. The patent drawings referred to in describing this combination are given in Fig. 1, which shows three possible arrangements of the receiving magnet; the first with the axes of the core and vapor tubes parallel; the second, with these perpendicular, and the third with the body of the vapor tube completely filling the interpolar space, probably the most efficient arrangement. Pactical trial only can probe whether or not this apparatus solves the troublesome problem of repeating on long lines; but, nevertheless, the possibility of a solution is made more evident thereby.

A NEW RECEIVER.

Now that the principles of good receiver design are quite generally known, very few radical departures are to be looked for, such improvements as are made being chiefly along the line of improvements in detail construction to slightly facilitate manufacture or repair. Such improvements are those described in a patent for a receiver just granted to Messrs. S. Sands and C. Cadden, of Cleveland, Ohio, and assigned to the Williams-Abbot Company. The novelty lies in two features. The first is the device for absorbing the mechanical stresses between the receiver and its cord. This is a stirrup attached to the magnet to which the cord braiding may be secured. The second is the provision of a threaded rubber annulus between the cap piece and casing proper. This annulus screws down upon the diaphragm, its external threads engaging threads upon the inside of the flange of the diaphragm cap of the casing proper. The cap is then mounted by engaging with threads upon the internal surface of the annulus.

DOUBLE-DIAPHRAGM TRANSMITTER.

Mr. E. B. Fahnestock, of New York City, has now made farther developments of the double-diaphragm transmitter, the details of the construction of this novel instrument being given in a patent recently issued. Probably a sectional view will be of best service for showing the arrangement of its parts, such as that given in Fig 2. This section is taken in a plane parallel to that of the mouthpiece. The outer cross-hatched portion is the casing into which the transmitter slides. This is so shaped as to form a shallow sound chamber for each of the two diaphragms. The part marked *C* is an internally-flanged ring, which serves as the foundation upon which the microphonic button is built. Secured to this on either side of the flange are the auxiliary diaphragm of mica, *N N*, which are pierced at the middle by the studs of the two metal-mounted carbon electrodes, *O*. Secured to the outer ends of these studs between a nut and spacing blocks are the diaphragm proper, *K K*. These are free at their peripheries, but are placed in recesses designed to prevent the direct access of the sound waves to the rear of them, a condition which the inventor states is conducive to clearness.

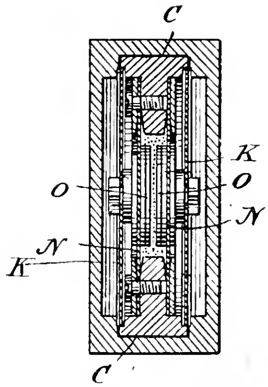


FIG. 2.—FAHNESTOCK TRANSMITTER.

CALL APPARATUS.

One would scarcely think that a telephone switch hook could do service as an automatic telegraphic sender, but nevertheless such a function has been assigned to it in an invention of J. D. Peachey, of East Orange, N. J. This invention provides that the starting of any call by a subscriber, denoted by his removing his receiver from the hook, will be followed at once by the registration by automatic telegraphic means of his number, in dot-and-dash code, upon a Morse register. To accomplish this signal the switch hook is given a long throw and moves under the influence of a heavy spring, the speed being controlled by a dash-pot. In its upward motion a contact piece attached to the hook trails over a series of properly spaced contacts through which the code signal is sent in. On the downward motion no contacts are made, as a deflecting spring throws the moving contact out of position. This particular type of signal would at first thought seem to be of no value; but it is probably designed to co-operate with its inventor's telephone fire alarm scheme, which has been already described in these columns.

PLUG EJECTING JACK.

A switchboard jack designed to automatically eject a plug inserted in it upon the sending in of a clearing-out signal has been patented by R. G. Dunfee, of Fostoria, Ohio. The ejection of the plug is accomplished by a spring which becomes compressed by its insertion, being latched until the current from the ring-off releases its trigger through the agency of the clearing-out coil. The apparatus is probably of far greater value in theory than in practice.

SELECTIVE SIGNAL SYSTEM.

Another step-by-step selective signalling system has appeared, this time in a patent granted to G. Babcock, of Chicago, and assigned to the Stromberg-Carlson Company. This system has some features not usually included in such systems, the most notable of which is an indicator to show the central office operator on disconnection whether or not she has restored the line to normal. Unfortunately, this signal is associated with the connecting cords and not with the abnormal line, and the operator in order to correct any indicated error, must remember which line the particular cord in question was last used with. In some cases the locating of the desired line would be very easy, but where the operator's load was heavy, the very condition conducive to the failure to restore lines, the task of remembering which line was forgotten would be a most difficult one.

American Lighting Development in Venezuela.

Some interesting contracts have just been placed here for various lighting equipments for Venezuela. A number of others have been decided upon and several orders are expected to be closed shortly for more American machinery to be installed in hydraulic and steam power plants in the same South American country.

Carlos G. Palacios, the chief engineer of the electrical end of the Caracas Gas & Electric Light Company, is now in New York on behalf of his company, and also for the Electric Light Company, of La Guayra, both of which concerns will be furnished with considerable American apparatus. Mr. Palacios was the introducer of American electrical machinery into Venezuela, where he has installed the majority of the leading plants—both water and steam power. Some twenty years ago he was connected with the old United States Electric Light Company, of Newark, N. J. The Caracas Company at present draws the bulk of its power—800 hp—from a 2,000-hp hydraulic plant, which is located at El Juaire, about 12 miles distant from the Venezuelan capital. In the city it operates a steam plant capable of developing 500 hp, and equipped with McIntosh-Seymour engines, General Electric generators, and Babcock & Wilcox boilers. This steam plant is to be considerably enlarged and an outfit of 1,000-hp capacity will be put in. Crossley gas engines—four of 250 hp each—will be employed to operate Stanley alternating-current generators of 200-kw capacity each. The lighting plant to be installed at La Guayra—the port of Caracas—will have an initial capacity of 3,000 incandescent and 250 arc lamps. The power house equipment will comprise a 14-in. x 36-in. Hamilton Corliss engine, direct-connected to an 80-kw generator of Stanley manufacture. The boiler will be of Robb-Mumford type, 125 hp. It is anticipated that this plant will be doubled in capacity within six months.

Cuidad Bolivar, an important commercial city of some 15,000 inhabitants, located in the extreme end of Venezuela, on the Orinoco River, is to have an up-to-date American lighting and power plant, whose capacity in the first instance will be 800 hp. Mr. Palacios will act in an advisory capacity to the promoters of the new enterprise, who are wholly Venezuelans. Power will be generated by steam.

Projects are also under way to utilize two important water powers in North Venezuela. In the vicinity of Macuto a town of some 3,000 population, there is located a water fall no less than 2,000 ft. high and calculated to be able to develop 5,000 hp. At Juan Diaz about the same head and capacity are available. It is also contemplated to take advantage of a large water power named the Mamo Falls, capable of developing more power than either of the other two, but with less head.

The lighting plant at Valencia, which is a steam one of 300 hp, having a McIntosh-Seymour engine and a generator of General Electric manufacture, is to be nearly doubled in capacity. At Maracaibo the lighting plant, whose capacity is 1,200 hp, is to be extended. The present equipment comprises McIntosh-Seymour engines, Root boilers and General Electric generators. The water power plant which lights Merida is to be doubled in capacity. The existing machinery develops 400 hp. The water wheels are of Pelton built, direct-connected to Stanley generators. At Tachira the 300-hp hydraulic plant—Pelton wheels and Stanley generators—is to have 500 hp additional equipment.

CURRENT NEWS AND NOTES.

NEW YORK ELECTRICAL SOCIETY.—The 241st meeting of the New York Electrical Society will be held at the American Institute, 19 West Forty-fourth Street, at 8 P. M., February 17. Mr. Ralph D. Mershon will lecture on "The Gas Engine for Central Station Service."

RADIOACTIVE DINNER.—The Technology Club, which is the New York Alumni Association of the Massachusetts Institute of Technology, had a "radium" banquet on the night of February 5. President Pritchett, of the Institute, made an address in which he expressed the hope that the day might come when the nation would draw on "Tech." for its administrators and leaders. The feature of the evening was a radium demonstration, the chief item being cocktails of fluorescent liquids rendered radioactive and glowing in the dark when lifted to the lips.

ITALIAN POSTAGE STAMPS.—As to the new Italian postage stamps noted in these columns last week, it is stated that the painter Michetti, who designed the new Italian postage stamps, has devised an ingenious detail for the two-centesimi stamps, which are in honor of Marconi—a telegraph pole from which the wires hang down useless. All the stamps were made at the desire of the King, who had come to the conclusion that Italy's stamps were no better than those of France, England and Germany, and did not reflect honor on a country known as the home of classical art. The other electrical stamp does honor to Volta.

PURIFYING JUICES.—A patent granted to Messrs. Alexander Kollrepp and Alfred Wohl, of Berlin, Germany, refers to some improvements in the electrolytic treatment of sacchariferous solutions of any kind, as juices of beet root, sugar cane or refinery juices. Essentially, the process of the inventors consists in the separation of the alkali by "electrodialysis," or by amalgamation on a mercury cathode, and in the binding of the acids, liberated at the anode, by basic compounds of lead oxide or zinc oxide or hydroxides of thin metals, suspended in the juice. The employment of saccharate of lead for the latter purpose is especially recommended.

CHICAGO INSTITUTE MEETING.—The Chicago branch of the American Institute of Electrical Engineers announces a "Telephone" meeting for February 16, 1904, at the usual time and place, 1741 Monadnock Block, at 8 P. M. This meeting was postponed from February 2, the date first announced. The general subject of the meeting will be the "Automatic Telephone Exchange." Two papers will be read and discussed at that time. The "Economics of the Automatic Telephone Exchange," by F. J. Dommerque, and "Two Methods of Giving Toll Service with Automatic Exchanges," by Charles S. Winston.

GREAT FIRE AT BALTIMORE.—On Sunday, February 7, the city of Baltimore was devastated by a fire which continued burning 48 hours and destroyed property to the estimated value of $150,000,000 to $200,000,000. The fire began in a wholesale dry goods store and is reported to be due to the explosion of gasoline kept in a tank and employed to run an engine. Very few details are obtainable as we go to press, but it would appear that the Western Union, Bell Telephone, Postal Telegraph and United Light & Power and Railway systems have suffered very severely. Some of the plants have been wiped out or wholly destroyed, and there has been an urgent call for new apparatus.

CONSTRUCTION OF PLANTÉ PLATES.—A patent granted on February 2 to Mr. Joseph Bijur, of New York City, who has been active in recent years in developing a new form of storage battery, relates to the mechanical construction of the plates. His battery is of the Planté type, very minutely divided strips, shelves or shreds of lead (afterwards to undergo a process of formation) being autogenously united with lead or lead-antimony supports. His present patent relates to the arrangement of the strips in such a way as to insure that the crowding effect of the layer of active material produced afterwards during formation does not lessen the strength of the plate.

TRAMPS AND TELEPHONES.—One of the many benefits of the use of the telephone in rural districts is the check upon the lawless tramp. In one county in Indiana the tramp nuisance has been largely mitigated by the prompt enlistment of the Sheriff's aid by telephone. Out there it is the belief that where there are telephones tramps cannot abide.

RADIUM IN MONOPOLY.—The *Matin* and other Paris newspapers are loud in demanding that radium remain a specific French article, which all the world shall buy here. "Radium," say the papers, "is a French discovery, and we would be foolish to allow other nations to profit by the genius of our scientific men." At the same time Austria is being savagely attacked "for keeping up the price of the raw material"—in order to protect her Bohemian glass industry.

N. E. L. A. ANNUAL VOLUME.—The National Electric Light Association has just issued its volume of transactions containing the full report of the Chicago convention of 1903. It is a superb record in every way and reflects great credit upon all concerned. It embodies, moreover, a great deal of valuable matter in the shape of papers, discussions, reports, answers to questions, etc. The main part of the volume embracing the report proper runs a length of 538 pages, but there is a huge appendix inclusive of two or three appendices making at least another 300 pages. The members of the Association, if they got nothing else, might well rest satisfied with this evidence of the Association's activity and influence.

NATIONAL ELECTRICAL CONTRACTORS.—The National Electrical Contractors of the United States held their quarterly meeting at the New Willard Hotel in Washington, D. C., on February 1. After the morning session the delegates were entertained at luncheon by the local members of the Association. During the day they visited the White House and were presented to President Roosevelt. Mr. E. McCleary, of Detroit, president of the Association, made a short address, which was responded to by President Roosevelt in a very happy speech. The members expressed themselves as highly pleased with their reception. There was a good attendance at the meeting. The annual meeting will be held at St. Louis on September 13, 14, 15 and 16 next.

HARDENING ALUMINUM.—Since the commercial introduction of aluminum an important problem has been the discovery of means for hardening the material so that it might enter into uses which the softness of the pure metal precludes. It is claimed that a discovery of such a means has recently been made by W. Rubel, of Germany, the process of hardening being a chemical one. The new metal is called "meteorit" and is claimed to retain all the good qualities of pure aluminum and possess important new ones. The specific gravity is practically equal to that of aluminum; the metal is not affected by acids, the atmosphere or sea water; it can be cast like iron, has 8 per cent. greater tensile strength than cast iron, and can be recast without losing its qualities. It can be rolled cold and does not become brittle when hot; it has nearly the conductivity of copper, will keep a high polish, and can be plated. We understand that the American patents for this new metal are now being offered for sale.

TROUBLE IN KOREA.—On January 24 the United States State Department at Washington received official information of an attack by a mob of native Koreans on an electric car because it had killed a Korean. The news came in the following cablegram received from Minister Allen at Seoul: "This morning on the electric railway, which is the property of American citizens, a Korean was accidentally and unavoidably killed. Thereupon a mob of natives attacked and partially destroyed the car. The operators of the car would have been injured had it not been for the presence of mind and action of our guard, and a serious riot would have occurred." Although there have been previous reports of disturbances in Korea, this is the first mob attack made on the property of Americans. The railroad is owned and operated by Americans, H. R. Bostwick, of San Francisco, and H. Collbran being its principal officers. It runs through the heart of Seoul. The United States Legation guard now consists of 100 marines. The reinforcement of this guard has been urged, and could be effected in a week's time by details of marines from the Philippines.

LETTERS TO THE EDITORS.

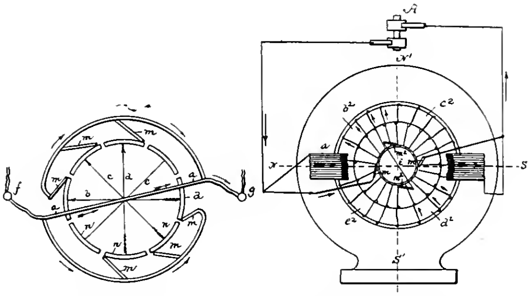
Invention of the Alternating Current Commutating Motor.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest in your issue of January 16 the note in the Digest (page 143) in regard to the controversy between Mr. Latour and Messrs. Eichberg and Winter regarding the priority of invention of the motor in question. The interest aroused in this subject will perhaps justify a suggestion from me as to the solution of the puzzle, "who is the original inventor?"

As there has been much work done in alternating-current commutating motors in the past decade, I had the suspicion that the fundamental principle of compensation applied in different ways in the Latour and Eichberg-Winter motors, was embodied in some other machine before. My suspicions were confirmed by finding United States Patent No. 476,346, filed on November 14, 1888, by Mr. M. J. Wightman and granted in June, 1892, which describes and illustrates fully the actual Latour compensated motor, not only in principle, but in construction.

The drawing and the principal points of this patent are sufficient to demonstrate that the inventor in 1888 was guided to study and



WIGHTMAN ALTERNATING-CURRENT COMMUTATING MOTOR.

propose his motor by the same motive that guided M. Latour in 1902. To quote from the specifications: " . . . . a successful alternating-current motor must have very little self-induction. The difficulty in using an ordinary series or shunt motor for alternating current comes from this cause. . . . . . . An alternating-current motor consisting of a closed circuit armature having opposite commutator brushes maintained in position approximately ninety degrees from the main brushes and connected directly with one another, said main brushes being connected to a source of alternating current, etc. . . . . "

Further comments are unnecessary, but it may be added that for the second time in recent years an old compensated alternating-current motor (or motor provided with means for diminishing the self-induction of the armature) is successfully resuscitated by virtue of the improved construction of electrical machinery. This was the case with the George-Heyland and now with the Wightman-Latour-Winter-Eichberg motors. The conclusion is that a study of the patents records is to be recommended to inventors in place of text-books.

CHICAGO, ILL. VICTOR MARTINETTO.

[The specifications of the Wightman motor refers to the patent of Elihu Thomson of May 17, 1887, on the repulsion motor, and state that, while the principle of the repulsion motor is utilized, "the alternating current in both field magnet coil and armature are both directly derived from an external source of current, which current is led through the two members in such direction that the synchronous alternations will each cause repulsion between them. The source may be of any desired nature—as, for instance, an alternating dynamo or a transformer. In practice, the best results are obtained by connecting the field magnet coil and armature in multiple to the alternating-current wire leading from the source. A simple form of motor embodying the invention would consist of an armature and field magnet such as shown in the [Thomson] patent before referred to, the connections to the open-circuited coils of the armature being made such that as they successively come into circuit with the source they will carry alternating currents from the same, each of which will be in opposite direction to the simultaneously-flowing alternating current in the field magnet coil. . . . The principle of my motor is to cut out of action those portions of the motor which have great self-inducion. This can only be done by utilizing the repulsive effect and throwing away the attraction or using its self-inductive effect to take coils out of circuit." The essential point of the four claims of the patent is, as stated in claim 3, "a commutator by which the armature coils in one-half of the magnetic field or fields are cut out of circuit, the coils in the remaining half being alone used for producing the motive power."—Eds.]

Distribution of Gas Power.

To the Editors of Electrical World and Engineer:

Sirs:—In view of the fact that large gas engines are now practical as prime-movers, the thought suggests itself that gas could be used to distribute power over large areas.

Take, for instance, a large urban railway system, it seems possible that instead of having one or more large central stations delivering high-tension alternating currents to rotary sub-stations, that a large gas plant could be used which could be connected by pipe lines to sub-stations, these sub-stations to contain gas engines running generators feeding the lines as at present.

It seems that a plant of this description would have advantages over the present system, namely, immunity from break-down, to which the present high-voltage distribution systems are liable, since the primary distribution of energy would be made by pipes laid underground. The gas plant would also produce by-products which could be disposed of at a profit, and there would be a saving in fuel costs on account of the higher efficiency of energy transformation in the prime-movers, etc.

St. Louis, Mo. J. D. Edwards, Jr.

[A number of patents have been issued to Mr. George Westinghouse on systems of gas distribution in connection with electrical generation. Among the patents are one or more relating to electric traction work which cover the automatic starting and stopping of gas engine sub-station plants through contacts made by an electric car approaching or receding from the block served by the plant.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Tandem Connection of Induction Motors.—Danielson.—An illustrated article on the use of induction motors in rolling mills and in iron works in general. In a large Swedish iron works induction motors are used throughout, most of them being of the ordinary type, so that their speed cannot be easily varied. One motor, however, is used which, without losses in a rheostat, can be operated at the nearly synchronous speeds of 428, 375 and 333 r.p.m. The machine consists of a combination of two motors; the main motor, which is an ordinary 14-pole induction motor, and an auxiliary

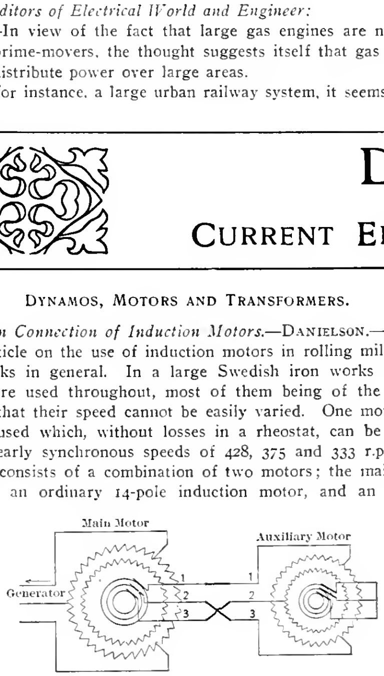


FIG. 1.—TANDEM CONNECTION OF INDUCTION MOTORS.

motor, which can be operated as well as a two-pole or as a four-pole motor. To get a speed of 428 revolutions the main motor is operated alone, while the auxiliary motor is without current. To get 375 revolutions, the auxiliary motor is connected so as to act as a two-pole motor and is connected in tandem with the main motor. To get 333 revolutions, the auxiliary motor is connected so as to act as a four-pole motor and is connected in tandem with the main motor. The power is always 150 hp. At 333, 375 and 428 revolutions and full load the efficiency is 87, 88 and 89 per cent. and the power factor 81, 83 and 92 per cent. It is necessary to design the

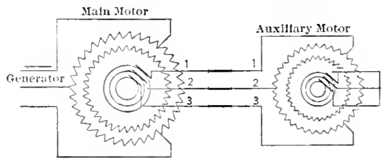


FIG. 2.—TANDEM CONNECTION OF INDUCTION MOTORS.

auxiliary motor so that the leakage is very small and the magnetizing current is also small. In the above motor only the direct tandem connection is used. If one would also apply the so-called differential tandem connection it would be possible to get with the same motor two other speeds, namely 500 and 600 r.p.m. It would only be necessary to provide the rotor of the auxiliary motor with slip rings. The author finally discusses the following three possible tandem connections between a main motor and an auxiliary motor. Fig. 1 shows the direct tandem connection; Fig. 2 shows the differential tandem connection in which the main motor is connected to the supply network, while Fig. 3 shows the differential tandem connection in which the auxiliary motor is connected to the supply network. The arrangement of Fig. 2 gives a better efficiency than that of Fig. 3, but in Fig. 2 the motor does not run up by itself to the desired speed while it does so in Fig. 3.—*Elek. Zeit.*, January 21.

Leakage Factor of Induction Motors.—Breslauer, Zorowski, Hobart, Behrend.—In his book on the induction motor, Behrend had given the following formula for the leakage factor: It equals a constant multiplied by the ratio of the radial depth of the air-gap to the polar pitch. This "constant" varies, however, somewhat for different conditions of design. In a recent paper of Hobart (Electrical World and Engineer, January 25), the variation of this "constant" was discussed in detail and curves were given for the same for completely closed and for wide open slots, with varying

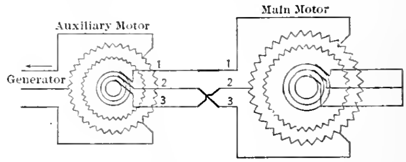


FIG. 3.—TANDEM CONNECTION OF INDUCTION MOTORS.

ratio of the radial depth of air-gap to the polar pitch at air-gap. In connection with this paper of Hobart, which was also published in *Elek. Zeit.*, a discussion of Behrend's formula has been started in the correspondence columns of the latter journal. Breslauer attacks the assumption that by increasing the radial depth of the air-gap, the leakage factor should always become worse. He refers to former researches in which he has shown that if the air-gap is increased, the magnetizing current must correspondingly increase, while the short-circuit current does not remain constant, but also increases to a certain degree. Under certain conditions the increase of the short-circuit current may be even greater than that of the magnetizing current, so that with an increased air-gap the overload capacity and the maximum power factor may be increased. If the rotor is fully removed he has found that the short-circuit current generally increases by 30 or 40 per cent. He thinks that Behrend's formula should be used with caution, since it supposes that the short-circuit current remains constant with varying air-gap.—*Elek. Zeit.*, November 26. Zorowski agrees with Hobart that the use of too great a rotor diameter is a mistake, but he denies that the reason is that the power factor would be too small; he thinks the reason is based on considerations of economical design. He claims that Hobart exaggerates the influence of the "free" winding on the leakage, and that the poor power factor (0.83) in Hobart's example is due to bad design. For the predetermination of the leakage factor of induction motors he has found Niethammer's method to be the most exact one, in which the magnetic reluctances of all leakage fields are calculated.—*Elek. Zeit.*, December 3. Hobart replies to Zorowski that the motor given by him as example was not as an example to show; that the diameter was much too large and the length much too small, and that a better power factor would have been produced if the dimensions had been correspondingly changed. He thinks that Zorowski and many other designers underestimate the influence of the "free" length upon the leakage.—*Elek. Zeit.*, January 7. Behrend replies to Breslauer that the latter's experiments (which showed that the magnetizing current increased with increasing air-gap) were made with a motor with closed slots and the air-gap was increased, the iron cross-section in the bridges at the sides of the slots was also decreased and the magnetic reluctance of the field of self-induction was increased. It is self-evident that under such conditions the short-circuit current must become greater. But this is a case which is of no practical importance and which is not intended to be covered by his formula. What is of importance is to know how the short-circuit current varies, if the air-gap is changed, without changing the form of the slots and the thickness of the bridges. His formula was based on experiments with rotors of different diameter, but of the usual form of slots. He has now repeated these tests and has corroborated his old results. He has found that Breslauer is wrong in stating that the short-circuit current is greater with the rotor removed than under normal conditions. He has tested all new types of induction motors designed by him and has found that the stator consumes about the same short-circuit current when the rotor is removed or when it is in place. The differences in the current depend much more on the type of winding than on the fact that the rotor may be removed.—*Elek. Zeit.*, January 21.

Single-Phase Motor.—SCHÜLER AND MÜLLER.—Two communications criticising the single-phase motor of Corsepius recently noticed in the Digest. Schüler remarks that the motor is really no single-phase motor, but a two-phase motor in combination with a single-phase-two-phase converter. It has long been known that an ordinary single-phase motor can be used for changing single-phase into polyphase current. While Corsepius' motor is theoretically interesting, it has too great practical disadvantages, being expensive and having a poor power factor. From the figures given by Corsepius his motor has a power factor of 0.56 at full load, which may, however, be partly due to the imperfect design of the experimental motor. There is at present a practical need for single-phase motors with a great starting torque and also for single-phase motors which start with a slight torque and a very small starting current (larger motors in connection with lighting systems). For both applications he believes the commutator motors to be very suitable. He does not think that Corsepius' motor can compete with the latter. It is now possible to build alternating-current commutator motors which, with regard to sparkless running of the brushes, can be compared with good direct-current motors. Müller also remarks that during starting period the auxiliary motor of Corsepius is nothing but a converter which supplies two-phase current to the main motor, so that the latter starts in the same way as a normal two-phase motor. The auxiliary motor must furnish during this time the whole energy for the second phase and can, therefore, not be too small if it shall not be heated too much or fall out of stop.—*Elek. Zeit.*, January 21.

REFERENCES.

Non-Synchronous Single-Phase Motor.—EICHBERG.—A communication, in reply to Görges, on the theory of the single-phase motor, and especially on the "cross field." This has here another function than in the direct-current motor, in which the cross field may be diminished without diminishing the action of the motor. On the other hand, in the single-phase motor the cross field which is produced is the real magnetic field, which, together with the ampere windings of the stator winding, produces the torque.—*Elek. Zeit.*, January 14.

Diagram of the Induction Motor.—HEYLAND.—Some theoretical and historical notes on the development of the circular diagram of the induction motor. He says that what is now called the Ossana diagram was already given by him in his first publication on this subject.—*Elek. Zeit.*, January 21.

LIGHTS AND LIGHTING.

Incandescent Lamp of High Economy.—BRESLAUER.—In a paper read before the Vienna Electrical Society he exhibited a new incandescent lamp patented by Just, which is claimed to represent an exceedingly important progress in electric lighting, since the lamp is claimed to use only half the current per candle than the carbon filament lamp. Such lamps have been built for 30 candles and 110 volts with a useful life of 250 to 300 hours and a consumption of 1.7 to 2 watts per candle. Two such lamps of 30 candles were exhibited by the speaker. The commercial manufacture of the new lamp, "the filaments of which are treated with an addition of boron nitride," is said to be neither more difficult nor more expensive than that of carbon filament incandescent lamps. To a question whether lamps for 16 candles and 110 volts have been made he replied that the manufacturers have not yet succeeded in doing so, but they hope to be able to build this normal type in the near future. The manufacture of 16-candle lamps for voltages up to 50 volts is, however, already possible.—*Elek. Zeit.*, January 21.

Osmium Lamp.—LOMBARDI.—An account of an investigation in which he measured the temperature of the filament of the osmium lamp by the same method which Weber had applied for the investigation of the carbon incandescent lamp. He first gives a summary of Weber's theory. Weber had found that the temperatures corresponding to the normal brightness of a great many different carbon filament lamps were all in the interval between an absolute temperature of 1565° and 1586°. Only for lamps with very strong brightness, or for lamps with thick filaments, which can be operated without disadvantage at higher temperatures and with greater economy, the normal temperature was found about 40° higher. The present author concludes from analogous measurements with the osmium lamp that the temperature of its filament at normal brightness is about 1435° (apparently meaning absolute temperature, which would correspond to 1162° C.), this is about 135° less than the normal temperature of the carbon filaments of ordinary incandescent lamps. To explain that nevertheless the economy of the osmium lamp is much better than that of the carbon filament lamp he takes recourse to Weber's theory, according to which the economy of an incandescent lamp depends upon two independent quantities, namely, the absolute temperature and a characteristic value, called by him the "illuminating capacity" (Leuchtvermögen). If operated at an equal temperature between 1400° and 1500° absolute temperature, he concludes that the osmium lamp would have an economy 9.1 to 12.5 times better than that of the carbon filament lamp. He considers his measurements with the osmium lamp to be an excellent confirmation of Weber's theory. The main result of practical importance is that the considerable improvement of economy, observed with the osmium lamp, is not due to an increase of temperature, but exclusively to the considerable difference between the "illuminating capacity" of osmium and carbon. It is, therefore, not impossible that other substances which are much cheaper and have a high melting point and are more rigid at high temperature can be used for the manufacture of incandescent lamps.—*Elek. Zeit.*, January 21.

Incandescent Gas Light and Electric Arc Light.—A note stating that an official report of Seggel and Eversbusch concerning the best lighting system for the Bavarian public schools had been in favor of incandescent gas light. To counteract this the Schuckert Company had presented another report by Lehmann-Richter, giving the results of comparative tests with two arc lamps or 14 gas incandescent lamps in a school room. The illumination was good in both cases and sufficiently uniform. The electric light did not deteriorate the air nor increase the temperature considerably. With gas incandescent light the temperature at the height of the pupils' eyes was increased in three hours about six degrees, while the carbonic acid contents of the air was increased five times. This is thought to be more than permissible for sanitary reasons. The cost of operation of the Welsbach lights is smaller than that of the arc light in the beginning, but after a short use the cost of operation of the Welsbach mantles becomes as high as that of the arc light.—*Elek. Zeit.*, January 21.

REFERENCES.

Electric Arc.—SCHULZE.—An account of an experimental investigation on the electric arc between metal electrodes or between a metal and a carbon electrode, and especially on the voltage loss in the arc. To explain his results the author brings forward the hypothesis that such quantities of electricity, as used in lighting currents, can go over from a solid body or from a liquid into a gas only in connection with molecules of the solid body or the liquid; that is, only under the condition that the latter body evaporates.—*Ann. d. Phys.*, Vol. 12, 1903, page 828; abstracted in *Elek. Zeit.*, January 21.

Electric Arc.—STARK.—An account of an investigation in which the author endeavors to elaborate the view that in the electric arc positive and negative ions are the carriers of the electric current. One of his principal assumptions is that in the arc light the "negative electron ions are obtained from the cathode itself, not by ionization, but by electrification." The cause of the emanation is the high temperature of the cathode.—*Ann. d. Phys.*, Vol. 12, 1903, page 673; abstracted in *Elek. Zeit.*, January 21.

POWER.

Thury High-Tension, Direct-Current Power Transmission.—In a description in the Lond. *Electrician* of the power transmission between St. Maurice and Lausanne, the opinion had been expressed that a transmission on the series direct-current system is "hopelessly out of date." The Compagnie de l'Industrie Electrique, which had installed this transmission, contradicts vigorously and refers to the experience at Lausanne (where the very peculiar combination of the Thury system for transmission to the city with three-phase transmission within the city is used). It is stated that since the day of putting the installation into service, in July, 1902, until now the high-tension, direct-current transmission "has not been interrupted one hour for reasons of failure of the electric plant, while the secondary distribution, which is carried out with alternating currents at a pressure of 3,000 volts only, has had to be stopped several times on account of failures of the transformers or of the line." It appears that the Thury system is considered especially suitable for large power transmissions and for long distances.—Lond. *Elec.*, January 22.

Power in Mines.—CAMERON.—An illustrated article on the use of electric power in an oil mine in the Lothian district in Scotland. Three-phase induction motors are used for breaking, hauling, pumping, etc. Their great reliability is emphasized and it is mentioned that a 30-hp induction motor is employed to drive gas-exhausters in the distillation plant, and has been running for six months without a single stoppage, and for most of this time, without stand-by power. Any stoppage for a moment of these exhaust fans would be extremely serious, since the gases would rush back into the retorts and cause an explosion. For traction two locomotives are used, supplied with 500 volts direct current from a trolley wire. The results of the introduction of electric power have been a great reduction in coal consumption, as compared with many mines in the neighborhood: economy in labor, since the induction motors practically do not need attention; greater elasticity, cleanliness and convenience.—Lond. *Elec. Rev.*, January 8.

REFERENCES.

Drilling and Riveting Machinery.—PERKINS.—A fully illustrated article on portable electric drilling and riveting machines for use in shipyards. He distinguishes the following three types: Those operated by electric motors without electromagnetic devices for holding drills to plates; those with such electromagnetic devices, and electro-pneumatic drills and riveters which use electricity only to hold the machine against the plate to be riveted.—*Cassier's Mag.*, February.

Water Power Plant in Greece.—GUARINI.—An illustrated article on the first hydroelectric plant of Greece, at the foot of the mountain of the Muses. There are two 130-kw, 5,000-volt, three-phase alternators mainly for use in connection with a pumping station.—*Eng. Mag.*, February.

TRACTION.

Surface Contact System.—A description of the "G. B." surface contact system, which is being used on an experimental line in England. The bare conductor, consisting of stranded galvanized iron cable, is drawn through plain stoneware pipes, and is suspended at convenient intervals by vitrified clay insulators. Every 7 ft. 6 in., corresponding to the distance between studs, a short vertical earthenware tube is cemented to the main horizontal pipe, as shown in Fig. 4. Into this vertical portion of the pipe system the laminated stalk of the stud is let, the upper portion of the intervening space between it and the tube being subsequently filled up with bitumen, a packing of jute yarn preventing this material from falling through.

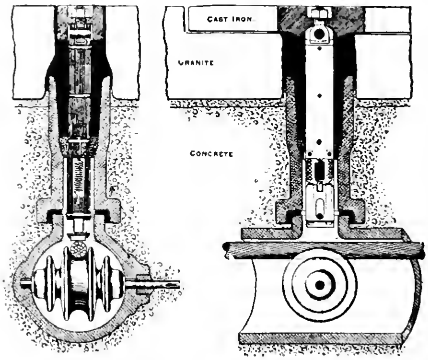


FIG. 4.—SECTIONS OF STUD.

A loosely fitting contact plunger, consisting of a laminated body and a carbon contact piece, slides in the brass-lined fork of the stalk. It is electrically connected to the stalk by flexible copper conductors and is held up from the cable against the force of gravity by an insulated phosphor-bronze spring. The stalk is connected to the cast-iron stud by a somewhat flexible joint, but this does not prevent it from making good electrical and magnetic contact. A recessed granite block receives the stud, which is level with the track. Each car is provided with a magnet rigidly suspended beneath the car and a battery of accumulators which serves for starting only, being charged during ordinary running. One pole of the magnet is in the form of two parallel iron bars, suspended at a distance of about two inches above the center of the track. Between these two bars are a number of iron tongues, suspended by

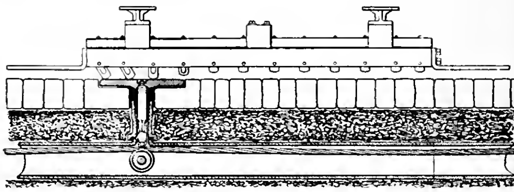


FIG. 5.—CURRENT-COLLECTING DEVICE.

springs, but free to move a considerable distance up and down. These are all connected at their lower ends by one flat chain belt, about 5/8 in. wide, which is kept parallel to the track at a distance of approximately 3/8 in. by the springs and tongues referred to. In order to have a continuous supply of current, the belt is made longer than the distance between any two studs. As the car comes over each stud, both the flexible chain belt and the sliding plunger are attracted downwards, and the former, on coming in contact with the stud, completes the electric circuit. In case the stud should remain alive after the chain belt has passed it, the supply is interrupted by means of chains fixed to the end of the car and trailing on the track, coming in contact with the live stud and causing a maximum cut-out on the car to operate.—Lond. *Elec.*, January 8.

Electric Traction on Trunk Railroads.—VANDEVILLE.—An article the greatest part of which deals with a comparison between the following two Italian electric railways: The Lecco-Sondrio-Colico & Chiavenna road (105.4 km, three-phase transmission, at 20,000 volts to transformers along the line, which reduce the voltage to 3,000, at which pressure three-phase motors on the trains are supplied), and the Milan-Porte Ceresio road (73.02 km. three-phase transmission at 12,000 volts to converter sub-stations, the trains being supplied with 650-volt, direct-current from a third rail). Both railways are in commercial operation. The author concludes that the only advantage of alternating-current traction is the use of high voltage for long-distance lines. However, a direct-current system can also be used over a comparatively long line, if a series system is used. The motors may easily be constructed for 1,000 volts, and by using four motors on a car, couple in pairs of two in series, a voltage of 2,000 may be used on the line. He, therefore, thinks that the superiority of the alternating current begins only when a voltage of 3,000 to 10,000 is to be used.—*L'Eclairage Elec.*, January 23.

REFERENCE.

Electric Traction on Trunk Railways.—BONNIN.—The first part of an article in which the author gives considerations on the future of electric traction on trunk railroads. In order to use the present railway cars, it will be necessary to employ electric locomotives, and the problem resolves itself into two questions: that of the cost and that of the system of current to be employed. The author begins to discuss the second question, but does not reach a decisive result in the present installment.—*La Revue Tech.*, January 10.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Cologne Station and Double Tariff.—OVERMANN.—A paper read before the Cologne Electrical Society. The city has now two electric stations. The one plant contains four 500-kw machines, the second station four 1,000-kw machines. The ratio of the sold kilowatt-hours to the available kilowatt-hours was 15.5 per cent., 24.5 per cent., in 1900, 1901 and 1902, respectively. It is thus seen that the load factor has only recently been increased, due to a lower rate for electrical energy. Data are given on the financial results during the last seven years, and it is shown that even if only a small profit is made per kilowatt-hour a considerable increase in the sale of electrical energy produces good financial returns in general. There is now used a double tariff, according to the time at which the energy is used. During the time of reduced rate 5 cents is charged per kilowatt-hour for use up to 1,000 kw-hours; for 1,000 to 2,000 kw-hours the first 1,000 kw-hours are charged $50 and every further kilowatt-hour 4.5 cents, etc.; for more than 20,000 kw-hours the first 20,000 kw-hours are charged $690 and every further kilowatt-hour 2½ cents. During the hours of the higher tariff 12½ cents are charged per kw-hour up to 1,000 kw-hours. For 1,000 to 2,000 kw-hours the first 1,000 kw-hours are charged $125 and every further kilowatt-hour 11¼ cents, etc.; for more than 40,000 kw-hours the first 40,000 kw-hours are charged $2,850 and every further kilowatt-hour 3¾ cents. The time of the higher tariff is in January, between 4.30 P.M. and 9 P.M.; in February, 5.30 to 9.00; in March, 6.30 to 9.00; in April, 7.30 to 10.00; in May, 8.00 to 10.00; in August, 7.30 to 10.00; in September, 6.30 to 10.00; in October, 5.30 to 9.00; in November, 4.30 to 9.00; in December, 4.00 to 9.00. At all other times the reduced rate is charged so that during June and July this lower rate is always charged. No difference is made whether the energy is used for lighting or power purposes.—*Elek. Zeit.*, January 21.

Stepney.—An illustrated description of the Stepney Borough Council electricity works, which is worked in conjunction with a refuse

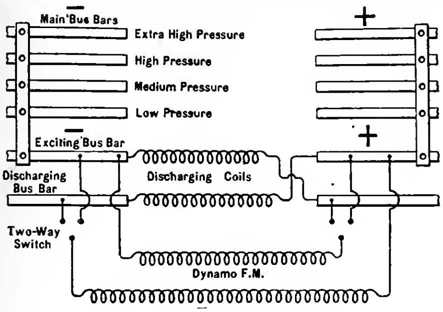


FIG. 6.—DIAGRAM OF CONNECTIONS.

destructor which, however, can furnish only a limited amount of steam. The plant contains four 275-kw and one 500-kw dynamos. The arrangement of the switchboard is interesting and is shown in Fig. 6. The positive and negative panels are each provided with four main bus-bars. By means of short bars at right angles to these, and suitable plugs and sockets, any feeder can be plugged on to any bus-bar. Similarly, separate bus-bars may be employed for separate generators, or they may all be plugged together. This arrangement permits of feeders which supply distant points being raised to a higher potential than those supplying points close to the station. The dynamo and feeder cables are so arranged as never to come into contact. There are two smaller bus-bars below the main bus-bars, the top one supplying the exciting current, and the lower one being called the "discharge bar." Instead of employing a separate coil for each dynamo for damping the rises of potential due to self-induction obtained when breaking the field, only two coils are used for all machines in the station. According to the direction in which the fields are wound, they are connected up as shown in the diagram, and the result is a considerable simplification and reduction in the number of switchboard connections.—Lond. *Elec.*, January 8.

Frankfort Electric Station.—An abstract of the official report of the Frankfort electric works. There are two stations. In the first a new 5,000-hp steam turbine has been installed which has been found to be absolutely reliable. Although built for 2,600 kw, single-phase current it is able to give up to 3,200 kw. The whole station contains four steam dynamos each of 552 kw, four steam dynamos each of 1,033 kw, and one turbo-generator of 3,200 kw. The consumption of fuel per generated kilowatt-hour was 1.63 kg. (3.6 pounds), against 1.72 kg. in the preceding year. There were generated in 1902 15,773,781 kw-hours. The house connections aggregate 16,110 kw, which is equivalent to 322,200 incandescent lamps of 16 candles. The second plant has a capacity of 402 kw direct current and 1,000 kw, three-phase current.—*Elek. Zeit.*, January 7.

Liquid Rheostats.—NIETHAMMER.—Some theoretical considerations on the design of liquid rheostats. There are two types. In the first the liquid in the containing box is constant and the electrodes are movable; in the second the electrodes are stationary and the quantity of liquid is changed. The author gives some numerical data on the resistance of various electrolytes, suitable for this purpose, and then shows theoretically that one should distinguish between liquid rheostats used only for a short time (for instance, for starting) and those which are in circuit for a longer period. For the former one should endeavor to use a large quantity of liquid with a small surface, which for the latter case a small quantity of liquid with a large surface is preferable. In the latter case the surface should be corrugated or a containing vessel of ring form should be used.—*Zeit. f. Elek.* (Vienna), January 17.

ELECTRO-CHEMISTRY AND BATTERIES.

Permanent Magnets.—WEICHSEL AND HIECKE.—Two communications referring to a recent discussion by Emde whether a permanent magnet is to be considered as the seat of a certain number of lines of force or of a certain m.m.f. In opposition to Emde, Weichsel arrives at the result that the m.m.f. of a permanent steel magnet is to be considered constant. He gives some theoretical considerations to prove that we must assume that when the magnetic reluctance is increased, a permanent magnet gives off energy in some form, perhaps heat. Hiecke criticises some theoretical suppositions of Emde and Busch. He agrees with the latter that in producing a permanent magnet, the magnetism becomes the stronger, the smaller the reluctance in the air-gap in the magnetic circuit, other things being equal. He has found that permanent magnets for a registering instrument when magnetized with the pole shoes (which considerably decrease the magnetic reluctance) obtained a much higher magnetism than when magnetized without these pole shoes. Concerning Emde's fundamental question mentioned above, he claims that practically constant properties can be found in permanent magnets only if they are subjected to no or very small external magnetic influences. In this case the number and direction of the lines of force and the m.m.f. are constant. If, however, a strongly magnetized body is approached to the magnet, the number and direction of the lines of force is changed. This change will be instantaneous if the movements of the molecules inside the magnet can go on within the elasticity limit. If, however, a further external impetus is necessary, in form of a very strong movement of the molecule or of a long series of preceding changes of positions of other molecules, the changes of the lines of force in the permanent magnet will require time. A well-known example for this phenomena is a gradual increase of the tractive forces of a magnet to the poles of which an armature has been attached.—*Elek. Zeit.*, January 14.

Rotation of Lines of Force.—DUESING.—Hoppe had investigated whether the lines of force of a magnet revolve with it, and has found that they do so, since they show a slight drag in the direction of rotation. The present author has investigated the further question as to whether the lines of force revolve with a rotating armature when the magnets remain fixed, and also found a slight drag in this case. He laid a flat iron ring between the poles of a permanent magnet, covered it with paper and dusted iron filings upon it. With a proper field strength he obtained a slight tracing of the lines of force within the ring, in spite of its shielding action. He then substituted a piece of photographic paper for the ordinary paper, and made the ring revolve about its own axis. The tracing of the lines of force obtained during the rotation was fixed by holding a lighted match over the paper. The tracing showed a distinct but slight inclination of the lines of force both within the ring and outside of it in the direction of rotation. The ring must, therefore, have dragged the lines of force with it to some extent.—*Ann. d. Phys.*, 1903, No. 13; abstracted in Lond. *Elec.*, January 22.

REFERENCE.

Magnetic Fields of Coils.—Koenig.—An article in which the author shows how to determine, with the aid of diagrams, the field in any point near a coil without iron core through which a current passes.—*Elek. Anz.*, January 14, 21.

Electro-Chemistry and Batteries.

Soldering Aluminum.—An anonymous communication in which the following composition of a solder for aluminum is given: 10 parts bismuth, 30 parts zinc, 60 parts pure tin. The bismuth and zinc are first melted and the tin is then added; the whole is poured into molds about a foot long and about the size of a pencil. To do the soldering the writer uses a stick of solder, an old nickel aluminum spoke and a blow torch. The pieces to be soldered are held in a vise or any convenient place, the flame is applied from the torch until they are hot enough to melt the solder, when it is applied, then the surface to be soldered is scraped with a file or scraper. The solder is melted on to each piece and worked around with the spoke; the parts are then held together in front of the flame and the torch is removed.—*Am. Mach.*, January 7.

Dielectric Constants of Solvents and Solutions.—Eggers.—An account of an experimental investigation in which he measured the dielectric constants of various hitherto uninvestigated solvents, notably sulphur compounds. It is shown, notably in the case of the nitriles, that the dielectric constant is not an additive property, but depends to a very great degree on the relative chemical structure of the molecule. In cases where several solvents were used with the same solute, the dielectric constants of the mixture did not indicate that the solute exerted a similar influence in each case. This points to the conclusion that the dielectric constant of a solution is not a simple function of either constituent, but is due to an indefinite compound, i. e., a compound acording to variable proportions, resulting from combination of the constituents.—*Jour. Phys. Chem.*, January.

REFERENCE.

Nickel and Copper Analysis.—Browne.—An illustrated description of an automatic device for the use of a storage battery and an incandescent light circuit for nickel and copper analysis. The current is so divided as to furnish a steady flow to the nickel plating and half as much to the copper plating frames.—*Electrochem. Ind.*, January.

Units, Measurements and Instruments.

Wehnelt Interrupter.—Van Dam.—An article in which he refers to Zehnder's simplified form of the Wehnelt interrupter. The author describes a further simplification. The difficulty of mounting the platinum pencil in such a manner that no liquid can pass it, is overcome by using india rubber instead of ebonite. As long as the current does not exceed 0.6 amp. per sq. mm., good Para rubber is consumed exceedingly slowly. The author has only once renewed the rubber in his apparatus within the last two years. The operation is of extreme simplicity. The brass rod with the soldered-in platinum wire can be placed directly in the glass tube without using an extra brass tube. Hard solder need not be used, since the joint does not come into contact with acid. The concussions are deadened by the rubber in such a manner that there is practically no danger of breakages. The author uses a tube of 8 mm. internal diameter, to one end of which another tube half that width and about 3 cm. long is fused. The brass rod with platinum wire 1 mm. thick is introduced into the glass tube, and a piece of tubing of the best Para rubber and less than 1 mm. in internal diameter is slipped over the projecting platinum wire. It is wetted with water and then pressed into the narrow tubing.—*Ann. d. Phys.*, No. 13, 1903; abstracted in Lond. *Elec.*, January 8.

Measuring the Resistance of Highly Insulated Substances to Perforation.—Walter.—A long reply to some criticisms brought forward against his method which was described in the Digest October 17. He denies that Holitscher (Digest, November 21) is justified in saying that the method depends too much upon the skill of the operator. He considers that the drop of wax used by him is an advantage because the irregularities of the surface of the material which are of such great importance are thus entirely excluded, and what is measured is the "internal" resistance to perforation. The needle electrodes he also considers an advantage, because with the use of plates as proposed by Holitscher the dielectric hysteresis heat is unnecessarily increased, so that thereby the real internal resistance to perforation is clouded by secondary phenomena. In practice, of course, the condition of the surface and the hysteresis heat are of importance, but these two factors ought to be tested by separate methods. He points out that by his method he has found the following three important general results on the internal resistance to perforation. First, glass containing lead has a considerable smaller resistance than ordinary glass. Second, hard rubber has a considerably smaller resistance if inorganic salts are added to it than without the same. Third, a hard rubber material can be made which has about three times the resistance of that of ordinary kinds of this material. Another criticism which had been made was that the resistance to perforation was formerly measured by the alternating-current voltage required for perforation while he measures it by the equivalent spark length of an induction apparatus between needle electrodes in air. He thinks this is the proper way since measurements of the alternating-current voltage do not give uniform results. —*Elek. Zeit.*, January 7.

REFERENCE.

Influence of Wave Form on the Application of the Two-Wattmeter Method.—Dina.—A criticism of a paper of Bloch recently noticed in the Digest. The present writer claims that Bloch's theory is wrong. He has formerly obtained the following results which are valid for any number of harmonics. The true power factor (determined from the power, the voltage and the current) is smaller than the cosine of the angle between the partial voltage and the partial current for the fundamental wave. The power factor determined by the tangent formula may be either greater or smaller than the cosine of the phase difference between the partial voltage and the partial current for the fundamental wave. The tangent formula gives a value of the power factor larger than the true one.—*Elek. Zeit.*, January 14.

Telegraphy, Telephony and Signals.

Telegraphone.—Strecker.—A brief paper read before the Berlin Electrical Society. He exhibited some apparatus of the Danish and German telegraphone companies. As is well known, the telegraphone is a magnetic phonograph; the transmitted telephone currents pass through the winding of the small electromagnet, before the one pole of which a steel wire or a steel ribbon or a steel disc is rapidly moving. The varying magnetizations due to the telephone currents are impressed on the steel wire or disc. If afterwards the same ribbon or disc is passed before another small electromagnet of the same type, which is connected to a telephone, the original speech is reproduced at the telephone. In the exhibited apparatus either steel wire or discs were used. The wire apparatus has the advantage that it gives louder sounds, because it is possible to move the wire much more quickly. An apparatus with a length of wire of 6,000 meters is sufficient for a conversation of 40 minutes. They have used the apparatus successfully for transmission from Strasburg to Berlin and from Frankfort to Berlin. In another form of apparatus the telegraphone is used in connection with the ordinary telephone, for the use of cautious business men. When they have an important conversation they connect the telegraphone with the telephone and have the whole conversation taken down by the former. Another application is for replacing a stenographer; instead of dictating something to the stenographer, one speaks into the microphone and the whole speech is taken down by the telegraphone. The typewriter then takes the telegraphone and takes the dictation from the latter (as is now sometimes done with the phonograph). If the telegraphone speaks too quickly, she pushes a button and the telegraphone not only stops at once, but goes somewhat back and repeats the last words. In the apparatus with a steel disc the latter rotates, while the electromagnet moves slowly in a radial direction towards the center of the disc. The conversation is, therefore, taken down in form of a spiral line. After a conversation has been impressed upon a steel disc, the latter may be sent by mail to the addressee, who can then hear the message by putting the disc in an identical telegraphone. Compared with the written letter, the "telegraphone letter" has the advantage that it reproduces not only the words but also accents, emphasis, etc.—*Elek. Zeit.*, January 7.

REFERENCES.

Telephone Cables.—Schmiett.—An illustrated article on the manufacture of telephone cables with several cores and air insulation.—*Zeit. f. Elek.* (Vienna), January 17.

Localization of Breaks in Submarine Cables.—Davidson.—A brief mathematical article on the different formulas for determining the resistance from the testing station to a break.—Lond. *Elec. Rev.*, January 8.

Miscellaneous.

Cure of Cancer by Zinc Ions.—Leduc.—A description of a cure of a cancroid growth, which was in the right wing of the patient's nose, and had existed in a constant state of ulceration for five years. He applied to its whole surface a plug of hydrophil cotton impregnated with a one-per-cent. solution of zinc chloride. This was connected with a positive pole of a battery whose negative pole was connected with some part of the body through a large inert electrode. A current of eight milli-amperes was passed for 12 minutes without causing any pain, and boric vaseline was subsequently applied. The crusts detached themselves immediately, and ten days afterwards the ulcer was completely scarred over and of good aspect. Ten weeks afterwards the scar remained perfect, with the exception of a slight sore at the tip of the nose, which was treated similarly.—From *Arch. d'Elec. Med.*, December 15; in Lond. *Elec.*, January 8.

REFERENCES.

Magneto Ignition.—An illustrated description of the Albion system of magneto ignition for internal combustion engines. It consists generally of a magnetoelectric generator driven directly from the crank-shaft of the motor, generating the necessary current for the igniting spark. From the magneto current is led to make-and-break spark plugs of simple design fixed on the combustion chamber of each cylinder, the make-and-break being operated by a trip rod and cam mounted on the half-time shaft. The ring-shaped armature of the generator is bolted to the engine casing and the field magnets are mounted on a spider keyed to the crank-shaft. The device is described in detail and illustrated.—Lond. *Elec.*, January 8.

Machine Tools.—A fully illustrated article on special machine tools at the Corliss engine shops. With the exception of the frame milling machine, every tool is driven by vertical steel shafts.—*Iron Age*, February 4.

Biographical.—A biographical sketch, with portrait, of Lewis Buckley Stillwell, the electrical director of the Interborough Rapid Transit Company, of New York.—*Cassier's Mag.*, February.

New Books.

Elements of Electromagnetic Theory. By S. J. Burnett, Ph.D. New York: Macmillan Company. 473 pages, 145 illustrations. Price, $3.00.

The object of this book, as stated by the author in his very brief preface, is "to present in systematic and definite form a simple, rigorous and thoroughly modern introduction to the fundamental principles of electromagnetic theory, together with some of the simpler of their more interesting and important non-technical applications." This is a worthy object, but somewhat difficult of attainment. Several writers have attempted to simplify Maxwell and other authorities, but in some instances the simplification has been more difficult to grasp than the original. The union of profound mathematical powers with a faculty for logical and perspicuous writing is rare, and of a value commensurate with its rarety. The author of the present work is happy in many of his demonstrations; they are elaborated without the unnecessary use of mathematical symbols, the stumbling block of lower grade mathematicians, and while carrying conviction by rigorous reasoning, are not unnecessarily prolix. The mode of treatment of some other demonstrations may not be the best possible, but on the whole the book is extremely satisfactory in mathematical method.

In speaking of the "mechanical conception of the electric field," the author wisely remarks that "this conception" . . . "leads to results by no means wholly consistent." On the other hand, in dealing with the theory of the dimensions of units, the author shows a diminished power of resistance to the logical fallacies of the Rückerian philosophy. The remarks about the dimensions of permeability and capacity recall memories of the polemics upon the subject of "qualitative mathematics," published in that journal some years ago.

Mathematical treatises on electricity usually consider Green's theorem early in the book, but the present work omits it altogether. This is not objectionable in a work which, like this one, makes no attempt at exhaustive treatment of the subject, but confines itself to elementary matters. It is much better than to give an unsatisfactory treatment of the theorem, as is sometimes done. Anyone who has read Green's original paper knows that it is more lucid than some of the commentaries on it. There are other books intending to cover the same field, and although this one does not pretend to originality except in the mode of treatment, it has a *raison d'etre.*

The Elasticity and Resistance of the Materials of Engineering. By Wm. H. Burr. New York: John Wiley & Sons. 978 pages. Price, $7.50.

The present edition of this standard work constitutes almost a new book, one-half or more of the entire volume being new matter. The work as a whole is divided into two parts, analytical and technical. The former consists of five chapters treating the general theory of the subject under the following heads:

Theory of elasticity in amorphous solid bodies; hollow cylinders and spheres, and torsion, flexure, resilience, combined stress conditions. In the development of pure theory the standard methods are for the most part followed, though the author's individuality is often present in the discussion of special points. Taken as a whole, these five chapters furnish an excellent treatise on the general theory of the subject, developed to the extent likely to be needful for the purposes of the engineer.

Part II contains the results of theory applied to the problems of actual engineering construction, and contains most of the new matter in the present edition. It consists of fourteen chapters covering the following topics: Tension, compression, long columns, shearing and torsion, bending or flexure, concrete-steel members, flange beams, connections, plate girders, rope and chain cables, working stresses and factors of safety, miscellaneous problems, fatigue of metals, flow of solids. The chapter on "Concrete-Steel Construction" has received especial attention, and the author has endeavored to set forth here the treatment of concrete-steel beams and other members with sufficient fulness to meet the advancing requirements of this rapidly extending field of engineering construction. Throughout this section of the work the treatment is admirable in arrangement, ample in scope, clear in style and with a due admixture of experimental fact and general discussion. The treatment is especially full in the presentation of tabular matter giving the results of great numbers of tests and relating to all manner and form of constructive material. This section of the work is followed by an appendix of four chapters giving a more general and extended development of the theory of elasticity in amorphous solid bodies. It is not expected that the subject matter of this appendix will be of any great value to the general practitioner; nevertheless, every thorough student of the subject will need to be familiar with the generalized and fundamental treatment of the problems which it presents, and it is for such that the treatment of the appendix is intended.

A further appendix contains the tables and technical data furnished by the Cambria Steel Company, and published in their hand book on structural materials. This matter will be found of great practical value in structural practice, and at the same time is intended to add to the value of the work as a text-book for purposes of instruction, by facilitating the giving of extended practical exercises.

As a whole this work in its present amplified form takes a leading place in the world's literature of the subject. The name of its author carries justly the weight of long years of experience as an investigator, a teacher, and a successful practitioner and advisor. The present volume is one such as we might expect from the long distinguished professional career of its author, and as a general treatise on the subject it will long serve as a standard for use in class room and for daily reference on the part of the practical engineer. Both author and publisher are to be congratulated on the appearance of so extended and so thorough a work on a subject of such fundamental importance to the entire field of engineering practice.

Largest Pipe Organ in the World for St. Louis.

One of the most interesting musical and semi-electrical features of the St. Louis Exposition will be the immense pipe organ built by the Los Angeles Art Organ Company, of Los Angeles, Cal., for the Kansas City Convention Hall Company, and which will be the official concert organ at the Festival Musical Hall. It is, we understand, the largest pipe organ in the world, and is certainly the largest aggregation of musical mechanism placed under electrical control. It is 63 ft. long, 30 ft. deep, 50 ft. high. It has 10,059 pipes. The largest metal pipe is 37 ft. 6 in.; weight, 840 pounds; smallest metal pipe, ¾ in., 3/10 in. diameter; weight less than ½ ounce. The largest wood pipe is 22 x 27 in. inside; stock, 2½ in. thick, 32 ft. long; it weighs 1,500 pounds. Over 80,000 ft. of lumber were used in the organ interior; this does not include that used in the construction of the case. It has 130 miles of electric wire, 140 speaking stops, 1,300 magnets, 99 mechanical movements and is capable of producing 17,179,869,183 distinct tonal combinations. It takes 12 large furniture cars to move it and weighs 250,000 pounds.

Fig. 1 herewith shows the organ set up in the factory, without the display pipes; and its relative size can be inferred from the surrounding objects. The instrument will be played from two independent consoles of the most perfect construction and design. The most important console is movable (Fig. 2) and is connected to the organ by an electric cable 150 ft. long. This console contains the

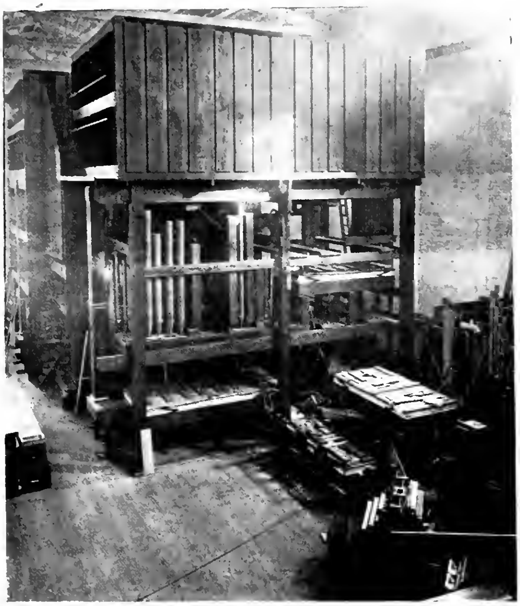


FIG. 1.—ST. LOUIS FAIR PIPE ORGAN.

radiating and concave pedal clavier, the five manual claviers, the 140 draw stop knobs, the five tremulant draws and the 36 coupler draws, the 40 push buttons belonging to the adjustable combination system, and all the foot pedals controlling the expressive powers of the whole organ, etc., etc. This console is for the virtuoso who performs in the usual manner with hands and feet.

The second console is stationary, and is entirely devoted to the builders' double-roll automatic self-playing attachment. Through the agency of the double or twin rolls, the most complicated orchestral scores can be rendered with absolute accuracy, and compositions can be performed which are far beyond the powers of the most accomplished organist. This console resembles that first described, except that it does not possess the manual and pedal claviers, which are not necessary where the double-roll, self-playing attachment appears. Within its arms, so to speak, sits the musician, entirely unembarrassed with the calls of six claviers upon his hands and feet, having at his immediate command the vast tonal forces (represented by 10,000 pipes) of this gigantic organ; his hands simply engaged in manipulating the draw-stop knobs and combination buttons, and his feet controlling the flexible and expressive powers of the instrument. The double rolls do all the rest.

The bellows of the main portion of the organ will be operated by two 10-hp motors, at 220 volts, direct current. The echo organ bellows will be operated by a 1½-hp motor of 220 volts, direct current. The wind-chests, through which the wind from the regulators is distributed to the 140 speaking stops, and the 10,059 pipes, are

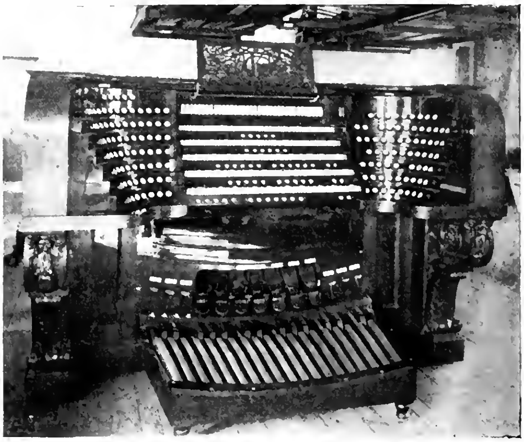


FIG. 2.—CONSOLE OF ST. LOUIS FAIR PIPE ORGAN.

12 ft. long and of widths sufficient to give every rank of pipes planted thereon ample speaking room.

The organ is constructed under the Fleming electropneumatic system, which gives the most satisfactory results. The organ contains 1,300 magnets, as noted above, for both key and draw-stop actions. There are 130 miles of wire in magnets and cables, from No. 20 up to No. 34 B. & S. gauge. There are also 1,616 automatic combination knobs for setting combinations electrically throughout the organ. There are five automatic electric swell engines for the

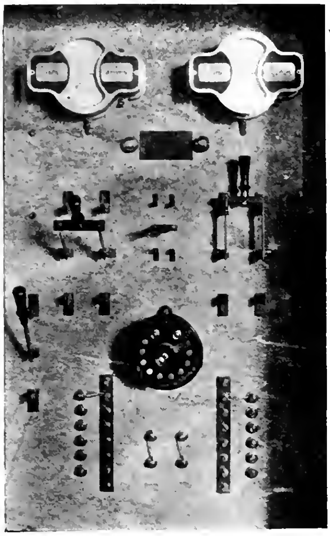


FIG. 3.—SWITCHBOARD.

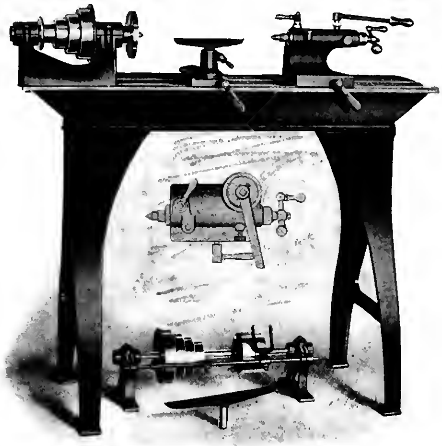
actuation of the swell shutters. There are above 7,000 open circuits in the organ. The company's special contact wire, of unusual costliness, is used in the key and coupler actions. The single-contact system is used, so arranged as to be durable and always reliable. The coupler action contacts clean themselves automatically, and all trouble is thereby prevented. The storage batteries used will have four cells of two volts each, with normal discharge of 50 amp for eight hours. There will be a motor-generator of 220 volts, direct current, with a capacity of 10 volts and 40 amp., to charge the batteries.

The switchboard (Fig. 3) has a voltmeter and ammeter to show the discharge voltage and strength of the batteries at all times. There will also be a polarity indicator, also a pilot lamp, which will indicate, to a certain extent, the strength of the batteries. There are also a voltmeter and an ammeter on the switchboard, one showing the voltage charging the batteries and the other showing the amount of the current going into the batteries. Switches are provided for throwing the generator on and off, and for throwing the current off the organ when not in use. The switchboard consists of a marble slab mounted in a handsome oak case with glass door for display purposes.

The entire instrument was built under the personal supervision of Mr. W. B. Fleming, the inventor of the system which bears his name.

Speed Lathes.

Embodied in the construction of the "Star" speed lathes are several new features of interest to users of this class of tools. The spindle is made from a crucible steel forging, has large hole and runs in large phosphor-bronze bearings, which are self-oiling and dust-proof. Each bearing is oiled by a double set of oiling wicks, which supply the bearing continuously with a liberal amount of oil. The surplus oil runs back into the oil wells, which prevents dripping and waste of oil. After the oil wells have been filled with a good quality of lubricating oil the lathe will then run for a long time



SPEED LATHE.

without further attention in this respect. The cone pulley has four steps, is turned inside as well as outside and is in perfect balance for high speeds. The head stock is the web pattern, strong and heavy.

The tail stock is the curved or cut-under pattern, the tail spindle having a new combination screw and lever motion with graduated dial. The dial is graduated by sixteenths and is valuable for drilling, counterboring, countersinking, etc., to a desired depth. The dial is movable and may be set at any point. To change from screw to lever motion it is only necessary to loosen the thumb screw releasing the spindle sleeve. The long hand lever can be lifted off when not in use. The tail stock has a long bearing on the ways and is firmly locked to the bed by a convenient lever—always attached—no wrench being required. The hand rest is provided with short and long T-rests, the rest socket and saddle are locked to the bed by a cam-locking device and the T-rest is held in its socket. Both are operated by levers always attached.

The bed is broad, deep and, being thoroughly braced by cross webs, is very stiff and rigid. The front way is flat and the back way is V-shaped. A convenient shelf is secured to the back of the bed for the reception of tools, etc. The countershaft has self-oiling and self-aligning shaft bearings, four step cone and tight and loose pulleys.

Each lathe is furnished with a face plate, two point centers, and, when desired, with slide rest, draw-in chuck and collets, etc. The 10-in. and 12-in. "Star" speed lathes are made by the Seneca Falls Manufacturing Company, 422 Water Street, Seneca Falls, N. Y.

Motor Starter for Variable Speed Work.

There is a large demand for a motor starter with which is combined a field regulating resistance for use with variable-speed motors, the speed range being obtained by field control. The requisites for this combination may be stated as follows:

1. That the field rheostat shall be so interlocked with the motor

FIG. 1.—MOTOR STARTER.

starter that the motor cannot be started under condition of weak field. 2. That the field rheostat must have twenty or more steps

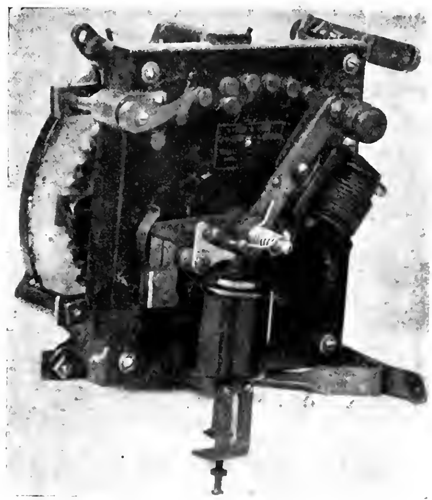


FIG. 2.—MOTOR STARTER.

(at least 20) in order to give even gradations of control. 3. That the starter must be entirely enclosed—to prevent short-circuits due to flying of metallic chips, etc. 4. That the starter must be equipped with an independent interlocking circuit-breaker which will protect the motor at all times, both during the period of starting and in the full running position. 5. That the no-voltage release must be independent of the field strength and connected across the armature terminals (it is not satisfactory to connect this no-voltage release across the line, as an arc will be formed at the switches when opened if so connected).

The Ward Leonard Electric Company has constructed a combination starter, as shown in the accompanying cuts, which is claimed to entirely fulfil all the above conditions, and also meets the specifications of the United States Government regarding such apparatus.

Outlet Switch Boxes.

Recent changes in the rules of the Underwriters' National Electrical Association affect outlet boxes. The Chicago Fuse Wire & Manufacturing Company, Chicago, New York and Buffalo, is making the "Union" outlet switch box designed to fit all makes of rectangular push button switches and flush receptacles. The "Union"

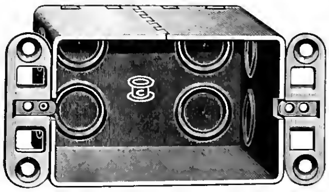


FIG. 1.—OUTLET SWITCH BOX.

box fulfils the latest requirements of the Underwriters in all respects and has "knock-outs" in the bottom and ends of the full thickness of the walls. Special attention is called to the fact that this box is formed from cold-rolled sheet steel of heavy gauge and is dove-tailed together, making it perfectly smooth outside, so that it will slip into a recess in plaster or woodwork, leaving the wall

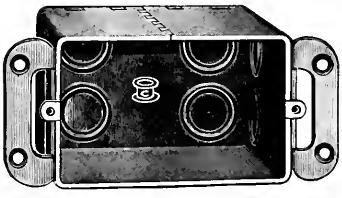


FIG. 2.—OUTLET SWITCH BOX.

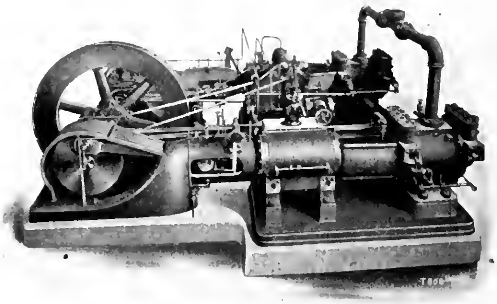
in perfect condition when the switch and plate are in place. The box is nicely finished in black enamel.

The Chicago Fuse Wire & Manufacturing Company further call attention to the adjustable feature in Fig. 1, making this box a perfect fit for any style, while Fig. 2 takes all switches having connections 3¼ in. c. to c. There is also a further style for specific plates and switches.

Compressed Air Power Plant at the St. Louis Exposition.

The central compressed air power plant at the St. Louis Exposition will contain two main compressing units, one cross-compound, two-stage Cincinnati-gear compressor, having 13 and 24-in. steam cylinders, 22 and 14-in. air cylinders and 24-in. stroke, with a displacement at 125 r.p.m. of 1,300 cu. ft. per minute, and one cross-compound, two-stage, Meyer-gear compressor, having 12 and 20-in. steam cylinders, 18 and 11-in. air cylinders and 18-in. stroke, with a displacement at 100 r.p.m. of 530 cu. ft. per minute. The first machine is to supply the general compressed air requirements of the Exposition, while the second is to supply the transportation exhibits. The larger machine is of special interest as being the first compressor of its type publicly exhibited, although a number of similar machines have been, and are being, installed in private plants. A 2,800-ft. machine is at the present time being placed in the Jersey City power house of the Central Railroad of New Jersey.

The general construction of one of these machines is herewith shown. The frames, as will be noted, are of massive construction, with a long bearing on the foundation, while the steam and air cylinders, joined in the direct line of thrust by heavy cast-iron housings, are also supported by bed plates under their entire length, the weight of each side being thus taken on two large bearing surfaces extending to the ends of the machine, avoiding the objectionable features of overhung cylinders, and giving the compressor great stability. The general construction is characteristic of the best grade of engine work, and comprises removable quarter boxes and main bearings, steel-forged connecting rods, with wedge take-up, specially large crank and wrist pins and cast-steel cross heads with adjustable babbitted slippers, top and bottom, working in bored guides. The reciprocating motion is of the simplest possible character, this simplicity in construction permitting low reciprocating weights without sacrifice of strength. These features allow satisfactory balancing, and, in connection with the long bearing on the foundations, insure an especially easy-running machine. The steam valve gear is of the four-valve type. Steam distribution is effected by means of short, double-ported, slide valves, working at either end of the steam chest on a valve face as close as possible to the cylinder bore, the port volume being restricted as far as the large valve area will allow. The exhaust valves are of the Corliss rotary type and are placed at the bottom of the cylinder. This construction has been followed in order to produce a valve gear having the essential advantages of a Corliss, namely separate passages for



COMPRESSED AIR PLANT.

the steam and the exhaust with corresponding reduction in cylinder condensation, together with short, straight ports and small clearance. On the other hand, the complicated Corliss releasing gear has been eliminated, the action being positive throughout.

The air valve gear is, however, the distinguishing feature of this machine, combining in a very ingenious manner the positive action, noiseless operation and durability of the mechanically-moved valve with the elasticity of the poppet valve. The noise and rapid wear of the poppet valve, due to the impact of the valves closing at the reversal of stroke, is eliminated by mechanically closing the passages underneath the poppet valve, and leaving a cushion of air upon which the latter seats. The three fixed points in the compression cycle, namely the opening of the inlet, the closing of the inlet, and the closing of the discharge, are positively and mechanically controlled; the opening of the discharge, which is the only variable point in the cycle, is controlled by the automatic poppet valves, which are relieved, however, of the necessity for quick closing, and are consequently free from the objectionable features of noise and rapid wear.

The cards from one of these machines, operating at a speed of 150 r.p.m., show a steep expansion line on the air cards, indicative of the small clearance and high volumetric efficiency of the machine, the large valve area being indicated by the practical coincidence of the inlet and atmospheric lines and by the uniform discharge line. The rounded admission of the steam cards, which might in ordinary engines be deemed objectionable, is due to the maker's practice of giving the steam valves a slight negative lead to offset the expansion pressure at the beginning of the air cards. These machines are built by the Laidlaw-Dunn-Gordon Company, of Cincinnati, Ohio.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The tone of the stock market was heavy, and there was a general unsettled feeling, due to unfavorable war news, poor reports about the iron trade prospects and absence of outside support. The death of Mr. W. C. Whitney occasioned some scattered selling of stocks of traction and other interests with which he was formerly identified, Brooklyn Rapid Transit being particularly weak at the close. United States Steel securities were quite heavy for a time on unfavorable reports as to the steel and iron trades and on talk of poorer earnings. Under the influence above mentioned Brooklyn Rapid Transit suffered a net loss of 6¾ points on the week's trading, which was active, 149,870 shares having been sold. The closing quotation was 40⅜, which was only ⅜ above the lowest figure of the week, the highest being 47⅜. Metropolitan Street Railway ranged in price between 117 and 120½, closing at 117½, this being a net loss of 3½. Manhattan Elevated closed at 142¼, a loss of 1¼. The electrics—General Electric, Westinghouse, Western Union and Telephone—were all down, General Electric, however, suffering the smallest loss of all, viz., ⅛ point, closing at 170. Westinghouse common lost 6 points, closing at 161; Western Union, 1, closing at 87¾, and American Telephone and Telegraph, 2 points, the last price of the week being 126. In the curb market nearly everything was reactionary in sympathy with the downward tendency in the stock market rather than because of any special developments. In Electric Boat holders are firm, asking 25, while only 10 is bid. Electric Vehicle is held at 10, with 8 bid. New York Electric Vehicle Transportation is quoted at 5½ bid, with 6 asked. Following are the closing quotations of February 9:

NEW YORK.

	Feb. 2	Feb. 9		Feb. 2	Feb. 9
American Tel. & Cable......	82	82	General Electric.	170	167
American Tel. & Tel........	126	124	Hudson River Tel..........	..	..
American Dist. Tel....	22	22	Metropolitan St. Ry.........	120¼	117¼
Brooklyn Rapid Transit ...	45⅝	41	N. E. Elec. Veh. Trns.......	..	..
Commercial Cable.	175	183	N. Y. & N. J. Tel...........	137⅛	..
Electric Boat.	18	17	Marconi Tel.............. ...	..	..
Electric Boat pfd...........	45	40	Western Union Tel...... ...	88	87¾
Electric Lead Reduction.. .	1	1	Westinghouse com....	165	161½
Electric Vehicle............	9	9	Westinghouse pfd..........	180	175
Electric Vehicle pfd.........	13½	13			

BOSTON.

	Feb. 2	Feb. 9		Feb. 2	Feb. 9
American Tel. & Tel	127	124	Western Tel. & Tel. pfd....	82	81*
Cumberland Telephone....	113	114½	Mexican Telephone.........	1½	1¼
Edison Elec. Illum..........	236	236	New England Telephone. .	121	120½
General Electric.............	170	167	Mass. Elec. Ry..............	21½	20½
Western Tel. & Tel	10	10*	Mass. Elec. Ry. pfd.... . .	78	77

PHILADELPHIA.

	Feb. 2	Feb. 9		Feb. 2	Feb. 9
American Railways.........	44	44	Phila. Traction..	97⅝	97½
Elec. Storage Battery.. ...	59	50	Phila. Electric	6	6
Elec. Storage Battery pfd.	59	50	Phila. Rapid Trans.........	14⅝	13⅞
Elec. Co. of America.	8⅛	7⅞			

CHICAGO.

	Feb. 2	Feb. 9.		Feb. 2	Feb. 9
Central Union Tel.	..	..	National Carbon pfd........	70	94
Chicago Edison.........	150	..	Metropolitan Elev.com.....	17	17
Chicago City Ry....	165	166	Union Traction	5	5
Chicago Tel. Co.............	..	..	Union Traction pfd.........	30	29
National Carbon..	28	28*			

*Asked

CUYAHOGA TELEPHONE REPORT.—The comparative statement of earnings and expenses for the year ended December 31, 1903, for the Cuyahoga (independent) Telephone Co. of Cleveland, follows:

	1903.	1902.	Changes.	
Gross	$396,490	$385,852	Inc.	$10,638
Exp. and taxes	216,460	229,709	Dec.	13,240
Net	$180,030	$156,143	Inc.	$23,887
Charges	129,259	155,600	Dec.	26,341
Surplus	$50,771	$543	Inc.	$50,228
Employes' share of profits (for six months)..	4,155	......	Inc.	4,155
Net surplus	$46,616	$543	Inc.	$46,073

JOHN T. HUNT.—A meeting of creditors of John T. Hunt, who did business as Zimdars & Hunt, electrical contractors, at 127 Fifth Ave., New York, who made an assignment recently, was held at the office of Goeller, Shaffer & Eisler, 207 Broadway, and a committee was appointed to make an examination and report a basis of settlement. The liabilities are about $50,000 and assets estimated at from $28,000 to $30,000. Hunt started in business in 1879 with C. E. Zimdars as a partner. They continued together until 1887, when Mr. Zimdars withdrew and the latter's wife became partner up to February, 1903, when Mr. Hunt bought her interest, and he has since continued the business alone under the old firm style. The causes of the assignment were the long strike in the building trade last summer and fall, and the recent stringency in the money market.

STANDARD UNDERGROUND CABLE CO.—The annual report of this company, as noted on next page, makes an excellent financial showing. The board of directors elected for the ensuing year is as follows: Mark W. Watson, John B. Johnson, James H. Willock, Robert Pitcairn, J. N. Davidson, John Moorhead, B. F. Jones, Jr., Joseph W. Marsh and W. A. Conner. The only change in the board is represented by the election of W. A. Conner, who has been at the head of the manufacturing department of the company since 1884. At the meeting of the board of directors for purpose of organization, held on January 29, the former officers were re-elected as follows: Mark W. Watson, president; Joseph W. Marsh, vice-president and general manager; Frank A. Rinehart, treasurer, and C. M. Hagen, auditor.

ALBANY TRACTION MORTGAGE.—The Board of Directors of the United Traction Company, operating the traction system of Albany and Troy, has approved of a financial plan, the main feature of which is the issue of a mortgage for $6,500,000. The issue is to be used for the redemption of outstanding bonds of the subsidiary companies as they mature and to pay for improvements already made and in progress, while $1,339,000 is reserved for future extensions and betterments. Nine hundred thousand dollars in bonds will be offered for sale at this time. The Central Trust Company of New York is to be trustee under the mortgage. The plan contemplates, it is said, some extensions or consolidations with other roads.

BATAVIA, N. Y., LIGHTING TROUBLES.—Under a decision rendered by Justice Truman C. White and filed in the County Clerk's office at Batavia, N. Y., in the Supreme Court action brought by Mrs. Frances A. Baker, of Rochester against the Consolidated Gas and Electric Company of Batavia and others, the foreclosure is ordered of a second mortgage for $20,000 on the company's property and Edward C. Atwater, of Batavia, an attorney who is secretary of the Batavia Carriage Wheel Company, has been appointed receiver of the Consolidated Company.

DIVIDENDS.—The directors of the Niles-Bement-Pond Co. have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable February 15. A semi-annual dividend of 4 per cent. was also declared on the common stock, 2 per cent. payable March 19, and 2 per cent. June 18. The directors of the Pratt-Whitney Co. declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable February 15.

MARCONI WIRELESS TELEGRAPH business is reported increasing to such an extent that the Marconi Wireless Telegraph Company of America shows the astonishing fact that the business passing through Marconi shore stations in America to and from Atlantic steamers, had gained 350 per cent. in December, 1903, as compared with 1902. At this rate a good showing ought to be made for the year.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade and transportation are affected throughout the West by the weather conditions, while in the East retail winter trade is reported good. As to spring trade, however, some irregularity is noted. The market in the principal commodities was excited. War news was the ostensible cause of this, although speculation is responsible, too, to some extent. Wheat supplies are 25 per cent. smaller than a year ago; country offerings are light; milling requirements have been heavy and a large short interest in May has been forced to cover at a loss. Taking the situation as a whole, however, there is every reason for confidence as to the spring outlook, the irregularities noted here and there being only superficial and temporary. There is little change in the iron trade. Snow blockades have had the effect of reducing supplies and strengthening prices in the East, but buying is limited. Finished products do not show any special activity. The sales of 40,000 tons of rails to a Canadian railway is reported at a price $5 below the rate asked the American roads. Plates and structural material are quiet; wire is selling well, however. Agricultural hardware is in good demand in the West. Other metals—copper, tin and lead—are all lower. In the copper market, there was greater weakness, and official quotations have been marked down ¼c. Lake is quoted at 12⅜ a 12⅝c.; electrolytic 12¼ a 12½c.; casting stock 12¼ a 12⅝c. The business failures during the week ending February 4 were about the average in number, *Bradstreet's* making the aggregate for the United States 216, as against 242 the week previous, and 208 the corresponding week in 1903.

ELECTRIC POWER FOR BRIDGE.—The McCombs Dam bridge across the Harlem River, New York, has one of the largest and handsomest highway draw spans ever built. It is 400 feet long, and has a 40-foot roadway and two sidewalks each nearly 10 feet wide. The moving mass weighs about 2,200 tons, and until now has been operated by a 40 hp oscillating cylinder steam engine with differential gear reducing its speed from 19 to 1. The ends of the bridge were lifted by a separate mechanism with hydraulic jacks driven from an accumulator in the engine room. It was locked by hydraulic centering rams. About two minutes was required to open or close the draw, and the cost of maintenance of the mechanism was very large. In order to simplify and expedite operations, the engine has been replaced by a 20 hp alternating-current motor furnished by the General Electric Company, and believed to be the first one of this size and character applied to such purposes. The motor is also connected by a clutch to a system of gears and shafts, which extend from the centre of the bridge to both ends and operate toggle joints which replace the hydraulic lifting apparatus. The latch has also been replaced by an automatic device designed by Boller & Hodge, New York. Only one man will be required where three were previously needed, and it is believed that the bridge can be swung open or shut in one minute or less. The improvements have been made by the employees of the Department of Bridges, New York, Mr. Martin Gay, assistant engineer in charge of structures on the Harlem River. The machine work was done in the Brooklyn Bridge machine shops.

MEXICAN WATER POWER PROJECTS.—There are a number of new projects to develop water power in Mexico for electric light and power purposes and for irrigation. Theodore V. Peereborm and associates have acquired a concession from the Mexican authorities for the purpose of utilizing 40,000 liters of water per second from the Janapa River located near Cordoba in the state of Vera Cruz. The power will be used for generating current for light and power use in that vicinity. Another scheme is to build a plant on the Rio Grande River, in the State of Chihuahua, permission having been secured by Edward T. Le Clair. The franchise concedes the use of 15,000 liters per second. Fernando Gonzalez proposes to utilize the water of the Amacusac River for the irrigation of the valleys of the Iguala and Cocula, State of Guerrero. Charles Connant plans to use 20,000 liters of water per second from the Yagin River in the district of Guaymas, State of Sonora. His is, also, an irrigation scheme. The Walthalla Colonization Company anticipates the construction of a large irrigation plant which will be used to flood a large area of agricultural land in the vicinity of Naranja, State of Jalisco.

MEXICAN TRACTION PLANS ACCEPTED.—The plans of the Mexican Traction Company for the electrical conversion of the Circuito de Barrios tramways, a mule line operating in the heart of Mexico City, have been approved by the municipal authorities. The company has made application for permission to extend the Barrios line into the Colonia del Paseo, and the Colonia Nueva del Paseo and also into various streets of the American colony. Mr. R. M. McAdoo, of 15 Wall Street, is president of the company. He is now in Mexico. Pittsburg capital will build the system which will aggregate more than 100 miles. The initial capacity of the power plant will be 2000 hp. Twenty 40-feet cars with four motor equipments of 56 hp each will be ordered in the first instance. The Pittsburgers primarily interested in the enterprise are James B. Oliver, Julius Breler, Reuben Miller, James H. Park and Frank B. Smith, all of whom outside of Mr. Oliver are prominently identified with the Crucible Steel Company. A. T. Montmorency, of Mexico City, is the chief engineer of the company. The entire system is expected to be in operation in about twelve months.

STANDARD UNDERGROUND CABLE CONFERENCE.—The annual conference of the branch office managers of the Standard Underground Cable Company with the general sales, the manufacturing, the construction and the executive departments of the company, was recently held in the general offices of the company in the Westinghouse Building, Pittsburg, the session covering three days. The report of each manager for the year 1903 and the business prospects for the year 1904 was presented and discussed, together with ways and means for rendering more efficient service in every department to the customers of the company, who now number considerable over 1,000. A pleasant social feature of the occasion was a theatre party given by Mr. J. W. Marsh, vice-president and general manager of the company, to the visiting managers. The branch office managers attending the meeting were Mr. Charles J. Marsh and Mr George L. Wiley, from the New York office; Mr. Frank Clark Cosby, from the Boston office; Mr. T. E. Hughes, from the Philadelphia office, and Messrs. J. P. Wiley and E. J. Pietzcker, from the Chicago office.

PACIFIC COAST POWER TRANSMISSION.—The Corona (Cal.) Gas and Electric Company will run a three-mile transmission line to the Auburndale tract to furnish power there and at intervening points. George and Albert Le Gaye, who have bought 300 acres of the former town site in the Auburndale tract, of W. H. Jameson for $7,000, will use a greater part of it for raising alfalfa. They will sink wells and install a pumping plant. The dynamos are now running almost the full capacity. The company intends to duplicate the plant as soon as necessary.

JAPANESE MUNICIPAL TRACTION PROJECT.—The municipal authorities of Osaka—the principal commercial city in Japan—propose to construct an extensive electric traction system. City bonds to the amount of 3,500,000 yen—about $1,250,000—are to be issued for the purpose of capitalizing the undertaking. This is the first instance of the construction and operation of a street railway being mooted by a Japanese municipality, all such enterprises so far having been undertaken by private capitalists. We trust that the war will not interfere with the enterprise.

MEXICAN ELECTRIC RAILWAY PROSPECT.—The Mexican advices state that a local syndicate is being organized in the City of Puebla, State of Puebla, Mexico, with a view to constructing an electric railway between that important Mexican city and Totinshuecan. Francis Barnard, the manager of the Ferrocarril Urbano de Puebla and the Ferrocarril Industrial de Puebla, is primarily interested in the project. The length of the road will be about seven miles.

PARSONS TURBINES FOR SYDNEY.—Parsons steam turbines have been ordered for installation in the extension of the Ultimo central power station of the Sydney city and suburban electric traction system, operated by the New South Wales government. The existing power house equipment was contracted for with the General Electric Company, the engines being of Allis build. The additional installation will have a capacity of about 5000 horse power.

AMERICAN TELEPHONE ORDERS.—Among switchboard shipments recently reported by the American Electric Telephone Company of Chicago, are the following: Hotchkiss, Colo., 100 line express; Neodesha, Kan., 100 line special; Wauseon, Ohio, 100 line express; Urbana, Ohio, 105 line express; Topeka, Kan., two shipments 100 line express; Plainsboro, N. Y., two, 30 capacity special; Milwaukee, Wis., 100 line express.

JAPANESE STREET RAILWAY PROJECT.—A scheme to construct an electric railway between Kyoto and Otsu, as proposed by Mr. Asano, of Tokio, and other Japanese capitalists has, according to advices just received here, been approved by the leading business interests in both cities, and a syndicate is in process of formation for the purpose of carrying out the enterprise. The length of the road will be some 30 miles.

YUCATAN ELECTRIC TRACTION PROJECT.—The United Railways of Yucatan which operates the majority of the steam roads in Yucatan, propose to convert the existing mule roads in the capital city, Merida, into electric traction, and to construct more lines. The New York purchasing agents for the United Railways are Thebaud Bros., 87 Broad Street. It is expected that some 30 miles of track will be electrically operated.

EQUIPMENT FOR NOME PLACER MINING.—The Puritan Gold Mining Company of Nome, Alaska, of which W. H. Powell, of Milwaukee, is president, is about to purchase considerable electrical equipment to be used for operating dredges at the company's property, which is located about two miles from Nome City. The company is incorporated under the laws of Wyoming with a capital of $2,000,000.

GENERAL ELECTRIC MOTORS FOR MEXICAN MINE PUMPS.—The General Electric Company has secured a contract for a number of motors varying in capacity up to 200 hp for direct connection to centrifugal pumps built by the International Steam Pump Company, for installation in Mexican mines.

NEW TELEPHONE SYSTEM FOR MANILA.—The Manila Telephone Company, which operates the present system in the Philippine capital, is to modernize and considerably extend the installation which will necessitate the purchase of a large quantity of equipment on this side.

STEEL STACK FOR MANILA POWER HOUSE.—The Riter-Conley Manufacturing Company, of Pittsburg, Pa., has secured the contract for the large steel stack for the power house to be built by the Manila Electric Lighting and Railroad Corporation.

BALL ENGINE ORDER.—The Continental Coal Company, Columbus, Ohio, has recently placed in operation two 400 hp heavy duty side crank engines, built by the Ball Engine Company, Erie, Pa., at its mine, No. 255, Jacksonville, Ohio.

General News.

THE TELEPHONE.

TOMBSTONE, ARIZ.—The Tombstone Telephone Company has been incorporated by E. T. Ijams, E. U. Ijams, W. C. McFarland and others. The capital is $180,000.

CONWAY, ARK.—The Conway Telephone Company has been incorporated with a capital stock of $10,000. L. H. Pyle is president.

DARDANELLE, ARK.—The Arkansas Telephone Company has been incorporated with a capital stock of $20,000. The incorporators are: J. B. Crownover, W. R. Hayden, A. L. Blackwell, C. W. Brown, A. D. Perry and Geo. N. Goodier.

ANAHEIM, CAL.—The City Council has adopted a resolution to advertise for sale the telephone franchise requested by the Home Telephone Company.

SAN FRANCISCO, CAL.—The Sunset Telephone & Telegraph Company has been incorporated with a capital stock of $3,000,000, the amount actually subscribed being $10,000. The object of the company is to deal in all kinds of electrical supplies in the Pacific Coast states. The company is to build lines throughout this section of the country, the total length of which is given as 1000 miles. The directors are George S. Ladd, John I. Sabin, Louis Glass and others, of San Francisco.

ATHENS, GA.—It is stated that a new independent telephone system will be established here. Mr. L. D. Goodrum, of Pennsylvania, is promoting the enterprise.

MIDDLETOWN, ILL.—The Middletown Mutual Telephone Company has been incorporated with a capital stock of $2500. The directors are: Thomas Dorgan, P. J. England and others.

TAMPICO, ILL.—The Tampico Farmers' Mutual Telephone Company has been incorporated with a capital stock of $4900. The directors are: W. M. Maloney, A. C. Hunter and others.

DANVILLE, ILL.—The Vermillion County Telephone Company, it is stated, has bought out the Central Union system. This is thought to be the first instance on record where a local company has compelled the surrender of the Central Union. The capital stock of the new company was recently increased from $150,000 to $4,000,000.

CHICAGO, ILL.—The stockholders of the Automatic Electric Company have voted to increase the capital stock of the company to $2,000,000, making the total $5,000,000. This is the company that is manufacturing the equipment for the Illinois Tunnel Company's telephone system in Chicago. It is also at work on orders for thirty other exchanges throughout the country.

CHERRYVALE, IND.—The Cherryvale Telephone Company has been incorporated with a capital stock of $350.

PORTLAND, IND.—There is every indication of a telephone war being inaugurated in this city. The Bell Telephone Company is preparing to establish an exchange in opposition to the Home Telephone Company.

INDIANAPOLIS, IND.—A number of telephone companies in this State have abolished the custom of making a "morning test." Many patrons objected to the unnecessary annoyance and since the practice has been discontinued the service is equally as good.

NEWCASTLE, IND.—It is stated that the independent companies in Henry County will probably be consolidated in the near future. There are nearly 4,000 independent telephones in the county, and the object of the consolidation will be the exchange of service for mutual interest.

SWEETZER, IND.—At the annual meeting of the Sweetzer Telephone Company new directors were elected as follows: L. M. Hoggatt, J. B. Reed, A. Bechtel, J. C. Lake and Louis Oyler. The new board in turn elected Mr. Hoggatt president, Mr. Reed treasurer, and Mr. Bechtel secretary. The report for the year was very gratifying.

LAGRANGE, IND.—The Northern Indiana and Southern Michigan Telephone Company has completed arrangements for better service. The office at Lima will be made an all night office. The company began February 1st to give the market and weather reports over its 14 party lines from Lima to all its subscribers. These reports and the night service has increased the demand for telephones.

SPIRIT LAKE, IA.—The Midland Telephone Company will install a local exchange in this place.

CLARE, IA.—The Fort Dodge Telephone Company contemplates the installation of an exchange in this place.

CEDAR FALLS, IA.—The City Council has granted a franchise for a mutual telephone company in this place, as proposed by Mr. R. A. Davison.

SIOUX CITY, IA.—The Independent Telephone Company has the contract for the construction of a toll line from Odebolt to this city, a distance of 60 miles, and another to Lemars, 25 miles.

FORT DODGE, IA.—The Fort Dodge Telephone Company has elected officers for the coming year as follows: O. M. Oleson, president; C. D. Koch, vice-president; L. A. Thorson, secretary; E. G. Larson, treasurer.

WEBSTER CITY, IA.—Ten different telephone companies operating in Hamilton County have been consolidated. They are the Kamrar Co., the Jewell-Wall Lake Co., the Ellsworth Mutual Co., the Williams Co., the Stanhope & Northeastern Co., the Randall Co., the Jewell & South Cairo Co., the Jewell & Northwestern Co., the Stratford Independent Co., and the Blairsburg Co.

FALL RIVER, KAS.—The Fall River Telephone Company has been incorporated with a capital stock of $3000.

AUGUSTA, ME.—The Amazon Wireless Telegraph & Telephone Company has been organized here with a capital stock of $1,000,000, of which nothing has been paid in. The officers are J. Berry, Augusta, president, and L. A. Burleigh, Augusta, Treasurer.

READING, MICH.—The Central Telephone Company has been incorporated with a capital stock of $10,000.

MARQUETTE, MICH.—Crawford & Sons, timber operators of Cedar River, may build a telephone line from Cedar River to Stephenson in the spring.

DETROIT, MICH.—The stockholders of the Co-operative Telephone Company have approved a bond issue of $50,000 for extensions and improvements.

MURDOCK, MINN.—A telephone line is projected from Murdock to Louriston and Buffalo Lake.

HOWARD LAKE, MINN.—The Howard Lake Telephone Company will make a 10-mile extension in the spring.

MINNEAPOLIS, MINN.—The Twin City Telephone Company has declared the eighth quarterly dividend on preferred stock at the rate of 7 per cent. per annum.

ELKO, NEV.—The Northern Telephone & Telegraph Company has been incorporated with a capital stock of $10,000 by J. G. Taylor, R. H. Mallett and others. The company is already operating a line between Tuscarora, Edgemont, White Rock and Columbia, and will extend it to other points north.

MIDDLETOWN, N. Y.—Te directors of the Orange County Telephone Company have re-elected the following officers: President, Charles Higham; vice-president, A. B. Wilbur, and secretary, W. C. Ramsdell.

WILMINGTON, N. C.—It is announced that the lines of the Long Distance Southern Bell Company will be extended from Wilmington to Florence, S. C., a distance of 110 miles. The Bell Company is taking down the wires of the recently absorbed Interstate Company at Wilmington.

MIFFIN, OHIO.—The Mifin and Widowville Telephone Company has increased its capital from $1000 to $5000.

CLEVELAND, OHIO.—The Telephone Hygenic Company has been incorporated with a capital stock of $100,000. The directors are F. B. Williams, T. H. Hogsett and others.

IRONTON, OHIO.—Eastern capitalists have purchased the property of the Lawrence Telephone Company, having exchanges here, at Ashland, Catlettsburg, Russell and Rush, Ky., and minor points. It is stated semi-officially that the Central Union Telephone Company is the purchaser.

HARRISBURG, PA.—The annual report of the Pennsylvania Telephone Company shows that 368 miles of toll pole lines were rebuilt, and 758 miles of copper metallic circuits substituted for iron wire.

CHESTER, PA.—The Keystone State Telephone & Telegraph Company has begun a general system of renovation along its lines in the county. Two new trunk lines are being constructed to Chester from Philadelphia. In connection with this, the exchange will be removed from Moore and located either in Lansdowne or Darby.

WASHINGTON, PA.—J. T. Behout, of Claysville, has purchased all of the property of the Federal Telephone Company in Buffalo, Blaine and Donegal townships. Mr. Behout also purchased interests in the Claysville Telephone Company, which system will be operated in connection with that portion of the Federal system acquired by him. Exchanges will be established at Claysville, Taylorstown and various other points in the townships named.

COLMAN, S. D.—The Colman Electric Telephone Company has been incorporated with a capital stock of $10,000.

MEMPHIS, TENN.—The Memphis Long Distance Telephone Company has executed a mortgage for $1,000,000 with the Tennessee Trust Company as trustee; bonds to this amount to be floated to meet expenses, complete the plant and acquire other properties.

ELKHART, TEX.—The Elkhart Telephone Company which was recently organized here has constructed and put into operation a telephone line to the towns of Slocum and Denison Springs, a distance of fifteen miles. The line will be extended.

MERHERRIN, VA.—The Lunenburg Telephone Company has increased its capital from $500 to $5000.

JANE-LEW, W. VA.—The Beeghley Telephone Company of this place has been incorporated with a capital stock of $50,000. The incorporators are: Lloyd Beeghley, Hattie Beeghley, R. A. Beeghley, Weston, W. Va., Mary A. Swisher, Charles Beeghley, Jane-Lew, W. Va.

DAVENPORT, WASH.—The Creston & Sherman Telephone Company has been granted a telephone franchise on the public highways of the county.

WHEELING, W. VA.—The National Telephone Company has completed connections with the South Penn Telephone & Telegraph Company operating between Waynesburg and Uniontown. The company has also completed a direct line to Mannington, where connection is made with the system of the Consolidated Telephone Company, and the line to Wellsburg is nearly completed.

JANESVILLE, WIS.—The Rock County Telephone Company has decided to extend its lines.

LEEDS, WIS.—The Leeds Farmers' Telephone Company has increased its capital from $5000 to $10,000.

RIVER FALLS, WIS.—The St. Croix Valley Telephone Company has increased its capital stock to $1500.

MADISON, WIS.—The Rhinelander Mutual Telephone Company has increased its capital stock to $10,000.

GRAFTON, WIS.—The Grafton Telephone Company has been incorporated with a capital stock of $4000. The directors are J. G. Buck, F. C. Mintzlaff and others.

RIDGELAND, WIS.—The Dunn County Telephone Company of this place has been incorporated with a capital stock of $10,000 by M. L. Randall, A. L. Pongratz and J. R. Ferguson.

Electric Light and Power.

DOUGLAS, ARIZ.—A company has been formed here for the purpose of establishing another electric light and power plant. It has a capital stock of $60,000. H. C. Mayer is manager of the new company. The stockholders are F. S. Douglas, W. G. McDonald, A. S. Pierce, C. J. Lachance, D. A. Richardson and others.

SAN FRANCISCO, CAL.—The United Gas and Electric Company held its annual meeting on January 21. The officers elected were: J. E. Green, president; C. E. Green, vice-president, and C. H. Pennoyer, secretary. R. J. Davis replaced George A. Nichols as one of the remaining directors.

MACOMB, ILL.—The Brookfield Gas, Electric & Heating Company of this place has increased its capital stock from $25,000 to $50,000.

AURORA, ILL.—The Aurora, Elgin and Chicago Light, Heat and Power Company has been incorporated, with a capital of $5000. Incorporators: Edwin C. Faber, John T. Huntington and William F. Harvey.

FT. WAYNE, IND.—The City Council has granted a 31-year franchise to the Ft. Wayne Electric Light and Power Company at $70 a year for street lights and 10 cents per kw. for private current. There has been a six months fight over this franchise owing to a sentiment favoring a municipal ownership plant.

JACKSON, KY.—An accident to the engine in the electric light station recently destroyed that machine to such an extent that the city was left in total darkness.

LEWISTON, ME.—Work is soon to be commenced on the new dam across the Androscoggin River. All of the electric power apparatus is on the ground, and it is expected that about 10,000 horse power will be available for distribution in Lewiston and Auburn early in the fall of this year.

ITHACA, MICH.—The managers of the Ithaca Light & Power Company shut down the plant recently on account of the high price of coal, which they claim prevents them from running the plant at a profit, and rather than lose money they decided to close down indefinitely.

GLASGOW, MONT.—Preliminary surveys are in progress for the construction of water works and an electric light plant. A. W. Mahon is the engineer.

LIVINGSTON, MONT.—The new electric light plant of the Livingston Water Power Company, which takes the place of the one destroyed by fire on November 29 last, is now in operation. As yet no street lamps are in service and there will be none until the city pays up its back bills for street lighting. The streets are, therefore, unlighted.

SANTA FE, N. M.—The Capital City Light and Power Company has taken the preliminary steps looking to extending its transmission lines to the city of Albuquerque and Las Vegas. It is proposed to furnish those places with light and power for municipal and commercial purposes. The plans of the company contemplate the construction of a large electric power plant at the Pecos River Falls, situated fourteen miles from Santa Fe. Among those interested in the company are Colonel W. S. Hopewell, manager of the New Mexico Fuel and Iron Company, Santa Fe; J. C. Bonner, of Toledo, Ohio; J. W. Miller, mining engineer, of Denver, Colo., and A. R. Gibson, of Santa Fe.

GREENE, N. Y.—The citizens have voted to issue $4500 bonds, to complete the electric light plant.

HILTON, N. Y.—A. M. Lawrence, of Clyde, submitted an offer to this village to establish an electric light plant.

CATSKILL, N. Y.—The Catskill Illuminating & Power Company has increased its capital stock from $65,000 to $100,000.

BROOKLYN, N. Y.—Bids will be received February 15 by C. B. J. Snyder, Superintendent of School Buildings, New York City, for installing electric equipment in the manual training high school.

CLINTON, N. Y.—The capital stock of the Clinton Electrical Company has been increased by $15,000, and steam will be installed at the power house as soon as weather will permit. Work will be commenced with a view to increasing the water power.

LEROY, N. Y.—The Leroy Hydraulic Electric Company has petitioned the courts for permission to change its name to Leroy Hydraulic Electric Gas Company. The first named company about a year ago purchased the old gas plant and the street lighting plant, and it is now proposed to consolidate the two concerns under the latter title above given.

WINSTON, N. C.—The city of Winston has contracted with the Fries Power and Manufacturing Company for seventy arc lights at $60 per light per year, the contract covering three years, beginning March 31, 1904.

NEWTON, N. C.—Shields, Sons & Co., of Providence, R. I., have secured an option on a valuable water power on the Catawba River near here, and it is said will begin a big electric development to supply power to neighboring cotton mills.

TOLEDO, OHIO.—At the annual meeting of the Toledo Railways & Light Company the present officers and directors were re-elected for the ensuing year. The annual report of President Everett showed that the gross receipts were $1,663,794, an increase of $204,702 over the previous year. The operating expenses were $856,526 as compared with $726,779 in 1902; and the net earnings were $807,279 against $123,312 in 1902.

HARRISBURG, PA.—At the annual meeting of the Harrisburg Light, Heat & Power Company the following named officers were elected:: President, E. Z. Wallower; vice-president, Harry C. Ross; secretary and treasurer, Harry W. Stone; general manager, Charles C. Kinter.

READING, PA.—The following named officers have been elected by the Reading Electric Light & Power Company: Jerome L. Boyer, president, and J. H. Righter, secretary. The company will be twenty-one years old on March 8, and during its existence it has declared 62 dividends amounting to $565,000. This is equal to 200 per cent. on the original capital stock.

PHILADELPHIA, PA.—Judge McPherson, in the United States Circuit Court has issued a decree of foreclosure ordering the sale of the Lehigh Power Company's plant in and around Easton, Pa., to satisfy the claim of the Central Realty, Bond & Trust Company, trustee of the mortgages securing the bondholders. This action was taken on account of the default of the company in the payment of interest due on its bonds amounting to $325,491.25. Mr. Russell C. Stewart was appointed special master to conduct the sale.

WEBSTER, S. D.—The council committee is considering the matter of increasing the capacity of the electric light plant here.

MITCHELL, S. D.—J. B. Mickellsell and Fred. Fairchild have purchased the local electric light plant, and will install additional machinery.

MEMPHIS, TENN.—The Memphis Electric Supply Company has increased its capital stock from $5000 to $50,000.

WACO, TEX.—The citizens have voted to issue bonds for an electric light plant, water works and a sewerage system. F. H. Meader is recorder.

WILLS' POINT, TEX.—The Wills' Point Electric Light Company has been organized with a capital stock of $10,000. The incorporators are O. L. Johnson, Charles E. Brown and W. B. Rogers, all of Wills Point.

MARBLE FALLS, TEX.—It is reported that the falls of the Colorado River at this place are to be utilized for generating electric power for an electric plant that may be installed here. The names of the parties interested are not given.

CISCO, TEX.—The Cisco Electric Light Company has been organized here with a capital stock of $10,000 for the purpose of installing and operating an electric light and power plant. The incorporators are W. A. McSpadden, Aaron L. Mayhew and Abner L. Mayhew, all of this place.

FILLMORE, UTAH.—The city officials are considering the installation of an electric light plant here early in the spring.

ORANGEVILLE, UTAH.—The towns of Orangeville and Castledale are considering the construction of an electric light plant and a joint committee consisting of A. G. Van Buren and J. B. Crawford, of Orangeville, and W. J. Seeley, of Castledale, have been appointed to investigate the matter.

WATERVILLE, WASH.—The City Council has entered into a 15-year contract with George H. Gray & Son, of Entiat, to furnish electric light and power to Waterville at $50 per horse power per annum. The plant is to be in operation by September 1.

OCONOMOWOC, WIS.—The Council has decided to secure bids for improving the electric light plant.

SHELL LAKE, WIS.—The citizens have voted to borrow from the State $10,000 for an electric light plant and water works.

BELOIT, WIS.—The Beloit Electric Lighting Company will expend about $10,000 in improvements. J. S. Allen is manager.

WEST ALLIS, WIS.—The Village Board has granted to the Milwaukee Light, Heat and Traction Company a perpetual franchise for lighting. The company was given a 3 year contract for electric lighting.

PORT ARTHUR, ONT.—At a recent meeting of the council for the town of Port Arthur, the question of further developing the power on Current River received favorable consideration. It is the intention of the council to utilize from 8000 to 10,000 horse power, and to offer the surplus power at a low rate for manufacturers. It is said that taking the cost of the power development on a 5 per cent. interest basis the interest on borrowed cash for this purpose, which the town now pays, brings the cost down to about $4 per horse power per annum.

SHERBROOKE, QUE.—The shareholders of the Sherbrooke Electric Company have decided to accept the offer of the city to purchase the company's electric light plant and property for the sum of $200,000, provided the city will also take over the gas property of the company.

MONTREAL, QUE.—At the annual meeting of the shareholders of the Shawinigan Water and Power Company, the treasurer reported that the company was now selling in Montreal 6000 horse power, and at Shawinigan Falls, 20,000; that there was still a large surplus of power in the development at the Falls, the total being estimated at 100,000 horse power. The operation of the power plant at Shawinigan Falls had proved satisfactory, and the successful transmission of power to Montreal had demonstrated the commercial feasibility of transmission to any point within a radius of 100 miles of the Falls. The company was in receipt of applications for large amounts of power, and extensive additions to its electrical plant will be made.

MONTREAL, QUE.—The Montreal Light, Heat and Power Trust now includes the Montreal Gas Company, the Royal Electric Company, the Montreal and St. Lawrence Light and Power Company, the Imperial Electric Light Company, the Lachine Rapids Hydraulic and Land Company, the Standard Light and Power Company, the Citizens' Light and Power Company, and the Temple Electric Company. Further combinations are looked for, notably that of the Montreal Street Railway Company with which the combine is already closely allied. This trust was formed for the ostensible purpose of cheapening production by combination, but the experience of consumers shows that the cheapening of light and power to them has not resulted. The combination now controls all the lighting and supply of power of Montreal, St. Henri, Ste. Cunegonde, St. Louis, Westmount, Maisonneuve and Cote St. Paul, with a population of 322,327. It also controls the public lighting of the city of Montreal under a contract running until January, 1909. At a recent meeting of the Montreal Board of Trade, it was unanimously decided that electric light and power were too dear, and that steps should be taken to put an end to such monopolies as that of the Montreal Light, Heat and Power Company. It was stated that this company was at present charging its customers four times as much for power as the combination paid for its supply received from the Shawinigan Falls Company.

The Electric Railway.

WATSONVILLE, CAL.—W. J. Rogers has applied for a franchise to construct and operate an electric railway over certain streets in Watsonville. Bids for the franchise will be received up to 8 p. m., February 17. S. W. Coffman is City Clerk.

EAST ST. LOUIS, ILL.—The new power house of the East St. Louis & Suburban Railway Company is expected to be completed some time in March. The company then will abandon its three small outside stations, and depend entirely upon the new plant for power with which to run its cars. During the year the company has introduced a great many improvements. A unique feature has been the installation of a complete telephone system on its suburban lines. All the trolley poles have been numbered, and on every fifteenth pole a telephone connection has been hung. Each car also is equipped with a portable telephone, which can be quickly attached to the pole connection and communication entered into with the sheds, power stations, general office or superintendent's residence. In its annual statement the gross earnings of the company for the year are given as $448,067, and for its electric light plant $526,313, an increase of 36.43 per cent.

COLUMBUS, IND.—The City Council has granted a 50-year franchise to the Indiana Central Electric Railway Company, proposing to build a line from Columbus to Seymour and French Lick.

INDIANAPOLIS, IND.—The Wabash & Rochester Electric Railway, of Wabash, Ind., E. Spencer Pratt, secretary, has filed a mortgage for $900,000. The contract for the construction of the road has been awarded to United States Engineering & Construction Company, of Cleveland, Ohio.

HUTCHINSON, KAN.—The City Council has granted a twenty-year franchise to J. J. Burns, of Chicago, to construct and operate an electric railway in Hutchinson. Mr. Burns plans to purchase the Hutchinson Street Railroad, now being operated with horses.

BOSTON, MASS.—Representative John A. Coulthurst, of Boston, has introduced a bill into the Legislature which calls for the appointment of a special commission of five experts by the Governor to inquire into all public service corporations with a view of obtaining a franchise compensation and other results. The bill takes in all corporations like street railways, steam railroads, telephone and telegraph and gas and electric light companies.

DEERFIELD, MICH.—An effort is being made to obtain right-of-way from Briton through Deerfield for an electric railway, to connect with the Toledo line at Petersburg; a double track is to be laid and everything completed by summer.

BENTON HARBOR, MICH.—J. G. McMichael, of Chicago, has been given a franchise for an electric railway from Benton Harbor to Dowagiac, through Pipestone township. The road will touch all summer resorts along St. Joseph River. The only question now left unsettled is whether the road shall run from Eau Claire to Niles or from there directly to Dowagiac.

MINNEAPOLIS, MINN.—The County Commissioners have sold the old motor line right of way from Hopkins to Excelsior to the Minnesota Power and Trolley Company for $4,000.

ST. PAUL, MINN.—The City Council of South St. Paul has decided to make several amendments to a draft of a street railway franchise, which has been submitted to the council by the Twin City Rapid Transit Company.

GREENWOOD, MISS.—The Board of Trade has called a meeting of citizens to consider plans for building an electric railway from Greenwood to Belzona. This will serve a prosperous country not now reached by any kind of railways. It is proposed to handle both freight and passengers.

ELMIRA, N. Y.—Announcement is made that arrangements have been concluded for the building of a third rail electric railway between Elmira and Corning. The necessary application will be made to the State Railroad Commissioners at once. A private right of way has been secured.

NEW YORK, N. Y.—The Metropolitan Street Railway Company is considering a proposition made to it by Comptroller Grout that it operate cars on the Williamsburg Bridge, as a temporary measure of relief until such time as it will be possible to make arrangements for connecting the bridges on the Manhattan side. The suggestion is that the Metropolitan Company operate its cars on a loop around the Brooklyn terminal of the Williamsburg Bridge, thus obviating the necessity of a franchise in Brooklyn. There is plenty of room for such a loop in the Brooklyn terminal of the structure.

DEGRAFF, OHIO.—The Dayton & Kenton Electric Railway has let a contract to the Farnham Company, of Chicago, for the equipment of its projected line with the Farnham protected third rail. The officers of the electric railway company are: E. M. Hopkins, of New York, president; C. H. Pomeroy, of Saginaw, Mich., treasurer; W. E. Harris, of DeGraff, Ohio, secretary. The plan is to build lines from Dayton to DeGraff, New Carlisle to Springfield, DeGraff to Canton, and DeGraff to Bellefontaine.

NORFOLK, VA.—A company has been chartered here to build an electric railway to Elizabeth City, N. C. The distance is 40 miles. It is said that the Norfolk City Railway, which is owned by the Williams syndicate, of Richmond, is to build the road. General Manager Hathaway denies, however, that the company has any more interest in the charter than a traffic arrangement with the road when built.

BALLARD, WASH.—Surveys are being made in the interest of the Everett-Seattle Interurban Railway. It is understood that a franchise will be presented to the City Council at an early date, asking a right-of-way through the city.

MADISON, WIS.—The Outagamie Traction Company, of Appleton, Outagamie County, has been formed to build and operate an electric railway and power company, capital stock, $30,000; incorporators, Thomas Pearson, W. H. Holcomb, J. A. Hawes, John L. Jacquot and Paul V. Cary.

New Industrial Companies.

THE NATIONAL SWITCHBOARD COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $10,000 by Joseph F. McGrath, Gustavus A. Conover and George E. Groswold.

THE PITTSBURG AUTO-ELECTRIC COMPANY has been incorporated with a capital stock of $6000 by L. A. Ailes, Fred S. Ailes, R. S. Donaldson, E. W. McCormick and James F. Shepperson.

THE CRESCENT ELECTRIC COMPANY of Utica, N. Y., has elected officers as follows: President, J. C. Eichmeyer; vice-president, John Wenzel; secretary, W. P. Campbell; treasurer, A. J. Potter.

THE BOREAS ELECTRIC COMPANY has been incorporated at Washington, D. C., with a capital stock of $1,000,000. The incorporators are: Joseph Stretch, J. H. Lougborough, Jr., and J. Menick Freare.

THE CARBON MOTOR VEHICLE COMPANY has been incorporated in New York with a capital stock of $100,000. The directors are: C. A. Carbon, Brooklyn, and Leopold Soudheim and Eugene Soudheim, New York.

THE RICHARDS-RANDALL TELEGRAPH & TELEPHONE SUPPLY COMPANY of New York has been incorporated with a capital stock of $100,000. The directors are E. M. Jerome, F. M. Randall and G. C. R. Marshall.

THE ZINCOIL POLE COMPANY, of Texarkana, Ark., has been incorporated with a capital stock of $25,000 to conduct a general electrical supply business. The incorporators are John B. King, E. J. Spencer, D. C. Lingo and Charles M. Conway.

THE McKELVEY ELECTRIC COMPANY, of Youngstown, Ohio, has been incorporated with a capital stock of $10,000 to manufacture electrical appliances. The incorporators are: John Reed, Edward McKelvey, E. J. Anderson, F. W. Robinson, A. M. Wendlish and V. J. Laur.

THE CONDIT ELECTRICAL MANUFACTURING COMPANY has been organized at Augusta, Me., for the purpose of manufacturing electrical supplies. The capital stock is $200,000, of which nothing is paid in. The officers are I. L. Fairbanks, Augusta, president, and J. Berry, Augusta, treasurer.

THE BRADLEY RAILWAY SIGNAL & SUPPLY COMPANY, of Providence, R. I., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing and dealing in electric railway block signal systems and electrical supplies in general. The incorporators are Harold E. Bradley, Warwick; Eugene F. Bowen, Providence, and Stephen A. Wood, Providence.

Legal.

WESTERN UNION-BELL ACCOUNTING.—At Boston, on February 3, Judge Colt in the United States Circuit Court ordered the American Bell Telephone Company to give an accounting to the Western Union Telegraph Company, the successful plaintiff in the recent royalty suit against the telephone company. Everett W. Burdett was appointed special master to take charge of the accounting and to hear all evidence that may be presented. The suit of the Western Union Company was to recover royalties from the American Bell Company under the well-known agreement, and the present action is concerning the amount of money to be paid over.

ELECTRIC LIGHT NOT A MANUFACTURE.—A case was settled recently in the Supreme Court of New Hampshire over a dispute arising in the village of Warren. Pub. St. 1901, c. 55, Sec. 11, provides that towns may, by vote, exempt from taxation for a term not exceeding 10 years any manufacturing establishment proposed to be erected or put in operation therein. It was held by the court on appeal that furnishing electric light and power, and distributing the same, was not manufacturing, within such statute, and such business not being separable from a vote exempting an establishment for manufacturing lumber, and furnishing steam and electric power, and distributing the same, from taxation, the entire exemption was void.

"CAR AHEAD" PRACTICE INVALID.—The Appellate Term of the New York Supreme Court—Justices Freedman, Gildersleeve and Greenbaum—rendered a decision last week upholding the ordinance which prohibits street surface railroad companies from compelling passengers to take a "car ahead," and imposes a penalty of $100 for each violation. Justice Gildersleeve wrote the opinion and both his colleagues concurred. It is held that the ordinance which in substance requires street surface railroad companies to carry a passenger "to any regular stopping place desired by him upon such car's route," without change of cars except for transfer to a connecting line going in another direction, or in case an accident renders compliance impossible, is valid and reasonable. Justice Greenbaum, in a concurring opinion which he wrote, went further and said that were it not for the ordinance passengers on street cars would be subjected to peril, traffic would be congested, and much inconvenience caused.

Obituary.

MR. J. L. KEBLER.—We regret to note that Mr. John Leonard Kebler, vice-president and general manager of the Ward Leonard Electric Company, died very suddenly, February 2, at Albuquerque, New Mexico, from an acute intestinal disorder. Mr. Kebler graduated in 1900 from Columbia University, taking the degree of electrical engineer. He was a member of the American Institute of Electrical Engineers and was widely known throughout the entire electrical fraternity. His untimely death comes as a great blow to his associates and to his uncle, Mr. H. Ward Leonard, with whom he has been living for the past 16 years. Mr. Leonard Kebler, his brother, has gone for the remains and will take them to Cincinnati for burial.

Personal.

MR. W. C. BURTON, of J. G. White & Company, Limited, of London, arrived in New York last week on a business trip round the world.

MR. H. H. STANLEY, of the Columbia Phonograph Company, has sailed for China. He will make his permanent headquarters at Shanghai.

MR. W. B. CHURCHER, and not Mr. W. Scheidel, was the author of the interesting paper on "Rectifiers," presented at the recent annual convention in Milwaukee of the Northwestern Electrical Association.

MR. A. M. HUNT, of the Engineering Offices, San Francisco, is visiting the principal eastern cities. He will return to the Coast via Vancouver, B. C., where his firm is superintending a large electric power installation.

MR. F. E. DRAKE, the well-known electrical manager, now president of the Lanyon Zinc Company, of St. Louis, has been visiting New York city the past week on business matters connected with that important smelting enterprise.

MR. H. F. STEPHENS has been elected general manager of the Central New York Telegraph & Telephone Company in place of Mr. Jeffries Wyman, resigned. Mr. Wyman retains the position as second vice-president of the company.

MR. RICHARD T. LAFFIN, formerly general manager of the Worcester, Mass., Consolidated Street Railway, who was recently appointed general manager of the Manila Electric Light & Railroad Corporation, has sailed for that part of the world.

MR. WM. MAVER, JR., announces that his new book, "Maver's Wireless Telegraphy, Theory and Practice," will be issued February 15, 1904. It will be a valuable treatise on the art, especially on the practical side, many details of which have heretofore lacked publicity.

MR. WILLIAM BARCLAY PARSONS, chief engineer of the subway, declares that if increase in the population of New York continues at its present rate, a new road with a carrying capacity as great as that of the completed subway will have to be built every four years.

MR. J. L. PUTNAM, general manager of the Clark Automatic Telephone Switchboard Company, Providence, R. I., has been laid up for a couple of weeks or more with inflammatory rheumatism, but we are glad to note that he is convalescing and expects to be on deck again soon.

MR. H. H. SINCLAIR, general manager of the Edison Electric Company, of Los Angeles, Cal., has left that city for a year's cruise through the South Sea Islands. He is accompanied by his family, on his boat, the "Lurline," the largest and fastest schooner-yacht on the Pacific Coast.

MR. H. HINE, formerly vice-president and general manager of the Stanley Electric & Manufacturing Company and now largely interested in the development of Mexican water power, being president of the Guanajuato Electric Light & Power Company, is again in New York at the Waldorf.

MR. G. F. METZGER, A. M. Inst. C. E., M. Inst. E. E., announces that having been appointed consulting engineer to the Manchester Corporation, England, for the completion of the work initiated by him as its city electrical engineer, he is now practicing as consultant in electrical and mechanical engineering at 3 York St., Manchester.

MR. JOHN H. KELMAN, for 14 years past prominently connected with the Stanley Electric Manufacturing Company at Pittsfield, Mass., and now superintendent, has resigned, and will at once, it is understood, join the electrical forces of the Allis-Chalmers Company, an important statement as to whose plans appears elsewhere in this issue.

MR. O. A. SANDBORGH has resigned his position as assistant electrical engineer with the Marine Engine & Machine Company, of Harrison, N. J., to accept an appointment with the Westinghouse Electric & Manufacturing Company at East Pittsburg, Pa., whither he has now proceeded from New York, where he has a wide circle of acquaintances.

MR. HERBERT W. SMITH, late of the Stuart-Howland Company, Boston, has associated himself with Mr. George H. Swazey under the firm corporate name of Swazey & Smith, with offices at 53 State St., Boston, and storeroom at Charlestown, Mass. They will furnish all material for lighting and railway plants and make contracts for complete equipments.

MR. REUBEN DUNELL, of D. H. Burnham & Company, the Chicago architectural engineers, has sailed for Europe for the purpose of creating a new department for J. G. White & Company, Limited, of London. The London concern intends to devote part of its attention to the construction of office and other buildings in the British metropolis and other parts of Great Britain.

MR. GEO. B. GORDON, of the Gramercy Exchange of the New York Telephone Company, has been appointed to an important position with the Chesapeake & Potomac Telephone Company, which controls the telephone system of Washington, D. C. Most of Mr. Gordon's time in his new position will be given over to supervising the installation of the common battery system, which the company is now adopting.

MR. CHAS. R. PRATT, who recently began independent practice as a consulting engineer, with offices at 160 Fifth Ave., New York, announces that he has associated with himself Mr. E. Van Winkle, a young engineer of considerable experience, who has been connected with the Otis Elevator Company, the Marine Engine & Machine Company and was lately the general manager of the National Coin Counting Machine Company.

MR. THOMAS J. JOHNSTON and Mr. George C. Dean have associated themselves for the practice of law with the firm name of Johnston & Dean, with offices at 11 Pine St., New York. Their specialties will be practice in the United States courts, particularly in equity; patent causes, proceedings in Admiralty, causes removed from State to Federal courts, customs cases, bankruptcy cases, etc. Both members of the firm have been admitted to the bar in many jurisdictions, and are well known practitioners.

MR. W. A. BIXBY.—This gentleman has become manager of the Quincy (Ill.) Gas and Electric Company. He has for some time past managed the lighting companies at Decatur, Ill. The capacity and output of the electric light plant there has been increased 25 per cent., and a heating plant has been built. Altogether in these three plants $200,000 has been invested in the four years. Mr. Bixby went into the lighting business at Nebraska City, Neb., in 1883. Since then he has held positions at Galena, Ill.; Little Rock, Ark.; Wichita, Kan.; Sherman, Tex.; Lorain, O.; Champaign and Decatur.

DR. G. F. KUNZ.—Dr. George F. Kunz, of New York city, special agent of the United States Geological Survey, has been appointed Commissioner of the radium exhibit at the St. Louis Exposition, and has been authorized to prepare and procure material therefor, comprising radio-active substances of all kinds, and also exhibits to illustrate the action of radium compounds, ultra-violet light, and Roentgen rays upon mineral and chemical substances. This exhibit is to be made by the United States Geological Survey in the United States Government Building at St. Louis. There will be a second exhibit of radium and radio-active substances in the Mines Building.

MR. CARLOS G. PALACIOS, the head of the electrical department of the Caracas Gas & Electric Light Company, Caracas, Venezuela, is now here for the purpose of investigating the latest equipment, purchasing same, and determining what shall be installed in several water power and steam-driven plants about to be constructed or added to in that South American country. Mr. Palacios some twenty years ago was connected with the old United States Electric Light Company. He was the first to introduce American electrical machinery into Venezuela, where he has installed numerous plants. He may be found at the offices at 79 and 81 Wall St. of Kates & Bok.

MR. JOHN McGEORGE, consulting engineer of the Wellman-Seaver-Morgan Company, has resigned, the change to take effect March 1. He has been connected with the Wellman interests as mechanical engineer for over 13 years. After March 1, he will be located at No. 501 Citizens Bldg., Cleveland, O., having opened an engineering office, under the name of McGeorge & Sons, taking into partnership with him his sons. He expects to do general consulting business, paying particular attention to power plants and the engineering side of office buildings. Mr. Ernest McGeorge, at present with the Wellman-Seaver-Morgan Company, will resign at the same time to become a member of the new firm.

MR. W. S. LAYCOCK, the large British contractor for railroad fittings, supplies, etc., who has introduced a number of American devices, including the Gold electric car-heating apparatus, for use on British, Colonial and Continental European railroads, is now on a visit to this side. He intends to make arrangements while here for electric car-lighting equipment for use on British steam roads. Mr. Laycock's plant, the Victoria Works, Millhouse, near Sheffield, is the only one on the other side which is completely equipped with Yankee machinery—Brown & Sharpe, Pratt & Whitney, etc.—and driven by electric power. It cost nearly $500,000. Mr. Laycock is accompanied by Mr. George A. Wyld, his chief engineer. They are guests at the Waldorf-Astoria.

MR. SAMUEL S. DICKENSON.—We are glad to note that Mr. Samuel S. Dickenson has been brought to New York city to assume the newly created position and office of general superintendent of the Commercial Cables. This well-known, estimable and highly competent electrical engineer has been connected with the Atlantic Cable service since 1874. He established and has been the superintendent of the Commercial Cable Company's important station at Hazel Hill, Canso, Nova Scotia, since 1884. His technical knowledge and capacity for practical affairs made him extremely valuable in his regular occupation, and marked him as a specially suitable official to employ on such vital work as the selection of landing places and the establishment of new stations whenever the company required services of that delicate nature. Thus he was sent by Mr. Ward to the Azores in 1900 to select a landing place and to create its station at Horta, Fayal, for the Canso-Fayal cable. This cable placed the Azores and North America in direct telegraphic communication for the first time; and for his services in connection with the event, the King of Portugal decorated him with a distinguished military order. When, in 1901, the Commercial Pacific Cables were planned, he was again sent by Mr. Mackay and Mr. Ward to select landing places at Honolulu, Midway, Guam and Manila. He also established the office at Honolulu. The new office which he has come to New York to direct was made necessary by the increasing amount of executive work growing out of the development of the company's business, and which his admirable qualifications make him eminently capable of filling.

Trade Notes.

WESTINGHOUSE BALTIMORE OFFICE.—The Baltimore office of the Westinghouse Electric & Manufacturing Company has opened temporary quarters at 221 North Calvert Street.

OBERG & BLUMBERG, contracting electrical engineers, have removed their offices in New York city from 853 Broadway to 112-114 West Forty-second St. and 107-117 West Forty-first St.

BULLOCK ELECTRIC MFG. CO., of Cincinnati, O., has issued very appropriately for its portrait calendar for February, one bearing the portrait and biography of Mr. T. A. Edison, whose birthday falls on the eleventh day of the month. He was born in 1847.

THE CHICAGO FUSE WIRE & MFG. CO., Chicago, New York and Buffalo, is drawing attention to a new line of switch outlet boxes which it is now prepared to furnish. Special attention is called to the fact tha this box is made to take any of the best makes of rectangular push-button switches and flush receptacles in common use.

THE EUREKA COMPANY, Chicago and Genoa, Ill., is now prepared to furnish its new Bell style self-restoring ring-down switchboard on which it has been favored with many orders recently. This drop has met with universal favor with telephone engineers, and is a new departure from the regular restoring drops. Its new bulletin on this new board is now ready and it would be pleased to forward same upon receipt of notice.

REMOVAL.—The American Conduit Manufacturing Company announces that its main office has been moved from New Kensington to Pittsburg, Pa. The better facilities for communication thus obtained will enable the company to render better service to its patrons than before. The company invites all interested in conduit work to call on it at its new quarters. New improvements completed at the New Kensington factory, the company states, has enhanced the superior qualities of American conduit. The new office address is 413 Grant St., Pittsburg.

THE CENTRAL ELECTRIC COMPANY is sending out a circular which quotes some very attractive prices on American Circular Loom flexible conduit, for which it is sales agent. The company especially requests that any one who is in the market for this class of material should write for quotations. Attention is also called to the fact that the Central Electric Company is sales agent for Edison primary batteries, formerly known as Edison-Lalande batteries. The company carries a complete stock of these batteries and is prepared at all times to make prompt delivery.

RAND DRILLS.—Contradicting the suggestion of a slackening of business activities comes the report that the "Imperial" pneumatic tool department of the Rand Drill Company telling of the large increase of sales since the first of the year. That the sterling worth of its products is universally appreciated is proven by the orders received for piston air drills, Wood boring machines and hammers and the installation of a number of complete pneumatic tool plants in the railroad shops, ship yards, boiler works, foundries and bridge and iron works, both in this and in foreign countries.

THE ALUMINO-THERMIC PROCESS.—The Goldschmidt Thermit Company has been formed as a corporation under the laws of the State of New York, for the purpose of exploiting in the United States of America the alumino-thermic process invented by Dr. Hans Goldschmidt and protected by United States patents. It is proposed to conduct business generally in connection with the Chemical and Tin Smelting Works of Th. Goldschmidt, Essen-Ruhr, Germany (founded 1847), and the company is prepared to handle all products dealt in by the parent concern. Offices have been secured at 41 Wall St., New York

THE EMERSON ELECTRIC MFG. CO, of St. Louis and New York, has just issued for 1904 a very handsome and striking catalogue of its fan motors, so well known all over the world. The cover is dark gray embossed in red, gold and black, and shows a standard fan motor in high relief on a wall bracket. The contents are more extensive and detailed than in previous years, and enter very fully into the construction and design of its various types for high and low-frequency work. The various fan motors are illustrated complete and sectionally, and the careful descriptive text is admirable. All told, there are 62 small square quarto pages in this compendium of the alternating fan motor art.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., reports that it is enjoying great success in meeting the demands of the machine tool trade for controllers for use with variable speed motors, the speed variation being obtained by varying the field strength. The motor starter and field rheostat are so interlocked that the motor cannot be started under condition of weak field, and the fact that its field rheostats have a large number of points for control and its starter has an overload device which operates during the period of starting and the no-voltage release magnet is independent of the field strength, seem to have fulfilled the demands of the machine tool trade. It would be glad to cöoperate with any machine tool manufacturer in filling his demands.

LOCKE INSULATORS.—As has recently been exemplified and illustrated in this journal, a number of interesting new designs of high-grade insulators have been brought out and put on the market by the Locke Insulator Company, Victor, N. Y. We learn from Mr. Fred M. Locke, the president, that the company has lately considerably increased its facilities for handling small porcelain work, and desires acquaintance with the requirements of engineers and electrical manufacturers. Inasmuch as the Locke porcelain has been very highly developed for high voltage work, this should be of interest to all porcelain users. Its last publication, Booklet No. 7, is now being mailed, and will be sent on request to any one interested. The list of the large enterprises using these insulators is a long and convincing one.

OTTO WEISS MACHINE DEPARTMENT of the Chase Machine Co., of Cleveland, Ohio, writes us as follows through Mr. Thomas A. Aiton, manager: "We manufacture machinery used for forming electric wires and cables and for insulating the same. We manufacture a large range of these machines for all kinds of insulation from silk to lead. I worked from some four years in Berlin, Germany, as assistant to Mr. Otto Weiss, who was for many years the head engineer at Siemens Bros., London, and who manufactured and laid a great number of submarine cables. Later he established his own company in Berlin, for the manufacture of machines used in this line of work. Perhaps it would interest you to know that I have just placed a 4-head cabling machine with the Waclark Wire Co., at Bay Way, N. J. This machine is 96 inches long and weighs 55,000 pounds, and is used for making 61-wire strands up to two million circular mills. We have also placed several of these machines, as likewise similar ones though smaller, in many of the wire and cable works of this country."

PERFECT WINDOW LIGHTING.—Among the many methods of making a store-front attractive, well-lighted windows undoubtedly take first place. There can be no question as to what constitutes the best form of window lighting. The source of light must be hidden from view, yet the fullest illumination must be obtained from the lamps. This has become possible through the Frink system of lighting as embodied in the special patent window reflector of I. P. Frink, 551 Pearl St., New York. The reflector is composed of silvered corrugated glass set in a metal frame, designed on scientific lines so that all the light is reflected on the goods, yet is hidden from the sidewalk. Nothing is more annoying to an intending purchaser than to have his view of goods in a window blurred by the glare of electric lights. Progressive electricians are much interested in this subject and many have taken advantage of their opportunity by equipping the stores of their customers with Frink reflectors. A request to the above address will bring full information and estimate on the next store-lighting contract that any of our readers in the lighting field may have before them.

POOR'S MANUAL OF RAILROADS, recently issued, is considerably larger than any previous issue and correspondingly more complete in its scope and contents, returns of all leading railroads for the year ending June 30, 1903, or later, that were received up to Nov. 1, 1903, being included in its pages. Compared with the Manual for 1902, the current issue increased in the Department of Steam Railroads from 846 to 880 pages, the number of corporations for which statements are presented being 2,043 this year, against 1,937 in 1902. In the section devoted to statements of city and suburban railways, the number of corporations reported in 1903 is 1,177; in 1902, 1,156. The number of pages in this section is 257 in 1903, against 239 in 1902. In the department of miscellaneous industrial corporations, statements are presented for 236 enterprises against 199 in 1902. To provide space for this expansion in the scope of that department called for an increase of 32 pages, the Manual for 1903 devoting 145 pages to the presentation of statements of the affairs of "Industrials," against 113 pages in the previous issue of the book. It would be hard to find a more valuable statistical production than this as to financial investments and opportunities in the traction and industrial fields.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 2, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

750,793. SELECTIVE SIGNALING SYSTEM; Garrison Babcock, Chicago, Ill. App. filed July 17, 1903. (See page 326.)

750,807. TELEGRAPH APPARATUS; John E. Carney, Montgomery, Ala. App. filed Feb. 24, 1903. A telegraph instrument comprising a permanent magnetic system having one of its poles divided into two pole pieces, and armature being pivoted on one of said pieces and free to play between the remaining two pieces; a winding modifies the action of the system.

750,811. OIL-SWITCH; William H. Cole, Watertown, Mass. App. filed April 29, 1903. The invention relates principally to a non-porous plug through which the conductors lead into the oil casing and which prevents escape of the oil along the conductors.

750,818. TROLLEY HARP OR FORK; Fred P. Crockett and Osro P. Johnson, Kalamazoo, Mich. App. filed April 4, 1903. Details.

750,825. AUTOMATIC TROLLEY LINE REEL; Charles F. Davy, Mohawk, N. Y. App. filed March 19, 1903. A spring drum and ratchet for retracting the trolley pole.

750,835. TELEPHONE-TRANSMITTER; Ernest B. Fahnestock, New York, N. Y. App. filed Dec. 2, 1901. (See page 325.)

750,845. SWITCHING APPARATUS; John S. Goldberg, Chicago, Ill. App. filed Nov. 26, 1902. Details of a ringing and listening key.

750,873. INSULATING SLEEVE AND METHOD OF MAKING SAME; Norman Marshall, Newton, Mass. App. filed June 6, 1902. A cylindrical insulating sleeve having its ends of different diameters and having a seam running its full length with abutting edges intimately shaped to each other.

750,876. ELECTRIC PLANT FOR CHARGING STORAGE BATTERIES; Joseph B. Meriam and Mark B. Crist, Cleveland, O. App. filed July 25, 1902. The plant consists of a gas engine, a dynamo adapted to be operated as a motor for starting the engine, a switch by which the motor is supplied with current from a battery temporarily for starting the engine and mechanism whereby the engine will drive the dynamo and be automatically stopped when the battery is fully charged.

750,894. ELECTRIC ARC LAMP; Joseph A. Rignon, Berlin, Germany. App. filed April 11, 1902. Two carbons are mounted upon corresponding arms of bell cranks, the other arms of which are connected with the core of the solenoid; the carbons converge and are brought together and separated by the solenoids.

750,938. ALTERNATING CURRENT WATTMETER; Charles A. Brown, Chicago, Ill. App. filed July 24, 1900. The windings of the meter, one for pressure and the other for current, are superposed, whereby the fields produced thereby are collocated.

750,939. PROCESS OF MEASURING WATTS IN ALTERNATING-CURRENT CIRCUITS; Charles A. Brown, Chicago, Ill. App. filed Nov. 19, 1900. The process consists in creating a single field by the current and pressure in the system and subjecting a measuring element to the action of said field.

750,940. ALTERNATING-CURRENT MOTOR; Charles A. Brown, Chicago, Ill. App. filed July 13, 1903. A combination between two energizing circuits serving to carry currents adapted to produce magnetic flux following the same path, and an armature carrying a short-circuited winding in inductive relation to said circuits.

750,947. ELECTRIC CONTROLLER; Frank E. Case, Schenectady, N. Y. App. filed Sept. 16, 1901. Relates to the arc-extinguishing and deflecting devices in a car controller.

750,948. DEMAND DISCOUNT METER; Frank P. Cox, Lynn, Mass. App. filed Aug. 15, 1902. Means for changing the speed of the meter so long as the line current exceeds a predetermined maximum.

750,953. PLUG-EJECTING JACK FOR TELEPHONE-SWITCHBOARDS; Robert G. Dunfee, Fostoria, Ohio. App. filed June 6, 1902. (See page 325.)

750,966. SURFACE-CONTACT ELECTRIC RAILWAY; John H. Guest, Brooklyn, N. Y. App. filed Feb. 26, 1903. Improvements in sectional conductor systems wherein an electro-magnet is first energized by a light current to close the circuit to a section and afterwards maintained in an energized condition by the power current.

750,971. SWITCH FOR SERIES ARC CIRCUITS; Caryl D. Haskins, Schenectady, N. Y. App. filed Aug. 22, 1902. A movable diamond-shaped contact device co-operating with spring contacts for the purpose of making the lamp connections before breaking the circuit connections, and *vice versa*.

750,972. MEANS FOR CONTROLLING ELECTRIC BOOSTERS; Edward M. Hewlett, Schenectady, N. Y. App. filed Aug. 31, 1900. A cut-out in the booster circuit is actuated automatically when the motor which drives the booster ceases to operate.

750,980. FIELD-COIL STRUCTURE; Charles H. Kaler, Schenectady, N. Y. App. filed Aug. 5, 1902. Ventilating spaces are provided in a coil by inserting blocks of wood between sections of the winding.

750,991. RAILROAD SIGNALING DEVICE; Joseph R. Marchesseault, Meriden, Conn. App. filed Nov. 13, 1902. Details.

750,993. ELECTRIC SWITCH; George Monson, Schenectady, N. Y. App. filed July 25, 1901. The blade is forked at the end and passes over the outside of two spring clips.

751,003. CONTROLLER CASING; Charles L. Perry, Schenectady, N. Y. App. filed Oct. 26, 1900. A latch for securing the cover of the controller casing.

751,012. FUSE BOX; Robert H. Read, Schenectady, N. Y. App. filed April 1, 1901. Venting channels communicate with the passage containing the fuse and terminate in metal mesh which relieves the escaping gases of heat.

751,013. SIGNAL DEVICE FOR SEARCH-LIGHT PROJECTORS; Robert H. Read, Schenectady, N. Y. App. filed Aug. 3, 1901. The casing surrounding the carbons swings on a center coincident with the axis of the carbon, for the purpose of covering and uncovering the light.

751,015. ELECTRICAL MEASURING INSTRUMENT; Lewis T. Robinson, Schenectady, N. Y. App. filed Feb. 10, 1902. The parts are so related that the magnetic return-piece or counter-torque element, in shifting from a position of maximum flux to a position of minimum flux, will cover an angle greater than 90°, resulting in an effective scale angle exceeding 60°.

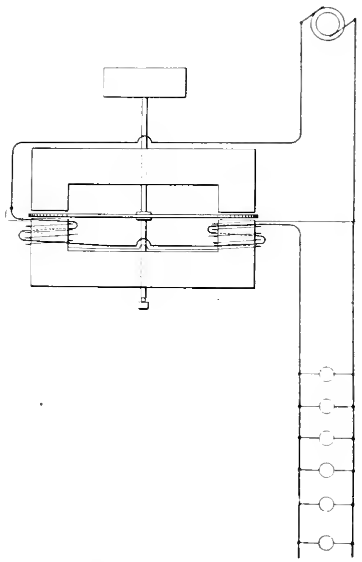
751,021. AUTOMATIC SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; Harry B. Snell, Cement City, Mich. App. filed April 25, 1903. Details of a signal switch actuated by the trolley wheel.

751,025. ELECTRIC ARC LAMP; George E. Stevens and Walter C. Fish, Lynn, Mass. App. filed June 14, 1902. For the purposes of low cost and simplified construction the lamp is largely constructed of porcelain and punched metal fittings.

751,029. LAMP SOCKET; Julius C. Tournier, Schenectady, N. Y. App. filed April 30, 1900. Details.

751,046. PLATE FOR STORAGE BATTERIES; Joseph Bijur, New York, N. Y. App. filed March 31, 1902. (See Current News and Notes.)

751,048. SIGNAL SYSTEM FOR ELECTRIC RAILWAYS! Charles P. Breese, Norfolk, Va., and Adoniram J. Wilson, Westfield, N. J. App. filed May 5, 1902. Details.



750,939.—Process of Measuring Watts in Alternating-current Circuits.

751,071. SIGNALING APPARATUS; Edwin L. Grauel, Rochester, N. Y. App. filed March 19, 1903. Relates to the construction of make-and-break signaling apparatus for calling upon the relays of telegraph lines when it is desired to annunciate a rapid, steady and extended signal.

751,084. ELECTRIC SWITCH; Ernest A. Lowe, Plainfield, N. J. App. filed Jan. 17, 1902. A construction for obtaining strength in a switch blade which has mechanically attached to it and in the circuit an inclosed fuse.

751,100. ELECTROMAGNETIC ORE SEPARATOR; Ellen M. Oviatt and Alexander Dean, Denver, Colo. App. filed May 3, 1901. Details.

751,103. TELEPHONIC CALL INSTRUMENT; John D. Peachy, East Orange, N. J. App. filed Jan. 6, 1903. (See page 325.)

751,120. ELECTRICAL CONTROLLER AND BRAKE-OPERATING DEVICE; Walter W. Tice, Rahway, N. J. App. filed April 7, 1903. Details.

751,150. ELECTROMAGNETIC ORE SEPARATOR; Alexander Dean, Denver, Colo. App. filed Dec. 13, 1902. Wedge-shaped pole pieces overlapping each other, and over which the ore-carrying belts travel, are provided with adjustments for determining their relative position.

751,163. FEED WHEEL FOR AUTOMATIC TELEGRAPHIC PERFORATORS AND TRANSMITTERS; John Gell, London, England. App. filed March 17, 1903. The pins for drawing along the tape are carried by a sleeve which is slipped over the feed wheel and is adjustable to make the pins register accurately with the perforations in the tape.

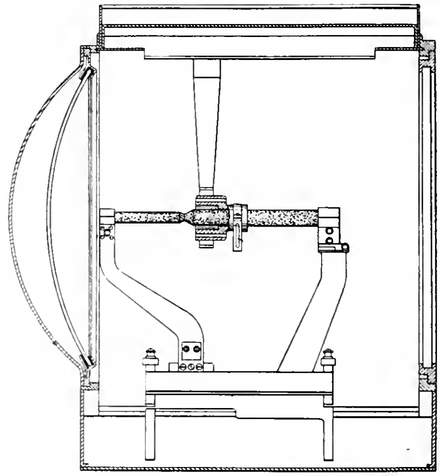
751,170. PROCESS OF ELECTROLYTICALLY PURIFYING JUICES. Alexander Knollrepp, Berlin, and Alfred Wohl, Charlottenburg, Germany. App. filed June 10, 1902. (See Current News and Notes.)

751,174. ELECTRIC SWITCH; William F. Irish, East Orange, N. J. App. filed July 23, 1902. Details.

751,175. THIRD RAIL FOR ELECTRIC RAILWAYS; Lloyd G. Johnstone, New York, N. Y. App. filed Oct. 10, 1903. The rail is covered by a metal plate supported on springs, and adapted to be forced downward by the shoe on the car to obtain the necessary contact.

751,191. ELECTRIC MOTOR; Hiram P. Maxim, Pittsburg, Pa. App. filed March 12, 1903. A motor frame comprising two cylinders and two end plates clamped together and completely inclosing the armature, the field-magnet pole pieces and coils and the commutator.

751,193. ELECTRICAL ALARM DEVICE; Burnett Menkin, Philadelphia, Pa. App. filed July 30, 1901. The invention comprises normally-open first and second circuits, in the latter of which the alarm is included, means for making and breaking the first circuit, a movable contact device for closing the second circuit and automatically breaking the first, and a switch for breaking the second circuit.



751,013.—Signal Device for Search-light Projectors.

751,227. ELECTRIC CUT-OUT; William H. Verner, Pittsburg, Pa. App. filed Aug. 28, 1902. Details.

751,228. CABLE HANGER; Richard H. Villard, New York, N. Y. App. filed Aug. 5, 1902. A strap with clamping-hook.

751,271. APPARATUS FOR HEATING AIR OR LIQUIDS TO A CONSTANT TEMPERATURE; Victor Eltz, Abbazia, Austria-Hungary. App. filed June 18, 1902. An expansible liquid automatic circuit controller.

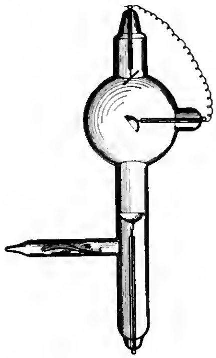
751,294. APPARATUS FOR ELECTRICALLY TRANSMITTING AND RECEIVING MESSAGES; Arthur T. M. Johnson, Highbury, England. App. filed June 6, 1902. A transmitting instrument having a secondary winding, and means for producing impulses therein at different rates, a number of receivers each operated by impulses of two different rates, one of which is common to all the receivers and the other specific to the particular receiver.

751,298. TROLLEY; John Kelly, Pittsburg, Pa. App. filed July 11, 1903. The lessening of pressure of the wheel on the wire throws up guard arms which prevent the wheel from actually leaving the wire.

751,304. ELECTRIC VACUUM DISCHARGE TUBE; Michel Krouchkoll, Paris, France. App. filed May 26, 1902. A bunch of glass fibre or capiliary tubes contained in the X-ray tube serves to retain a certain amount of gas by which the vacuum is regulated.

751,321. ELECTRIC LIGHT FIXTURE; John J. Miller, Pittsburg, Pa. App. filed May 21, 1903. Incandescent lamps are arranged upon a horizontal rail to be slid along the same to bring the light to the most advantageous position.

751,344. TELEPHONE-RECEIVER; Lewis Sands and Charles C. Cadden, Cleveland, Ohio. App. filed March 6, 1903. (See page 325.)



751,304.—Electric Vacuum Discharge Tube.

751,353. ELECTRIC BLANKET; Frank K. Singer, Wheeling, W. Va. App. filed Sept. 8, 1903. A heating resistance is distributed throughout the blanket.

751,354. INSULATED WIRING TACK; Donald G. Smart, Grand Rapids, Wis. App. filed Jan. 5, 1903. An insulating plate is adjusted under the T-head of a tack to prevent cross-connecting the two wires of the circuit that may be caught under the head of the tack.

751,362. THERMOSTAT; John L. Ward, Ord, Neb. App. filed July 9, 1903. An expanding rod moves an index finger over a scale until it touches a contact, when an alarm is sounded.

751,363. PRINTING TELEGRAPH RECEIVER; James D. White, London, England. App. filed June 19, 1903. Details.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, FEBRUARY 20, 1904. No. 8.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, FEBRUARY 20, 1904.

CONTENTS.

"THE BLUE RIBBON."

The annual dinner of the Institute last week was a much larger affair than expected and far larger than anything of the kind heretofore carried out under Institute auspices. A dinner to which nearly 500 people sat down, and with over 100 more as spectators is in itself quite a notable affair, but when it celebrates a particular anniversary and is attended by features of unique interest, it becomes memorable. The fact that the dinner signalized the twenty-fifth anniversary of the incandescent lamp and the founding of the first electrical medal of award in this country would in itself be enough to make it stand out conspicuously. It is, therefore, a matter of general congratulation that, according to universal testimony, the dinner was a success in proportion to its magnitude and significance. Those who saw the banquet hall of the Waldorf-Astoria certainly looked upon a remarkably brilliant spectacle, to which the presence of so many ladies contributed in no small measure.

The exercises of the occasion were also worthy of it, and the speeches full of excellent matter, which while not all of the light touch-and-go nature that makes for the laughter or cheering of the moment, stands better the test of time as an expression and record of the feeling of the hour. Mr. Insull, in turning over the Edison Medal and Deed of Gift to the Institute, struck a happy keynote when he characterized the medal as a "blue ribbon" of the profession that every young electrical engineer should be glad and proud to win. We believe the medal will not only help the young men, but will benefit the Institute in bringing it in even closer touch than now with the great body of coming members of the profession. The Edison Medal Association is, finally, to be congratulated on the ease and celerity with which it raised the proposed $7,000, a sum larger than that deemed necessary for the John Fritz Medal and adequate after all preliminary expenses have been met, for all the purposes embraced in its foundation.

THE BALTIMORE FIRE.

We are able to present in our pages this week some interesting data in regard to the Baltimore fire and its effect on the electrical services in that city. On the whole, it is a matter of congratulation that the telegraph and telephone services suffered so little and that such slight damage was inflicted on the lighting and street railway plants. It might have been a great deal worse, especially in view of the wholesale destruction of property, and this naturally brings us to a consideration of the lack of water supply and fire-fighting facilities in general. All reports from Baltimore go to show that the firemen did not have an adequate supply of water at any time. And yet an inexhaustible supply was at hand—"water everywhere, but not a drop to drink." If the firemen had only been able to avail themselves of the salt water all around the burning district they could doubtless have saved enough property to pay for the pumping plant many times over.

The same elements occur in considering the problem of fire extinction in New York City, and we are glad to note that Mayor McClellan has revived the plan to equip Manhattan Island, or at least its more valuable business sections, with salt water mains for fire purposes. These could be readily associated with electric motors for pumping the supply, and the project, if worked out on broad, adequate lines, should pay for itself several times over in higher insurance and lower rates for the districts covered.

In this connection we wish to emphasize what we have said before and is now our solemn duty to say again. The fire alarm system of New York is sadly and seriously behind the times. It is grossly inadequate. It needs practically entire renovation and reconstruction and the work cannot be taken in hand too soon. If Mayor McClellan will only secure a report from competent, disinterested experts he will find our statements justified and will realize that, with salt water mains or without, he cannot too soon overhaul the fire alarm system itself of this great western metropolis with all its incalculable wealth to be protected.

THE THEORY OF ALUMINUM ELECTROLYTIC RECTIFIER.

Within the last few years much interest has been displayed in the aluminum-carbon electrolytic cell, since experiments have been made looking towards making the apparatus industrially available as a rectifier. It is known that when a plate of aluminum is opposed to a plate of carbon in a suitable electrolyte, the cell so formed offers but little obstruction to an electric current entering at the carbon and leaving at the aluminum; that is to say, when the aluminum is the cathode. On the contrary, when the current is reversed and the aluminum is made the anode, the cell offers a very marked obstruction and practically shuts off the current, if the voltage does not exceed 20 or more volts. Consequently, when such a cell, or a battery of such cells, is inserted in the path of an alternating current, the semi-waves directed towards the aluminum go through with but little drop of pressure, or waste of power, while the intervening and oppositely directed semi-waves are automatically shut off, to a greater or less extent. In other words, the alternating current has become converted into what is substantially a unidirectional pulsating current. Such an arrangement could, of course, only utilize half the alternating-current impulses. But by the use of divided circuits or branches, with a pair of such batteries, all positive waves could be utilized unidirectionally in one branch, and all negative waves unidirectionally in the other, the two could coact, in most cases, to produce a unitary result, equivalent to complete rectification of the alternating current. The apparatus, however, has not yet come into practical use, mainly owing to relatively large losses of energy in the electric valves. That is to say, the current is not instantly shut off, as soon as the aluminum turns anode, but a certain amount has to go through, in order to shut off the rest, like the "wire-drawing" in an imperfectly adjusted steam valve. If this wire-drawing loss of power could be eliminated, the cell might be capable of some practical service on alternating-current circuits.

In the last number of the *Physical Review,* Mr. S. R. Cook contributes an article of some experiments made to elucidate the action of the aluminum rectifier. There is already quite a literature upon the subject, and various rival theories. The theories differ both as to the nature of the chemical action and also as to the nature of the electrical action. With reference to the electrical action, some contend that the opposition to the electric current, or the electric barrier, of the cell, is wholly, or substantially, a matter of ohmic resistance. They say that when aluminum is made the anode, the anions, either primary or secondary, are hydroxyl ions, which form an oxide or a hydrate film on the aluminum, and virtually coat it with an insulating paint. The high e.m.f. at the terminals of the cell under this condition they attribute entirely to IR drop of pressure in this high-resisting film. Others contend that the cell in the obstructive condition is the seat of a positive c.e.m.f., like the back e.m.f. of an electric motor at work. This difference of opinion resembles that which exists over the nature of the potential difference in the voltaic arc. In the latter case the phenomenon has been known for a longer time, and has formed the subject of more numerous investigations, so that the discussion has been more active and polemical. Some contend that the difference of potential at the voltaic arc is either wholly or substantially an IR drop of potential in ohmic resistance. Others contend for the existence of a true c.e.m.f. At the present time the advocates of resistance seem to have the best of the argument. The latest researches seem to indicate that of the fifty odd volts pressure at the arc, only a volt, or less, can be regarded as real c.e.m.f., like that of a voltaic cell, and the great remainder is due to the resistance of the carbon vapor column.

In the case of the aluminum cell, Mr. Cook seems to advocate the c.e.m.f. theory. Yet he admits that the film of material covering the aluminum anode—which he thinks is Al_2O_3—has a very high resistivity. Consequently, we have difficulty in precisely apprehending his conclusions. In the main, however, he regards the charged anions as being denied access to the aluminum anode by the superficial film of oxide. The negatively-charged anions are caught and arrested by this film, as torpedoes might be caught and kept from reaching the hull of a vessel by a torpedo-net. The layer of charged ions caught in the net constitute a layer which, according to the article, gives rise in some manner to a c.e.m.f. It seems reasonable, indeed, that the anions should be caught and massed together in this way; but the voltage of each anion cannot be more than about one volt, and the mechanism whereby the massing of such ions can build up a c.e.m.f. of some fifty volts is hard to realize. Moreover, if, as is admitted, the oxide film on the aluminum offers a high electrical resistance, then the passage of current through the film must produce a part, at least, of the observed potential difference.

During the steady flow of a unidirectional electric current through a conductor, it is usually impossible to tell whether the potential difference at the terminals of the conductor is due to resistance or to c.e.m.f. Take a thermo-electric junction, for example. If a current of one ampere determines a pressure of one-tenth of a volt at the terminals of the junction, there may be a thermo-electric c.e.m.f. of one-tenth of a volt and no resistance; or, there may be no c.e.m.f., but one-tenth of an ohm resistance; or, there may be partly c.e.m.f. and partly resistance. The power expended in the conductor by the current will be one-tenth of a watt on either hypothesis. The only hope of discerning which condition exists, during the continuance of the current, is to study the gradient of potential, and ascertain whether it be continuous or abrupt. If it be continuous, the inference is that resistance is involved. If it be abrupt, while the material is continuous, the inference is that c.e.m.f. is involved. In the case of the aluminum cell, the potential difference is developed in so short a distance that this test is hard to apply. When, however, the current is suddenly removed, there can be no residual c.e.m.f. if the effect is entirely due to resistance. On the other hand, if the effect be due to a real c.e.m.f. the latter generally persists to some extent after the removal of the impressed current. Thus, in the polarization cell, in the thermo-junction, in the magnetic circuit of hard steel, etc., the removal of the impressed current, or flux, leaves a clearly perceptible c.e.m.f. or c.m.m.f. In the case of the voltaic arc, no appreciable residual c.e.m.f. has yet been detected. The article mentions that when the current polarizing the aluminum-anode cell is suddenly interrupted, there appears to be a distinct and powerful residual c.e.m.f. If this exists in a circuit of negligible inductances, then this is indeed evidence of a real c.e.m.f. But apart from this, the remainder of the evidences cited in the article do not seem to us at all conclusive. The subject should receive further investigation.

Alternating Current Railway Motors.

We count ourselves fortunate having been able to present to our readers in our issue of last week so interesting a discussion as that in which Messrs. Lamme and Steinmetz played the principal rôles at the last Institute meeting. It not infrequently happens that during the progress of a discussion many important matters which have been—well, let us say secluded—in the papers themselves, find the light of day, and in this instance the tail certainly wagged the dog. The game opened with a very lucid and pertinent discussion by Mr. Lamme of the whole question of single-phase railway motors, including particularly a comparison between the series and the repulsion types, with respect to their design and properties. On the whole, Mr. Lamme's remarks were the most illuminating which we have yet heard regarding the new railway motors, and we commend them heartily to the careful attention of those interested in the subject. We do not altogether agree with the speaker's classification of the commutating single-phase motors. It seems to us that a sharp line should be drawn between the pure series-wound motor in which the currents delivered to field and armature flow in one and the same circuit and are dynamically in the same phase, and those in which the phase difference between the currents in armature and field is part of the organic theory of the motor. The pure series type to which Mr. Lamme has adhered is in principle and theory on all fours with the series-wound, direct-current motor. The latter, as is well known, does not reverse by reversal of the current at its terminals, but only when the reversal is as between armature and field. If such a machine is fed with an alternating current at one cycle per second, the same relation holds true, and so on up to the point where, with increasing frequency inductance and parasitic currents, block the game.

Mr. Lamme's work has been to plan the structural features of the motor so as to permit the frequency to be carried up to a figure within the range of commercial alternating practice, and so far as has transpired he has done a very workmanlike job. As he explains in the discussion, he has cut down the serious inductance of the field by making it very weak compared with the armature and by working at low saturation. He has provided a very powerful armature, thus throwing the main work upon the element of which the inductance is less serious, and, as we learn from his English patent, he has perforated the salient poles longtitudinally to lessen the otherwise great cross-magnetizing effect of the powerful armature. He has employed resistance in the commutator leads to diminish the effect of the coils short-circuited in commutation and has, in short, used to good advantage all the arts of the skilled designer. And he states in the most unequivocal manner, that the result has been to eliminate sparking as a practical difficulty. On the other hand, the motors developed by Winter and Eichberg and by Dr. Steinmetz belong squarely in the category of alternating-current machines. They deal with field magnetizations and currents displaced in phase and brought into harmony by establishing a fixed polar line in the armature through the agency of the commutator. They may be treated in theory as motors having rotary fields, although as we intimated in our notice of Dr. Steinmetz's paper, this treatment is not necessary any more than it is in the case of a pure induction motor. The repulsion motor invented by Prof. Thomson is one of the most ingenious and interesting of the alternating class and possesses many of the most valuable properties of a pure series motor. In fact, the series characteristics making it essentially a motor for vairable speed undoubtedly stood in the way of its progress when it was invented, the demand then being for motors of inherently constant speed. Now, freed by the progress of the art, like the series motor, from the incubus of high frequency, it has been developed into a machine of great and immediate value.

As regards the relative merits of the two types, it is too early to speak from experience. Each type must in practice transform down for the armature the voltage of the trolley wire. The series motor does this by a separate transformer, the repulsion motor by transformation in the motor. As between the two processes we are not inclined to think that there will prove to be any material difference either as regards efficiency or power factor. The losses will be distributed somewhat differently in the two. As Dr. Steinmetz pointed out, the repulsion motor will utilize less iron and more copper and works its iron at higher density than the series motor. Up to the maximum voltage for which the fields of the repulsion motor can be wound, we should think it would have a material advantage in total weight of equipment over the series motor. At higher voltages than this it would lose such advantage. Both types can be used on direct currents, the series motor perhaps the more readily of the two, being the less separated in design from a direct-current motor. Both can return energy to the line by way of braking and the series motor can be, if need be, "slugged" like a direct-current motor. Both suffer from a poor power factor at starting, poor even compared with standard polyphase motors, against which low power factor is often discharged; but as Mr. Lamme pointed out, the actual volt-amperes taken in starting are not excessive owing to the efficient means of control available with alternating currents. The speed-torque curves of the two types are much alike, not differing more than would two motors of the same type but of different design, and when at or near normal speed the power factors are amply high in spite of a liberal air-gap, much larger than is usual in the polyphase motors.

As regards the practical working properties of these two types of motor, it is too early to speak with much certainty. Both Mr. Lamme and Dr. Steinmetz agreed that little can be told regarding the relative excellence of series and repulsion motors by experiments on one line of machines operated in both ways, for the fundamental elements of correct design differ in the two cases. Moreover, the game is as yet young and in a matter which depends almost entirely upon the *virtuosity*—to steal a word from Pharisees—of the respective designers, one could only guess at final results. It seems to be agreed that the sparking problem has been solved, within limits at least, and that in general operative properties the new motors will have most of the virtues of the ordinary ones, in addition to some peculiarly their own. Present indications are that the alternating motors will be materially heavier than the present standard railway motors, and also by a few per cent. less efficient. We have little doubt that further experience will relieve one or the other of these conditions, but hardly both unless at great additional cost of construction. However, as we have repeatedly stated, the efficiency of the worst of the newcomers compares favorably with the efficiency of the best direct-current railway motor with a rotary converter tied to its tail. Also, the small increase in weight of motor may be considered as merely of an academic interest, since the proportion of dead weight to live weight in any motor car is large and varies far more from one type of car body to another, than in virtue of a change in motors. Nobody protests at a few hundred pounds extra weight in a new and elegant car body. As for the motors, time will tell.

Telegraphic Work in Baltimore During the Fire.

The experiences of the telegraph companies during the great Baltimore fire last week were quite thrilling, and we believe that many of our readers will be interested in the narrative given below of the ordeal undergone by the staff of the Postal Telegraph-Cable Company. Elsewhere in this issue are some other data regarding the more fortunate escape from destruction of the light and power plant of the United Electric Light & Power Company.

The main office of the Postal Telegraph-Cable Company at Baltimore was located on the twelfth floor of the steel skyscraper of the Continental Trust Building on the corner of Baltimore and Calvert Streets. A large force was on duty during the conflagration and when it became evident, about 7 P.M., that there was danger of the destruction of the building all wires north and south were connected through in the subway terminal room in the basement. The records and some apparatus were hurriedly moved to a branch office about half a mile from the main office and other apparatus was packed and taken to the ground floor ready for removal.

At 9.15 P.M. the Continental Trust Building caught fire, burning rapidly, and the operators were compelled to leave, barely having time to get out. The rain of fire in the streets was so intense that Superintendent Lemon, Manager Moore and Cashier White, the last ones to leave the building, had to run for their lives, abandoning the instruments that had been carried as far as the door step. The force then groped their way to the branch office, being drenched to the skin by a bursted hose en route, only to find that that office was also on fire and that the records and apparatus previously removed from the main office had been consumed. The terminal poles where the underground cables meet the aerial lines in the northern and southern sections of the city were then visited, temporary quarters were secured near them, and offices opened for business. These offices were in operation before midnight, one of them being in a Hebrew sweatshop amid surroundings that were far from agreeable.

The executive department in New York was apprised of the conditions and the first morning train leaving New York for Baltimore carried the Postal's portable quadruplex telegraph plant, consisting of an engine, dynamos, switchboard, motor transformers and quadruplexes arranged in cases in such a manner that they may be placed in operation in a few minutes after arrival at destination. Superintendent Lemon had secured new headquarters for the company at 219 North Calvert Street early on Monday morning and immediately begun stringing wires to that point, but unfortunately was short of instruments with which to work them, all spare apparatus and instruments, despite the efforts to save them, having been lost in the fire which burned both main and branch offices.

The portable multiplex plant and an ample quantity of spare instruments shipped from New York reached Baltimore about noon, but owing to the difficulty of obtaining trucks it was impossible to get them delivered until about half-past 5 P.M. A half hour later a full outfit of quadruplexes was in operation. By the following (Tuesday) morning the operating force of the company had been consolidated at the new office, a commissary department had been established, furnishing all employees with coffee and food, connections had been made from the underground system to the new office, and all wires cut into the switchboards there.

The wires cut through in the terminal room in the Continental Trust Building remained in working order between New York and Washington until about 3 o'clock on Monday morning, when they failed. An examination made by Mr. Skirrow, assistant electrical engineer of the company, on Tuesday morning, as soon as it was possible to get at the terminal room in the heated ruins, showed that the iron terminal frames had stood intact, but that the insulation and lead covering on all wires and cables in the room had been entirely consumed. He immediately restored the connections, although parts of the basement were then burning and continued to burn until Tuesday evening.

In addition to the regular force in Baltimore, Superintendent L. Lemon, of Philadelphia, was on the ground from 2 o'clock on Sunday; Superintendent of Construction W. H. McCollum, with several men, arrived early Monday morning, and Mr. Skirrow, with J. F. Needham and several assistants in charge of the emergency apparatus, arrived Monday noon. Mr. T. E. Fleming, special agent, went from New York to Baltimore on Tuesday and assisted in the permanent reorganization of the delivery and accounting departments.

The efforts made and the work done by the entire force elicited the highest commendation. Everyone forgot himself and worked with might and main to re-establish the service. Although nearly every employee suffered some personal loss, operators losing their typewriters and messengers losing their bicycles, etc., not a word of complaint was heard and, despite cold and hunger, every man and boy worked all day and all night and again the next night without rest until the service was fully restored.

So far as transmission on the wires was concerned, the traffic was handled with comparatively little delay even on Monday, but the company experienced very great difficulty in delivering the business, it being almost impossible under the conditions prevailing for messengers to find addresses. The local post-office, however, had escaped and the post-office people were sorting mail matter promptly and business houses were calling at the general delivery windows for their mail. The Postal Telegraph Company, therefore, immediately dropped into the post-office and telegrams which could not be promptly delivered by messenger and in this manner effected deliveries of telegrams as expeditiously as possible under the circumstances.

In the meantime, the regular messenger delivery service was rapidly being re-established by means of a card index on which new and temporary addresses were systematically entered as quickly as they could be collected. The regular deliveries were still further expedited by the use of a special "outlook" envelope, the front of which was partly composed of translucent paper, so that the address of the original message could be read through the envelope, thus obviating the necessity for addressing it.

The prompt and efficient restoration of the telegraph service did more than any other one thing to assist in bringing order out of chaos and in allaying the apprehensions of business houses throughout the country by making it possible for them to communicate promptly with their Baltimore correspondents and thus learn the status of their business affairs. Notwithstanding the fact that the volume of commercial and press business handled during the three or four days succeeding the fire was very largely in excess of the normal business, it was handled with remarkable promptness.

The Pratt Street Power House in the Baltimore Fire.

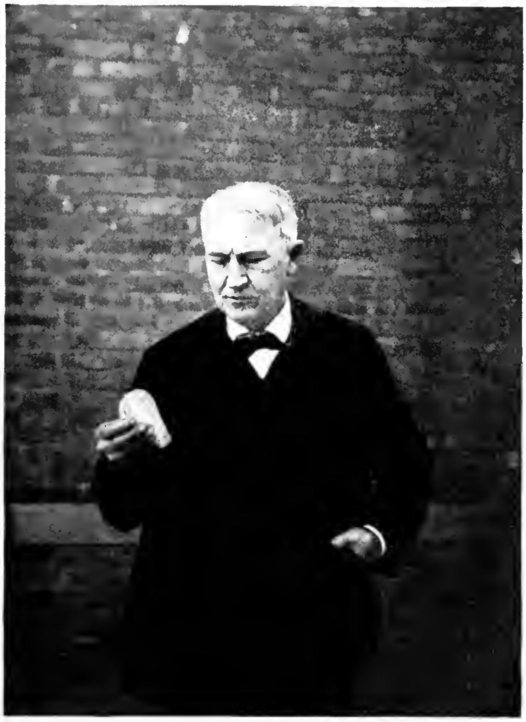
One of the remarkable features of the great Baltimore fire was the saving of the Pratt Street power house of the United Railways & Electric Company, with all of its valuable electrical machinery, although the building was in the midst of the conflagration. The saving of the house and its contents was a piece of great good luck for the whole city, as well as for the company that owned it, as it permitted of the starting up of the street railway service within 24 hours after the fire was under control and a resumption of service which otherwise might have been delayed for weeks.

The power house consisted of three sections, the first section being the old power house, in which was installed direct-current apparatus; the second section is the boiler room, and the third section is the new plant, in which is installed four Westinghouse 2,000-kw, 132,000-volt, three-phase, fly-wheel type, alternating-current generators. The bus-bar structure is in the basement and over this are installed the oil switches, three for each generator and three for each feeder. The control of these switches is in a gallery built at the end of the generator room.

The old part of the power house was destroyed, and in the new part, where the new generators are located, the basement was flooded with water nearly up to the bottom high-tension bus-bar. The building in which this machinery was installed, however, is absolutely fireproof, the window casings and frames being of copper and the glass provided with wire netting. While the flames raged all around, the building did not suffer and in fact a cat which was in this power house came through alive. The old power house burned early Monday morning; by Tuesday afternoon at 5 o'clock the water had been removed from the basement of the new section, test had been made of the Westinghouse apparatus, and the result was that the machines were placed in operation at this hour and started in to furnish current to the sub-stations, and have been running ever since without difficulty.

Annual Dinner of the American Institute of Electrical Engineers.

THE annual dinner of the American Institute of Electrical Engineers, held Thursday, February 11, at the Waldorf-Astoria, was an event of unusual importance in Institute annals and in electrical history in America. It celebrated the twenty-fifth anniversary of the practical perfection and commercial introduction of the incandescent lamp, and the dinner occurring at an opportune season of the year was associated also with Mr. Edison's birthday. A few months prior to the affair, the Edison Medal Association was formed to found a medal in the Institute which would signalize this anniversary in electric lighting development, and at an early stage it made arrangements with the Institute dinner committee so that the dinner might be devoted more particularly to the celebration of the anniversary. If the reports of the daily press are to be taken as any criterion, the affair was one of the most notable of the kind celebrated in recent years in this city, the New York *Herald*, for example, speaking of it as a banquet that for novel effects in decorations, ingenious souvenirs and noteworthy messages of congratulation probably was never eclipsed. The Institute dinner committee comprised Messrs. Calvin W. Rice, chairman; Arthur Williams, T. C. Martin, Charles W. Price, E. H. Mullin, Calvert Townley, F. C. Bates, Bancroft Gherardi, Jr., and W. J. Hammer, with whom were associated Messrs. R. R. Bowker and Frank J. Sprague on behalf of the Edison Medal Association. The officers of the Medal Association contributing actively also with its executive committee to the success of the event were Messrs. Samuel Insull, chairman; Charles Batchelor, vice-chairman; Frank S. Hastings, treasurer; R. T. E. Lozier, secretary.



THE MAN AND THE LAMP.

The banquet was given in the grand ballroom of the Waldorf-Astoria at 7.30 and was preceded by a reception to Mr. Edison at 6.30, when he received the congratulations of the guests assembled, numbering not far short of 500, and including well-known and distinguished people in scientific, artistic, technical, literary, financial and commercial circles. The ballroom was most elaborately decorated for the occasion under the direction of Mr. Arthur Williams, and has never looked so well. In addition to the regular incandescent lighting, the tiers of boxes were all elaborately festooned with Elblight cable and lamps entwined with smilax, and incandescent lamps also adorned the speakers' table in long festoons. Back of the speakers' table were draped American flags and a pyramidal arrangement of 57 incandescent lamps, and in the middle was a handsome oil painting, loaned by Mr. W. J. Hammer, of the modest little house at Milan, Ohio, where Mr. Edison was born, in 1847. Above it was the shield of the State of Ohio and on the two sides were the shields of New Jersey and New York, as being those States most prominently identified with his inventions and work. The menu prepared for the occasion was a sumptuous piece of work, being vellum quarto of 12 pages and cover printed in blue and gold, and containing a portrait in color by the Ives process made from a well-known bust of Edison. This Mr. Edison had been good enough, at the request of the dinner committee, to autograph in advance, so that every guest carried away a memorial which of itself was valuable and interesting as a souvenir of the occasion. The "end covers" of the menu were elaborately worked out in gold, with the initials of the Institute and of Mr. Edison encircling magnets and incandescent lamps; and the same motif was reproduced as a border for each page. The menu included also two sextets written for the occasion by Mr. R. R. Bowker, which are quoted below, one novelty in connection with them being the fact that they were not written out but were dictated directly to the phonograph.

The dinner committee had also prepared a number of other interesting conceits and surprises which added greatly to the charm and interest of the occasion. The stick pins for the boutonnieres were little incandescent lamps furnished by the General Electric Company. The cover of the sorbet box was a large reproduction in old ivory celluloid of the statue of the Genius of Light made by the Italian sculptor, Bordiga, and now one of the prominent features of the library at the Edison Laboratory. The ices were molded in the form of incandescent lamps and were brought in in a procession by some 40 or 50 waiters, each of whom carried a large pastry model of some electrical device or invention, including huge reproductions of the early Edison dynamo, the Edison phonograph, a multipolar machine, resistance boxes, electric automobiles, badges of the Institute and other effects. All these and sundry other details were received with great enthusiasm by the occupants of the ballroom who, it may be noted, included 150 ladies, most of whom were in full evening dress. The rostrum, or speakers' table, was occupied by President B. J. Arnold, having Mr. Edison on his right as the guest of honor; Prof. Elihu Thomson, Prof. C. F. Brackett, Dr. A. E. Kennelly, President C. A. Coffin, of the General Electric Company; President Ambrose Swasey, of the American Society of Mechanical Engineers; Mr. John Fritz, Mr. Samuel Insull, president of the Edison Medal Association; Mr. C. L. Edgar, president of the National Electric Light Association; Mr. Joseph B. McCall, president of the Association of Edison Illuminating Companies; Mr. W. H. Fletcher, president of the Engineers' Club; Col. R. C. Clowry, president of the Western Union Telegraph Company; Mr. A. B. Chandler, president of the Postal Telegraph-Cable Company; Mr. George G. Ward, president of the Commercial Cable Company; Mr. W. J. Wilgus, vice-president New York Central Railroad; Mr. J. J. Carty, president of the New York Electrical Society; Mr. C. F. Scott, chairman of the Union Engineering Building Committee of Fifteen; Mr. R. W. Pope, secretary of the Institute, and Mr. T. C. Martin, toastmaster.

After the service of the dinner President Arnold called the company to order and read the following message from President Roosevelt:

THOMAS A. EDISON, Waldorf-Astoria, New York:
I congratulate you as one of the Americans to whom America owes much; as one of the men whose life work has tended to give America no small portion of its present position in the international world.

The reading of this dispatch was received with great applause and a standing toast was drunk to the health of the President of the United States. Mr. Arnold then delivered an interesting speech on the Institute and its relation to the affair of the evening, in the course of which he said:

We have met on this, the day of our annual feast, not only to renew the friendships incidental to those engaged in a common cause, but to assume an obligation which, if administered faithfully by us and our successors, shall tend to stimulate the ambition of many of our student class and bring to some of them that intangible something called success. If you ask me what is success, I cannot answer; but those whose ambition is to add to the sum of human knowledge or accomplish something for the material advancement of the race, need no answer.

It is to this class of young and ambitious men that our attention is directed to-night. If, in the future, they need inspiration, let them recall this occasion and remember that around these tables sat men who were the exponents and active agents of one of the greatest forces in nature, and that through their achievements in mastering this silent force, there was effected in a brief period of but little over twenty years one of the greatest advancements in material wealth and scientific knowledge in the history of the world.

Either around these tables sit, or associated with us in similar societies across the waters are the men, who, through their efforts have converted our cities from darkness into day, increased the range of human speech, bridged our oceans for the transmission of intelligence, with and without wires, made it possible to preserve the human voice long after the speaker has passed away, emancipated the horse, and who bid fair to continue to eliminate the element of distance in the transmission of electrical energy until the steam locomotive, formidable rival that it is, shall have been emancipated to its final extinction.

It is especially fortunate that our profession is so young that we can select for our first distinction the one whom we all agree is now the most deserving and instead of honoring him after he has passed beyond the appreciation of earthly honors, we are able to have him with us to-night, to see and to feel the esteem in which he is held by his protégés, who recognize in him not only a man of great natural genius, but also the exemplification of what has been defined as genius itself, "the ability for hard work." Therefore, as the dean of the greatest technical school of the world through which the graduates of all other schools must pass, the school of practical experience, and in which school he has eclipsed us all in individual achievement in those arts which tend for the material benefits of his race, do we recognize him and by these ceremonies honor ourselves in thus honoring and officially perpetuating the name of Thomas Alva Edison.

At the close of his remarks Mr. Arnold introduced Mr. Martin as toastmaster, who, in proposing the health of the guest of honor, said:

The American Institute of Electrical Engineers is proud to embrace in its membership to-day the foremost inventors of the age and the greatest captains of industry, and has placed upon its golden tablets many an auspicious discovery and art to celebrate. But it surely could find no worthier hero among them and no better gift to mankind to signalize than the man and the lamp around both of whom we twine to-night the laurel wreaths of our admiration and our love.

There should be encouragement in the founding of this medal tonight for every struggling, ambitious youth in America. Let us and let our sons recall and applaud the cheery little newsboy at Detroit; the half-shod, half-frozen operator seeking bravely a job along the icy pikes of the Central States; the gaunt, untutored experimenter in Boston, taking eagerly needed fees for lectures he was too modest to deliver; the embryonic inventor in New York, grubstaked by a famous Wall Street man for his first stock ticker; the deaf investigator at Menlo Park who wreaked unique retaliation on his affliction by preserving human speech forever with his phonograph; the prolific patentee who kept the pathway to the Patent Office hot with his footsteps for nearly forty years; the genius, our comrade, who took this little crystal bulb in his Promethean hand and with it helped to give to the world a glorious new light which never was before on land or sea—Thomas Alva Edison.

Mr. Edison had declined to make a speech of acknowledgment, but had consented to wire his response, and to carry out this purpose the Western Union Telegraph Company had furnished for the evening an Edison quadruplex set with an extension key, so that Mr. Edison could send his message without leaving his place. The message was received at one end of the speakers' table on a portable Postal quad set by Mr. A. B. Chandler, who, a great many years ago, gave Mr. Edison his first official position by making him electrician of the old Atlantic & Pacific Telegraph Company. The wires were carried above the table on a regular pole line. The message was transmitted at the same time over a wireless telegraph system between the table and the other end of the banqueting room, installed by the Marconi Company. Mr. Edison's reply was as follows:

I want to thank first of all my fellow-members of the American Institute of Electrical Engineers for the great honor done me in thus celebrating my birthday, associated with the twenty-fifth anniversary of the completed development and successful introduction of the incandescent lamp. Your expressions of good will gratify me deeply. While I cannot but rejoice at the place which the incandescent lighting art has made for itself among the inestimable comforts and conveniences of civilization, I feel that my share in the work is exaggerated by this prominence given me to-night.

To my old friends and associates who have founded the Edison Medal in the Institute—I can but extend you thanks again. If I could do it in return, I would found a medal for every one of you, for you are just as much entitled to recognition as I am. You gave me your friendship and loyalty, your watchful days of toil and sleepless nights of anxiety. Some of you helped to perfect the art by your engineering skill, your legal ability, your financial aid.

The early days were enough to tire our any one's courage and persistence, but you stood it all, and put up with me into the bargain. Now, in noble revenge for the burdens I put on you, and in addition to all the evidences of friendship in the past, you add this unusual token of continued affection. I should not be human if I were not profoundly affected and deeply grateful.

This medal is founded to encourage young men to devote their best thought and work to electrical development. I rejoice in this stimulus to harder study. Better trained and educated than were we pioneers of the times before every college and university had its electrical course, these coming men of the future should, and I believe will, carry forward to triumphs and arts heretofore undreamed of, the principles and applications of electricity to which I have tried humbly to devote my life and energies from the hour my hand first touched the key. God bless them, and you, my dear friends, and this American Institute of Electrical Engineers.

While the message was being sent the toastmaster read selections from a number of congratulatory messages, cablegrams and telegrams received, including the following:

Hearty congratulations birthday; sorry not present celebrate 25th anniversary your great invention. MARCONI.

It is most unfortunate that I cannot be present when the "King of the Telegraphers" is to be crowned with the Medal Crown. Though absent, yet I here profess to the monarch loyal and unfaltering allegiance, swearing to render him at any and all times such service as the most potent head of the clan that ever ruled his people, ever received from his humble and devoted subjects.

To which I hereby pledge our life, our fortune and our sacred honor. Long life "King Edison the First." ANDREW CARNEGIE,
Liegeman to King Edison the First.

"73" to one and all.

Ohio claims a large share in the glory of Mr. Edison's career by reason of the good start she gave him. The people of Ohio are deeply interested in his great achievements and rejoice over the fame he has won.

Speaking as the representative of Ohio, and for myself, I join you in felicitations to the guest of honor, and extend to him my best wishes for many years more of usefulness.

MYRON T. HERRICK,
Governor of Ohio.

Will you be kind enough to extend to Mr. Edison my sincere congratulations upon his fifty-seventh birthday? It is hard to realize that so many wonderful achievements could be crowded into the brief space of years since Mr. Edison arrived at manhood. It is still more difficult to appreciate the full effect of his inventions; what they mean to the civilized world in added comfort, economies, in expediting business and in bringing the whole world in closer communication.

With the friends who will surround him on this occasion I beg to join in extending best wishes for many years of usefulness and honor. BENJAMIN B. ODELL, JR.,
Governor of New York.

I am glad to know that the American Institute of Electrical Engineers propose to do special honor at their annual dinner to Mr. Thomas A. Edison, a distinguished citizen of New Jersey, whose remarkable achievements have been an honor to his State and country and of the highest usefulness to mankind.

Few men in history have found so wide a range for their inventive genius, and perhaps no one has contributed more by his inventions to make life safer, or more enjoyable or happier than he. New Jersey is proud of him, not alone for his wonderful achievements, but for those sterling qualities of manhood that make his life a model and an inspiration to all. FRANKLIN MURPHY,
Governor of New Jersey.

From President Francis, of St. Louis Fair.

Extend my warmest felicitations to Mr. Edison and assembled guests. I wish to express my admiration for the genius of mind and craft of hand that have accomplished so much in a quarter of a century, and I hope the presentation of electricity at the coming universal exposition will fittingly evidence these great achievements. The Exposition is honored in having Thomas Alva Edison high on the roll of its honorary chiefs. D. R. FRANCIS.

From Lord Alverstone, Lord Chief Justice of England.

Hearty good wishes to Mr. Edison. I look back with greatest interest to his brilliant inventions in electric lighting and telephony, which I had the great pleasure of successfully maintaining in all the courts in England.

From Lord Kelvin.

I join heartily with the American Institute of Electrical Engineers in gratitude to Edison for his great electric work and for the phonograph, a most exquisite and instructive scientific discovery, and for his many other useful and well-worked-out inventions for the public good.

From Prof. Colombo, Italy.
I enthusiastically join in the honors paid to-day to my dear and illustrious friend Edison, whose system I am proud to have introduced first into Italy.

From E. De Fodor.
Admiring your great inventions, Hungarian friends send sincerest congratulations.

From Paris.
The electricians of France send their heartiest congratulations to Mr. Edison on the occasion of the ovation in his honor. Mascart.

From Berlin.
Greeting and kind wishes to American engineers. Congratulations to Edison on the twenty-fifth anniversary of his inventing the glow lamp. Gisbert Kapp.

Hearty congratulations to our honorary member of the Elektrotechnischer Verein. Emil Naglo.

From the Italian Society of Electrical Engineers.
Honor to your illustrious guest. Fraternal greetings to the American Institute of Electrical Engineers. Ascoli.

Other messages were received from Mayor McClellan; the president of the English Institution of Electrical Engineers; Francis Jehl, Joseph Wetzler, G. A. Hamilton, C. P. Bruch, etc. It is needless to say that Mr. Edison's health, his response and the messages were all received with immense applause and enthusiasm.

The toastmaster then remarked that Englishmen had always been prominent in the work on the incandescent lamp, and that they had with them that evening Mr. Charles Batchelor, to whose brilliant work the perfection and successful introduction of the lamp in this country was so largely due. Another Englishman brought over by Mr. E. H. Johnson had been with Mr. Edison as his private secretary and confidant all through the period of storm and stress and was now lighting one of the dark places of the world with the Edison lamp, Mr. Samuel Insull, president of the Edison Medal Association.

Mr. Insull then presented to the Institute the Medal Fund and the Deed of Gift in connection therewith. He recited details from the Deed of Gift as to the nature and objects of the medal, which he characterized as the blue ribbon of the profession. He then proceeded in some brief, well-chosen remarks to outline the extent and importance of Mr. Edison's work; and while he did not minimize the lamp, showed it was but one detail in a vast and extensive system upon which depended the erection of an entirely new art.

Those prominent and distinguished experimenters who, prior to and contemporaneously with Mr. Edison, sought to produce a commercial incandescent lamp, followed the path hewn out for them by the early series arc light experimenters. They, as a result, made the mistake of producing a low-resistance lamp operating in series, and consequently requiring a varying potential, resulting in a system impossible to operate on a large scale. It remained for Mr. Edison, with a foresight almost supernatural, to see that what was needed was a constant potential system which would respond to the demand of every kind of service, and as a result he gave us the high-resistance lamp, the multiple-arc and feeder systems, embodying principles which all successful inventors have since been compelled to employ in their distribution systems—whether dealing with direct or alternating currents, with systems of lighting (except series-arc lighting), and with systems of electrical power, whether moving or stationary. In short, Mr. Edison gave us as the result of his brilliant inventive work at Menlo Park, the cardinal engineering principles of the great industry with which his name is so intimately associated, and in making these contributions to scientific and industrial progress he achieved such a position that I think posterity will not adjudge us of undue enthusiasm if we name him as the greatest electrochemical experimenter and the first electric light engineer of his day.

It is not alone as the experimenter and inventor, as the mathematician and engineer of this industry for which Mr. Edison is entitled to recognition. It should be borne in mind that at the time of his first exhibit of his light and power system on a considerable scale at Menlo Park in the winter of 1879-80, there were no factories for the production of the apparatus required for use in connection with the system, nor were there in existence, except in their crudest state, any of the numerous appliances used between the generator and the lamp, and which have since become every-day necessities. These appliances had to be developed and factories for their manufacture organized before it was possible to build the first plant and distribution system which was successfully started in New York in the fall of 1882. Things which to-day we do as a matter of course, because they have been done by others before us, presented great difficulties in the first ten years of the twenty-five years which this occasion marks. All these matters were dealt with under the guiding hand of Mr. Edison himself. The credit of carrying his great work as an inventor to a successful commercial issue is, therefore, due to him, and thus, besides being the inventor of his electric light and power system, he was in every sense the captain of the great industry resulting from his successful laboratory work.

I will not attempt on this occasion to mention the other branches of electrical work in which Mr. Edison has so greatly distinguished himself as an inventor and in connection with which he has contributed so much to the industrial development of our time. What he has done outside of the electric light and power field would be a sufficient life's work for most men.

The work that he has accomplished should prove a great inspiration to future generations of students of the electrical engineering profession. When, as a result of competing for the Edison Medal, which we hope will prove, so to speak, the blue ribbon of the profession [applause], they study the life of the great master after whom this prize is named, they will find that without any of the advantages of collegiate education, without any early training except that gained as a train boy and telegraph operator, blessed with little beyond a quick mind and a strong constitution, but with a will to work and a great power of concentration, this country boy from the West rose from so lowly a beginning to be the foremost electrical inventor of his time. [Applause.]

Dr. A. E. Kennelly, of Harvard University, past president of the Institute, then accepted the medal on behalf of the Institute and in thanking the members of the Edison Medal Association said:

I want, on behalf of the American Institute of Electrical Engineers, to voice our universal sentiment in expressing our appreciation of the cause which you have founded as a worthy and enduring monument to the fame of Mr. Edison. In the old days of Greece, in the days which were said to belong to the heroic time, men strove for the laurel crown. It was the idea of all men that the laureate wreath should rest upon their brow. To-day, in modern guise, and actuated by the more modern and altruistic spirit, this laurel wreath you have converted into a golden circle, that shall perennially flourish from year to year and pass from generation to generation to testify to the worth of the pioneer in whose honor it was founded. We want to thank you for what you have done in creating this fund. Not only do you incite enthusiasm in the young man, whose age is set forth in the deed as not to exceed twenty-five years; not only do you enhance the fame of Edison and perpetuate it in future years, but you also stimulate those institutions in which the future Edisons may be trained and engender this spirit of generous rivalry and emulation among the alma maters of this favored country. Broad and generous are the terms of the deed lying before us. Although our Institute is a corporation under the laws of the State of New York, this deed declares that any youth, of any country, educated at any college or institution from Texas to Labrador or to the Behring Straits, may qualify for this medal. Applied science and pure science know no barriers, and only understand and recognize the barriers of the unachieved and the unknown. The action taken here this evening should stimulate every worker in electrical interests all over this globe. I hope that this medal from year to year will inculcate some of the spirit in which this inventor strove and accomplished. It is a favorite saying of his that inspiration, in the main, is only another way of spelling "perspiration"; and that there is no secret so deep in nature, so recondite or remote, but persistent and ardent human labor will bring it to the surface. For that proposition this medal and this Institute stands. Moreover, you have set a golden seal upon this proposition—that pure science, or theory and applied science, or practice, are so closely connected, so intimately associated, in our modern life and in our modern dealings with nature, that the Edison medal cannot distinguish between them—that invention born of both throws lustre alike on both and forever will be a connecting link between them.

Prof. Cyrus F. Brackett, of Princeton University, was then introduced as one who had taught where Joseph Henry sat and who had had the distinction and honor of making the first scientific tests on the Edison lamp. He gave an interesting account of the manner in which these tests were conducted and spoke of the lively recollection he had of the difficulties encountered by Prof. Young and himself when, at the suggestion of Mr. Edison, they went to Menlo Park with such apparatus as the University then afforded to use in determining the efficiency of his dynamo employed in producing the incandescent lamp. Prof. Brackett said:

On behalf of the colleges and universities of the United States and Canada, I accept, with feelings of lively satisfaction, such responsibility as the founding and purpose of this medal confer.

It is fitting that such a medal be provided to bear witness to the skill and triumphs of the modest man whom we would honor on this occasion. I have said "would honor"; the fact is, that he has long been wearing, without affectation, the honors we are merely recognizing.

A mere enumeration of the things he has achieved would fill a very large and brilliant chapter in the history of applied science. His system of multiplex telegraphy, his invention of the telephonic transmitter, of the incandescent lamp, his system of electric distribution, his improvement of the dynamo, his invention of the phonograph—all these and many more which time does not allow me to mention, are the reasons for the honors which are his by well-earned right. And these, in some way, symbolized by the medals which shall be struck in his name, will prove a mighty stimulus to those who shall strive to obtain them as the years go by. As this occasion marks the twenty-fifth year of the art of incandescent electric lighting, it may be of interest to glance backward, for a moment, to the condition of the art of illumination, as it existed more than twenty-five years ago. Outside the large towns, into which gas had been introduced, the "tallow dip" and the whale-oil lamp maintained a doubtful contest with the powers of darkness, tried the patience of the saints, but did not abate the profanity of the wicked. Then came the era of the so-called "burning fluids" which, although better, could hardly be called means of grace. In the early sixties oil was "struck" in Pennsylvania. As a result the great whales and the "tar-heelers" had rest. The sunshine garnered through the ages, poured forth in every hamlet and hut. The candle was no longer placed upon the candle-stick, and everybody praised the bountiful Providence which had prepared such a luxury.

If any one ever saw an electric light in those old days, he was one of the favored few who had access to the dingy laboratory of the college professor, who, on stated ocasions, exhibited it as it left the hand of Davy. It was a most interesting spectacle, the memory of which is even now treasured by those of us who witnessed it.

But, although this arc light was too powerful for purposes of general indoor illumination, it demonstrated clearly to those who could forecast the future that electricity would have its place in the art of illumination whenever its cost should not be prohibitive, provided convenient distribution could be made.

Such was the condition of affairs when Mr. Edison undertook the solution of the general problem of dividing the current and distributing it to small incandescent lamps suitably placed. He solved it completely, and if we require a monument to this victory we have only to look around. Wherever this man may go in the wide world his pathway will be lighted by the results of his own genius.

Mr. Joseph B. McCall, of Philadelphia, president of the Association of Edison Illuminating Companies, was then introduced as one who, while just a little too old to compete for the medal, was not disabled from enjoying an equal distinction, namely, that of winning the golf cup of the Association, and as representing the gentlemen numerously in evidence that night who were doing all they could to give the world the best shine for five cents. Mr. McCall prefaced his remarks with some very humorous and pertinent anecdotes, outlined the history of the Edison Illuminating Association, and alluded to the splendid example that would be given the growth of electric lighting in the Edison Memorial Exhibit at the St. Louis Exposition. He said, in conclusion:

The year 1882 saw a total production of incandescent lamps of only about 100,000. Ten years later the total consumption in this country amounted to about 4,000,000 yer year, and in 1903, practically twenty-one years after, the manufacture of incandescent lamps was commenced in commercial quantities, the total consumption in the country reached about 45,000,000 lamps per annum. Think of it, gentlemen! It is not many years since, when, in the larger cities of this country, a connected load of 100,000 16-cp equivalent was considered a mark to work to, while now it runs up into the millions. I do not know that there is anywhere a record of commercial results than can compare with this. It is unnecessary for me to say what this has also meant in the great improvements which have been made in all kinds of apparatus and appliances. You know them.

A splendid lesson of this growth will be given at the St. Louis Exposition by the Edison Association—an Edisonian Exhibit, suggested by Mr. Insull, and now being prepared under his direction with great care and thoroughness, showing the great development from the small dynamos in the beginning to the great installations in the modern central stations. I am sincerely thankful for the privilege of being with your Institute to-night; grateful for the opportunity of paying my respects to the Great Man of Electricity, and I join your Society and guests in wishing for him many happy years, filled with continued good health, honors and successes.

The last speech of the evening was that made by Mr. C. L. Edgar, president of the National Electric Light Association. In calling upon him the toastmaster remarked that it was felt that the great perfection reached in the lighting art as a whole was due to the efforts of a great many distinguished and able men, among whom might be mentioned Elihu Thomson and Brush, Edward Weston and Swan, Wallace and Farmer, Fuller and Wood, Westinghouse and Hochhausen, Stanley and Steinmetz. The mention of the name of Thomson was received with long and continued applause, which did not cease until Prof. Thomson had risen to his feet and bowed. An ovation also followed immediately afterward in connection with the mention of the name of Mr. Coffin as a great captain of industry in the art and a great consolidator who brought it out of a period of chaos and confusion. Mr. Edgar said, in regard to the affair which had called them together that night:

I do not know who is responsible for the idea of the Edison Medal Association; whoever he is he deserves our thanks. I can conceive of nothing more appropriate than founding a fund, such as has been described here to-night, for the purpose not only of perpetuating Mr. Edison's memory and his work and his genius, but of perpetuating it among the class of young men to whom we must look for future development. I think it is particularly appropriate that the gold medal is to be given to the best work done by a member of the graduating class of one of our universities. I do not think that in the past there has been a very tangible connecting link between the students of our colleges and the men whose places they are to take in later life. I do not know how much the parent organization of the American Institute of Electrical Engineers is doing here in New York to bring them closer together. I do know, however, that the branch work which we are attempting to do in Boston and which I have no doubt is being done in other university centers is bound to have a very considerable effect in bringing closer together the students and the men engaged in the electric light industry in general. My recent connection with the Boston branch has shown me this more clearly than ever before. We have, as you all may know, in our vicinity, Harvard and the University of Technology, both having at least two large organizations of students taking an electrical course, and I venture to say that until the branch was organized scarcely any of them knew even by sight the class of men whom they themselves were likely to join in later life. What the branch work has begun in this respect will be made much more definite and tangible by the work inaugurated by the Edison Medal Association, and those in charge of its inception and carrying out are to be congratulated on having chosen a field, above all others, in which it will do the most good.

Before the assemblage broke up the New York Edison Company sent a photographer into the galleries and there an excellent picture was taken of the main table and 300 or 400 people still remaining. The explosion was very short, lasting only for a minute or two, and the picture is one of the best ever secured on a large scale by the means of the incandescent light. Thus closed fitly a memorable night.

The sextets written for the occasion by Mr. Bowker are appended:

LUX BENIGNA.

"Let there be light!" flashed the Creator's word,
And lo! the vibrant Vast with life was stirred,
Till last came Man. And Man is most divine
As he, with spark of genius, makes to shine,
Smiting the Dark to life, a living light
That into Day redeems the human Night.

FAMA ETERNA.

Blest is the man who, for his country dies;
Twice blest he who lives to serve mankind;
Thrice blessed he who, in life's little hour,
Searching God's treasure-house with lucent eyes,
A lamp for all men and all times may find,
And thrill the world with light, and heat, and power.

EDISON MEDAL DEED OF GIFT.

The Deed of Gift of the Edison Medal, as summarized by Mr. S. Insull, chairman of the Medal Association, provides as follows as to its chief features:

"1. The medal shall be awarded to such qualified student as shall have submitted to the Institute, in accordance with the provisions of this deed and of the regulations which may be prescribed by the Edison Medal Committee, the best thesis or record of research on theoretical or applied electricity or magnetism.

"2. Each competitor for the medal, in order to be qualified, must have graduated and received a degree during the year for which the medal shall be awarded, in some course of study at some institution of learning in the United States of America or Dominion of Canada, which course of study shall include the branch of electrical engineering. The United States Naval Academy and Military Academy are included within the institutions from which competitors may be qualified.

"3. Not more than two students may compete in any one year from any one institution of learning, nor may any student compete unless duly presented for competition through the faculty of the particular institution at which he is a student.

"4. The course of study must be one normally requiring not less than two years of continual residence and work.

"5. The thesis or record must not exceed six thousand words, not inclusive of words employed in explanation of accompanying drawings.

"6. No competitor shall be of greater age than twenty-five at the day of his graduation in such course of study."

Grounding of Constant Potential Systems.

BY S. BINGHAM HOOD.

THE object of grounding a constant potential system is to insure that under no possible conditions can the pressure rise above that normally on the circuit. This applies to all systems irrespective of the voltage at which they are designed to operate. The point at which the ground should be placed should be such that the pressure between the grounded leg and any other corresponding points shall be equal, or at the neutral point. Where it is impossible to obtain a neutral point then, of necessity, the attachment must be made to one of the other wires of the circuit, unless an artificial neutral is established.

To illustrate the object of grounding a system we will assume an arrangement of circuits commonly found in all large distributing systems (see Fig. 1). With all sections of such a system normally clear of grounds, the effect of accidental crosses and grounds will be taken up.

A ground on wire *a* gives a potential between ground and wire *b* of 5,500 volts; between ground and wire *c* of 7,700 volts. The same applying to accidental ground on wire *c*. With ground on wire *b* the potential to ground of wires *a* or *c* will be 5,500 volts. It is, therefore, clear that by permanently grounding wire *b* the possible potential is limited to the working potential of the circuit. Unfortunately, the general existing conditions prohibit such grounding on the high-tension section.

Most stations using high-tension feeders distribute either wholly or in part through underground cables. The first cables installed, some years ago, were insulated as in Fig. 2, each wire being insulated to withstand a pressure equal to that of the circuit, or double this

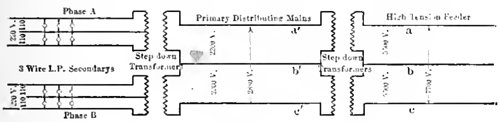


FIG. 1.—ARRANGEMENT OF CIRCUITS.

from wire to wire in the same cable. The several wires thus covered were built up into circular form and surrounded with a lead jacket.

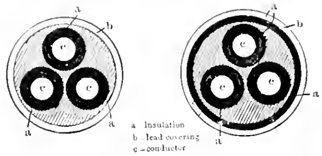
However, as the insulation between any wire and the lead sheath was only designed to withstand the working pressure, and when a ground occurs at any point on the system the factor of safety would be entirely wiped out, the result being a simultaneous breaking down of the insulation at other points on the system. In order to overcome this all new cables are, or should be, insulated, as in Fig. 3, the built-up cable having an insulation between it and the jacket equal to that on each wire. In this way a ground on any wire will not subject other points of the cable to potential above that for which it is designed to withstand. Unfortunately, the first type of cable is still largely in use, preventing permanent grounding until they are removed.

If a permanent ground were established it would not be necessary to place insulation on the grounded wire; consequently an additional amount of insulation could be placed on the other wires without increasing the cost.

Considering the middle stage of the system, the primary distributing mains, the same conditions apply as in the high-tension section; but owing to the lower voltage the danger of break-downs are not so great, but still exist to a very considerable extent.

Considering the effect of various grounds and crosses between the high-tension and primary systems, assume first a cross between wires *c* and *c'* with both systems clear of grounds, and no indication of trouble. A ground now occurring on wire *a*, the potential to ground of wire *c'* will be 7,700 volts, *b'* 9,900 volts, and *a'* 10,580 volts. This is the most severe condition which could exist, other combinations varying between this and a minimum of 5,500 volts, which can readily be determined by the data of Fig. 1. Should such a combination occur there would be an immediate break-down of the insulation at some point on the primary mains. With a primary system in first-class condition the weakest point would probably be between the coils of transformers feeding the consumers' premises, the breaking down of which would subject the inside wiring to a potential to ground of anywhere between 2,620 and 10,580 volts. The resulting disturbance requires no description. That such a result is seldom known to occur is explained in two ways: First, the general insulation of the primary system is seldom as high as that of the transformers connected to it, but the general improvement in overhead construction is rapidly removing this safeguard. Second, where such a break-down has actually occurred there is rarely enough left of the general combination, including the building where final ground connection was made, to tell what the original trouble was.

By permanently grounding wire *b'* any crosses between the primary and high-tension system would result in grounding the high-tension



FIGS. 2 AND 3.—SECTIONS OF CABLES.

wire upon which the cross occurred, either directly through ground connection on *b'* or through the transformer coils from wires *a'* or *c'*. It would, therefore, be impossible for any trouble, between these two systems, to spread to the low-tension secondary mains or to cause serious damage to the intermediate primary system. With both wires *b* and *b'* grounded it would be impossible for damage to result at any point except that where cross actually occurred. The same arguments apply to crosses between primary and the low-tension secondary mains, so that it is unnecessary to go into details as to the last section of the system.

The successful and safe operation of any constant-potential system requires that its voltage to ground must never exceed under any condition that normally on its circuits. From the above it should be clear that the only method of insuring such results is to permanently ground one wire of the system, and such grounding should be made compulsory in all cases where it is operated in conjunction with, or in the vicinity of, those of higher potential.

The illustrations and figures given above are taken from a three-wire, two-phase system, as offering the severest conditions to be found in practice. Single-phase, three-phase star, or delta, or combined star and delta give generally a slightly lower maximum voltage on the conditions shown above.

It is now necessary to consider the conditions to be met by grounding the low-potential distributing mains, an illustration of which, for future reference, is given in Fig. 4.

All low-potential circuits requiring over 660 watts should be wired and operated on the three-wire system, unless the load consists of one receptive device requiring over this amount of power, in which event it should be operated wherever possible from the outer wires of the system, thereby preserving the balance and requiring considerably less weight of conductors. The two-wire system, besides requiring an excessive investment for conductors, does not readily permit of grounding, owing to the grounded leg carrying the same amount of current as the other wire.

In a properly balanced three-wire system the neutral wire carries only a small percentage of the total current. By placing the per-

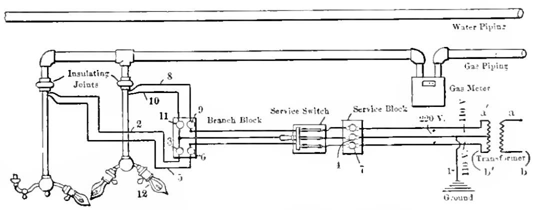


FIG. 4.—DIAGRAM OF GROUNDED CONNECTIONS.

manent ground on this neutral, should it accidentally open, the ground connections would not be called upon to carry any large amount of power; consequently, they need not be made as heavy or with as much care as would be necessary for their operation on a two-wire system.

A grounded direct-current, two-wire system might, under certain conditions, result in severe electrolytic action upon other metallic structures in its vicinity. This would not be true of a three-wire system, as the neutral current would be of small amount, and in most cases of an alternating character, reversing at each change of the unbalanced load.

Referring to Fig. 4, we will assume that ground connection 1 is made by a driven pipe or small plate buried in moist earth, the resistance of which under even the most favorable conditions will seldom be less than 50 ohms. With wire *b* (Fig. 4) grounded, a cross between wires *a* and *a'* will allow, with ground resistance above, a current of about 46 amp. to flow at a pressure of 2,310 volts. On a branch primary line or individual transformer this would probably be enough to open the protective device on the primary circuit. However, should wire *a* be a main feeder this current would not open the circuit-breaker, and, consequently, this current would continue to flow through the ground pipe and still leave all points on the secondary system at a potential of from 2,090 to 2,310 volts to ground. In addition, the wire, frequently uninsulated, leading from the line to this ground connection, would also be at this potential to ground, and a person touching it while standing on the street would probably receive a fatal shock. The writer recalls one instance where the drop of potential was between such a ground and a street railway track about 15 ft. distant, and a horse crossing the line between pole and track received sufficient current to cause him to shy and turn around in line with the current path. The drop of potential through the earth between his hind and fore feet was then sufficient to instantly kill him, although at no time was he in actual contact with the charged pole or the railway track. This is one of the most forcible illustrations of the dangers of imperfect grounding.

While this current was flowing it will be supposed that the insulation to ground at point 2 was destroyed, and a low-resistance connection established to piping or other conductor connected to ground. This would produce a short-circuit at 2,310 volts through the house wiring and neutral service, resulting in blowing of fuses 3 and 4. The high potential would then establish a destructive arc at these points, probably starting a fire before the large breaker on *a-b* could open. This is identically what would happen under the same conditions if the ground pipe or plate had been omitted. It is, therefore, clear that a ground of this character, while furnishing protection in some cases, is worse than useless, as it furnishes a fancied protection, which in reality does not exist.

Considering the secondary feeders as being clear of other systems, a ground is placed at 5 on wire *b'*. There will now be a circuit established through the accidental and permanent ground, with a resistance of 50 ohms, neglecting resistance of wires. This allows a current of slightly over 2 amp. to flow, or insufficient to blow the fuses at either 6 or 7, and there being no indication of this trouble it would be allowed to exist. This places all points on wire *a'* at a potential of 220 volts to ground, with neutral at 110 volts to ground, being the same as if the ground connection at 1 did not exist. A ground occurring at 8 on wire *a'* would produce a 220-volt short-circuit between 5 and 8, probably blowing fuses 6 and 9. These fuses could not be replaced until one of the grounds is removed. Assuming that the one at 5 is cleared, then ground 8 allows the same conditions to exist on the opposite side of the circuit or system.

Instead of this combination we assume that ground occurred at 10, with ground 5 still on. There is then a 110-volt short-circuit between neutral and *b'*. The wireman sent to repair this does not readily locate grounds 10 or 5, gets disgusted, reverses circuit by placing wire 5 in fuse 3, and wire 2 in fuse 6, puts in the fuses and reports everything O. K. There are now two "permanent and effective" grounds on the neutral, in addition to the ineffective one at 1. All is well and good until a cross occurs between the secondary system and some high-potential circuit, when the result is a job for the insurance adjuster.

Another frequent and generally serious result is caused by fuse 11 blowing before fuses 6 or 7, resulting in 220 volts being thrown into all receptive devices on circuit 12, and in their immediate and violent destruction.

If the ground connection, 1, were made to an underground piping system the resistance would not be over one or two ohms, in which case a cross between a high-potential circuit would immediately open its protective device and also prevent such a high potential from reaching the main part of the consumer wiring before such device had opened. It would also be impossible to hold a fuse until the grounds occurring on the outer wires had been removed. It would still be possible to clear these grounds by reversing the two-wire branch, throwing the ground on the neutral; but this would not be likely to have any serious results owing to the low resistance of the permanent ground. A method of preventing this reversal will be taken up later.

It is, therefore, evident that a neutral permanent ground must be required, but that such ground must be of extremely low resistance. The only method of obtaining such a ground is by attaching to an underground piping system. This cannot readily be accomplished below the ground level, owing to the necessity of opening the street to reach such a pipe, and to the difficulty of obtaining a satisfactory and permanent connection when the pipe is buried in the earth and subject to all street disturbances.

The only practical method is to attach to a gas, steam or water pipe on the consumer's premises. This should be made before reaching the consumer's service block or switch, and to the service side of any gas meter.

Every consumer should be so connected in order to insure that the removal of one connection may not leave the entire system unprotected. In the case of consumers fed from individual transformers at least two grounds should be made in order to insure that failure of one will not permit the system to operate ungrounded. In the case of a large secondary network there would be a multiplicity of grounds capable of carrying many times the total current on the system.

In buildings of timber construction it would be well to require that the gas meter outlets be bridged by a substantial bond, and also that gas piping be connected to other piping systems. The reason for this is that if gas piping should not be in electrical connection with other piping systems in the building, and a connection be established with the electrical wiring, current would flow through the gas meter.

Should the gas meter outlets be open, owing to absence of the meter, there would be a potential of 110 volts across the outlets. This would hardly apply to water meters, unless the meter was absent, as it is almost an impossibility to overheat a pipe or meter containing flowing water with any current generally used in one building.

To safely operate a three-wire system the neutral must remain closed under all possible conditions of service, in order that the receptive devices cannot possibly receive the full voltage between outer wires. Contrary to this, the present rules require both fuses and switches on this neutral wire, the accidental opening of which constitutes a serious fire risk. All protective devices should be required to be placed on the outer wires only, the neutral being run continuously to all points. In addition, the neutral should be permanently grounded at every distributing point, and at each outlet (provided a grounded pipe is available at the outlet), the object being that should the neutral conductor become broken the piping systems would preserve the continuity of the circuit. When it is considered that a ⅜-in. pipe, the smallest used in piping buildings, will safely carry 50 amp., and that the unbalanced load on a system never exceeds 25 per cent. with the most careless balancing, such a pipe would supply the maximum neutral current for 800 lights. Taking into consideration that but a small part of the piping in a building is so small, the danger of overheating it is insignificant compared to the risk from a broken neutral. The pipe joints being all made by screw threads their conductivity could be assumed as being at least equal to that of the pipe itself, so there would be slight danger from this source.

This method should, however, not be construed to permit the use of the piping system as a permanent conductor for the neutral current, the object only being to insure the continuity of the neutral should the normal path become defective. The piping being in multiple with the neutral conductor will, of course, carry a proportion of the current; but, as such piping is capable of safely carrying the total current, there would be no danger of overheating. Further, should a bad joint occur in the piping the resistance would be raised and the current automatically decreased in the pipe and increased in the neutral conductor. Should a bad joint occur in the same section as a broken neutral, there would, of course, be a heating of the joint. In practice this would not be likely to occur. A joint sufficiently bad to offer any appreciable resistance would not be sufficiently tight to hold gas. The chances of such a combination occurring are probably not one in a million, and further, should it occur there would be a disturbance in pressure at the receptive devices with an unbalanced load, sufficiently great to be investigated at once.

An attempt to attach an electric circuit to piping systems is generally met with opposition from the general public, owing to the impression that a shock may be received from such piping. That such is an impossibility is clearly evident when it is considered that such piping must of necessity be at earth potential, or the same as that of any person standing upon the ground or other earthed conductor.

Having shown the necessity of thoroughly grounding the neutral, it is evident that to require any insulation upon it is clearly a waste of both labor and material. This neutral could be run with bare copper conductors, rigidly secured to the building (but not insulated from it) or pulled in with other wires in conduit systems, all joints and taps being made up solid in preference to any screw-connecting devices. It should be carried direct to all outlets and not to any switch or controlling device. Such switches should be placed on outer wires only, being double-pole on three-wire mains and single-pole on two-wire branches. There are two reasons for this: First, double-pole snap switches frequently become short-circuited from careless handling. Second, any fixture ground can be rendered harmless by opening the outside wire at the switch, which would not be possible were the switch placed on the neutral. This applies to all grounded systems irrespective of whether bare or insulated neutral is used.

Let us next take up the wiring of fixtures, particularly those known as "combination," in which gas and electric arc used on the same fixture. Owing to their generally poor construction these fixtures are not adapted to electric wiring in a permanent form. The practice is to file a notch in the shell of parts slipped over the main supporting stem, the conductors being carried successively through these notches. A slight turning of any of these shells results in grounding the fixture to the wiring.

Should the wire so grounded be an outer there would then be a short-circuit through the permanent ground on the neutral. The practice of placing an insulating joint between the fixture and supporting pipe renders the completion of such a short-circuit impossible, leaving a potential of 110 volts across the members of this joint; and there being no indication that this trouble exists it is allowed to continue. Were there no gas in the piping, the chances of any further trouble would be remote; the gas, however, deposits a film of carbonaceous composition across the insulation on the interior of the joint, permitting a slight leakage of current across the gap. This deposit becoming greater in time, and being further carbonized results in heating of the joint, destroying its gas-retaining qualities. If the heating becomes sufficiently great the gas will become ignited at this point, and the flame, being sucked up between ceiling and floor, spreads beyond control in a surprisingly short time. While this carbonization may require years to reach a dangerous value, the final disruption is very rapid, resulting in a fire without any appreciable warning. The use of these joints constitutes one of the greatest fire risks from electric wiring and should be condemned at once, irrespective of whether the system is grounded or operated clear.

In place of these joints a solid brass coupling should be used, having cast upon it a substantial screw connection for attachment to the neutral conductor of the circuit. The fixture lead connected to neutral or grounded feed could, and preferably should, be of bare copper wire, extending from top of fixture to the sockets. This would leave room in fixture for a heavier insulation on the outside wire, and would also prevent the reversal of any portion of the system in order to throw an accidental ground on the permanently grounded leg of the circuit.

An installation using such a full grounded system would be absolutely free from any danger from crosses with high-potential circuits or from lightning discharges, and could not be operated with any but the intentional ground on the system. With the permission of the Underwriters, such a system would be immediately adapted by all contractors, owing to its being installed for from 10 to 20 per cent. less than under the present rules. One such installation would furnish protection to all the old installations on a network, thus reducing the fire hazard on all the older work.

This full-grounded system being permitted, manufacturers could profitably bring out a line of wire and fittings along the following lines:

Wire.—Conduit wire, fixture wire and flexible cords to be heavy rubber-covered, braided wire, surrounded by an armor of copper ribbon or woven copper gauze, such armor to be used as the grounded conductor of the circuit.

Distributing Cabinets and Switchboards.—For three-wire to have but two buses, with double-pole fuses and switches; two-wire branches to have but one fuse and switch. This would allow practically double the spacing now possible, without increasing the size of the board.

Fixture Sockets.—Outside shell and outer contact to be in electrical connection. Inner contact to make and break, for key sockets, on outer wire binding post, the post being arranged concentrical with outlet pipe, allowing the socket to be screwed on fixture without bending or kinking wire in any way; no connecting post to be placed on outer contact, the fixture arm to be used as the grounded conductor. Bare stem wire, or armor on armored wire, to be connected to fixture body at bottom of fixture; such body preferably being made of brass and having a connecting lug cast upon it, similar to that upon the connecting joint at top of fixture.

The electrical fire risk in any building equipped with an electric installation using wire and fixtures as above would be practically eliminated, any trouble occurring being confined to the interior of the grounded armor for sufficient time to allow of the opening of the protective device, and such device could not be kept closed until the trouble was removed. It being a physical impossibility to remove the permanent grounds on the system, this trouble could not by any possibility be shifted in such a way as to place another fire risk upon the circuit.

The entire working conductor being surrounded by a grounded shield, it would also be impossible to receive any shock from the wires or fixtures, unless this shield was intentionally removed. This would remove one of the great objections of the general public to grounding under the present system of wiring.

Tesla Patent Decision.

Judge Seaman of the United States Circuit Court of the Eastern District of Wisconsin, has handed down a decision on a motion for a preliminary injunction against the National Electric Company, applied for on the grounds that a polyphase synchronous motor manufactured by that company infringed four Tesla patents granted May 1, 1888, two of these being fundamental patents and two on specific means. The injunction was denied on the grounds that previous decisions sustaining Tesla patents did not pass upon the question whether they also covered polyphase synchronous motors.

Judge Seaman discussed the several opinions sustaining Tesla patents, beginning with that of the New England Granite Company case, and concluded that the terms of these only apply to polyphase non-synchronous motors. The sweeping opinion in the New England Granite Company case he considers must be treated as modified by subsequent opinions, and he quotes Judge Brown to the effect that Tesla discovery was not broadly the use of alternating currents of different phase with an ultimate object of rotating any shaft. No case involving the use of a motor operated in synchronism has been brought to final hearing, though such use constantly appeared, while litigation was vigorously prosecuted against non-synchronous infringements—one instance being that of the continuous manufacture of synchronous motors by a defendant, who was under injunction against infringement by a non-synchronous motor in suit and this without interference until lately. The question of infringement in the present case under the fundamental facts depends upon the scope of the invention and involves a broader construction than was involved in any other prior cases, and consequently the court denied the motion for preliminary injunction.

Wireless Telegraphy in Alaska.

A dispatch from Tacoma, Wash., states that wireless telegraphy between Nome and St. Michael has practically failed, the distance between the two points being too great for successful transmission during winter weather. It is suggested that the government establish two more stations in order to accomplish the desired result. Stations have already been established at Port Safety, near Nome, and St. Michael, at a cost to the government of $6,000. The distance across Norton Sound between the two existing stations is about 125 miles.

Efficiency Test of 1250-K.W. Steam Turbine for Interborough Company, New York City.

By A. M. Mattice.

DURING the present period of rapid introduction of the steam turbine, it is of especial interest to observe its economic performance under conditions of test approximating those of future daily service. Data of definite and dependable character has, in many cases, been of such noticeable scarcity that results of carefully-conducted tests should merit special attention and credence. The following presents the most important results of a series of performance tests conducted at the builder's works upon a 1,250-kw Westinghouse-Parsons steam turbine-generating unit, the first of the three units selected by the Interborough Rapid Transit Company for the illumination of the New York Subway. The tests were executed on October 12-15, 1903. The calibration of the various instruments and the computation involved were all verified by Julian Kennedy, consulting engineer, Pittsburg.

CONSTRUCTION.

Turbine.—The turbine is of the two-cylinder, multiple-expansion, parallel-flow type, arranged in tandem compound and direct-connected through a flexible mechanical coupling to the generator. The three sections of the unit are mounted upon a single bedplate, thus making the unit self-contained. Both turbine cylinders are covered with non-conducting material secured in place by sheet-steel lagging. In the pipe connection between the outlet of the high-pressure cylinder and the inlet of the low-pressure is inserted a separator. The condensation collecting at this point is normally removed by a trap, but during the tests the water was collected in a vessel of known cubical contests fitted with a water gauge. After recording the amount separated the water was returned to the exhaust main and was subsequently included in the total steam consumption.

The turbine is governed by a fly-ball governor of great sensitiveness, positively driven from the end of the shaft. Steam is admitted in short puffs at intervals of about 2½ seconds, the duration of each puff being controlled by the governor mechanism. The admission steam is thus not throttled in proportion to the load, but is always admitted at approximately boiler pressure, thus securing the highest efficiency from the temperature range available. The governor spring tension is adjustable by hand during operation, so that the speed of the turbine and consequently the load (if operating in parallel with another unit) may be readily controlled. In addition to the regular governor, the turbine has an overspeed safety governor which operates with high-pressure steam an automatic quick-closing throttle valve inserted in the main steam pipe. This governor is positively driven from the turbine shaft and may be adjusted to operate at any predetermined overspeed.

Overload capacity up to 50 per cent. of normal rating is secured by a hand-operated by-pass valve admitting high-pressure steam to the second stage of the turbine. The effect of the by-pass is well shown in the economy curves.

The bearings of the turbine unit are continuously and automatically lubricated by an oil-circulating system operated by a small plunger pump driven from the turbine shaft. This pump delivers oil under a head of about 18 inches. This gravity head is sufficient to thoroughly flush the bearings, which are of the flexible shell construction and of sufficient size to avoid the use of any oil under heavy pressure. The oil is returned to a reservoir in the bedplate and is cooled on its way to the bearings in a copper coil surrounded by cold water.

Generator.—The turbo-generator is of the revolving field type delivering three-phase, 60-cycle current directly to the distributing system at a pressure of 11,000 volts. The unit operates at a speed of 1,200 r.p.m., thus requiring a six-pole field. The rated capacity at full load is 1,250 kw with 25 per cent. continuous and 50 per cent. intermittent overload capacity. As efficiency tests had been periodically made upon the generator, no detailed tests were made at this time, but the entire unit was tested as a whole, from steam input to electric output.

Fig. 1.—General View of 1,250-kw Turbo-Generator.

Contract Guarantees.—The contract provisions covering the efficiency of the unit were as follows: With 175 pounds steam pressure at the throttle, 27 inches vacuum, measured by mercury column and referred to a 30-inch barometer, the consumption of steam at various loads should not exceed the following:

	Dry Saturated Steam.	Steam Superheated 75° Fahr.	
Full rated load	15.7	13.8	lbs. per e.h.p. hour.
¾ "	16.6	14.6	" " " "
½ "	18.2	16.2	" " " "
¼ "	23.2	20.8	" " " "

Method of Test.—After being assembled complete in the erecting shop, the turbo unit was transferred by traveling cranes to one of the testing foundations. As no foundation bolts are used no further preparation was necessary to operate the turbine than to connect up to the steam and the 36-inch exhaust pipes, each of which has outlets at the various testing pits.

During the superheated-steam tests, the steam was superheated by an independent gas-fired superheater, which forms part of the permanent testing outfit in the Westinghouse turbine shop.

The exhaust steam was condensed in an Alberger counter-current surface condenser, provided with separate dry and wet air pumps, the former being of the two-stage type with Corliss gear. This condenser is one of several employed only for testing purposes. It was tested for leakage immediately before and after the tests, and the correction applied to the observed steam consumption of the turbine.

At the conclusion of each test the water in the drainage or hot well of the condenser was left at the same height as at the beginning. Even a considerable error in this respect could have no material effect on the results. The hot well is 36 inches in diameter, and, assuming the temperature of the water to be 110° F., a depth of one inch of water would be equivalent to 36.5 pounds in weight. In the case of a turbine developing 1,000 ehp, for instance, at a consumption of 14 pounds of steam per ehp hour, the total steam used in one hour would be 14,000 pounds. If, then, an error of one inch should be made in the level of the water in the well after a one-hour test, the error would amount to only 35.5/14000, or about one-quarter of one per cent.

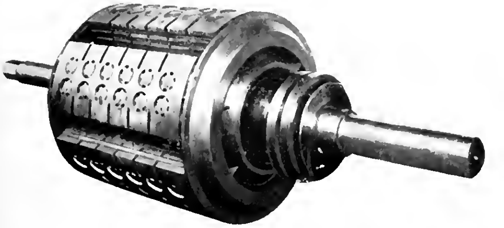


FIG. 2.—ROTATING FIELD.

The tests were conducted in the same manner as are the regular commercial tests of all turbines built in the Westinghouse shops. The number of tests was, however, greater than is usually called for, and extreme accuracy was secured by the duplication of all instruments. Throughout the several tests all readings, including weighings of condensed steam, were made at intervals of five minutes.

Measurement of Load.—The electrical load was applied by means of a large adjustable water rheostat, which also forms part of the regular testing outfit. As the generator pressure of 11,000 volts might prove a source of danger to the attendants if passed directly into a water rheostat, the voltage was reduced by step-down transformers to about 550 volts. All electrical measurements were, however, made between the generator and the transformers.

Voltage was measured by two voltmeters, one being used as a check on the other, the pressure on the instruments being reduced by potential transformers having a ratio of 100 to 1. Each of these voltmeters was arranged so that it could be plugged in between any of the three terminals of the generator.

Current was measured by a duplicate set of long-scale, dead-beat ammeters. In each of the three phases were inserted two-current transformers, in series, each connected to a low-voltage ammeter. In addition to the two ammeters in each phase, a carefully calibrated Siemens dynamometer was plugged into the various phases at each reading. The dynamometer readings alone were used in the case of the lightest loads, by reason of the difficulty in reading the ammeters with sufficient accuracy for the purposes of the test. At each reading three successive observations were taken.

All the electrical instruments, including the potential and current transformers, were carefully calibrated in the Westinghouse Electric & Manufacturing Company's standardizing laboratory immediately before and immediately after the tests.

Pressures, Temperatures and Speed.—Steam pressure at the throttle was observed by a duplicate set of gauges and vacuum by a mercury column connected to the turbine exhaust.

Temperatures of steam were measured by duplicate thermometers inserted in thermometer cups in the steam pipe. During the saturated-steam tests two throttling calorimeters were used and the quality was maintained as near as possible to that of dry saturated steam by drying it in the superheat just enough to evaporate the moisture which had condensed in the long run of piping leading from the boilers.

The speed of the turbine was ascertained from the speed of the oil pump, which is geared to the turbine in the ratio of 31 to 4. A tachometer was used to detect sudden small variations of speed, if such should occur, as well as to show the speed regulation when the load was suddenly increased and decreased. The records of speed, however, did not enter as factors in the measurement of power, which was ascertained entirely by observations of the electrical output.

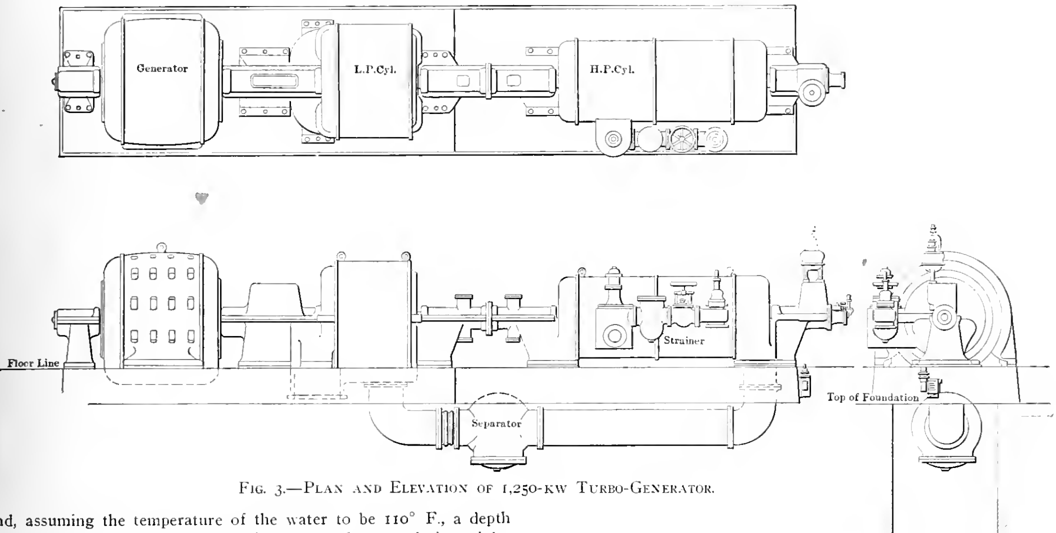


FIG. 3.—PLAN AND ELEVATION OF 1,250-KW TURBO-GENERATOR.

FIG. 4.—ROTATING FIELD.

Regulation Test of Speed.—At the conclusion of the economy tests, a load of 1,309 kw was thrown off by opening the exciter circuit, with a resulting increase of 2 per cent. in speed. A load of 1,342 kw

TEST DATA

Test number.	20	10	9	8	6	22	23	24	19	16	15	14	12	21	7	5	18	17	13	11
	Dry Saturated Steam and 27" Vacuum.								75° F. Superheat and 27" Vacuum.					Dry Saturated Steam and 28" Vacuum.			75° F. and 28" Vacuum.			
Steam pressure outside of throttle, lbs. per square inch, per gauge	150.3	151.4	146.8	146.5	147.1	148.0	144.5	141.8	151.8	151.9	150.0	147.7	146.3	151.0	146.8	146.1	151.8	150.8	147.0	146.0
Vacuum at outlet of L. P. cylinder, referred to 30" mercurial barometer	27.08"	27.11"	27.1"	27.11"	27.11"	27.05"	27.05"	26.79"	27.15"	27.07"	27.15"	27.1"	27.1"	28.05"	28.1"	28.08"	28.05"	28.05"	28.1"	28.1"
Superheat, degrees Fahrenheit	....	....	......	......	......	......	......	......	76.6	77.2	77.0	76.15	76.0	......	......	......	75.5	77.1	76.5	78.25
Quality of steam	0.999	0.999	0.999	1.000	0.999	0.999	0.999	0.999	......	......	......	......	.....	0.999	0.999	1.000	......		......	....
Revolutions per minute	1201.0	1261.2	1199.4	1197.4	1195.6	1201.0	1200.0	1197.4	1201.0	1212.0	1209.0	1205.1	1200.0	1198.0	1200.6	1197.4	1217.0	1214.4	1203.8	1199.4
Load in kilowatts	196.95	342.73	655.98	989.53	1321.40	1489.4	1713.5	1988.0	191.0	333.55	664.67	986.23	1293.0	334.78	972.0	1363.95	198.4	333.15	977.64	1274.2
Load in electrical horse power	264.0	459.42	879.33	1326.5	1771.4	1996.5	2297.1	2666.0	256.0	447.1	891.0	1322.04	1734.9	448.74	1303.0	1828.3	266.1	446.6	1310.5	1708.0
Total weight of steam consumed per hour, lbs.	7155.0	9732.0	15074.0	20254.0	25712.0	28208.0	33036.0	40547.0	6734.0	9170.0	14181.0	19108.0	23903.0	9295.0	19334.0	25639.0	6300.0	8420.0	18180.0	22504.0
Lbs. steam per kilowatt hour	36.32	28.4	22.98	20.46	19.47	18.95	19.28	20.39	35.25	27.58	21.33	19.39	18.48	27.78	19.99	18.79	31.76	25.39	18.59	17.66
Lbs. steam per electrical H.P.-hour	27.08	21.18	17.14	15.27	14.52	14.13	14.38	15.21	26.3	20.51	15.9	14.45	13.78	20.71	14.91	14.02	23.68	18.86	13.87	13.17
Load in terms of nominal full rated load	0.157	0.276	0.525	0.790	1.060	1.190	1.370	1.590	0.153	0.267	0.531	0.790	1.038	0.268	0.778	1.091	0.159	0.266	0.780	1.020
DEDUCTIONS FROM THE ABOVE TEST RESULTS																				
Lbs. steam per equivalent I.H.P. of a reciprocating engine, assuming 90% combined efficiency of engine and generator, with losses constant at all loads	15.89	15.08	14.14	13.39	13.14	12.93	13.30	14.21	15.22	14.48	13.16	12.66	12.44	14.64	12.99	12.73	13.93	13.30	12.15	11.89
Ditto, assuming 85% combined efficiency	12.78	12.89	12.82	12.49	12.44	12.31	12.74	13.69	12.21	12.34	11.94	11.81	11.77	12.48	12.09	12.07	11.22	11.33	11.31	11.23

was then thrown on and a speed variation of 2.2 per cent. in the opposite direction was shown. This load on being thrown off showed a speed variation of 2.07 per cent.

Test of Safety Stop.—The speed of the turbine was increased by holding down the main governor lever, thus preventing the governor

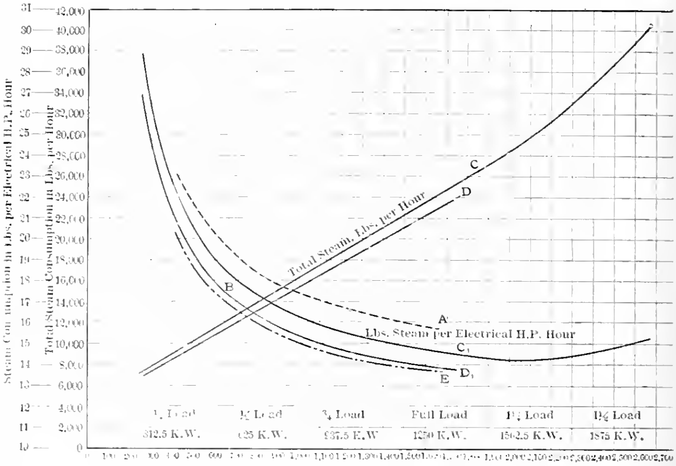


FIG. 5.—CURVES SHOWING GUARANTEED AND ACTUAL STEAM CONSUMPTION.

from controlling the speed. At 1,372 r.p.m., or 14.35 per cent. above normal speed, the safety stop operated and brought the turbine to rest.

Results of Economy Test.—The results of the tests for steam consumption are shown by the accompanying table. The tests from light loads to full rated load with 27 inches vacuum were made to determine the fulfilment of the contract guarantees, but the overload tests and those on 28 inches vacuum were made for general information. The tests were limited in scope and number by the necessity of removing the turbine from the testing floor to make room for other commercial work.

The tabulated results are shown graphically by the accompanying curves, Figs. 5 and 6. Fig. 1 is a comparison of the guaranteed

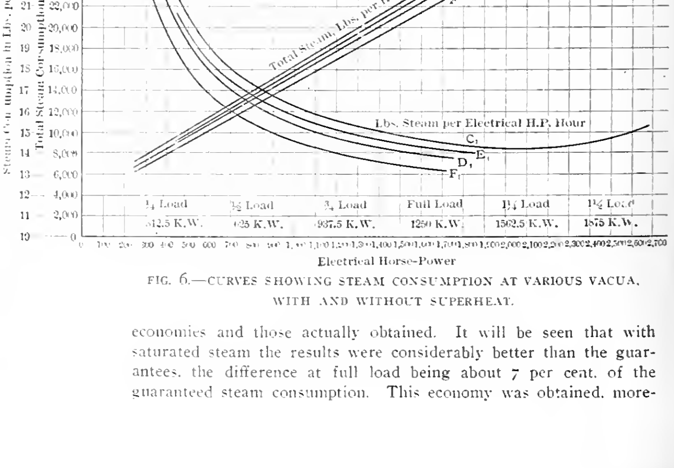


FIG. 6.—CURVES SHOWING STEAM CONSUMPTION AT VARIOUS VACUA, WITH AND WITHOUT SUPERHEAT.

economies and those actually obtained. It will be seen that with saturated steam the results were considerably better than the guarantees, the difference at full load being about 7 per cent. of the guaranteed steam consumption. This economy was obtained, moreover, with steam of only 147 pounds pressure, instead of under the contract condition of 175 pounds pressure, as the higher pressure was not available.

With superheated steam at the same pressure, the tests showed an economy so close to the guaranteed results that the difference is hardly perceptible in the curves. An additional curve (*E*) has been plotted to show the probable steam consumption which would have been obtained if the contract steam pressure of 175 pounds has been available, this curve having been computed on the basis of tests on other turbines at various pressures.

Fig. 7 shows these results, with the omission of the guarantee curves and the addition of the curves of steam consumption under

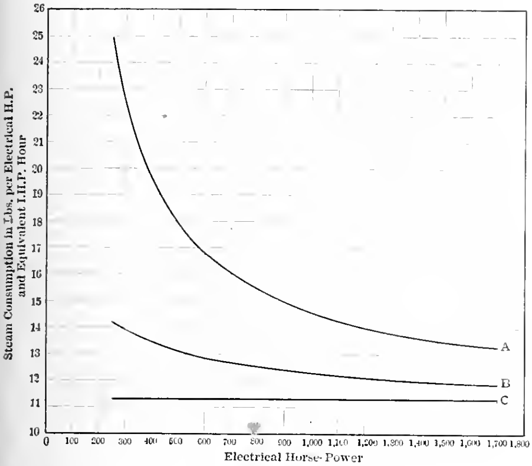


FIG. 7.—CURVES OF ECONOMY WITH AND WITHOUT SUPERHEAT, AT DIFFERENT VACUA.

28-inch vacuum, thus giving a comparison of the economy with and without superheat, and with different vacuna.

An important result shown by curve *C*, Fig. 2, is the effect of the by-pass on overloads. The material difference between the curvature of *C* and the by-pass curves published heretofore lies in the method of manipulation. If, when the turbine reaches full load, the by-pass is opened full, the water rate is suddenly increased by a small amount. As the load is further increased, the economy gradually improves and at the limit of the turbine capacity the full load water rate has nearly been reached. In the tests represented by curve *C* the operation was reversed, the by-pass valve being opened by hand at the various loads only sufficient to maintain normal running speed. Thus the by-pass steam is approximately proportional to the overload upon the turbine. The rise in the curve is marked only on heavy overloads, when the valve is nearly open and the best economy of the turbine is thus maintained throughout moderate overloads.

The curve *C* thus presents a striking similarity to the economy curve of a piston engine, except that the rise on under and overloads is less marked; or, in other words, the economy is greater.

Furthermore, a piston engine with the usual cut-off gear reaches its best economy at about three-fourths full load rating, the steam consumption being considerably greater at full load and increasing rapidly on overloads. The turbine, however, preserves its best economy, occurring at about full load, through a considerable range of overload, with the result that operation during peak loads on the station may be accomplished without the loss of efficiency occurring in engine operation.

COMPARISON WITH RECIPROCATING ENGINE.

From the curves it might at first appear that the steam consumption of the turbine is high at light loads, as compared with that of a reciprocating engine of corresponding size. Such an idea might naturally arise from the fact that it is customary to think of engine economy as steam consumption per indicated horse-power rather than per brake or electrical horse-power. The indicator does not, however, reveal engine or generator losses. In the turbine tests here described both are included in the figures on steam consumption.

In order to bring this point out more clearly, take for instance the results obtained under 75° superheat and 28 inches vacuum, shown in curve *A*, Fig. 7. The steam consumption at full load is 13.25 pounds, and at one-quarter load 19.25 pounds per ehp. If, for comparison, a combined efficiency of 90 per cent. be assumed for the piston engine and direct-connected generator, the steam consumption of the turbine per equivalent ihp would be 11.9 pounds at full load, which rivals the best modern steam engine performance.

The most marked economy of the turbine, however, in comparison with the engine, occurs at light loads. Assume now a reciprocating engine unit in which the total losses are constant at all loads, and also that the steam consumption per ihp is constant at all loads. Will the turbine meet these assumptions? And, under these conditions of constant losses and water rate, what will be the relation of water rate to output? Manifestly the total losses of the hypothetical engine, which amounted to 10 per cent. of the indicated work at full load, will be 20 per cent. at half load and 40 per cent. at quarter load. The corresponding efficiency will, then, be 90 per cent. at full load, 80 per cent. at half load and 60 per cent. at quarter load. It is safe to say that the extent of this lost power at light loads in the engine is not generally appreciated.

Considering further the assumptions, it should be borne in mind that they are greatly in favor of the reciprocating engine and do not represent actual performance. Firstly, the usual combined efficiency of a high-grade engine unit is more nearly 85 per cent. than 90 per cent., and even 85 per cent. is attained by few makes. Secondly, the indicated water rate of the engine is far from constant, whereas experience and data show that the water rate increases on both under and overloads. A test made by Prof. Jacobus upon a compound four-valve engine fitted with reheating receiver and steam jackets illustrates this point. The engine showed maximnm economy at about 700 ihp; at half the load the water rate increased 24 per cent. and at 1,000 maximum ihp nearly 7 per cent.

The assumption of constant losses is not far from correct for well-designed machines. Brake tests show that friction losses at heavy loads are but slightly greater due to the greater pressures on the various parts. Generator losses are likewise nearly constant. In the generator under test, the increase in loss from full to 1/4 load was less than 1/2 per cent. of the rated capacity.

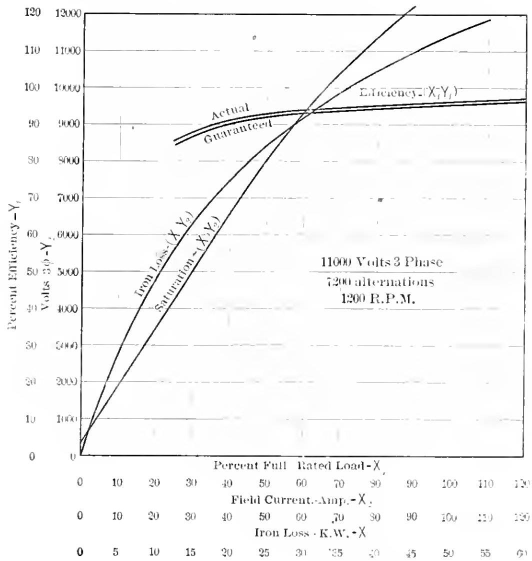


FIG. 8.—CURVES OF SHOP TEST OF 1,250-KW TURBO-GENERATOR.

Compare now engine performance with that of the turbine here described. Curve *A*, Fig. 7, shows the actual steam consumption per ehp hour. Curve *B* shows the consumption per equivalent ihp, under the assumption of constant losses and water rate, and of 90 per cent. combined efficiency at full loads. The increase in steam consumption at half load is but 4.6 per cent. and at overload the consumption decreases rather than increases.

Following out this method with an assumed total efficiency of 85 per cent., instead of 90 per cent., results are obtained shown in curve *C*. The indicated water rate of the turbine is 11.26 pounds and it is constant at all loads, thus confirming the original assumptions. In order to meet these results a piston engine must not exceed a water rate of 11.26 pounds per ihp at full load and must maintain this economy throughout its range of load.

The superior efficiency of the turbine finds explanation in the fact that expansion is approximately adiabatic; that the cylinder remains constantly at the temperature of the working steam and is not alternately heated and cooled as in the piston engine. Although mechanical losses in the engine are so nearly constant, the thermodynamic losses are so pronounced, particularly at fractional loads, as to preclude comparison with the steam turbine.

GENERATOR TESTS.

Individual tests on the turbo-generator were made in the Westinghouse Electric & Manufacturing Company's shops previous to the combined tests above described. These shop tests included the measurement of iron loss, determination of the saturation curve and short-circuit tests, and preliminary temperature runs. The characteristics of the generator are as follows: 1,250 kw, three-phase, 11,000 volts, 60 cycles, the full-load current being 65.6 amp. per terminal. Separate excitation of the generators is employed.

Results from some of the tests are shown graphically in Fig. 8. The actual efficiencies obtained were as follows:

	Actual.	Guaranteed.
1¼ full load	96.5%	96%
Full load	96	95.5
¾ "	95	94.25
½ "	92.7	92
¼ "	86	85

Following the customary practice, these efficiencies are calculated from measured electrical and magnetic losses, bearing friction and windage not being included. The short-circuit current of the generator is approximately 3¼ times the full-load current. The generator was run on open circuit for 11¾ hours at 12,150 volts, with full excitation. Under these conditions the maximum observed rise in temperature in stationary iron was 26.7° C. by thermometer, and the corresponding rise in the temperature of the field 16.7° C. With full load thrown off, the rise in voltage as estimated from the short-circuit test and armature resistance is under 6 per cent.

The Patent Office in Germany

The *Frankfurter Zeitung* of December 6, 1903, says: "The German Patent Office is overwhelmed with work. The number of applications for patents is still increasing. It was 27,565 in 1902 and will be about 29,000 in 1903 and 30,000 in 1904. Trade-mark applications for the last few years show an increase also. They were 9,924 in 1901, 11,168 in 1902, and will be about 12,000 in 1903. A further increase for 1904 is expected. Of the present five directors of the Patent Office four are lawyers and one a technologist.

"Another director is to be added. His duties will be principally to assist the president of the board of directors with reference to the technical personnel of the office, as well as to the general technical matters of the office, which, on account of the close relations of the patent office to the industries, are constantly becoming more important.

"Seventy-two technical clerks are at present employed in the examination of patent applications. In consequence of the great work involved in the examination of the steadily-increasing material, this force has become inadequate. An increase of nine technical clerks is necessary.

"In the two divisions for trade-marks there are at present, in addition to the two chairmen, five law and five technical experts and five assistant law referees. The necessity has arisen to increase the lawful organization of the division through additional members and cut off some of the assistants who can only take the place of a member to a limited degree. For 1904 two new lawyer members are required."

The Lamme Single-Phase Railway Motor.

We are enabled to present herewith illustrations and a description in detail of the Westinghouse straight-series, single-phase railway motor, which formed the subject of the English patent noticed in these columns last week.

The motor shown has a nominal rating of 125 hp on the basis of a one-hour run at full load with rise of temperature not exceeding

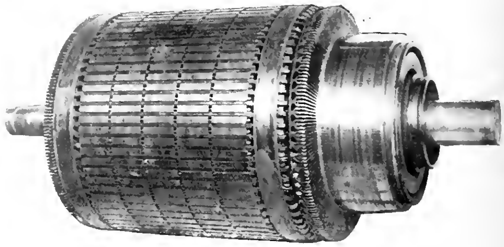


FIG. 1.—ARMATURE WITH COMMUTATOR AND BEARINGS.

75° C. Mechanically, it follows the general lines now regarded as standard for direct-current railway motors. The principal features peculiar to the new type are found in the construction of the magnetic field and in the winding of the armature and field coils. It is

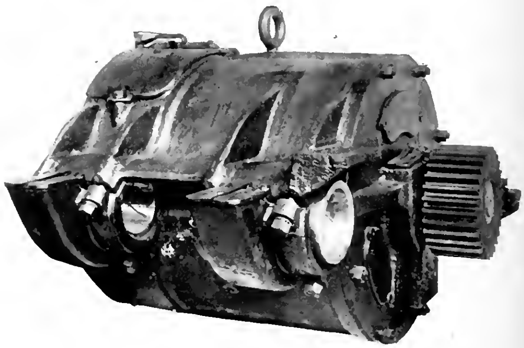


FIG. 2.—MOTOR, FRONT VIEW.

scarcely necessary to say that the motor is series-wound and of the commutator type.

The field frame consists of a cylindrical shell of cast steel, to which are bolted solid end brackets of the same material. These end

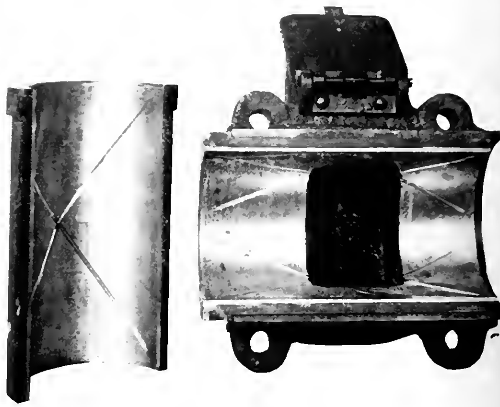


FIG. 3.—AXLE BEARINGS, BABBIT-LINED.

brackets contain supports for the armature bearings. The upper caps of the axle bearings are cast solid with the frame. The lower caps are rigidly held in place by heavy bolts. The axle bearings consist of cast-iron shells lined with babbit and divided into two parts. Solid shells, also babbit-lined, are used for the armature bearings. The bearing boxes are large and are packed with waste and oil lubrication is used throughout. The extensions which carry the axle bearings are especially strong and heavy. There is a large opening in the upper frame which permits access to commutator and brushes, and numerous hand holes are provided both in the end brackets and bottom of the motor. Lugs for "nose" suspension and support of the gear case are cast solid with the frame.

The field core is made up of circular punchings of soft laminated steel. The poles are rectangular in section and project inward, thus forming a magnetic circuit which is wholly laminated and without break from pole face to pole face. As the armature core is correspondingly constructed there is no mechanical joint in the magnetic circuit. The construction of the motor is in general the same as that which is used for ordinary alternating-current induction motors.

The field coils are wound with copper strap bent on edge, and held firmly in place by adjustable hangers of improved design. The

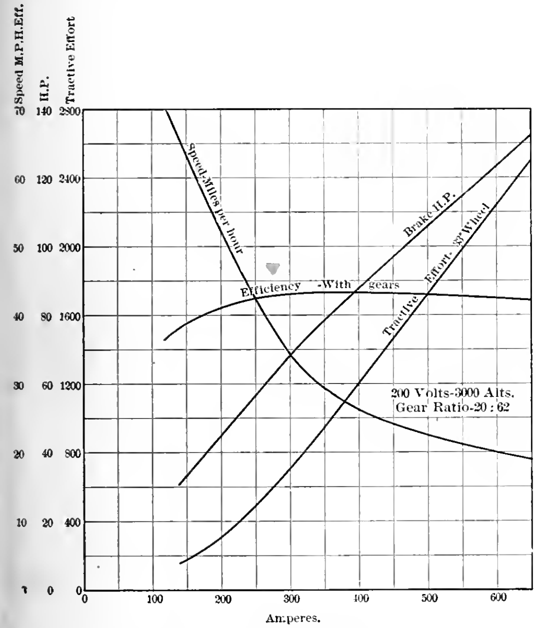


FIG. 4.—PERFORMANCE CURVES.

coils are all connected in series. Brush holders of the sliding shunt type are supported inside the end bracket, and carbon brushes are used.

The armature is of the slotted drum type with machine-formed coils. The core is composed of laminated punchings of soft steel built up upon a spider, with numerous ventilating spaces provided to permit air to circulate through the core and between core and coils. The slots are of the open type. The coils are made of copper strap without joint, and are held in place by retaining wedges of hard fibre, there being no band wires over the core. The winding is of the multiple type. The commutator is built up of cold-rolled copper segments with long necks.

The motor is wound for 225 volts and a frequency of 25 cycles or lower. Its general performance is shown by the curves in Fig. 4. These curves indicate the similarity in performance to the direct-current, series-wound railway motors now standard. Though designed primarily for operation on an alternating-current, single-phase circuit, the motor may also be operated by direct current. For this purpose a modification of the standard controlling apparatus is required.

The motor here described has been designated No. 91. A complete line of motors of this type has been designed by the Westinghouse Electric & Manufacturing Company for application to railway service of any class.

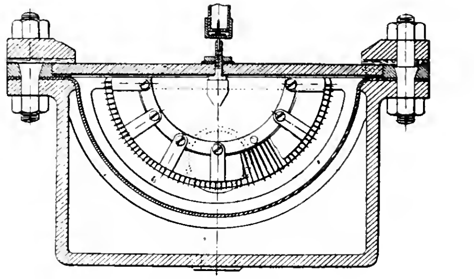
Recent Electrochemical Developments.

STERILIZING WATER BY OZONE.

While in this country that class of electrochemical processes in which chemical effects are produced by electric discharges has been brought into prominence by Bradley's celebrated work on the fixation of nitrogen from air, many inventors abroad have lent their energies to the development of the kindred process of ozonizing air and using the ozone for sterilizing water. On a commercial scale this method seems to have first been applied somewhat over 10 years ago in the city of Hamburg, where, during an epidemic of cholera morbus, smaller ozonizing and water sterilizing apparatus were installed in private residences, which were lighted electrically so that current was available for the other purpose. On a much larger scale such apparatus have been installed more recently in various cities, notably in Diesbaden, where the municipal water works are working in conjunction with an ozonizing plant. In view of the condition of the drinking water in many American cities, it is somewhat singular that such methods have not yet found any introduction in the United States on a commercial scale.

There have been devised quite a number of different ozonizers which vary greatly in design and especially in the nature of the dielectrics. While the Siemens and Halske apparatus, which appears to have found the most extended industrial application, uses glass dielectrics, others do not and are said to work satisfactorily. The use of glass is, of course, always a source of danger since it is liable to break. There is also a great variety in the design of sterilization towers. In general, however, the ozone is introduced at the bottom of the tower, which is filled with stone or sand, while the water passes downwards and thus comes into contact with the rising stream of ozonized air.

A patent granted on February 9 to Mr. A. J. Wessels, of Paris, France, relates to an ozonizer which is similar in design to that of Tindal. As shown in the adjoining illustration, a semi-cylindrical trough of metal, which forms one electrode, is placed inside a jacket of enamel. The intermediate space is filled with water for cooling purposes, since the process of ozonizing air requires that the temperature should not rise above a certain point. A glass cover forms the top of the apparatus and supports a series of metallic points, as shown in the illustration. The electric discharges take place between these points and the semi-cylindrical metallic trough below. The stream of air to be ozonized passes in a direction perpendicular to the cross-section shown in the illustration. The air is passed successively through several ozonizers, between which special cooling devices are inserted to reduce the temperature of the ozonized air, which goes from one ozonizer to the next one.



WESSELS OZONIZER.

MISCELLANEOUS.

A patent granted to Mr. O. Kartzmark, of Brooklyn, relates to details of mechanical construction of an apparatus for purifying liquids. Nothing is said concerning the electrodes to be used nor concerning the chemistry of the process, but it appears that like other inventors he intends to use anodes of such a nature that the anodic products of the current cause subsequent coagulation. In the apparatus described a receptacle with a series of parallel electrodes is placed in a larger vessel. The liquid is passed upwards between the electrodes and flows over the edges of the inner receptacle to the outer vessel.

A patent granted to Mr. A. J. Marschall, of Little Falls, N. Y., refers to the composition of an "exciting liquid" for use in a dry cell. It is a strong solution of zinc chloride with a small addition of ammonium chloride.

New Installation at City of South Norwalk Electric Works.

By A. E. Winchester.

THERE has just been completed an interesting installation, known as "The Enlargement of 1903," at the above plant, which has always been notable for its success. This enlargement is the third one required within five years to meet the increasing demands upon the plant, and is very gratifying to the advocates of municipal ownership. The original plant installed by the city was completed in 1892, at a cost of $22,500, and was used exclusively for street lighting. The movement in favor of the municipal plant was brought about by the poor service for street lighting, supplied by the local company. They supplied the city with 800-cp street lamps, and the demand was for something better. As the company did not respond to the demand, the city plant was built.

The construction and management have been carried on under

FIG. 1.—SOUTH NORWALK STATION.

a Board of Electrical Commissioners, consisting of three members, who were elected by the people from the establishment of the plant in 1892, until 1898, when the arrangement was made to appoint them by the council, which plan is still maintained. The present commissioners are: Mr. J. A. Volk, president; Col. Leslie Smith, treasurer, and Mr. Charles N. Smith, secretary. The plans and specifications of the original plant were prepared by and the construction was executed under the supervision of A. E. Winchester, formerly of the Edison Company, who was one of the electrical commissioners for ten years. He became general superintendent of the plant in 1897, and holds this position at the present time. The first installation consisted of a building containing a boiler, stack, engine, two 60-light arc dynamos, with the necessary switchboard apurtenances, pole line and 86 arc lights. Up to the time of the present enlargement all of the apparatus with the exception of the iron stack have remained in service.

In 1895 the question of embarking in commercial lighting was agitated, and after two years' investigation an appropriation for this purpose of $20,000 was made by the people in 1897. This money enabled the plant to establish a complete commercial service on a paying basis. The growth of the new business was so rapid that a year later it became apparent that it would be necessary to double the output of the commercial branch, and in May, 1900, $17,500 additional appropriation was made available to meet the demand. About this time the Connecticut Lighting & Power Company, which already had instituted suits against the city for alleged damages, etc., on account of the plant, also attempted to prevent the city from supplying commercial lighting or enlarging its plant. An injunction was obtained which was to have been argued before the Supreme Court, but after considerable legal cross fire, which did not stop operation or enlargement, all suits were withdrawn, leaving the city with a clear field to continue the operation of its plant. The city plant does not have a monopoly of the business, as there is a keen though harmonious competition between it and the local company which supplies commercial lighting by means of both electricity and gas; though it confines its energies to promoting the use of the latter. The streets are lighted exclusively by the city plant, which also now supplies over 90 per cent. of the commercial electric lighting and power.

The finances of the municipal plant are managed in a manner similar to that of a private enterprise, the city paying a fixed annual rate of $60 per annum each for the street lamps, and the customers are supplied at 10 cents per kw-hour for lighting and 5 cents for power, as maximum charges, with a sliding scale of prices proportioned to the service used.

Several new enterprises have been attracted to the city by the low rates established for power. In all cases this is lower than it can be made for, by individual customers, and where the installation is of moderate size, the rates are exceedingly low. For a continuous consumption of, say, 50 hp measured by the customers' meters, the rates would be 1.9 cent per hp-hour, corresponding to $4.95 per month, of 26 ten-hour days. There is no place known, except Niagara Falls, where power can be obtained so cheaply and at the same time relieving the manufacturer of the expense and annoyance of operating a power plant. The plant, therefore, enables the people of South Norwalk to enjoy the advantages of lighting and power, 24 hours per day, under most favorable conditions, of excellent quality and at remarkably low rates.

The building, now nearly double its original size, is a substantial brick structure, 48 ft. wide, and 109 ft. long. It has coal house extension with a capacity of 100 tons and is located adjacent to the railroad depot, not far from the center of distribution. In addition to the electric lighting plant, the building contains the city fire alarm system, and the power house whistle is used in connection with the fire bell to sound alarms. The chimney, built in 1898, to replace the original iron stack, is of red brick, built on a natural rock foundation, and in its base is located a fire-proof safe deposit vault for the city records. The "Enlargement of 1903" was decided upon after a careful investigation and report confirming the recommendations of General Superintendent Winchester, made by Prof. George F. Sever, of Columbia University, to a committee appointed by the council. In October, 1902, an appropriation of $20,000 was made to carry out these suggestions. The recommendations advocated the removal of the original belted engine with the two arc dynamos and

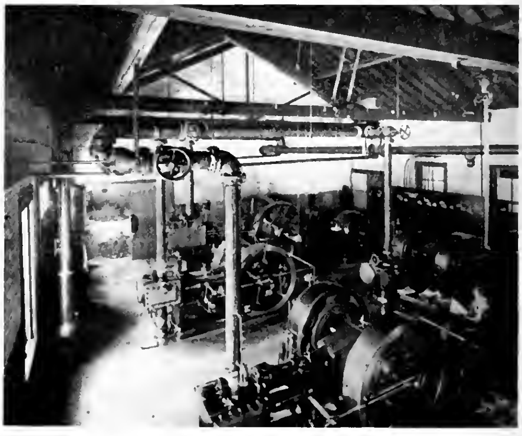


FIG. 2.—VIEW OF INTERIOR OF STATION.

the substitution for these units, of a motor-driven arc machine, capable of supplying 130 enclosed arc lamps, and the installation of a large modern unit to assist in supplying the commercial circuits. The load increased so rapidly that the existing equipment was threatened with serious overloads, until the installation of the new apparatus was completed.

One of the advantages of the new arrangement is that the arc lighting circuits are no longer dependent on any one engine for their operation, as the motor is driven directly from the bus-bars, and any of the five units, operating at 250 volts, has sufficient capacity to operate it. The space occupied by the motor-driven arc unit is so much less than the previous belted arrangement that it was possible also to place the 165-kw direct-connected unit in position without any addition to the building, or changes to the remaining apparatus. Careful records of the load show that this unit is normally sufficient to carry the arc lighting system and a considerable portion of the commercial load without operating the other engines, except at night, during the peak of the load.

The report by Prof. Sever recommended charging for electric current by means of meters, as the business had outgrown the scope of the contract system then in use. The meters have been installed, and their effect on the load curve of the plant is very interesting. The peak becomes sharper and the all-night load is less, showing conclusively that many people were negligent in using current when unnecessary in the old system of flat rates. Another interesting feature is the great demand for 8-cp lamps for residence lighting, in the place of 16-cp. On the whole, the customers appear to be very well satisfied with the meter system, and many find a considerable reduction in their bills over the old rates.

Specifications were prepared by the general superintendent, covering the "enlargement," and after being duly advertised, the conract was let in open competition to Messrs. Bellman & Sanford, of New York City, as general contractors to carry out the work. The motor-driven arc machine consists of a No. 12 four-circuit Brush machine operating at a speed of 500 r.p.m., and connected by means of a flexible coupling to a 90-hp, 8-pole motor. Both of these units were supplied by the General Electric Company, and are mounted upon an oak sub-base to insulate them effectively from the floor. The specifications called for uninterrupted operation of the city lighting system, and the old apparatus was shut down at one o'clock one night, the machinery dismantled, and the new apparatus set up and in working order before six o'clock the evening of the same day. The unit has been in operation uninterruptedly ever since that time, and has given complete satisfaction. The new switchboard panel was built to match the old switchboard, and all the switches were designed to be duplicates of those at present in use. The switchboard work was accomplished in such a manner that there was no interruption to the street service and the clause in the specifications requiring that continuous operation should be maintained was fully carried out, for which Messrs. Bellman & Sanford deserve great credit. After the arc machine was erected, the foundations for the new unit were built the unit erected thereon and the new piping connected to the present mains.

FIG. 3.—THE NEW UNITS.

The large unit consists of a 165-kw, 250-volt Fort Wayne generator, direct-connected to a 20 x 18 Watertown four-valve engine. This unit is mounted on a common sub-base of cast iron that rests upon massive foundations. The generator is guaranteed to carry an overload of 50 per cent. for two hours withut distress, and the engine will drive it under these conditions by slightly increasing the cut-off. The steam economy of this unit operating under full load is guaranteed to be 27 pounds when operating with 90 pounds steam pressure non-condensing. The generator efficiency is 92 per cent. at full load. The combined efficiency of these units is so high that at full load. The combined efficiency of this unit is so high that it is effecting a considerable saving in the operating expenses of the plant over the three small units which it supplements.

The design of the plant arranged for two steam mains cross-connected. By closing proper valves, it was possible to erect the new piping without interfering with the operation of the plant. Extra heavy piping was used throughout and the joints made up with 1/16-in. rubber packing. The pipe covering used was a combination of asbestos and cork, neatly covered with canvas and painted to match the other piping.

The old type open arc street lamps were replaced with modern enclosed arc lamps, which operate on a 5-amp series current. These lamps are manufactured by the Fort Wayne Electric Company. The cases are of sheet copper, and entirely water and bug proof. The former attribute is very necessary owing to the heavy fogs and storms along the coast. The efficiency of these lamps is greater than the old type and the diffusion of the light by the inner globe makes them more satisfactory to the city. The result of the better illumination is at once apparent on the streets.

After the installation of the machinery was finished, a test run of one week was made, to show that it fully complied with all of the specifications. It was then painted and striped to match the remainder of the machinery in the power house, and all the work left completed to the satisfaction of the general superintendent, and reflects most favorably on the skill and expertness of the contractors.

The results of the change and the improved machinery are already apparent in the economy of operation. Where it was previously necessary to operate four boilers, on the peak load, from two to three carry it now without difficulty. The average saving is nearly a ton of coal per day. This great saving is due to the higher efficiency of the new engine and the greater economy of the motor-driven arc machine. In addition to this, there is a considerable saving in the labor of trimming the lamps, as the new lamps burn 100 hours at a trim, compared with the old ones, which burned only 14 hours.

The plant to-day is thoroughly modern, inventorying about $88,000, of which about $16,000 has been paid from profits. Its normal capacity is 700 hp, supplying 108 street arc lamps, a commercial load of between 6,000 and 7,000 16-cp lamps connected and electric power for 26 manufacturing concerns.

FIG. 4.—VIEW OF SWITCHBOARD.

During the eleven years' existence of the plant it has saved the city in the item of street lighting alone, including all operating expenses, interest, depreciation, etc., over $27,500 as the difference between the average rate of the State, and what the cost has been from the city plant. As the original cost to establish the street lighting system was $22,500, the saving has not only paid for the plant, but leaves a net balance of $5,000 to the good. Aside from this, the commercial income yields an annual profit varying from $3,000 to $5,000, which is used to reduce the debt, and in time, under favorable conditions, as judged by the past results, will eventually free the plant of debt.

Probably one of the greatest, if not the greatest, factor in the success of this municipal enterprise may be traced to its independence from politics, which never have had any voice in its management or appointments, and the fact that it is operated to all intents without dictation from the local government.

The Recent Great Fire in Baltimore.

FIG. 1.—ELECTRIC LIGHT POLE.

THE great fire in Baltimore, which, breaking out on Sunday morning, February 7, destroyed probably $100,000,000 in property in the space of 48 hours, has already had its main features made known to every one who reads the daily newspapers. It has also been profusely illustrated from pretty well every point of view. It is not necessary, therefore, that in referring to the electrical conditions there we should repeat that which has already been covered almost *ad nauseam*. As has already been mentioned, the telegraph, telephone, electric light and street railway services suffered severely and their financial loss was considerable; although the interruption to service was remarkably short owing to the energy displayed by the officials of the various companies. We are glad to be able, however, to to present a few views of the devastation from some snapshots taken by Mr. Douglass Burnett, formerly of the New York Edison system, who has but recently become general manager of the United Electric Light & Power Company, of Baltimore, and who, in fact, may be said to have received thus his "baptism of fire" on being inducted into his new position.

The snapshots shown are some of those taken February 8 and 9 in the burned district, one of them, Fig. 2, looking north on Charles Street from the corner of Baltimore Street toward the Union Trust Building. It shows the overhead wires, which, curiously enough, were to have been abandoned upon the opening of the subway system on February 10. Invitations were to have been mailed on the Monday morning, the day after the fire, for the opening of the new rotary station on McClellan Street. The opening was to have taken place on Wednesday afternoon at 3.30, when the United Company expected to turn current on to the new underground, three-wire, direct-current system. Fig. 4 shows the new McClellan Street station, which had a most fortunate escape, the only damage being the breakage of the windows through the falling of neighboring walls. Fig. 5 shows the rotaries, transformers, etc., in this station after the fire. The building is surrounded by walls of gutted buildings in every direction, but the management has noted no damage was done to it except where the wire glass was cracked by the heat and where some of the sashes were broken by falling walls and bricks.

The United Company's men received the first fire signal when the automatic alarm in the Hurst Building not far away went off, and several of them went immediately to the premises, arriving when the first explosion occurred. Mr. Burnett himself saw personally the first flames burst from the building and was on his way to it and within two blocks of it at the time of the explosion. He and his men were thus on the ground from the very beginning of the fire. The service was shut down as soon as practicable, but the city lighting was resumed a few minutes after dusk in all but the burned territory; and the power circuits were in operation next morning. The McClellan Street station and the Pratt Street railway power house, both of which stood up so wonderfully while in the thick of this

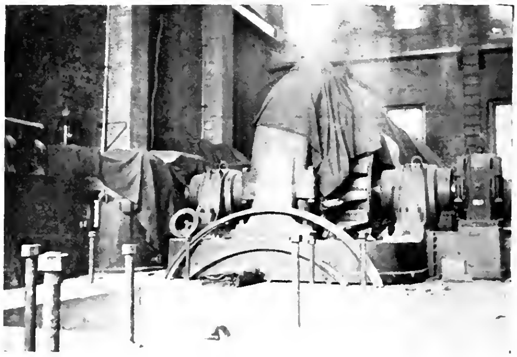


FIG. 5.—INTERIOR OF STATION.

unexpected fire, were designed by Mr. P. O. Keilholtz, consulting engineer of the company. In all probability Mr. Keilholtz did not have the remotest idea that his work would ever be subjected to such a test and strain as this; but he would wish no better example of endurance in design and equipment than was afforded at both places. It still remains a wonder that both plants were not wiped out of existence, and central station men might doubtless do worse than study the features of construction embodied in the stations named. As we understand it, the fire would have destroyed Pratt Street had the material there afforded the least encouragement.

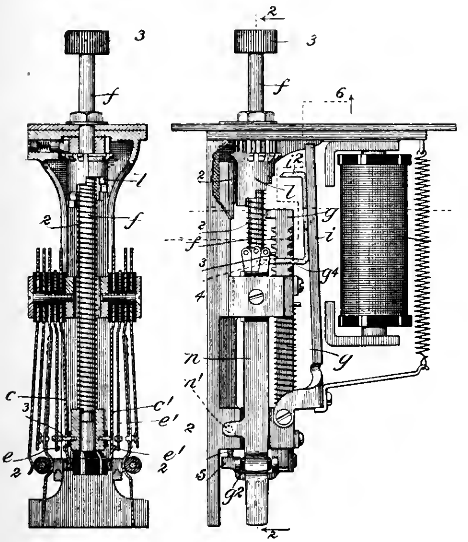
It is a remarkable fact that while 30 city arc lamps on a rough estimate were in the burned district, a number of them were in place or could be readily renewed. One of the views herewith, Fig. 1, shows one of the several city arc lamps in the district with the globes, lamp and the shepherd's crook intact, the wooden post being partially burned away. Another view, Fig. 3, shows the Hotel Carrollton on the left; the Continental Trust Building in the middle distance, where the Postal Telegraph Company's headquarters were wiped out, and the Maryland Trust Building on the right. The fire alarm box can be seen in the foreground. As usual, it was one of the curiosities of the fire to notice what was destroyed and what by some inexplicable chance was left standing and almost unharmed.

FIGS. 2, 3 AND 4.—VIEWS OF THE BURNED DISTRICT.

New Telephone Patents.

CODE-RINGING KEY.

Probably the most extraordinary ringing key of recent years is one for automatically giving code signals on non-selective party lines, which has recently been invented. With such a key it is aimed to overcome the drag upon the operator occasioned by the time and care necessary to send clear and distinct signals. Incidentally, at least one source of annoyance to subscribers is removed. This results from the fact that an indicator serves to show what code was last sent out on the key and the operator may repeat it in case of failure of the called party to answer without the necessity of questioning the calling party as to the station desired before an additional signal may be sent. A side view of the key as developed is shown in Fig. 1, together with a sectional view which shows the arrangement of springs. What may be called the key to the situation is, however, not shown, being an interrupter continuously driven, and included in the current leads which supply the keys. This interrupter times the interval between, and the duration of, the component rings which form the signal. It consists of two elements —that which controls the ringing current and that which controls a direct-current circuit, which restores the key to normal after the completion of the desired signal. These are so mounted upon their common shaft that the angular position of a dead segment of one corresponds exactly with that of a live segment of the other; that is



SCRIBNER-M'BERTY RINGING KEY.

to say, that while the restoring current is being supplied the ringing current is cut off and vise versa. The operation of the key is effected from a single button, which has two motions—a rotative one about its spindle as an axis, and a vertical one. The process of sending a signal first requires that the button be rotated until a pointer traveling with it indicates the desired party number upon a dial formed upon the key face. There is also traveling with the key spindle a stepped collar, *l*. This engages the ratchet bar, *g*, and the ultimate depression of the ratchet bar is dependent solely upon which step of the collar is in position to engage the bar. Ten-party lines are evidently contemplated, the bells of five stations being on each side of the line, the return circuit being earthed. Therefore, a switching device must be provided to connect the generator to the desired side of the line. This comprises the two sets of springs next the plunger, marked *C e'* and *C'e'*, together with the cam wedge of hard rubber secured to the end of the push spindle. This cam is so shaped that when turned to the right it affects one pair of springs, so that the ring is on one side of the line, and if turned to the left the other side of the line will be rung upon.

As soon as the key has been set and the depression begins, the supply of ringing current is temporarily cut off. Next the ratchet bar becomes engaged and depressed. This affects the ringing key proper, this embracing the outer sets of springs. However, no signals are sent as the current supply is cut off until the plunger returns to the uppermost position. This it strives to do as soon as released; but it only succeeds in doing it at a time when the interrupter is on a segment corresponding to silence of the bells, as its motion is restrained by the dog i_2, except when the armature *i* is pulled up. If this provision were not made the first ring might be of irregular duration. When the plunger has returned home and closed the ringing supply to the key, the code ringing begins, following the commutator; at each silent period the wedge of the ringing springs returns one step toward the normal position, being stepped along by the detent vibrating by the restoring magnet, as this receives direct curreent from the commutator during the silent periods. When the normal is finally reached the ringing springs become released by the wedge rolls dropping into their grooves. Just as this occurs a small pawl which has been restraining the plunger from being depressed during the automatic operations, is tilted to free the spindle for a further signal, should this be found necessary. Two patents have been granted for this key, both assigned to the Western Electric Company. C. E. Scribner has obtained one of these, while Frank R. McBerty has been granted the other one.

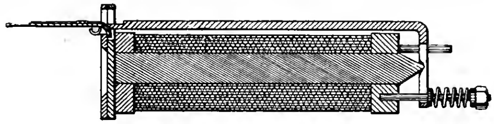
HAND TELEPHONES.

Two patents have been granted for designs of hand telephone apparatus. One of these describes a receiver of the general outward appearance of the old Bell hand telephone. The novel features, however, are several in number. First of all, the diaphragm is given an initial tension by an annular spring, which is forced upon it by the receiver cap. This bows the diaphragm toward the magnet pole. Second, the diaphragm is provided with a pole piece. This enters the end of the coil spool, the magnet being cut short to permit of this. The combined result, the inventor, Mr. Ernest Gundlach, of Western Springs, Ill., states, is an increased efficiency.

The second hand telephone combines a transmitter, a receiver and a calling buzzer within one piece of apparatus, the whole being assembled after the manner of the hand microphone of foreign practice. The calling device is contained within the receiver casing and consists of a buzzer, the magnet of which is that of the receiver. A switch upon the handle of the apparatus effects the transfer of circuits to the talking or calling conditions, as described. The whole forms a compact instrument apparently fairly well suited to the interior or house system working for which it is designed. Mr. E. T. Billig, of New York City, has obtained the patent covering this apparatus.

DIRECT-CURRENT DROP.

Fig. 2 shows a rather neat direct-current line drop which has recently been invented by Lambert Schmidt, of Weehawken, N. J. The



SCHMIDT ANNUNCIATOR.

magnetic circuit is very well designed, the air-gap being extremely small. The use of the core as a knife edge for the swinging armature is commendable, resulting in extreme simplicity of construction. The operation of the drop will be evident at a glance.

CENTRAL ENERGY SYSTEM.

A central energy system in which two repeating coils are used in each cord circuit forms the subject of a patent obtained by J. H. Lendi, of Chicago, and assigned to the Kellogg Switchboard & Supply Company. The object of using two repeating coils is that by so doing each can serve an additional function—as the winding of a supervisory relay. One winding of each coil is included in the battery supply circuit of one subscriber, while the other winding has a condenser inserted in circuit. In using the coils the condenser section of one is placed in parallel with the battery section of the other. Thus the relay armature associated with each coil responds only to the proper subscriber, while the inductive relations of the two ends of the cord circuit are such as to warrant good transmission.

SEMI-AUTOMATIC SWITCHBOARD SYSTEM.

What may be called a semi-automatic system has been invented by J. Kitsee, of Philadelphia. In this system a continuously revolving selector connects the operator to calling subscriber one by one in the order of the origination of their calls. The selector is stopped each time a call is found until the connecting plugs have been inserted in the jacks. Then the selector starts the process of locating and connecting the operator to the next call. This scheme does not seem very practical and, therefore, detailed explanation is omitted.

SOUND INTENSIFIER.

Mr. Gustaf T. Swenson, of San Pedro, Cal., has added to the applications of the telephone as a receiver for wireless telegraph signals. He arranges two electromagnets and a battery as a shunt upon the coherer, and by this means the received signals vary the magnetization of the magnets. These latter affect respectively the two diaphragms of a sort of receiver microphone repeater, which in turn affects a telephone receiver. Of course, no questions of timbre or quality are involved, great volume of sound in proportion to the received energy being alone desired.

Ohio Independent Telephone Companies.

A meeting of the independent telephone companies of Ohio will be held in Cincinnati, February 17, 18 and 19. The purpose of the meeting is to discuss closer association among the Ohio independent companies. The Independent Telephone Traffic Association of Cleveland is back of the movement. Several weeks ago a meeting was held in Columbus with the same aims in view and a committee was appointed to take up the question. One of the chief aims of the Cincinnati meeting will be the formation of a State association to take the place of the present association, which is now practically disrupted. Following the formation of an Ohio association it is the aim to form an inter-state association to combine similar associations in several of the central states. The purpose of holding the meeting in Cincinnati is to give encouragement to the independent companies that are now working to secure admission to Cincinnati; also to demonstrate the strength of the independent move in Ohio.

A Trade Mark Decision.

Judge Brown, of the Circuit Court of the United States, District of Massachusetts, has handed down an opinion enjoining a company which renews incandescent lamps from retaining the letters "G. E." in the stems of lamps renewed. The gist of the opinion is that this trade-mark is practically removable in the remaking of lamps, since it can be obliterated at an expense of only 55 cents per thousand lamps by applying to the exterior of the stem and over the trade-mark a small quantity of chemical paste. Since the bulb is opened on remaking to insert new filaments and to fasten them to the ends of the leading-in wires with carbon paste, the application of the same paste for the obliteration of the trade-mark the court held to be an obvious expedient. The opinion states that there is strong evidence that the real purpose in affixing an indelible trade-mark was for the ordinary purpose of a trade-mark and not, as the defendants alleged, as a part of a scheme to attack its business of remaking lamps. In summing up the court says that the complainant has a valid trade-mark. The defendants without legal justification put forth lamps bearing on this trade-mark. Though they did so without any intent to deceive and have been honorable in intention and in their business methods, and so far as appears have caused no actual deception, yet the use of this trade-mark in violation of its legal rights entitles the complainant to an injunction.

Independent Telephones in Post-Offices.

A special dispatch from Cleveland, O., of February 13 says: "Frederick S. Dickson, president of the Cuyahoga Telephone Company here, has won his fight against President Roosevelt and Postmaster-General Payne. The latter, with the President's sanction, ruled that post-offices throughout the country should use only one telephone, viz.: the one that had long-distance connection with Washington. This meant the loss of a large sum to the independent telephone interests of the country. Dickson pleaded with Mr. Roosevelt to intercede, but without success. But through many Senators and Representatives he has succeeded in getting the Payne ruling modified so that the independents will have a chance.

CURRENT NEWS AND NOTES.

MICA MINES in Charleroix County, Quebec, are mentioned as places where minerals are obtainable with remarkable radioactive qualities.

TROLLEYS IN NEW HAMPSHIRE.—The electric and traction street car companies in New Hampshire, of which there are eighteen, made a disappointing showing during the last year, according to the annual report of the State Railroad Commissioners. The Manchester Street Railway was the only one which earned a dividend. The street railroads in the State have 228 miles of track, $3,552,119 stock, $2,066,000 in bonds, and $1,109,003 liabilities. The gross income was $834,894; operating expenses, $796,795; taxes and interest, $103,250, and a deficit of $65,161. The Manchester road had a divisible income of $31,807.

FREEZING OUT A LEAK.—An interesting piece of engineering was recently carried out in St. Louis. A leak occurred in one of the cofferdams being used in the construction of the foundations for the new plant of the Union Electric Company on the river front. Water from the river poured through the leak and it looked as if serious damage would result. Finally the mechanical engineer of a near-by refrigerating plant met the situation by freezing out the leak. He laid ammonia pipes from his plant to the point where the leak existed and the breach was soon closed with solid ice. The water was then pumped out and work resumed.

STEAM AND TELEGRAPH.—Echoing the sentiment and ideas of Maud Müller, the London *Daily Telegraph* discusses the recent Pilgrim dinners in London and New York, conducted simultaneously by cable, and says: "Picturesque and genial as the event was in itself, and appealing with singular success, as it does, to the spirit of friendly good humor which, happily, is the dominating factor in the intercourse between the British and American peoples to-day, it has a profound meaning, whereof serious historians of the future may well take account. The nations in spite of themselves are being knitted together by the conditions of modern intercourse and the spirit of modern science in a mesh of subtle, invisible strands which is morally as strong as hoops of steel. If steam and telegraph, for instance, had existed in the latter half of the eighteenth century it is certain that the separation of the race would never have taken place."

SALE OF FRANCHISES.—Assemblyman Finch, of New York, has introduced in the New York Legislature a concurrent resolution amending the State Constitution with regard to the disposal of franchises to public service corporations. The proposed amendment was one which would absolutely forbid the giving away of any franchise or public utility, and compel the same to be sold at public auction. In the charter of the City of New York and the charters of second-class cities this is already provided for. But the significant thing in the resolution, so far as New York City was concerned, is a provision compelling the resale of franchises at public auction every fifty years, thus compelling the street railway companies, gas companies, telephone and telegraph companies, and all other public service corporations to repurchase their franchises from the city after they have enjoyed them for a fifty-year period.

MAGNETIC STEEL.—Mr. Robert A. Hadfield, vice-president of the British Iron and Steel Institute, has taken out an American patent under date of December 1, 1903, which covers the results obtained in the now classical papers of Barrett, Brown and Hadfield, first published in the *Proceedings* of the Royal Dublin Society and later in the *Journal* of the English Institution of Electrical Engineers. From this patent it appears that the heat treatment which Mr. Hadfield gives steel, either in castings or transformer plate, is quite as important as the original crucible charges from which the steel is made. It is rather startling to have perhaps the first living authority on the practical heat treatment of special steels announce that by an ingenious use of heat treatment and composition combined, he has succeeded in producing a magnetic material showing a magnetic permeability higher, and a hysteresis action lower, than the purest iron commercially obtainable.

ELECTRIC AUTOMOBILE SPEED.—In the recent automobile contests at Ormond Beach, Fla., the speed record for electric machines was lowered by Mr. W. J. Hastings on the Baker torpedo "Kid" with a mile in 1:00⅘ min., and the kilometer in 0:37⅗ sec.

ELECTRIC POWER ON NEW YORK CENTRAL.—The New York Central Railroad Company has, according to to a dispatch from Yonkers, N. Y., promised to build a large power house in that city at a cost of $2,500,000. It has laid before the Mayor and Aldermen plans to eliminate all grade crossings in the city preparatory to the introduction of the third-rail system. The plan approved will be submitted to the Legislature for final action. It is stated that the plans contemplate the use of five tracks to Croton.

PARIS TROLLEYS AND CABS.—A cable dispatch from Paris says that the Paris cabman is being threatened with loss of patronage and power by the slowly-increasing improvements in urban transportation facilities, notably in the instance of the Metropolitan underground system, with its three- sou (three-cent) fares. The cabman's syndicate is considering a project of reducing single fares so that the first 400 meters (quarter of a mile) be paid at a minimum rate of seventy centimes (fourteen cents), and also of attaching an automatic distance indicator, the same as that used in Berlin and Vienna.

RADIUM AND CANCER.—A cable dispatch from Vienna of January 28th says: "Professor Gussenbauer, an eminent surgeon, has discovered that contraction of the gullet caused by cancer can be alleviated in certain cases by the use of radium. The experiment was made of applying sixty milligrammes of radium in a rubber capsule to the affected part. The radium rays decomposed the cancerous growth, enlarging the gullet and allowing food to be swallowed, thus obviating an operation for the introduction of food into the stomach. The experiment is somewhat dangerous until further knowledge is obtained, inasmuch as too much radium will decompose the ulcer so rapidly that there is risk of perforating the gullet."

TRADE-MARK PROTECTION.—Many of our readers are interested in an appeal that has been sent out for support of national legislation for trade-mark protection. It is believed to be very desirable, and essential to place trade-marks on an interstate footing, and bring all trade-marks used in "commerce among the several States" under Federal statutory protection. The bill introduced by Senator Stewart January 12, 1904 (Senate Bill 3353), is intended to extend to trade-marks used in interstate commerce the statutory rights and privileges accorded to trade-marks used in foreign or Indian commerce. This bill provides also for a bureau, at the head of which shall be a Register of Commercial Marks, appointed by the President, at a salary of $3,000 a year.

BEARING OIL IN INDIA.—An article in the *World's Work* for February says: "When the American Engineers were building an electric power station in the Mysore territory in Southern India they found that something was wrong with the lubrication of the machinery. The oil disappeared. They discovered that a Hindu must, by his religion, take a periodical bath in oil. To him oil is oil. The workmen had drained the bearings for bathing purposes. How to stop the thieving was a puzzling problem until some one solved it. The Hindu does not eat meat, and he will not touch anything that has blood in it. Two or three animals were killed, therefore, and blood was dripped into the bearings. There was no more stealing of oil; however many other things were stolen."

FREE TELEPHONE SERVICE IN CHICAGO.—The Illinois Tunnel Company, which operates the new automatic telephone exchange in the business district of Chicago, gave notice to its subscribers February 5 that all service would be free up to April 1, 1904, and that all charges for past service would be canceled. The object is to educate the public up to using the new automatic service. So far the automatic telephone has not been used as much as it might have been had it not been on a strictly measured rate of 5 cents per call, whereas many of the Chicago Telephone Company's instruments are on a flat rate and others are on a guaranteed minimum rate for measured service; so that the automatic telephone would only be used when the old telephone was busy, or especially quick connection was desired.

INSTITUTE BUILDING FUND.—The Building Fund Committee of the American Institute of Electrical Engineers has taken hold very vigorously of its work of raising funds from among the members primarily, and next from electrical concerns benefited by engineering progress. It has just addressed circulars to all the membership, from which it has already raised considerably over $30,000, some sums being promised in a lump and others spread out over a term of five years. The committee hopes to secure practically the name of every member on this subscription list, and is greatly encouraged by the hearty and public-spirited responses it is receiving from all over the country. A careful and elaborate plan of campaign, to which we shall again have occasion to refer, is being inaugurated and is to be persistently pushed.

A. I. E. E. PHILADELPHIA LOCAL MEETING.—At a meeting of the Philadelphia Branch of the American Institute of Electrical Engineers, at the Engineers' Club, of Philadelphia, on the evening of February 8, Mr. C. E. Bonine gave a talk on the "Principles of Alternating-Current Motors," which was followed by an abstract by Mr. E. P. Coles of Mr. Walter I. Slichter's paper on "Speed-Torque Characteristics of the Single-Phase Repulsion Motor," and Mr. Charles P. Steinmetz's paper on "The Alternating-Current Railway Motor," which were presented at the New York meeting. Mr. C. E. Renshaw, of the Westinghouse Company, Pittsburg, gave a paper on "Alternating-Current Railway Motors." Mr. Renshaw dwelt upon the many advantages the alternating-current motor has over the direct for railway purposes, and went into details as to the principles governing the single-phase alternating-current motor. The discussion was participated in by Messrs. Cutler, Thomas Spencer and Breed.

WIRELESS IN BRAZIL.—Mr. K. K. Kenneday, United States Consul at Para, Brazil, writing recently says: "Experiments with a wireless telegraph system which have been quietly carried on between Manaos and Iquitos during the past few months have shown such satisfactory results that the cable company has bought the right to use the system between Para and Manaos, and the manager of the Manaos office is now in Para making final arrangements for installing the system. No other improvement is so important to the commercial interests of the Amazon Valley as the installment of a reliable telegraph service between Para, Manaos and upriver points. Owing to the character of the country through which it must pass a land line is impossible, and it has been found equally impossible to keep a cable line in steady operation. The present cable, recently laid and maintained at an enormous expense, is rarely in working order more than one or two days per week. The rapid and violent fluctuations of exchange in this country render it almost vital for merchants, shippers and brokers to keep in close and uninterrupted touch with their branch houses and agents at all points, and the constant breakages of the cable are looked upon as a calamity."

STATE GUARD ELECTRICIANS.—A bill is before the New York Assembly providing for enlistment of five technical expert civilian electricians as engineers of heavy artillery National Guard State of New York, for service in coast defenses, has been introduced and passed in the lower house with a fair chance, if pushed, of passing the State Senate and becoming a law. This bill, as we understand it, is the outgrowth of articles published a year or more ago in Electrical World and Engineer and was proposed or endorsed by members of the American Institute of Electrical Engineers, who took up the subject of having the National Guards of Massachusetts, Connecticut and this State (the only ones with heavy artillery organization), employ, with sergeant's rank, technical electrical engineers from civil life to handle coast defense plants such as are used in practice drills at Willets Point, Fort Totten and other coast defense points. We published several articles about it and described the manœuvres and experiments, at Fort Terry, of a volunteer engineer, Sergeant M. C. Sullivan, of one of the Thirteenth Regiment's companies, who gave a demonstration at the Military Tournament last year, in Madison Square Garden. We understand Col. Austin, of the Thirteenth, and Capt. Taylor, of the same regiment, are deeply interested in this bill.

Letter to the Editors.

Radium and Helium.

To the Editors of Electrical World and Engineer:

Sirs:—Considering the intense interest manifested in the marvelous performances of radium and kindred substances, would it be proper and permissible for a layman to put in a word on the subject?

Two statements recently made seem suggestive of a probable solution of the problem. The one is that radium maintains a higher temperature than its surroundings, the other that the emanated matter is helium. Does not this indicate that the phenomenon must be supposed analogous to what is commonly called combustion? This would, of course, imply that helium is a compound, not an element, but is there anything impossible in that? A piece of charcoal, for instance, at red heat, exposed to oxygen mixed or combined with other matter, will issue carbonic acid or other gases as the case may be—whether with or without measurable wave lengths I don't know. But the process will keep the temperature of the coal above that of its surroundings and the expelled—emanated—gases will give off their heat to whatever they strike and remain gaseous until a very low temperature is reached, exactly as in the case of radium. That the gases are expelled at a greater rate of quantity and a smaller rate of speed than the helium, does not alter the apparent similarity of the process.

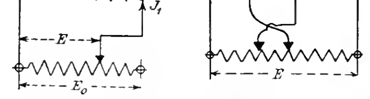
But this surmise would also imply that radium diminished in quantity by the so-called radiation. Perhaps it does, unless something is added to it from a source unknown. There would still be room for much interesting research, and more wonders may yet be found in connection with it.

Chicago, Ill. S. T. Sue.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single Phase Commutator Motor.—Eichberg.—A very long paper, illustrated by a great many diagrams, on single phase commutator and their regulation. The author first discusses in general the phenomena which are of importance in a commutator motor and gives a review of the properties of the ordinary series motor and repulsion motor and deals finally with the Eichberg-Winter motor. Its arrangement is diagramatically shown in Fig. 1. Both the exciting voltage e and the total voltage E can be adjusted, although in high voltage motors the regulation of E would be inconvenient. The motor has a single phase stator winding and a rotor which is absolutely identical with a direct-current armature. The rotor winding is used in a double way. In one axis it is short-circuited so that it may be considered to form a short-circuit winding $W_{11}{}^1$ for the stator winding W_1. In points (brushes $b\,b$) which have the same potential as the short-circuited brushes $B\,B$, the exciting currents are introduced. It would, of course, be just as well possible to provide two separate commutator windings. With a two-pole arrangement it is necessary to use four brushes. With $2p$-pole series windings or parallel winding with Mordey connections, four brushes are also required; in the most general case $2p$ short-circuit and $2p$ exciting brushes may be used. The exciting current i itself is furnished by an adjustable series motor (or potential regulator). It is therefore always in phase with the primary current J_1. During



Figs. 1 and 2.—Single-Phase Commutator Motor.

starting, $W_{11}{}^1$ is essentially a short-circuited transformer which represents a relatively small impedance. With increasing speed, there is produced in $W_{11}{}^1$ (between the brushes $B\,B$) an e.m.f. in phase with i or J_1. The windings $W_1\,W_{11}{}^1$ therefore form together with increasing speed a transformer with an ohmic resistance load. In accordance with the increase of this load with increasing speed, the field Φ increases. The secondary circuit of the series transformer represents in the first moment a relatively high impedance. The less secondary turns are connected to the exciting circuit $b\,b$, the greater is the impedance of the series transformer. During starting, a very large part of the total voltage will be consumed by the transformer. With increasing speed, there will be produced between the brushes $b\,b$ an e.m.f. in phase with Φ. This annihilates the self-induction in the exciting circuit, and at a sufficiently high speed the secondary of the transformer will possess only a very small voltage, corresponding to the ohmic loss in the winding and the slot leakage. The total voltage E resolves itself during starting in such a way that W_1 gets a small pressure which, however, increases with increasing speed and soon reaches nearly the full value, E. The presence of the "cross field" Φ makes it possible to annihilate the short-circuit e.m.f. simultaneously with the annihilation of the inductance of the excitation winding. By varying the transformation ratio it is possible to adjust the ratio of F to Φ. Stator and rotor winding are independent of each other. It is therefore possible to apply directly a high voltage. In spite of the use of only one stator winding, the motor can be reversed, even without opening the stator circuit. If the secondary number of turns is increased, we get a higher speed for the same torque or a higher torque for the same speed. One may therefore start, without varying the primary voltage, simply by increasing the number of secondary turns. By this arangement it is possible to start, reverse, and stop the motor, without interrupting the high tension circuit. The curves obtained by the motor have already been reproduced and discussed in these columns. It is possible to arrange the motor so that it starts with full torque and maintains a given speed. The voltage at the exciting circuit and at the stator has approximately the same phase for nearly all speeds. It is therefore possible to get the voltage for the exciting circuit and the stator from the same transformer, the stator voltage being increased and the exciting voltage being diminished with increasing speed. Near synchronism only a few volts are used for excitation. Fig. 2 shows the arrangement which the author believes to be specially suitable for elevators and machine tool driving. The author sums up as follows what he considers to be the essential accomplishments of his system: The production and independent adjustment of the two fields, F and Φ in Fig. 1, results in the annihilation of the short circuit energy below the brushes and of the phase difference of the motor within wide limits. It is further possible to change the characteristic curve of the motor with constant total voltage (of the supply network), or, in other words, to get any torque at any speed. For high-tension motors it is possible to start, reverse and stop the motor, without opening the primary circuit. The motor has all good properties of the direct-current traction motor, among them the good action of commutator and brushes.—*Elek. Zeit.*, January 28.

Magnetic Dispersion in Induction Motors.—Behn-Eschenburg.—

An abstract of a paper read before the British Inst. Elec. Eng. The dispersion coefficient is defined as unity minus the ratio of the product of the coefficients of mutual induction to the product of the coefficients of self-induction of the primary and secondary windings respectively. It may be obtained experimentally as the ratio of the magnetizing current to the short-circuit current at equal terminal potential differences. It may be regarded as the sum of three distinct coefficients; first, the winding coefficient; secondly, the peripheral disperson; third, the flank dispersion. Concerning the first coefficient he says that in every motor a difference exists between the self-induction of the winding of one system and the mutual induction between corresponding portions of the windings of the primary and secondary systems, even if there were no so-called magnetic leakage to influence the relation. The reason is that mutual induction is the sum of the products of the magnetic lines by the number of conductors interlinked by each. Even if no magnetic line produced by the primary current fails to interlink with the secondary circuit, the number of times it interlinks the secondary turns depends upon the relative positions of the two circuits. There will be a relative position giving the maximum mutual induction, and one giving a minimum, and since one position is obtained from the other by steady motion, the average value will be the arithmetic mean of the maximum and minimum values. The winding coefficient is defined as half the difference beetween the maximum and minimum values divided by the maximum value. This coefficient is less the larger number of slots of the primary on the one hand or of the secondary on the other. In every motor, however, there come into operation magnetic leakages which may be separated into two stray fluxes so that we may distinguish between peripheral dispersion and flank dispersion. Peripheral dispersion runs along the face of the bore of the stator and along the phase of the cylindrical periphery of the rotor, since between the tops of the iron teeth of each single system over the openings of the slots there occurs a leakage of magnetic lines. These stray fluxes along the peripheral surfaces will bear to the mean total flux the same proportion as the magnetic reluctance of the path followed by the mean total flux bears to the magnetic reluctance interposed in the path of the stray magnetic flux between the tops of the teeth. The quotient of the stray flux by the main flux is called the peripheral dispersion coefficient. The second kind of magnetic leakage, called flank dispersion, exists outside the iron core. Those parts of the winding which constitute the end connections between conductors in the slots, and which project as curved winding bunches or bends at the flanks of the stator and rotor cylinders, give rise to a magnetic flux outside the iron core bodies. In the main this stray flux is equal to the magnetic flux

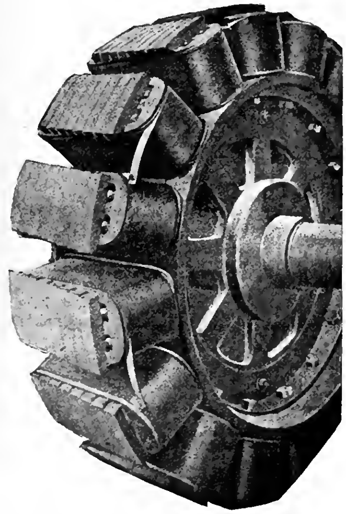


FIG. 3.—POLE CONSTRUCTION OF ALTERNATOR.

which would be created by an independent group of coils of a form similar to the two projecting bends at the two flanks, if put together as a coil. The author gives approximate formulas for calculating these three coefficients and by adding them he gets the total dispersion coefficient. He thinks that this coefficient may well form the basis upon which to design induction motors as upon it depends the power factor.—Lond. *Elec. Rev.*, January 29.—An illustrated reprint in full of the paper begins in Lond. *Elec.*, January 22.

Alternators Giving a Pure Sinusoidal e.m.f.—PATERSON.—A fully illustrated article in which it is said that the Oerlikon Company built the generators for the Lauffen transmission in 1891 with their pole pieces set at an angle to the axis of the pole wheel, with the result that the wave of electromotive force was very nearly a sine curve. The same firm is now building generators on this principle, and Fig. 3 shows the special pole construction. The iron is laminated throughout, the stamping being arranged in such a way that the polar edge makes an angle with the axis of the wheel. The distribution of flux with relation to the stator conductors tends to produce the desired effect.—Lond. *Elec. Rev.*, January 29.

REFERENCES.

Auxiliary Poles for Direct-Current Machines.—PUNGA.—An article referring to the paper of Pichelmayer who, as was recently noticed in the Digest, recommends the use of auxiliary poles for generating a special commutating field in order to insure perfect commutation. The present author remarks that such auxiliary poles have repeatedly been suggested before, but their use has distinct practical disadvantages which make the design difficult. Compared with the normal direct-current machine, a machine provided with auxiliary poles is more expensive. The use of auxiliary poles will be only justified when the voltage and the speed are comparatively high so that the design of a normal machine would become impossible, for instance, in the case of a 500-kw machine running at 1,000 revolutions per minute. In connection with steam turbines the use of auxiliary poles should be in place.—*Zeit. f. Elek.* (Vienna), January 24.

LIGHTS AND LIGHTING.

Three Phase Arc.—MERCANTON.—An account of experiments which he has made with a three-phase are, using three carbons arranged symmetrically and inclined to each other so as to form a triangular pyramid. The results depend to some extent upon the nature of the carbons used. The carbons should contain substances capable of volatilizing and "nourishing" the arc. Fig. 4 shows the

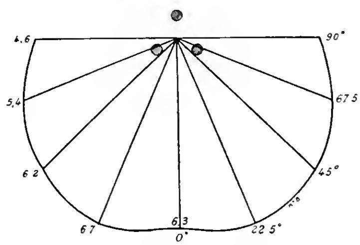


FIG. 4.—THREE-PHASE ARC.

results of photometric measurements with one set of such carbons, the lengths of the radii representing the candles per watt so that for 0° one watt gives 6.3 candles or reversely 0.160 watt is consumed per candle, which is a rather good efficiency. In spite of the advantages of the three-phase arc he thinks that mechanical complications would prevent its introduction into general use, but for special uses where regulation by hand is possible, and especially in connection with searchlights, the three-phase arc is thought to be able to render important service, on account of its steadiness and high light effect.—*L'Eclairage Elec.*, January 30.

Triplex Lamps.—HOPPE.—The first part of an article in which the author discusses the result which have been obtained in practice with the connection of three 35 to 37-volt arc lamps in series across 110-volt mains or of six such lamps in series across 220-volt mains. The advantage gained is that no energy is wasted in series resistances (as is the case with two 42 to 46 lamps in series across 110-volt mains). But on account of the series resistance being avoided, certain conditions must be vigorously fulfilled, if the light shall be good and steady. The regulating devices must be absolutely exact and in good working order, the best material must be used for the carbons, and there must not be any large variations of the voltage of the mains. Moreover, these lamps need special attendance, and if one lamp comes out of order, a comparatively large number of others is involved. The article is to be concluded. In the conclusion the author proposes to discuss the question of cost.—*Elek. Anz.*, January 24.

REFERENCES.

Lighting.—Lummer.—The first part of an article in which the author emphasizes that in spite of the enormous development of electric lighting we have not made any radical progress in the principal problem of lighting. The goal to strive at should be to produce light without heat. We need cheaper light, not more light. To test the progress made by a new system of lighting, it has been considered all-important to determine the price per candle. Although this value is practically important, it does not give any indication of the real economy, i. e., the ratio of the light produced to the energy consumed. The lighting engineer should base his researches more on scientific principles.—*Zeit. f. Belenoht*, January 10.

Power.

Individual Motor Drive.—Cooper.—An article in which the author points out that in many cases motors are used for driving machine tools which are entirely too small where they are expected to yield a considerable range of speeds by field regulation. Some examples of this kind are mentioned. When installing an electric motor it is important to know the conditions under which the maximum amount of power is required. If the maximum power be coincident with the maximum speed, and the amount of power decreases with the speed, a motor having field regulation is ill adapted to the work of furnishing different speeds. If the power required is nearly constant or if it decreases as the speed increases, this method of regulation is much more applicable. Some remarks are made on the determination of the maximum power required. Due consideration should always be given to the well known facts that the power of a direct-current motor decreases in inverse ratio as the increase of speed when the speed is increased by field regulation, and that the power increases in a direct ratio as the increase of speed when the speed is increased by increasing the volts impressed upon the armature. With field regulation the limiting condition is the tendency to sparking at the commutator, while with regulation by varying the impressed voltage, the limiting condition is heating of the armature. If it is desired to increase the speed 100 per cent. by field weakening, one must have 100 per cent. margin for sparking at normal speed, if the motor is to carry normal load at the increased speed. The same is true in regard to heating, if the speed is to be decreased by lessening the impressed volts. These rules are graphically represented in a diagram. A motor whose speed is to be varied by changes in voltage, field excitation remaining constant, will be directly proportional in size to the change in speed; while a motor whose speed is to be varied by change of field excitation will be in size as the square of the change of speed. For determining relative sizes of motors for constant horse-power application, the following rules are given: The total range of speed, using both variable voltage and field regulation, is as the square of the range of voltages. The change of horse-power is directly proportional to change of voltage on armature, field being constant. The change of horse-power by change of field strength is inversely proportional to change in speed, the voltage on the armature remaining constant. The relative size of motor, as referred to the maximum speed, is directly proportional to its speed variation when using variable voltages. The relative size of motor, as referred to the maximum speed, is as the square of the speed variation when using field regulation.—*Cassier's Mag.*, February.

Electric Power in Australian Railway Workshops.—An illustrated description of the electrical equipment of the railway workshops at Ipswich, Queensland. The power house contains three 200-kw generating sets each consisting of a single-acting compound engine directly connected to a 220-volt, 60-cycle, two-phase alternator. The motors installed vary from 1 to 75 hp and are all induction motors, the majority with squirrel-cage rotors. The number at present installed is about 170 and the aggregate power over 1,200 hp. Where speed regulation is required, the squirrel-cage rotor is replaced by a wound and insulated secondary, connections from which are made by means of collector rings on the shaft to external resistances. Thus the motor is enabled to exert full load torque at a number of speeds less than ful speed, depending on the number of notches in the controller. For crane work, however, suitably designed squirrel-cage motors can be used. The shop equipment includes 11 cranes, each operated by three motors, one for hoisting, one for cross traversing, and one for traveling.—Lond. *Elec.*, January 22.

Power Plant of Apartment House.—Moses.—An article on the general arrangement of the power plant and mechanical equipment of apartment houses. He recommends to get steam from the boilers at 100 to 150 pounds pressure, to use it expansively in the engines, etc., taking a few of the heat units available and allowing the pressure to drop from this initial to 2, 3, 4, 5 pounds as required. Thus, a portion of the energy of the steam is used for producing power, after which it enters the heating system, the drying coils in the laundries and the heater for the water fed to the boilers. In these it loses its latent heat and becomes condensed and returns to a receiving tank, whence it is pumped and returned to the boilers. The following three wiring systems are in use in apartment houses: two-wire 125-volt direct-current, three-wire 125-volt direct-current (one wire having double the carrying capacity of the others so that this is really a two-wire system with one of the wires split in two); a three-wire system with 240 volts between the outers. The first system should be used where no outside service is required; the second where outside service is required for lighting only; and the third where the outside service is required for lighting and power both alternately with the plant. The mechanical equipment is discussed in detail.—*Eng'ing Mag.*, February.

REFERENCES.

Large Electric Distribution System in Switzerland.—A note stating that the 10,000 water power station near Vallorbe has recently been completed and supplies not less than 190 municipalities with light and power. Current is generated at 13,000 volts and distributed at this voltage.—Lond. *Elec.*, January 29.

French Water Power Plant.—Domar.—A description of the Louziere hydroelectric plant which supplies current to a calcium carbide factory. There are three generating sets, each consisting of a 500-hp turbine coupled with a two-phase alternator.—*L'Eclairage Elec.*, January 23.

Traction.

"Tangential Traction."—Rosenfeld and Zeleney.—Some detailed information on this system which has been noticed briefly before in the Digest, and in its original form described in detail in an article printed several years ago. The principle is that a three-phase winding produces in a stator built up between the rails of the track, a horizontally moving field which corresponds to the rotating field produced by the stator of an ordinary three-phase machine. One

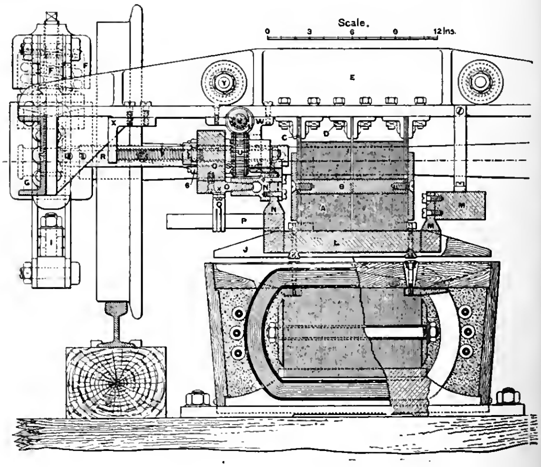


FIG. 5.—"TANGENTIAL" TRACTION.

may consider the stator laid along the track as part of an ordinary stator with an infinite diameter. The magnetic flux, travelling approximately at train speed, cuts the conductors of that part of the system corresponding to a rotor and called "propeller" attached to the motor car. The stator is not laid continuously along the line, but is divided into sections, spaced at certain distances apart. The train receives a constant pull, since the length of the propeller equals the distance between the axis of two stator blocks. Moreover, to avoid energy losses in those stator parts not utilized at the time for propulsion purposes, switching arrangements are provided by means of which only that section of stator blocks is supplied with current over which the train is passing. According to circumstances, a section is composed of one or more stator blocks. In the latter case, each of the three windings of the one block is connected in series with the corresponding windings of the next, and at the distant end of each section the three windings are short-circuited by a switch as the train enters the section. This switch is operated by a small low-voltage three-phase motor, the rails, which are insulated from one another and also in sections, acting as conductors for the rotor circuit. Since the stator of the switch motor is continually fed with current, the rotor will commence to actuate the switch as soon as its circuit is closed by a train entering the section. It is said that by reason of the low voltage in the rotor no special insulation of the rails is required. After the train has passed on to another section the switch opens automatically by means of a counter weight. Fig. 5 shows the section through the propeller and stator block, the right-hand wheel being cut off from the illustration. The stator block is 9 ft. long and 1 ft. 8 in. wide over the pole tips. The pole core has a section of 10 in. by 6¼ in. Altogether there are 24 coils, that is 8 per phase, and they are wound by copper wire 0.1 in. diameter. Current is fed to the winding at a pressure of between 1,300 and 2,000 volts. The propeller has a length of 60 ft., which is about equal to that of the two-bogie cars employed in the tests. The stator blocks were spaced over 18 meters. The propeller is composed of 12 bars, each 5 ft. 1 in. long, which are mechanically, electrically and magnetically connected by means of flexible joints. A squirrel-cage type of winding is adopted for the propeller, which, like the stator, is fitted with laminated pole shoes. For starting, however, the resistance P is inserted in the squirrel-cage winding. A device is fitted to the propeller by means of which the air-gap may be varied, but it seems impossible to make it less than 0.4 in. An experimental line of ¼ mile has been equipped by this system.—From *Bull. Inst. Montefiore, in Lond. Elec.*, January 29.

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Vienna.—An illustrated description of the municipal railway system of Vienna which, completed, will consist of about 350 km of track. The bow trolley system is used except in the center, where the underground conduit system is employed. The cars which operate in the center of the city are furnished with two plows, one on each side, with wings which fold up so that they can be lowered into the conduit. The power station is in two parts, one originally built for lighting and the other for railway work, although the two are now operated in conjunction. The coal consumption in October, 1902, was 1.117 kg per kw-hour. The engines in the larger power station are five in number, of 3,400 normal and 4,200 maximum hp, and operate three-phase alternators.—*St. R'y Jour.*, February 6.

Indianapolis & Northwestern Traction System.—An article on this interurban line. The main power plant comprises two steam-driven three-phase generators of 800-kw capacity. Current is delivered at 370 to 400 volts to the rotary converters in the power station, which are used to feed the trolley lines near the station. The remainder of the current is taken by three 300-kw step-up transformers which raise the voltage to 2,600, at which it is transmitted to the sub-stations for distribution. A statistical note states that the mileage of the interurban lines radiating from Indianapolis increased during 1903 nearly 100 per cent., not considering several large projects now under construction.—*St. R'y Jour.*, January 23.

Single-Phase Traction Motor.—See the above description of the Eichberg-Winter motor under Dynamos, Motors, etc.

Installations, Systems and Appliances.

Central Station Statistics of Great Britain.—A supplement to Lond. *Elec.*, January 8, gives a large table of all the electrical central stations in the United Kingdom with no tramway road. Very full information on the equipment is given in about 50 columns. There are in all 264 stations in operation, and 24 in progress of construction. A supplement to Lond. *Elec.*, January 25, contains a table of those central stations which supply current for both lighting and traction. There are in the whole 98 such stations. In an editorial on this subject it is said that when arc lamps of the Bremer and "flame" type made their appearance it was expected that they would revolutionize electric street lighting, but this has not been the case. The number of public arc lamps has remained nearly stationary. It is not expected that arc lamps will be largely employed for side street lighting. Nernst lamps have been extensively adopted, and it is said that for use on continuous current circuit they have established a good reputation, but there is room for considerable improvement in their behavior when worked by alternating currents (the Nernst lamps used in England are from the factory of the Allgem. El. Ges. in Berlin). In different parts of the country the motor connections have increased steadily, in some places even rapidly, the increase being greater for direct-current motors than for single-phase motors. Certain stations have adopted a tariff whereby energy is supplied for motive power at an extremely low rate, provided the consumer will refrain from taking current during "peak hours." Stepney and Brighton are cases in point; in these places a time switch is used, and, outside the prohibited hours, energy is supplied at a flat rate of 2 cents per unit. The number of undertakings "supplied in bulk" from power companies is largely on the increase.—Lond. *Elec.*, January 8.—Diagrams showing variations of the connections to the electricity supply works in London are given in Lond. *Elec.*, January 8; diagrams for the connections in London and in the provinces, in Lond. *Elec.*, January 15. There are also given some summary figures which apply to the aggregate connections to electric central stations, including power and tramway loads, but not including power supplied from purely tramway power houses . The total number of kw now connected in London is 167,640, and in the provinces 488,127, making a total of 655,767 kw in the United Kingdom. This shows an increase of 152,196 kw above the corresponding figure for December, 31, 1902. The equivalent of 8-cp lamps connected in the United Kingdom to date is nearly 22,000,000. The connections to stations under municipal control in both London and the provinces have increased out of all proportion to those under company control, and for the first time the former are now more than double the latter.—Lon. *Elec.*, January 15.

REFERENCES.

Compensated Potential Regulator for Single-Phase Current.—Fleischmann and Eichberg.—An article illustrated by diagrams, in which the authors first discuss the disadvantages of the ordinary potential regulators for single-phase current, and then describe an improved form which, however, as Osnos remarks, appears to be identical with the induction regulator used by Lamme in his single-phase traction system. (*Elec World*, 1902, Vol. 40, October 4, page 538).—*Zeit. f. Elek.* (Vienna), January 10, 24.

Electric Installations on Board Ship.—Leblond.—The conclusion of his article in which he discusses the general requirements of electric installations on ships. In the present installment he deals with the prime movers to which the dynamos are directly coupled, and with speed regulation.—*L'Ind. Elec.*, January 25.

Electro-Physics and Magnetism.

Radiations Emitted by Righi Vibrator.—Willard and Woodman.—An illustrated description of experiments made to determine the nature of radiation emitted by a Righi vibrator and the dependence of the length of a linear receiver upon the wave length with which it is in resonance, and which was the subject of editorial comment last week. This problem resolved itself into the measurement of the energy received from the same vibrator by resonators of different lengths, and the measurement of the wave lengths obtained with different resonators. The measurement of energy with a linear receiver of definite length showed the existence of a fundamental and upper partials. The relation of the receiver lengths for the fundamental and the successive upper partials stand in the relation 1, 2, 3. The damping in the Righi vibrator is less than the theoretical value computed by Thomson for the radiation from a single sphere. The grating space of the separating surface does not affect the wave length measured.—*Phys. Rev.*, January.

Radioactivity.—Bumstead and Wheeler.—An account of the results of an experimental investigation of the properties of a radioactive gas found in the soil and water near New Haven, Conn. It is apparently identical with the emanation from radium. If any other radioactive constituent is present it can be only in very small proportion. The density of the radium emanating, as determined by its rate of diffusion, is about four times that of carbon dioxide. The authors were unable to obtain the radioactive gas from mercury, recently described by Strutt, and are therefore inclined to attribute his results to an impurity in the mercury used.—*Am. Jour. Sc.*, February.

REFERENCES.

Magnetic Properties at Low Temperatures.—HONDA AND SHIMIZU.—An account of an experimental investigation of the magnetization and the magnetic variations of the length of ferromagnetic metals and alloys, especially nickel-steel, at the temperature of liquid air.—*Phys. Zeit.*, January 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Rectifier.—COOK.—An account of experiments made to find an explanation of the well-known behavior of the aluminium anode. He finds that the apparent resistance of the aluminium anode in potassium aluminium sulphate is not an ohmic resistance, but a resistance of the transition of the ions, primary or secondary. The formation of a film of alumina which is a very poor electric conductor, prevents the anions from reaching the conducting surface and thus discharging. When the electric pressure is greater than its "critical value" the film becomes crystalline in structure and in crystallizing exposes free metallic surfaces to the action of the anions, allowing them to discharge to the metallic surfaces. The value of the critical pressure and also the counter e.m.f depends upon the temperature. The critical electro-motive force for 1° C. is approximately 47 volts, and for 48° only 22 volts. The counter e.m.f. increases with decrease of temperature.—*Phys. Rev.*, January.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Bending of Magnetometer Bars.—CHREE.—A paper on the source of error due to the bending of magnetometer deflection bars. In magnetometer measurements, the deflecting magnet is carried by the deflection bar at an appreciable height above the centre of gravity of the cross-section, and then bending of the bar when in use, under its own weight and that of the magnet with its carriage, results in an increase of the distance between the deflecting and the deflected magnets. To keep the instrument properly level, there ought to be a counterpoise on the other arm of the deflection bar at the same distance as the deflecting magnet from the centre. In the absence of such a counterpoise, supposing the instrument originally level, the weight of the magnet and carriage causes a slight tilting. In consequence of this the point of suspension of the deflected magnet moves toward the deflecting magnet, thus reducing the horizontal distance between them.—From *Phil. Mag.*, January, abstracted in Lond. *Elec.*, January 22.

Carbon Resistance.—GRAY.—Longden has formerly shown how to make a fairly satisfactory high resistance by depositing soot on a plate of glass whose ends had previously been silvered with a wedge-shaped film. The present author substitutes a tube of glass for the plate. The ends after being silvered are wrapped with a ribbon of stout tin-foil, which is firmly bound on with copper wire so as to make good contact with the silver. Then the soot is deposited between the ends. The resistance tube is mounted on a block of paraffine and for the connections mercury cups are used.—*Phys. Rev.*, January.

Oscillator with Adjustable Capacity.—CASTELLI.—A description of an oscillator in which various systems of electric oscillations can be produced and their wave lengths can be varied continuously within wide limits. The primary and secondary plates consist of sheets of tin-foil suspended by pulleys and counterpoised so that they are at equilibrium at any level. They can also be slid forward or backward so that their distance apart and the amount of surface in direct opposition can be varied at will. In the course of his measurements with this oscillator, the author made an observation which he believes to be new. If a vacuum tube is used for discovering the nodes, and is gradually shifted beyond the node, it remains alight even in places where it would not light up if it approached it from the outside . The author compares this result with the fact that the distance between the carbons in an electric arc can be increased while the arc is playing to lengths at which an arc cannot be ordinarily formed.—From *Nuovo Cimento.*, July, August, abstracted in Lond. *Elec.*, January 22.

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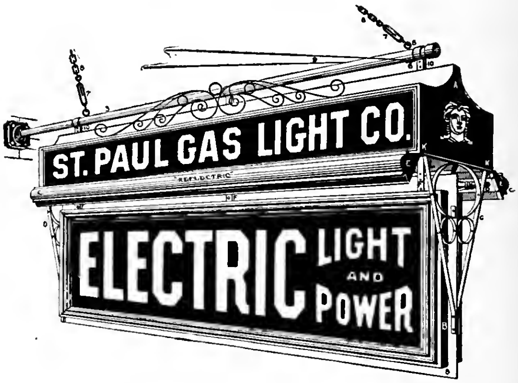
Magnetic Tests of Whole Sheets of Iron.—A fully illustrated description of the method of Richter, used by the Siemens & Halske Company for testing magnetic properties of iron sheets as a whole. The method has been noticed before in the Digest.—Lond. *Eng'ing*, January 29.

Electric Signs.

In giving a real brilliancy to frequented streets at night, the electric sign performs a service to the public, entirely aside from its utilitarian object, though in too many cases appreciation is blunted by inartistic forms and amateur construction, the full effect of which stands out clearly in the daytime. It is only recently that electric sign making has become an art, and before long we may expect to see the amateur sign maker wholly retired from the field. The accompanying illustration of a type of electric sign made by the Western Display Company, of St. Paul, Minn., shows what may be accomplished by inventive skill and making the most of the flexibility of the electric light, together with proper attention as to all mechanical details.

Instead of the ungainly box originating in the day when candles



ELECTRIC SIGN.

were the source of the illumination, the sign proper consists of two enameled plates on either side of a supporting metal frame. This construction, together with the enlarged top portion and the method of mounting produces an artistic effect recalling the pleasing signs of Old Paris. As will be noted, the lamps are mounted in a reflector from which the light is thrown with great brilliancy on the main display panels.

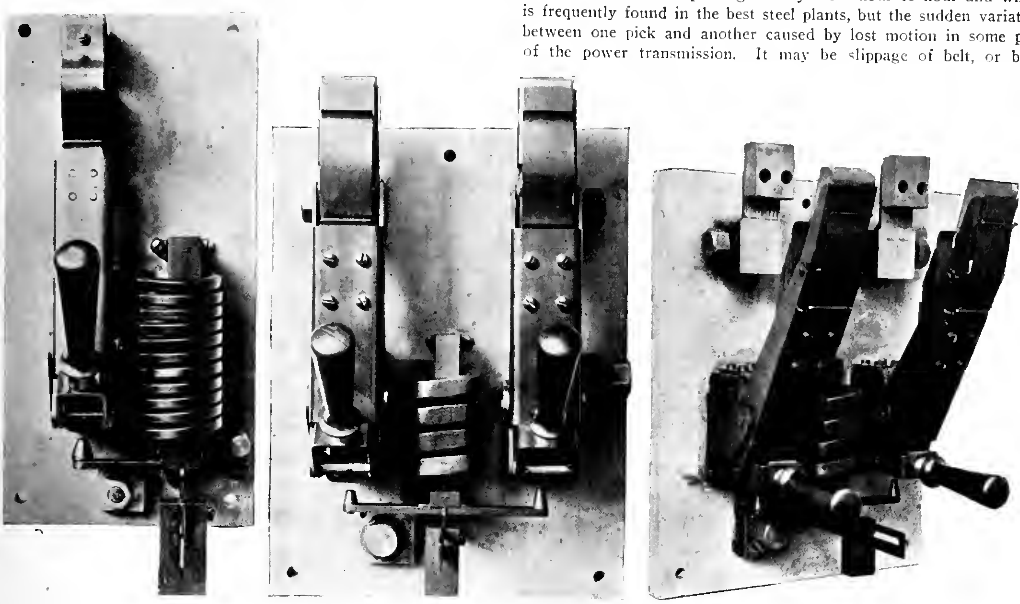
Above the main panels, which are of porcelain, is a glass panel on each side with white frosted transparent letters on a colored background, illuminated by transmitted light. The panels are interchangeable and can be removed without taking down the sign or disconnecting any wires. The wires for the electric lamps are encased in an iron channel and thoroughly protected from the weather. Both the transparent panel and the complete sign are free to swing.

New Type of Carbon Break Circuit-Breaker.

The constantly growing demand for a high-grade automatic circuit-breaker to be sold at a popular price has led to a still further development of existing types by the Westinghouse Electric & Manufacturing Company, resulting in a new type (Type D) which we illustrate herewith. In this device the current is shunted to carbon arcing tips and there ruptured as in the original type of Westinghouse circuit-breaker. The single break is used and the construction is such as to gain the highest degree of efficiency from these and the other features employed.

The circuit-breaker is designed for use upon circuits not exceeding 250 volts, and its distinguishing feature is the simplicity of construction. As will be noted from the illustrations, there is no complicated or hidden mechanism, the entire device being open to inspection. It is small and compact, and thus occupies but little space. There are but few parts, and the most of these are made from punchings, combining strength, lightness and smoothly finished surfaces at a cost which enables the makers to adopt popular prices. There are no springs to get out of order, the only thing of this kind being the flat strip which carries the carbon arcing tip and which also serves to throw back the movable arm when the breaker is opened. All screws are locked and the adjustments are few and permanent.

The movable contact is a laminated brush made from leaf copper and protected by a copper shunt, and so arranged that when the



Figs. 1, 2 and 3.—Carbon-break Circuit-breaker.

breaker is opened the current is shunted to the carbons above. The arc occurs when the final break is made on the carbons, the construction of the contacts aiding the natural tendency of the arc to rise and preventing it from being communicated to the other live parts. Flexible braided leads carry the current from the movable contact brush to the terminal, thus reducing the number of movable current-carrying contacts to a minimum. The temperature rise of the contacts is, in consequence, never over 20° C. with a normal current.

The breaking mechanism is simple. The current passes through a coil through which is thrust one pole of a laminated iron horseshoe electromagnet. The armature is attached to the other pole of the magnet, and is so placed that a current sufficiently strong will draw up the free end of the armature, a movable counterpoise serving to vary the amount of current required. When the armature is drawn up contact points attached to it strike the toggle joints which hold the breaker closed and the circuit is opened. If desired, it can be opened by hand at any time, in the same manner as an ordinary switch.

The circuit-breaker is made with one, two, three or four poles, thus covering all the requirements for alternating-current and direct-current circuits. The single-pole breaker is particularly adapted for use upon motor or lighting circuits when a switch is used in series to complete the circuit after the breaker has been closed. In the two-pole breaker the two poles are closed independently. A switch to complete the circuit is not necessary, as the tripping mechanism is so designed that a short-circuit or an overload will cause the first pole closed to open immediately upon closing the other. This feature combines the functions of two devices at practically the cost of one with added convenience and saving of space.

The three-pole circuit-breaker for use upon three-wire direct current or three-phase alternating-current circuits, and the four-pole circuit-breaker for two-phase alternating-current circuit, are both so arranged that the poles are closed at the same time by the same handle and tripped simultaneously, either by hand or by tripping coils.

As regularly made, the circuit-breaker has front connections, as shown, but when desired for switchboard mounting a threaded copper stud for rear connections is substituted. It is neatly finished in black oxide and presents an attractive appearance.

Motors for a Silk Factory.

Every manufacturer of textiles knows the importance of constant speed in weaving. By this is not meant the slight variation in speed which takes place gradually from hour to hour and which is frequently found in the best steel plants, but the sudden variation between one pick and another caused by lost motion in some part of the power transmission. It may be slippage of belt, or back lash of counters, or many things combined; but the primary cause is that the machine using the power is so far away from its source, thus making its transmission necessary through many belts and counter shafts. In many cases the trouble is so bad that it almost

Fig. 1.—Electrically-operated Silk Loom.

prohibits the making of light weight goods. Many things are tried to overcome the trouble, and journals are tightened up until the loom will barely run, or speed is reduced, or more picks are put in. Any one of the three may partly correct the evil, but any one of them only adds to the cost of production. This is one reason why looms, especially those utilized in the manufacture of silk, both in broad goods and ribbon, are not driven at their maximum speed. Silk calls for the most extreme regularity of texture. Whatever the quality of the goods, the beauty of the finished piece depends greatly on its evenness. To get this regularity, speed and production are sacrificed, because there is a limit at which a belt-driven loom can be run and make even work. If the limit is exceeded the momentum of the backward and forward motion of the lay is increased. The fly-wheel loses the control it has at a slow speed, and the blow of the lay becomes uneven, because the accelerated motion of the loom has also increased many fold whatever lost motion was in it before and "shirry" cloth is the result. In order to keep up the speed the plan is to put in more picks and so offer a better resisting medium to the blow of the lay, thus overcoming in a measure the defects. But this is wasteful. If we have a loom belted to the main shaft a higher speed can be obtained and better goods can be turned out than when the power is taken through many counter belts and shafts. All looms cannot be belted to main shafts, or, in other words, the power cannot be taken direct from its source, that is, from the engine to the loom. It cannot be done by belts, but it can be done by means of individual motors which seems especially adapted to the weaving of silks from the lightest to the heaviest fabrics. It might be thought too delicate a piece of mechanism to do the work; that the sudden jar caused by the banging off of the loom might wreck the motor; but it stands the strain under the severest tests even when geared up without the interposition of huffer springs.

As to gearing a motor direct to a loom: Some advocates of a belt connection between motor and loom say that it is necessary to act in a manner as an absorbent of the momentum, so that when the loom stops suddenly the elasticity of the belt and the slippage of the pulley inside it will prevent any jar to the motor. Others who favor belt connection are the makers of motors, who wish to connect the motor up without trouble. It is claimed that is one reason why so many failures have been made in electrically driven looms. Instead of an electrician looking into the matter and adapting his motor to textile requirements, he insists on putting in a motor which, however well adapted it may be to run a fan, sewing machine or lathe, is not suitable to put on a loom. The mechanical electrical requirements of a motor for a broad silk loom are many. First it must be made to gear into the loom by means of a steel pinion. Then the motor must stop when the loom is stopped. The motor stops the loom in the same way that the motor starts it—by throwing the current on or off—with no secondary motion by throwing out or in a clutch and then the current. Another thing necessary is that the motor starts at full speed instantly, for where a loom holds a flying shuttle, it is absolutely necessary to start at full speed in order to drive the shuttle across and into the box with just the right force and it will not do to have it start too quickly and consequently give too much force to the blow of the picking stick.

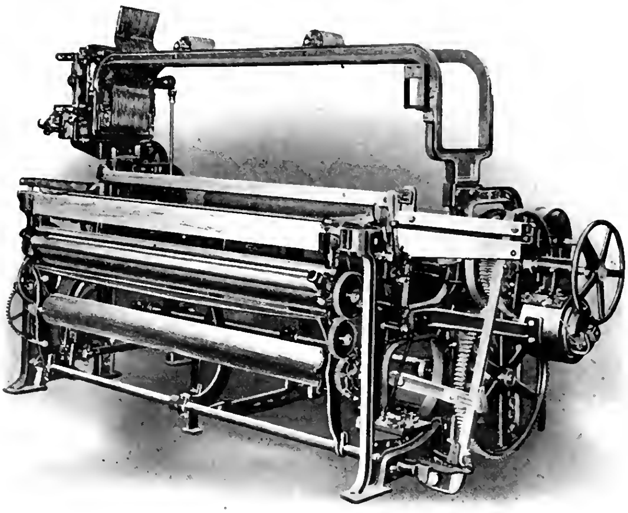


FIG. 2.—ELECTRICALLY-OPERATED SILK LOOM.

It is a great advantage also to have three speeds to a motor—the normal speed at which the loom is built to run, and say 12½ per cent. over and under. The motor should be light enough not to be cumbersome and yet strong. It should be directly attached to the loom and not to the floor. It should have plenty of reserve force behind it, so as to prevent it from unduly heating up when running, and that it may run equally well at a high or low speed. The higher the speed of course the more poweer is required from the motor and it also requires a reserve power in order to adapt it to the different fabrics woven in the same loom. At one time it may be a light taffeta requiring but very little power, while at other times a heavy brocade is being handled which would task the motor much more.

The silk factory at Andover, N. Y., owned by the Rochambeau Silk Company, has recently been installed throughout with motors directly connected to the looms, warpers and winders. This is the only silk plant in the country that is completely operated by direct-connected motors. The Northern Engineering Company secured the contract. There are 60 motors in all. They are ½-hp standard loom motors built by Roth Brothers & Co., of Chicago, Ill., and direct connected to Crompton-Knowles looms. The generating plant consists of a 50-hp Nash gas engine, vertical self-contained three-cylinder enclosed type, direct-connected to a 30-kw, 110-volt, 250-r.p.m. generator, built by the Commercial Electric Company of Indianapolis, Ind.

Nernst Lamp Company's Training School.

The Nernst Lamp Company will henceforth adopt the policy of establishing district offices in the larger cities of the United States and will deal directly with its trade through these branch offices, thereby resulting in a closer relationship between the manufacturer and the user. Each district office will carry a complete stock of the company's product and be in a position to give prompt attention to all orders received from its territory.

In carrying out these plans, the company finds it necessary to increase its selling force and will soon add to its staff a number of additional salesmen.

To increase the efficiency of its representative and other employees of the sales department, the Nernst Lamp Company have organized an "apprenticeship course" embracing a period of six weeks' time, during which time the apprentice will receive a nominal salary amply sufficient to pay all necessary personal expenses. The first two weeks will constitute a probationary period and will be spent in the nearest office of the company to which application is made, under the supervision of the district manager. While here the apprentice will have the opportunity of noting the methods employed by his tutor and assisting the latter in the discharge of his field and office duties. The remainder of the course will be given in the company's factory at Pittsburg, the third and fourth weeks being devoted to a detailed study of the mechanical and electrical features of the Nernst lamp, and the proper conditions and methods involved in its installation. This portion of the course will be concluded with a written examination on the work thus far encompassed. The fifth and sixth weeks will be spent in the study of maintenance and sales department systems and in practical work, in the maintenance and repairing of lamps, in the preparation of lighting plans, estimates, etc., and in actual soliciting under the tutelage of an experienced salesman.

Having completed the regular course to the satisfaction of his employers, the apprentice will be given a certificate to that effect and sent either to one of the branch offices where he will at once assume the duties of salesman or maintenance man under the supervision of the district sales manager, or to the Nernst lamp department of one of the company's central station customers. It is expected that the central station trade will constitute the bulk of the future business of the Nernst Lamp Company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was unfavorably affected by the hostilities in the East, the Baltimore fire and fears of extensive liquidation of securities by insurance companies. There was little public interest of a sepculative character and professional operators were bearish. One of the features of the market was the sustained strength shown by the United States Steel issues, which tended to advance in the face of the early weakness and held fairly well during the later depression, seeming to be the objects of a certain amount of short covering and of fresh accumulation. A good deal was heard regarding the probability that large contracts would be placed for the steel structural material required by Baltimore, and it was also claimed that the corporation will display large export sales this month, and that a readjustment of steel rail prices will be satisfactorily arranged with the railroads. There was some manipulative activity in Brooklyn Rapid Transit and other issues, but they did not attract any general attention. The curb market was heavy throughout the week with evident efforts by insiders of various corporations to realize on their holdings. Greene Copper sagged in connection with the new stock issue so that the rights became of slight value. The market for electric and traction stocks was in the main weak, closing at lower prices. American Telephone and Telegraph ruled at 123, closing at that figure, which was a net loss of 3 points. Western Union lost ⅝ point, closing at 87⅛. Brooklyn Rapid Transit was the exception and made a net gain of 2⅜ points, closing at 42¾ after having reached 43½. Metropolitan Street Railway fluctuated between 115 and 118, closing at 117½. General Electric lost 4 points on the week's business, closing at 166, after having reached 169. The closing figure was but one point above the lowest of the week. Westinghouse common closed at 160¼. Following are the closing quotations of February 16:

NEW YORK.

	Feb. 9	Feb. 16		Feb. 9	Feb. 16
American Tel. & Cable	82	81	General Electric	167	166
American Tel. & Tel	124	120½	Hudson River Tel	..	..
American Dist. Tel	22	22	Metropolitan St. Ry	117¼	118
Brooklyn Bapid Transit	41	43⅝	N. E. Elec. Veh. Trns	..	..
Commercial Cable	183	193	N. Y. & N. J. Tel	..	..
Electric Boat	17	17	Marconi Tel	..	..
Electric Boat pfd	40	42	Western Union Tel	87¼	87⅛
Electric Lead Reduction	1	¾	Westinghouse com	161⅛	160½
Electric Vehicle	9	8⅛	Westinghouse pfd	175	175
Electric Vehicle pfd	13	11½			

BOSTON.

	Feb. 9	Feb. 16		Feb. 9	Feb. 16
American Tel. & Tel	124	120¾	Western Tel. & Tel. pfd	81*	80
Cumberland Telephone	114½	114⅛	Mexican Telephone	1¼	1⅛
Edison Elec. Illum	236	232	New England Telephone	120½	119
General Electric	167	165	Mass. Elec. Ry	20½	20⅛
Western Tel. & Tel	10*	9	Mass. Elec. Ry. pfd	77	77

PHILADELPHIA.

	Feb. 9	Feb. 16		Feb. 9	Feb. 16
American Railways	44	..	Phila. Traction	97½	..
Elec. Storage Battery	50	..	Phila. Electric	6	..
Elec. Storage Battery pfd	50	..	Phila. Rapid Trans	13⅞	..
Elec. Co. of America	7⅞	..			

CHICAGO.

	Feb. 9	Feb. 16		Feb. 9	Feb. 16
Central Union Tel	..	..	National Carbon pfd	94	95
Chicago Edison	..	..	Metropolitan Elev. com	17	17
Chicago City Ry	166	162	Union Traction	5	4½
Chicago Tel. Co	..	..	Union Traction pfd	29	29½
National Carbon	28*	27⅛			

*Asked

EVERETT-MOORE TELEPHONE.—The creditors' claims against the Everett-Moore Telephone properties represented in the companies controlled by the Federal Telephone Company amount to about $3,500,000. Recently these creditors agreed to an eighteen months' extension of credit. It is stated that in the meantime these obligations are being funded, creditors being asked to take collateral trust bonds of the telephone properties. It is thought that this collateral will be marketable at the expiration of the period at a figure that will cancel all obligations. The bankers' committee still has charge of all Everett-Moore affairs, which are in the hands of an executive sub-committee. It seems improbable that the bankers' committee will be relieved short of the time stated. The Everett-Moore security holdings are all held by the bankers' committee, or rather subject to their order, as nearly all of it is hypothecated for loans in local banks. In the present state of the security market, the holdings would liquidate at a price that would leave the syndicate bankrupt, probably to the amount of the telephone indebtedness. Under favorable monetary conditions the syndicate could probably wind up within a year and come out a little ahead, but the bankers' syndicate has done so well that there is little likelihood of sacrificing values in order to make a clean-up. The expectation is that within a reasonable time all obligations will be so funded on the basis of marketable securities, so that in time the syndicate holdings will be released largely intact and representative of a handsome equity.

NEW YORK INTERBOROUGH.—The Interborough Rapid Transit statement covering operations of the Manhattan elevated lines for the quarter ending December 31, shows the best results in Manhattan's history. As compared with the corresponding period in 1902, the following increases are shown: Gross earnings increased 13.9 per cent.; net earnings increased 21.8 per cent., and surplus after charges increased 65.5 per cent. The item of charges which includes, besides interest and taxes, the dividend on Manhattan stock appears to have been swelled to some extent by the inclusion of certain sums in connection with the adjustment of some tax claims, but for the settlement of which the final surplus might have been somewhat larger. It is understood that the statement presented might have been made to look much more favorable were it not considered good policy to foster a very conservative view as to the real earning capacity of the property. A less "conservative" statement might have the effect of renewing the labor agitation which broke out among the company's employes more than once last year. The gross for the quarter was $3,657,709 and the the net was $2,261,314. The gross for the nine months was $9,868,249 and the net was $5,862,144.

COMMERCIAL CABLE STOCK.—Note is made of the recent advance in Commercial Cable. Business has been good, and the war makes it better by the demand for news. The Postal Company, owned by the Commercial, has just completed 550 miles of line between Omaha and Denver, giving it a third route a large portion of the way across the continent to handle the increase in business caused by the extension of the cable from Honolulu to Manila, which affords connection with China, Japan and the Far East. Upon the completion of this cable July 4 last, the rate from China and Japan was reduced from $2 to $1.12 per word from New York, and the press rate from $1 to 50c. per word. As a result of war this cable service will be employed largely by the press of the United States and Great Britain, as better time can be made this way across America for England, than by the Suez Canal.

BELL TELEPHONE REQUIREMENTS.—A leading Boston interest in the American Telephone and Telegraph Company says: "The American Telephone and Telegraph Company will this year need $20,000,000, but it may not need this money until the fall, although the company generally raises its money in July. It may be that the company will this year issue convertible 5 per cent. bonds, although the president recently informed me that this subject had never been given consideration. It may be considered better policy for the American Company to become a borrower of money this year than issue new securities if market conditions are not better next summer, than at present. The American Telephone and Telegraph Company may use a portion of a new capital issue this year for the acquirements of certain independent companies which it can secure at an equitable price." The statement comes from Boston that it is the intention of the American Telephone and Telegraph Company directors to issue some time within the next four or five months $15,000,000 in bonds. President Fish is now in California and is expected to return about April 1. After that the matter will probably be taken up for consideration. Nothing has been determined upon as to the rate of interest the bonds will carry. That matter will be decided probably by the money market. Some talk has been heard regarding convertible bonds, but nothing beyond the fact that $15,000,000 will be needed has as yet been determined upon.

WISCONSIN CONSOLIDATION.—The Construction Company of North America, of New York, has secured control of one of the most important interurban railways in Wisconsin. The company has been building the interurban line from Sheboygan to Plymouth, and the new power house of the Sheboygan Light, Power, and Railway Company, and with the securing of control will come the transfer to the New Yorkers of the local electric system as well. The properties are worth about $1,000,000, but the importance of the deal is in the fact that this road will be the vital link in the proposed line from Fond du Lac to Kaukauna, forty-five miles in length.

CAPITAL TRACTION CO., of Washington, D. C., reports gross of $1,413,312 for 1903, and net $822,374; charges and taxes, $114,187, dividends, $600,000. After various provisions for construction, equipment, etc., the surplus December 31 was $31,678.

DIVIDEND.—The Kings County Electric Light, Heat and Power Company has declared the regular quarterly dividend of 2 per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—A summary of trade reports from the various sections of the country shows that temporary irregularities exist, due largely to the continued cold weather. The Baltimore fire and the war in the East have also affected trade more or less. In the West the cold weather checks spring trade expansion, but in the leading Eastern markets there is some activity. In the South distribution continues active. The great fire in Baltimore and the hostilities between Russia and Japan have affected the speculative markets to some extent, and the strength of prices in many commodities is attributed to the latter development. Conservatism in industrial operations is the rule. Money is easy and the banking situation is a very strong one as regards supplies of liquid capital, but currency has ceased to flow from the country, and with enlargement of activities in all lines a firmer market is looked for. Railway operations are showing decreased gross earnings, due to the severe weather of January, following reduced net earnings in December. Building operations in Baltimore will naturally develop a large inquiry for structural and building material. Country buyers are increasing in number at Chicago, St. Louis and Kansas City, and reports from these centers indicate that a good spring trade is anticipated. In the Northwest dullness prevails owing to the cold weather, but a fair business is being booked. In the Duluth district, lumber mill operations are active. Trade is improving on the Pacific Coast, with special activity in war supplies. The iron trade is irregular, but the railroads have begun to buy. Other metals are dull. Copper was further reduced in price, and the market was very weak. The official quotations of the Metal Exchange were marked down another ⅛c., the closing figures being 12¼ to 12½c. for Lake; 12⅛ to 12⅜c. for electrolytic, and 12 to 12¼c. for casting stock. The London market is also down. *Bradstreet's* reports 202 business failures for the five days ending Feb. 22, against 216 the week previous and 217 the corresponding week last year.

NEW TELEPHONE SYSTEM FOR MEXICO CITY.—The construction of an extensive up-to-date Yankee telephone system is contemplated in Mexico City. S. G. McMeen, a Chicago telephone expert, is now in the capital of the Southern republic making a study of the field and mapping the results as a final preliminary to the digging of the trenches and the laying of the conduit and cable. The cables in the underground section of the city will be laid in terra cotta conduit at a depth of about three feet from the surface. At distances of every 500 feet, manholes will be placed so as to facilitate repairs to the cables. The weight of the cables will be about six pounds per running foot. A new central station will be constructed. The visual signal system will be employed. Plans and specifications are now in process of being drawn up, and it is expected that contracts will be awarded within the next few weeks.

THE INTERNATIONAL TELEPHONE MFG. CO. of Chicago recently closed a contract with the Kansas Telephone and Electric Company of Parsons, Kan., for a complete new central office equipment consisting of a 1,000-capacity, 600-equipped, mechanical self-restoring dropboard and protective devices, also 200 International telephones. The board is the International Company's latest design and is equipped with flash light transfers, pilot lamps in connection with both the line and clearing-out signals, and is thoroughly up-to-date in every respect. The International Company states that during the past 90 days it has secured orders for switchboards aggregating over 6,000 drops equipped, and has recently found it necessary to increase its capacity to take care of the growing demand for its product.

JANUARY FOREIGN TRADE.—The statement of international trade for January showed a large balance in favor of the United States. This was expected in view of the high prices for cotton and breadstuffs in connection with the tendency for imports to decrease. The balance of trade in favor of the United States in January was $59,044,000, being $10,226,000 in excess of January, 1903, and $9,038,000 in excess of 1902. The imports of merchandise in January decreased $2,505,000 as compared with January, 1903. For the seven months ended January 31 the balance of trade in our favor amounts to $363,399,000, being $104,932,225 over the same period in 1903, and $16,747,000 over the corresponding period in 1902.

ACQUIRES SULZER PUMP PATENTS.—The International Steam Pump Company recently acquired the rights to manufacture the high-lift centrifugal pumps constructed by Sulzer Brothers, of Winterthur, Switzerland. After considerable experimental work, the company has produced a pump which is claimed to be so far an improvement over the ordinary centrifugal pump that heads up to 2,000 feet may be overcome with high efficiency. These pumps will be manufactured on an extensive scale at the new Worthington Works at Harrison, N. J. Numerous contracts have already been secured for equipments to be operated by motors.

ELECTRIC TRACTION FOR VERA CRUZ.—The construction of an extensive electric traction system in Vera Cruz, Mexico, is projected. The present horse tramways in that part of the world are about 11 miles long. They are controlled by the British contracting firm of S. Pearson & Son, who have large harbor and railroad construction contracts in hand in various parts of the republic. Sir Weetman D. Pearson is president of the Vera Cruz Company. In addition to converting the existing lines to electric motive power, it is proposed to extend the system considerably.

BLOCK SIGNALS FOR MISSOURI PACIFIC.—The Missouri Pacific Railroad has contracted with the Union Switch and Signal Company for the installation of an electrical automatic block system on all its main line tracks. Work will be begun at once on the 283 miles between Kansas City and St. Louis. Signals will also be put in on the first 165 miles of track on the Iron Mountain Road out of St. Louis, and on the line between St. Louis and Poplar Bluff by May 1. The system will then be gradually extended to the other lines of the Missouri Pacific.

EQUIPMENT FOR RAILROAD SHOPS.—The firm of Mackenzie, Quarrier & Ferguson, Engineering Building, New York, has secured a contract from the Australian General Electric Company—which is the Antipodean branch of the General Electric Company—for a 150-hp Harrisburg standard simple engine; also an 80-hp one. Both engines are to be belted to General Electric generators of 85-kw and 50-kw capacity each. The equipment, it is understood, will be installed in New South Wales government railroad shops.

NILES CRANES FOR BALDT STEEL PLANT.—The Baldt Steel Company, which is constructing a large plant at Newcastle, Del., to be equipped with considerable electrical machinery, has awarded a contract to the Niles-Bement-Pond Company, 136 Liberty Street, New York, for the electric overhead traveling cranes to be installed. There will be five equipments, varying in capacity from 10 tons to 30 tons. Jeremiah J. Kennedy, 52 Broadway, New York, is acting as consulting engineer to the Baldt Company.

ALBERGER CONDENSER FOR WESTERN PLANTS.—The Alberger Condenser Company, White Building, New York, has just taken two substantial Western contracts for its specialties. The Economy Light and Power Company, of Joliet, Ill., have ordered a high-vacuum condensing equipment. A similar equipment, also a cooling tower, is to be installed in the plant of the United Gas and Electric Company, of New Albany, Ind.

LIGHTING A PASSENGER STEAMER.—The large passenger steamer, the "City of Buffalo," is now being lengthened at the Detroit Ship Building Co., Detroit, Mich., and an increase in the electric light plant is being made by the addition of a 90-hp direct-connected unit. The Western Electric Co., Chicago, will furnish the generator, and the Ball Engine Co., Erie, Pa., the engine.

SALE OF SECOND-HAND ENGINES.—The engines of the Eightieth Street power station of the New York Edison Company have been sold to the Whitehead Machinery Company of Davenport, Ia. The equipment consists of two 300-hp simple condensing and four 900-hp tandem compound condensing Hamilton Corliss engines.

EDISON'S STORAGE BATTERY IN ENGLAND.—Thomas A. Edison's new storage battery is to be placed on the British market. A strong syndicate, headed by Sir Ernest Cassel, and in which H. F. Parshall, the well-known American electrical expert, is interested, will float a company for the purpose of acquiring the British rights.

LEFFEL WHEELS FOR 3,000-HP PLOW-MAKING PLANT.—The Oliver Chilled Plow Company is to install a large electrical equipment for the purpose of operating its plant at South Bend, Ind. About 3,000 hp will be developed by means of water. James Leffel & Co. secured the contract for the wheels.

EQUIPMENT FOR MEXICAN PAINT FACTORY.—Extensive paint and color works located at Irapuato, Mexico, are to be entirely operated by electricity. Steam power is employed at present. Ricardo A. Barkley is the proprietor of the works.

EQUIPMENT FOR MEXICAN FLOUR MILLS.—Large flour mills located at Irapuato, and owned by F. J. Randall, of that Mexican city, are to be electrically operated throughout, and contracts will be awarded for the necessary equipment.

PLUMBAGO IMPORTATIONS.—Figures from McCullough-Dalzell Crucible Company show importations into the United States from Ceylon in 1903, of 44,013 barrels of plumbago in lump, chip, dust, etc.

General News.

THE TELEPHONE.

CONWAY, ARK.—The Conway Telephone Company has been chartered, with a capital stock of $10,000. L. H. Pyle is president; F. E. Perminter, vice-president, and Gussie E. Pyle, secretary and treasurer.

LOS ANGELES, CAL.—The Home Telephone Company is considering the advisability of advancing its commercial rate from $4 to $5 a month.

SAN DIEGO, CAL.—The Home Telephone Company has paid $300 for a franchise to operate in this city. A plant costing at least $120,000 is promised. Long distance communication with outside cities has been arranged through the United States Telegraph & Telephone Company.

LOS ANGELES, CAL.—The stockholders of the Pomona Valley Mutual Telegraph & Telephone Company have voted a $20,000 bond issue, bearing 6 per cent. interest. The money thus raised is being used for construction purposes. The company has contracts for 500 telephones, 400 of which have been installed.

HARRISON, IDA.—The Interstate Telephone Company is installing many telephones here, in active competition with the Bell Company.

HARRISONVILLE, ILL.—The Harrisonville Telephone Company has increased its capital from $20,000 to $30,000.

KNIGHTSTOWN, IND.—About 125 representatives of independent telephone systems met at New Castle and perfected a permanent organization by electing O. H. Garriott, of Cadiz, president.

INDIANAPOLIS, IND.—The Cynthianne Telephone Company has filed articles of incorporation. The capital stock is $3000. John T. Arnett, U. C. Canada and Floyd Whitsel are the incorporators. The principal office will be in Cynthianne.

VELPEN, IND.—The Velpen Home Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $5000. The company will build and operate in Pike and Dubois counties with principal exchange and office in Velpen. L. R. Bradwell, W. S. Risley, A. S. Morgan and others are the incorporators.

SHELBYVILLE, IND.—The Mutual Telephone Company is establishing a rural exchange in Sugar Creek Township, another in Van Buren township and a third system in the neighborhood of London and Boggstown. In addition to connecting up these rural lines the company expects to erect a line west on the Marietta pike connecting a number of residences.

CUMBERLAND, IND.—The Cumberland Telephone Company, of this city, is preparing to make important and extensive improvements. The concern was organized over a year ago, with a capitalization of $10,000. The officers are: William Gale, president; F. W. Weise, secretary. A new exchange will be built in Cumberland, and considerable money will be expended in extending the lines to supply the large demand for service.

NEW CASTLE, IND.—The officials of the 14 independent telephone companies in Henry County held a meeting on February 1, and effected an organization for the purpose of co-operation, the exchange of service, mutual benefit, to encourage the extension of lines and to unite in an effort to fight competition introduced by the Central Union people. Dr. Garrett, of Cadiz, was made president, and George Watts, of Knightstown, secretary.

WABASH, IND.—The Central Union Telephone Company, which has been operating here without a franchise for the past four months, has made formal application for a franchise. The council directed the city clerk to notify the company that unless the officials sign and accept the franchise offered to the company some time ago, the city authorities would begin the removal of all poles and wires in the streets and alleys. It is generally believed that the company will accept the franchise as it stands.

SHELBYVILLE, IND.—The Central Union Telephone Company has perfected plans for the rebuilding of all its outside construction and installing a new switchboard. The new switchboard equipment will be of the central energy type of the Western Electric Company. It is the purpose of the management to extend the use of the telephone to every town, no matter how small, throughout the entire Shelby County, and at all places to put telephones in at the most reasonable rates consistent with good service.

RICHMOND, IND.—The annual meeting of the Richmond Home Telephone Company was held February 2, and the following persons elected directors: E. H. Cates, Samuel Dickenson, J. W. Moore, J. M. Lontz, A. C. Lindemuth, L. M. Flesh and W. P. Orr. The present officers were re-elected, including A. C. Lindemuth as president. The company has enjoyed a remarkably prosperous year. Four hundred and nine new telephones were installed during the year, making the total present number 1971. It is expected that the 2000 mark will be reached soon.

AUGUSTA, ME.—The Plymouth Telephone Company has been organized at Plymouth, with a capital stock of $10,000. The officers are: President, A. O. Ward, of Plymouth; treasurer, W. G. Loud, of Plymouth.

WAVERLY, MINN.—The Wright County Telephone Company has been incorporated with a capital stock of $50,000. The directors are G. W. Jennings, C. E. Wright and others.

MEXICO, MO.—A meeting of telephone managers will be held to devise a plan to have all of the lines in Audrain County meet at a central point, probably in this city. J. N. Rosser, of Rush Hill, president of a company forming for the construction of a line from this city to Laddonia, is the promoter of the project.

MIDDLETOWN, N. Y.—The new officers of the Orange & Sussex Independent Telephone Company recently elected are as follows: President, George G. Otis, of Newburgh; vice-president, George F. Ketcham, of Warwick; secretary, M. C. Tuthill, of Washingtonville; treasurer, W. D. Haggerty, of Sussex.

OSWEGO, N. Y.—The City Council has granted a franchise to the Empire State Telephone & Telegraph Company to construct a subway for its wires and cables in West Bridge Street and West Second Street of this city.

LIBERTY CENTER, OHIO.—The Farmers' Mutual Telephone Company has been organized, with A. C. Clinton, president. The company will build a farmers' system.

CRESTLINE, OHIO.—The Bell Telephone Company is making an effort to secure a new franchise in Crestline. Some years ago it secured a franchise, but did not build.

NORWOOD, OHIO.—The Norwood Citizens' Telephone Company has applied for a franchise and will probably secure the grant. At present the Bell Company holds the field.

WESTON, OHIO.—The Weston Telephone Company has elected S. A. Murphy, president: G. B. Spencer, treasurer. The company reports a good gain during the past year.

URBANA, OHIO.—The United States Telephone Company has completed a line between Urbana and Springfield, and the Urbana Telephone Company is now giving long distance connection with all points south of the city.

MT. PLEASANT, OHIO.—The Mt. Pleasant Telephone Company, capital stock $5000, has been incorporated by J. M. Bennett, J. A. McGlenn, Michael Gallagher, C. P. McMillan and E. B. Jones. An exchange will be built at Mt. Pleasant.

PAINESVILLE, OHIO.—The Painesville Telephone Company has elected F. A. Searl, president; W. R. Radcliff, treasurer, and C. M. Grauel, secretary and manager. The company made a good gain during the year, and has recently installed a new switchboard.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has elected Frank Hart, president; J. W. Shoneher, secretary; F. W. Whitaker, treasurer, and A. B. Crawford, general manager. The company has about 1500 telephones in operation and is making rapid gains.

BRYAN, OHIO.—O. L. Spanger has been appointed general manager of the Bryan Consolidated Telephone Company, which has recently absorbed the Williams County Toll Line Company and the Bryan Telephone Company. The company is planning numerous extensions this year.

CANTON, OHIO.—The Stark County Telephone Company has elected F. S. Dickson, president; R. W. Judd, treasurer, and A. S. Hillhouse, secretary and general manager. The company is planning to extend its lines throughout the county, and will install several exchanges in small towns.

CONNEAUT, OHIO.—E. S. Barber and J. S. Brailey, of Wauseon, who built the Conneaut Telephone Company's system, have retired from the management of that company, and J. G. Palmer has been appointed manager. The company now has 676 telephones, an increase of 24 during the year. It will make improvements this year.

BELLEVUE, OHIO.—The Local Telephone Company has elected C. R. Callaghan, president and general manager; Frank Knapp, secretary, and J. H. Beatty, treasurer. The company owns exchanges in Bellevue, Norwalk, Chicago Junction, Berlin Heights, Greenwich, Monroeville, Plymouth, Milan, New London and Attica, and has over 200 miles of toll lines. It has 2300 telephones in service, and with improvements planned for it is expected the number will soon reach 3000.

CINCINNATI, OHIO.—The City Council has refused the various applications for independent franchises in the city, and all the applicants have applied to the probate court under the law which provides that companies may appeal to the probate court in case the application has been refused by the Council. The four competing independent companies are the Queen City Telephone Company, the Fitzsimmons Telephone Company, the Interstate Telephone Company and the Cincinnati Telephone Company.

COLUMBUS, OHIO.—Several bills of interest to telephone people have been introduced in the Ohio Legislature. Representative Ely, of Ashland County, has a bill to compel rival telephone companies to make concessions so that subscribers on one line may talk to subscribers on the other line on payment of a fixed toll. The bill provides that the connection must be made by the company desiring the connection. Representative Judy, of Darke County, has a bill limiting telephone rentals in all cities to $6 per month for business telephones and $3 per month for residences. This applies to old as well as new companies.

SCRANTON, PA.—The Pennsylvania Telephone Company is improving its service in this city and will expend $200,000 in the work. The improvements will include the installation of a new switchboard.

HUNTINGTON, W. VA.—The Bell interests have obtained control of the Ohio Valley Telephone Company, which has lines extending from Huntington to Pomeroy, Ohio.

BARABOO, WIS.—The Baraboo Telephone Company has amended its articles of incorporation in order to increase its capital stock from $30,000 to $50,000.

LARAMIE, WYO.—The Rambler Telephone Company will build a line from this city a distance of 18 miles to Tie Siding, where the line will be connected with an extension of a telephone line from Fort Collins, thus giving communication with northern Colorado towns.

OTTAWA, ONT.—Mr. Frank J. Leonard, general manager of the Canadian Telephone and Telegraph Company has written to the city clerk of Toronto, Ont., that his company is ready to do business with the city on the following basis: "Business telephones at a yearly rental of $36, residences at $24. We will pay to the city for competitive franchise the same fee that the Bell Telephone Company has been paying for exclusive privileges. We will build a conduit system through the principal streets of Toronto, as may be required by city ordinance, or, in case the city would build its own conduit system, we agree to lease ducts in said system, sufficient for our business at such rental as may hereafter be decided upon."

Electric Light and Power.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation, which maintains 820 miles of high-potential transmission lines and branches, exclusive of distributing systems in cities, lost only three insulators during the first 37 days of 1904. Locke insulators are used largely, and 40,000 volts is carried.

SAN FRANCISCO, CAL.—The Northern California Power Company will soon erect a three-story brick and stone building in Redding, Cal., for a general headquarters for the company, which operates about 100 miles of electric transmission lines. Supplies will be carried, and an electric repair shop will be located in the basement.

SANTA ROSA, CAL.—A committee of the City Council of Santa Rosa has received a report from Thomas Merk, of the Engineering Offices. He estimates that it would cost $30,000 to install a municipal plant to generate current for 100 arc lights, using steam from the city water works station. His figure on a plant to supply 6000 incandescent lights was $50,000.

SAN FRANCISCO, CAL.—The Mutual Electric Light & Power Company, of San Francisco, has filed the following report of its business for the year 1903: The total receipts were $115,051.94, including $114,788.20 from light and power. The expenditures were: General expenses, $25,975.23; manufacturing, $58,106.12; distribution $11,202.12; total, $95,283.47. The original cost of the plant is placed at $519,993, but its present value is said to be unknown. The capitalization is $500,000, and 41,000 of the 50,000 shares have been issued. A $400,000 bond issue has been authorized, but the bonds have not yet been sold. The floating debt outside of that portion covered by cash on hand, outstanding accounts and collectible assessments, amounts to $58,447.99. Two 1500-kw three-phase generators, with engines which are to be direct connected, are on the ground and will be installed as soon as arrangements are completed for commencing the new power station.

SAN FRANCISCO, CAL.—The American River Electric Company, of which Mortimer Fleishhacker, of San Francisco, is president, is now supplying the city of Stockton, Cal., with current from its water power electric transmission system. Commercial light and power circuits are included. The first 1500-kw Westinghouse 3-phase generator has been in operation or several weeks, lighting Placerville and operating a 250-hp gold dredge at Jenny Lind. The plant is on the American River near Placerville. A second 1500-kw generating unit is ready for operation, and it is the intention of the company to order a third unit which will probably be installed before the end of this year. The Folsom Development Company's large gold dredge at Folsom, Cal., is now receiving power from the American River Electric Company. The first dredge was recently completed, a second is in course of construction and a third will be commenced soon. It is estimated that ten gold dredges will be in operation in the vicinity of Folsom within a year. The American River Company established a record for rapid electric construction work on the Coast in building this plant and about 100 miles of pole line between May, 1903, and January, 1904.

WASHINGTON, D. C.—The National Light, Heat and Power Company has been incorporated by P. H. Kennedy, H. E. Warren and C. D. Wright; capital, $500,000.

WASHINGTON, D. C.—The Pan-American Electric Light & Power Company has been incorporated with a capital stock of $1,000,000. The incorporators are: Morris Simon, Max R. Raubitschek, William I. Murphy, R. S. Donaldson, E. W. McCormick, S. A. Terry and others.

JEFFERSON, GA.—Judge H. W. Beal and Paul B. Matthews are considering the advisability of establishing an electric light plant and water works.

CHICAGO, ILL.—The Commonwealth Electric Company is stated to have purchased property adjoining its present works; the plant will be enlarged.

CICERO, IND.—The Town Board has taken steps toward the building and installation of an electric light plant.

TIPTON, IND.—It is reported that the municipal electric light plant is to be enlarged.

EAST CHICAGO, IND.—The Indiana Trust Company, receiver, has recommended that the equipment of the East Chicago electric light plant be improved.

FT. WAYNE, IND.—The City Council has adopted the report of the committee on contracts and franchises, recommending the passage of the ordinance granting the Jenney Light and Power Company a franchise.

AURORA, IND.—The City Council has notified the Aurora Gas & Electric Light Company to discontinue lighting the city after March 1, and to remove its poles and wires from the streets within 20 days after the expiration of the contract, March 1.

INDIANAPOLIS, IND.—The Indianapolis Board of Public Works will advertise for bids until February 25, for a 10-year contract for electric lighting of the city. The specifications call for 1600 arc lights of 2000 cp each and 500 incandescents of 50 cp each. G. E. Fisher, representing the Fidelity Construction Company, of Detroit, has surprised the board with a proposition to build a modern municipal lighting plant, to operate it for 10 years, and then sell it to the city at a merely nominal price.

MUSCOGEE, I. T.—The Muscogee light and power plant, ice plant and gas franchise have been sold to a Chicago syndicate. This plant was built and owned by C. W. Turner and was the first electric light plant built in Indian Territory. With the plant goes a gas franchise granted by the city to the company, and an agreement and bond to construct and operate it. The consideration was $125,000. The Chicago company will also build a street car system.

WALNUT, IA.—The City Council has adopted plans for a $14,000 electric light plant.

NEW ORLEANS, LA.—The charter of the New Electric Light Company has been approved by the City Council, and it has been authorized to do business in this city.

WORCESTER, MASS.—It is reported in financial circles in this city that a syndicate of capitalists has been organized to acquire control of the electric lighting and gas business throughout the western part of Worcester County, from Worcester to Palmer.

BENTON HARBOR, MICH.—The City Council has let a contract for lighting the city to the Benton Harbor & St. Joseph Electric Light Company. The company will supply 125 1200-cp arc lights at $47 per annum each, this being a reduction from $70 each.

KOOCHICHING, MINN.—The Village Council is calling for bids to install a municipal electric light plant.

STILLWATER, MINN.—It is reported that the Stillwater Gas and Electric Company will make surveys and plans for a new dam in connection with a power house. The work complete will cost $200,000.

CLINTON, MISS.—The citizens have voted to issue bonds for the construction of water works and an electric light plant.

ST. LOUIS, MO.—The Anheuser-Busch Brewing Association has contracted for two 200-kw turbo-generator units for its plant in this city.

STANBERRY, MO.—The Stanberry Electric Light Company has been incorporated with a capital stock of $25,000, all paid in. The incorporators are: James T. Norman, Alvin C. Frisbie and Thomas D. Hussey.

COLUMBIA, MO.—A special election has been called by the City Council to vote on the proposition to issue bonds for $100,000 for the purchase of the waterworks and the electric light plant belonging to the Columbia Water & Light Company. The plant has been appraised at $67,000 by a board of commissioners, and that amount will be paid for the plant, the remainder being used in installing a system of deep wells.

JERSEY CITY, N. J.—The Monterey Light & Power Company has been incorporated; capital, $500,000. Incorporators: Kenneth K. McLaren, Robert L. Hogust and Roger H. Williams.

JAMESTOWN, N. Y.—The Warren Electric and Manufacturing Company has secured the contract for machinery for the municipal electric light plant for $8000.

MOORESVILLE, N. C.—B. A. Troutman, of Mooresville, is the promoter of a stock company which expects to build an electric light plant in this town.

SALISBURY, N. C.—The Salisbury electric light and gas plants have been sold to the Salisbury-Spencer Light and Railway Company. The electric plant will be used in the operation of the street railway now under construction.

RICHWOOD, OHIO.—The Richwood Light, Heat & Power Company, capital $30,000, has been incorporated by O. P. Lenox, L. G. Peet, B. Cahill, J. F. Wood and L. P. Albright. The company will purchase the lighting plant now owned by E. A. Schambs, and will add to the equipment and extend the service.

COLUMBUS, OHIO.—The Indianola Heating & Lighting Company and the Public Service Company have agreed on a consolidation. The former operates a lighting and heating plant on the North Side, and the latter is building a similar plant on the West Side. The capital of the new company will be $1,500,000. A. W. Field, who has been manager of the Columbus Railway & Light Company, is slated for manager of the consolidated company.

GROVE CITY, PA.—J. W. Russell, Jr., Borough Secretary, writes that the borough will probably construct a municipal electric light plant.

WILKESBARRE, PA.—The City Council has granted franchises to the Ashley Electric Light Company and the West Side Electric Light Company.

NEW CASTLE, PA.—The town has decided to erect a municipal lighting plant, and contracts for material will be closed at once. At present the Mahoning Valley Railway Company lights the town.

NASHVILLE, TENN.—It is reported that Meiklebam, Dunsmore & Ackerman, of New York, have agreed to take $2,000,000 of the stock and bonds of the Great Falls Power Company which, it is stated, will shortly begin the work of developing the Caney Fork falls near Nashville, where a minimum of 2000 hp is available. The concern proposes to supply power and light to many towns in central Tennessee.

WILLS' POINT, TEX.—The Wills' Point Electric Light Company has filed letters of incorporation, with a capital stock of $10,000. The incorporators are: O. I. Johnson, Charles E. Brown and W. B. Rogers.

NEWPORT NEWS, VA.—The Newport News Shipbuilding & Dry Dock Company contemplates the building of a plant for manufacturing electrical equipment for ships.

ELLENSBURG, WASH.—A special election has been held here, at which the citizens voted favorably upon the proposition of bonding the city for $20,000 for an electric power and lighting plant.

MONTICELLO, WIS.—E. L. Bables is reported interested in the construction of a lighting plant.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company has passed into the control of the Construction Company of America, which is building the interurban railway to Plymouth.

WHITEHALL, WIS.—As a result of the washing away of a portion of the mill-dam, this village is now without electric light. There are no prospects of resumption until warm weather sets in.

SHERBROOKE, QUE.—The Sherbrooke Heat, Light & Power Company has made a proposition to the Council of the city of Sherbrooke that if the company is granted a contract for 15 years, it will give a reduction on the flat rate of 16-cp lamps from $6 to $5, and an equal share of the net profits. It is expected that this proposition will be turned down, as the municipal ownership party claims that as the company is only able to pay 4 per cent. there would be little left for division. It is understood that if the electric company does not accept the city's offer of $200,000 for electric light and gas plants, that a company will be formed and electric light supplied the city at a minimum figure.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—The Mobile Light & Railroad Company will apply to the board of revenue of Mobile County for the right to extend the Whistler branch from Pritchard Station to Magazine Point.

BIRMINGHAM, ALA.—The annual meeting of the Birmingham Railway, Light & Power Company was held at the offices of the company in Birmingham. The officers now are: Robert Jemison, president; W. A. Walker and J. A. Emery, vice-presidents; J. P. Ross, secretary; C. O. Simpson, treasurer and auditor; J. A. Emery, general manager.

LOS ANGELES, CAL.—Abbot Kinney, who, with the old Los Angeles Traction Company, was engaged in building an electric railway from this city to Santa Monica in opposition to the Los Angeles-Pacific Railroad Company, has sold his interest to Gen. M. H. Sherman and E. P. Clark, of the Los Angeles-Pacific Company, for $280,000.

DENVER, COL.—Under a final decree issued by Judge Hallett, in the United States Court, all the holdings of the Denver, Lakewood & Golden Railway will be sold within 60 days for the benefit of creditors. There is due, according to the decree, to the holders of 627 outstanding bonds of the company, for principal and interest, the sum of $1,016,060, no part of which has been paid. The court has appointed a special master, who will take charge of the sale and report to the receiver and to the court.

NEW LONDON, CONN.—The Groton & Stonington Street Railway Company is perfecting arrangements for beginning the construction of its proposed road as soon as the weather moderates.

CHICAGO, ILL.—The Aurora, Elgin & Chicago Railway is about to issue second mortgage bonds to the amount of $500,000.

BELLEVILLE, ILL.—Attorney Charles A. Karch has received word from President J. R. Piercy and Chief Engineer Isaac C. Smith, of the Southern Illinois Electric Railway, which will build a line from Salem, Ill., to Belleville, where it will connect with the East St. Louis & Suburban, that they have been successful in disposing of their bonds to a New York firm, and that the work now under way will be pushed so as to have the lines in operation by July 1.

INDIANAPOLIS, IND.—The Marion County Construction Company, organized to construct and build electric and steam railroads, and other public works has increased its capital stock $25,000. C. E. Haugh is president and W. C. Smith, secretary.

COUNCIL BLUFFS, IA.—The City Council has voted to grant a franchise ordinance to the Council Bluffs, Tabor & Southern Electric Railway.

ARKANSAS CITY, KAN.—L. H. P. Northrup, who was given a franchise to build an electric railway in this city and an interurban road between Arkansas City and Winfield, and Arkansas City and Chilocco, has employed Thomas V. Hall & Company, consulting engineers, to survey the line.

HOPKINSVILLE, KY.—The Southern Kentucky Interurban & Traction Company is said to be contemplating the building of an electric railway from Hopkinsville to Franklin, Ky.

LEXINGTON, KY.—The plan of Cincinnati, Hamilton and other Ohio capital to construct an electric railway from Lexington, Ky., to Frankfort, Ky., a distance of some 30 miles, has been revived.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company is offering to float $250,000 5 per cent. first mortgage gold bonds, to be used in building into Louisville. The common stock of the company is $2,000,000 and the preferred stock is $1,000,000. The trustees of the new issue are the American Trust & Savings Bank, of Chicago, and the United States Trust Company, of Louisville.

BOSTON, MASS.—The Newton Street Railway Company has petitioned the railroad commissioners for authority to issue $250,000 5 per cent. coupon bonds, par value $500 each, the same to be used for additional extensions and equipment.

WORCESTER, MASS.—A petition has been filed in the State Legislature by the Worcester Consolidated Street Railway Company for authority to build an extension to its lines through West Boylston and Sterling, connecting Worcester and Leominister.

BOSTON, MASS.—The railroad commissioners have given their approval of the sale of the Framingham, Southboro & Marlboro Street Railway Company to the Boston & Worcester Street Railway Company, and have authorized the latter company to issue 1850 new shares to consummate the sale, the said new shares to be exchanged share for share for the capital stock of the Framingham, Southboro & Marlboro Street Railway.

DETROIT, MICH.—The Detroit United Railway Company will likely build an electric belt line to handle freight. The idea is to have an electric belt line upon which freight coming into Detroit can be handled, thus relieving the freight traffic on streets now crowded with passenger traffic.

TRENTON, N. J.—The Trenton Street Railway Company is installing an 800-kw generator in its power house. Additional boilers will be installed later, and the company proposes having practically a duplicate set of generating machinery, so that there will be little danger of a tie-up from accidents.

ALBANY, N. Y.—The Ithaca-Cortland Traction Company has been authorized to issue a mortgage for $650,000 for construction work.

ALBANY, N. Y.—The State Railroad Commission has given authority to the Central Long Island Electric Railway to issue a mortgage on its property for $500,000. It is proposed to build a line from Port Jefferson to Patchogue.

NIAGARA FALLS, N. Y.—The Electric City Railway Company has been incorporated to build a line eight miles long. The capital stock is $80,000 and the directors are Alvah K. Potter, Lockport; James S. Simmons and Frederick J. Brown, Niagara Falls.

NEW YORK, N. Y.—The Interborough Rapid Transit Company has ordered 200 steel cars for use in the subway. The cars will be delivered in the spring for use as soon as the road is opened to traffic. The new cars are to be 51 ft. 2 ins. long, including platforms, 12 ft. high from rail to roof, and 8 ft. 7 ins. wide over the sheathing. The interiors will have a aluminum finish. The seats will be of metal.

MARION, OHIO.—The Findlay, Forest & Marion Railway Company has been incorporated, with $10,000 capital stock, by Claude Meeker, Walter B. Beebee, H. E. Armbruster, M. B. Earnhart and William A. Morrison.

WARREN, OHIO.—The Warren, Cortland & Jefferson Traction Company has been incorporated, with a capital stock of $10,000. The incorporators are: John Lundy, P. N. Taylor, A. H. Gebert, J. L. Morgan and Geo. Pomeroy.

WILKESBARRE, PA.—There is talk of building a third-rail electric railway from White Haven to Wilkesbarre.

NEWHOPE, PA.—The Trenton, Newhope & Lambertville Street Railway Company has secured an option on the Newhope-Delaware Bridge, which is being constructed between this borough and the city of Lambertville, N. J. The company, which is connected with the New Jersey & Pennsylvania Traction Company and the Yardley, Morrisville & Trenton Street Railway Company, has a charter for a line from Yardley to this place, and it is understood that construction will begin in the spring.

LANGHORNE, PA.,—William B. Parry, who built the Newtown, Langhorne & Bristol Street Railway, and who has been actively interested in the movement to connect Philadelphia, Langhorne and Trenton by a direct electric railway, has secured rights of way over most of the route lying between Langhorne and Willow Grove. Private right of way has been secured, as far as possible, and the proposed line extends from this borough to Somerton, Philadelphia, thence to Bethayres, Alnwick Park, Heaton and Willow Grove, where connections would be made with the Philadelphia Rapid Transit lines for Philadelphia and Doylestown.

CORSICANA, TEX.—The Corsicana Traction Company has increased its capital stock from $100,000 to $125,000. It is reported that the company will make important improvements and will extend its system.

MEMPHIS, TENN.—The location of the line of the Shelby Traction Company of Memphis has been determined, and estimates are now being made for the construction of the twenty-mile line.

OGDEN, UTAH.—The La Porte Construction Company of La Porte, Ind., has been awarded the contract for the construction of the Burns-Bamberger road between Farmington and this city. The Salt Lake and Ogden Railway road extending from Salt Lake to Farmington will be converted into an electric system. The work is to be completed within ten months and will be commenced some time in March. About $5,000,000 will be expended on the proposed work.

NEWPORT NEWS, VA.—The directors of the Newport News & Old Point Railway & Electric Company have elected officers for the ensuing year as follows: President, William J. Payne; vice-president, Geo. A. Schmelz; treasurer, Henry A. L. Schmelz; secretary, D. C. Zollicoffer; general manager, H. H. Carr.

NORFOLK, VA.—Judge Waddill, in the United States Court, has granted the petition of the receivers of the Bay Shore Terminal Company to issue receivers' certificates to the amount of $150,000, which funds will be used by the company to complete its electric railway system through from the business parts of Norfolk to Ocean View.

DAVENPORT, WASH.—The Adams County Electric and Transit Company has decided to extend its system from this city to Crystal City, a distance of about twenty-six miles.

APPLETON, WIS.—W. H. Holcomb, J. A. Hayes, John L. Jacqet and Paul V. Cary have incorporated as the Outagamie Traction Company to build an electric railway between Appleton, Hortonville and other cities. The necessary franchises have nearly all been secured.

ROSSLAND, B. C.—MacDonald and Winn, of this place, are seeking incorporation for a company to build a line of electric railway from Crawford Bay on Kootenay Lake to a point near Fort Steele, East Kootenay district.

BRANTFORD, ONT.—Application will be made to the Parliament for a charter incorporating an electric railway from Thorold south to Port Colborne, east to Fort Erie, westerly through the counties of Welland and Haldimand to Brantford.

WALKERTOWN, ONT.—The Walkertown & Lucknow Railway Company is seeking incorporation to build a line of electric railway from this town to the village of Lucknow. A. H. Macdonald, of Guelph, is solicitor for the applicants.

GUELPH, ONT.—The Guelph Junction Railway Company will ask incorporation to build a line from Guelph to Goderich, with a branch to Listowel and another branch to St. Mary's and Clinton, via Stratford, with power to lease or sell to the Canadian Pacific Railway. Electric power will be used.

WINNIPEG, ONT.—Messrs. Campbell, Pitblado, Hoskin and Grundy, of Winnipeg, give notice of an application to the Manitoba Parliament for an act to incorporate a company to build and operate an electric railway and telegraph and telephone lines within a radius of 75 miles of Emerson, in the Province of Manitoba. Permission is also sought to construct and maintain a water power development on the Roseau River.

OTTAWA, ONT.—At the coming session of Dominion Parliament a company, in course of organization, will apply for a charter to construct an electric railway from Ottawa to Buckingham, thence up the Leivre River to a point on the line of the proposed Grand Trunk Pacific Railway, and on to James Bay. The names of those interested in this enterprise are withheld at present, but it is understood they comprise Ottawa and Montreal capitalists.

QUEBEC, QUE.—A project is under way to connect with the city of Quebec by means of an electric railway, a number of parishes surrounding that city. A company has been formed and application will be made to the Provincial Legislature for a charter. The capital of the new company will be placed at $100,000.

NEW INDUSTRIAL COMPANIES.

THE ALPHA COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $25,000, to construct power plants.

THE NATIONAL TELEPHONE CONSTRUCTION COMPANY has been incorporated at Chicago with a capital stock of $2500. The directors are E. J. Phillips, G. A. Herrick and others.

THE HARPER ELECTRICAL COMPANY, of Fort Wayne, Ind., has filed articles of incorporation. The company proposes to manufacture electrical supplies. Raymond and Joseph Harper and others are the promoters.

THE DRAWBAUGH PATENTS COMPANY has been incorporated in Jersey City, N. J., with a capital stock of $40,000. The incorporators are Leo J. Matty, Emilius W. Scherr and Herbert G. Ogden.

THE ELECTRIC BURGLAR ALARM & DEVICE COMPANY has been incorporated in Washington, D. C., with a capital stock of $60,000. The names of the incorporators are: G. M. Walker, J. E. Crandall and C. H. Neely.

THE MISSOURI AUTOMOBILE WORKS, St. Louis, Mo., with a capital stock of $10,000, one-half paid, has been incorporated. The shareholders are: Robert N. Collins, Christopher W. Johnson, Cyrus W. Haas, A. T. W. Pritchett and L. P. Graffmann.

THE GISSON-SHORT CYCLE AND AUTOMOBILE COMPANY, of Indianapolis, Ind., has incorporated with an initial capital of $10,000. This amount will be increased soon. The company will manufacture and sell automobiles, repair bicycles and automobiles, motor vehicles, etc. W. H. Brown, C. E. Short and C. E. Gibson are the incorporators.

THE STERLING ELECTRIC COMPANY, of Lafayette, Ind., has increased its capitalization $100,000. This money will be used for improving and enlarging the plant in order to take care of the company's rapidly increasing business. The officials deny the report that the company or plant is to be consolidated with Kellogg Switchboard and Supply Company, of Chicago.

LEGAL.

"HOW OLD IS ANN?"—"How old is Ann?" is a question that the Supreme Court of Virginia must decide. It came up recently at Richmond in the case of Northington vs. the Norfolk Railway & Light Company. The age of Miss Ann Northington, of Norfolk, when she signed a certain conveyance is in doubt. One side of the controversy contends that she was eighteen, while the other says she was twenty-three. When one of the attorneys stated that the proposition was "How old is Ann?" there was a burst of laughter, in which the court was compelled to join. It became apparent, however, that it was no joking matter, and that upon the decision of the court depends who will receive a large sum of money.

WAGNER MOTORS AND TRANSFORMERS.—Judge Adams, of the United States Circuit Court, St. Louis, handed down decisions in two important patent cases Saturday, February 13. One was the General Electric Company against the Wagner Electric Manufacturing Company, of St. Louis, for infringing a patent on electric motors. This was a motion for preliminary injunction. The court denied the injunction. The other case was brought by the Westinghouse Electric & Manufacturing Company against the Wagner Electric & Manufacturing Company, for manufacturing electrical transformers. Suit was brought on a patent granted to George Westinghouse, Jr. The court in this case decided that the transformer manufactured by the Wagner Company was no infringement of the patent sued on.

TELEPHONE AND EMINENT DOMAIN.—In Kirby vs. Citizens' Telephone Company of Sioux Falls, S. D., the question came up whether the erection of a telephone system in the streets of a city constituted an additional servitude. Upon appeal, the Supreme Court of South Dakota sustained the vacating of a preliminary injunction against the telephone company. Its points were: 1. Const. Art. 6, Sec. 13, providing that private property shall not be taken or damaged for public use without just compensation, and that the fee of land taken for highways shall remain in the owner, and Article 17, Sec. 18, providing that compensation shall be made before property is taken or injured, do not apply to the use of the streets of a city for the purposes for which they have been dedicated. 2. Under the direct provisions of Laws 1885, p. 208, c. 141, Sec. 3 (Rev. Civ. Code 1903, Sec. 554), a city may permit a telephone company to erect poles and maintain a telephone system on its streets. 3. The construction, maintenance, and operation of a telephone system on the streets of a city in such a manner as not to cause unnecessary injury or inconvenience to property owners is not an additional servitude for which an abutting owner is entitled to compensation.

ACCIDENT FROM CONDUIT WORK IN STREET.—The case of Leavitt vs. New England Telephone Company was settled recently by the Supreme Court of New Hampshire. In an action against the telephone company for injuries caused in passing over a sidewalk at a place where an excavation had been made by defendant, under license from the city, plaintiff's claim was that defendant was liable for the injuries without regard to the fact that the city had done part of the work of filling the excavation. Plaintiff offered no exceptions to the court's charge, but merely excepted to the admission of evidence in substantiation of the defendant's theory that, the city having completed the filling of the excavation, defendant was not liable. It was held on an appeal that plaintiff could not obtain a reversal on the theory that defendant's evidence was irrelevant, but should have excepted to the charge. The remarks of defendant's counsel to the effect that the concreting over the excavation was done for the city, and when defendant was stopped in its work by the superintendent of streets its liability ceased, furnished no ground for setting aside the verdict, as the statements of fact were supported by evidence, and the statements of law, if erroneous, would be deemed to have been corrected by instructions.

PERSONAL.

H. L. WEBB.

MR. HERBERT LAWS WEBB.—All the American friends of Mr. Herbert Laws Webb will be interested to know that after several years of residence in this country he has decided to take up his abode permanently in England, his native land. Mr. Webb has been connected with the development of electrical industries from his earliest youth, being a member of the well-known Webb family so prominent in submarine cable development in England in the last century, and one of whom was formerly secretary of the English Institution of Electrical Engineers. Mr. Webb is also a nephew of Sir W. H. Preece, F. R. S. As an electrical engineer Mr. Webb has been actively engaged in the practice of his profession since 1889, and before he came to the United States he had devoted his attention to submarine cable work. While in this country he gave his attention chiefly to telephonic development, although for a short period in 1892 he was editor of *Electricity* at the time that paper started. For several years past he was engaged as a member of the expert staff of the New York Telephone Company, for whom he made three trips to Europe on inspection work, as well as for the American Bell Telephone Company. For about a year past Mr. Webb has been in England as an expert connected with the Buckingham automatic telegraph system and in connection with telephonic work. In 1897 he gave evidence at the well-remembered Glasgow telephone inquiry and since that time has been called into other investigations of the same character. He is the author of an excellent guide to cable testing, etc., and of an admirable little telephone handbook which has had a wide circulation. To the electrical and general press and particularly to these columns, as well as to the magazines, he has contributed numerous articles on electrical subjects, chiefly of a telephonic nature. In resuming residence in London, Mr. Webb is making his headquarters at 8 Queen Anne's Gate, but he will shortly be moving into larger quarters where he will engage in the practice of consulting electrical engineer, giving special attention to telephonic work. The best wishes of his American friends follow him back to the old country, whither he returned during the last week or two.

MR. A. A. KNUDSON, the specialist on the subject, lectured before the Franklin Institute, Philadelphia, last week, on the corrosion of metals underground by electrolysis.

MR. W. H. BASSETT, of Jefferson City, Mo., has been appointed auditor and traffic manager of the Kinlock Telephone Company, of St. Louis, with headquarters at Jefferson City.

MR. P. LETHEULE, of the French Thomson-Houston Company, has been appointed by the French Government engineer of the French Department of Electricity at the St. Louis Exposition.

PROF. FRANK G. BAUM has resigned from the electrical engineering department of Stanford University to accept the post of electrical engineer for the California Gas & Electric Company, in connection with the Bays Counties and Valley transmission plants.

MR. LOUIS ALBERGER, of the Alberger Condenser Company, White Building, New York, who has been absent from his office for some three weeks past owing to indisposition, has gone for a trip to Cuba to look over the business situation in that part of the world.

MR. WILLIAM E. GAVIT has been elected vice-president of the old American Institute of New York, in whose spacious rooms and building the New York Electrical Society holds so many of its meetings. In this respect Mr. Gavit has been an active and influential friend of the Society.

MR. DOUGLASS BURNETT has been elected general manager of the United Electric Light & Power Company, of Baltimore, Md. Mr. Burnett has been identified with the New York Edison Company since 1894, and is a member of the American Institute of Electrical Engineers and of the New York Electrical Society.

MR. W. D. BALDWIN, president of the Otis Elevator Company, White Court Building, New York, has returned from a trip to Europe, whither he recently went in connection with the contract for the large passenger "lifts" to be installed in the London underground railroad system now being constructed by the Charles T. Yerkes syndicate.

MR. CAMERON FORBES, a member of an old Boston family well known in connection with Bell telephone history and development, and who has been prominently connected with the electrical firm of Stone & Webster since graduating at Harvard, has been offered by President Roosevelt an appointment as one of the commissioners for the Philippine Islands. He has accepted.

PRESIDENT H. S. PRITCHETT, of the Massachusetts Institute of Technology, while in Germany recently, spent some time studying the experimental electric road in the environs of Berlin upon which the uniform high speed of from 100 to 130 miles an hour is maintained. He will have an interesting account of his impressions in *McClure's Magazine* for March.

MR. J. H. WAUGH, of Pittsburg, Pa., has severed his connection with the Westinghouse Electric & Manufacturing Company and has assumed the active management of the business of the Electrical Equipment & Supply Company, of that city. This latter company has just been chartered under the laws of Pennsylvania, with a capital stock of $60,000. President Waugh is greatly encouraged as he starts out, business developing rapidly, with inquiries from all over the Union.

MR. JOHN F. KELLY, of the Stanley interests and president of the John F. Kelly Engineering Company, Singer Building, New York, has gone to

Milwaukee in connection with the development of the plans of the Allis-Chalmers Company, which concern, as mentioned in our last issue, is to enter into the manufacture of electrical machinery on an extensive scale.

MR. PUTNAM A. BATES, assistant secretary and sales manager of the Crocker-Wheeler Company, announces that he has resigned his position and will retire from that company on March 1 next. Mr. Bates has formed a partnership with Mr. John Neilson, who was until recently assistant secretary and assistant treasurer of the New York & Stamford Electric Railway, and under the firm name of Bates & Neilson, will conduct a general practice of consulting electrical engineering, with offices in New York City.

OBITUARY.

MR. ERASTUS WIMAN, of Staten Island, N. Y., died last week. He was at one time very active in electrical matters, especially telegraphy, and later on took up the development of electrical lighting with equal energy, establishing a large plant on Staten Island where he introduced also the alternating-current system for the streets. His electric fountain displays are well remembered by New Yorkers. Deceased was born in Churchville, Ont., in 1834.

H. W. OLIVER.—Mr. Henry W. Oliver, the well-known iron manufacturer of Pittsburg, died at Alleghany, Pa., on February 9, of a complication of diseases. Mr. Oliver was born in Ireland in 1840, and was brought to Pittsburg when two years of age. He began his business career as a messenger for the old National Telegraph Company at the age of 13, and ultimately became president of one of the largest iron and steel plants in the country. Mr. Oliver served in the Civil War, and throughout his life was active in politics.

M. A. HANNA.—Senator Marcus A. Hanna, of Ohio, died at Washington, February 15, of typhoid fever, after an illness extending over nearly two months. Deceased was one of the most widely known men in the United States, being prominent in national politics and in large business enterprises in Cleveland, which was his home. Senator Hanna was prominently identified with the street railway development in Cleveland, and at the time of his death was a director of the Cleveland Electric Railway Company. He was born in New Lisbon, O., September 24, 1837, and was consequently in the 67th year of his age. Special funeral services were held in the United States Senate chamber on Wednesday of this week, and the remains were afterwards taken to Cleveland for burial.

Trade Notes.

THE SPRAGUE ELECTRIC COMPANY has just issued a bulletin devoted to the W. L. engine type of direct-current generators, illustrating and describing them.

THE SPRAGUE ELECTRIC COMPANY announces that its Baltimore office, which was destroyed in the recent fire, is now located in the Maryland National Bank Building.

HADAWAY ELEC. HEATING & ENG. COMPANY, of New York City, announces that it has moved its offices to Room 322, No. 136 Liberty St. It has doubled its shop capacity, and is now able to take care of a large business.

CROCKER-WHEELER COMPANY, of Ampere, N. J., announces that its Chicago office has established headquarters for Western Ohio, at No. 1232 Union Trust Building, Cincinnati, O., with Mr. H. A. Brown as representative.

THE ELECTRIC PORCELAIN COMPANY, East Liverpool, O., has planned to make an addition to its already large plant, to cost $16,000. This extension is necessary in order to supply the rapidly growing demand for this company's goods.

THE ELECTRIC STORAGE BATTERY COMPANY.—Owing to the fire in Baltimore, the Electric Storage Battery Company has removed its Baltimore office to Philadelphia, and until further notice it will be at the headquarters, Allegheny Avenue and Nineteenth Street.

THE DOWNWARD LIGHT ELECTRIC COMPANY, 225 Fourth Ave., New York, has found its increasing business so widespread that it has been deemed advisable to open a branch office in Philadelphia. This is located in the Witherspoon Bldg.

C. & C. ELECTRIC COMPANY, 143 Liberty St., New York, has recently issued several bulletins, both quite voluminous, one giving a list of some users of its various generators and motors, and the other being devoted to illustrations and description, etc., of its "M. P." machines, direct-current, so well and widely known. Applications of the apparatus are shown, as well as details of construction.

ELECTRICAL MATERIAL COMPANY, of Baltimore, Md., informs us that it was fortunate enough to escape damage direct, from the recent great fire. Under the circumstances, it now looks naturally for a very large increase in business, and has decided to more than double its stock to take care of the inrush of orders. It is now in a better position than ever to make immediate shipments.

THE NERNST LAMP COMPANY, in accordance with its new policy of establishing district offices in the large cities, has recently opened an office at 47 State St., Detroit, Mich., and appointed Mr. Charles F. Case as district sales manager of it. The territory embraced by this office is the lower peninsula of the State of Michigan, the northwestern part of Ohio and the northeastern part of Indiana.

VIADUCT MANUFACTURING COMPANY.—We are glad to note that the great fire at Baltimore, Md., did not reach the offices of the Viaduct Manufacturing Company, of that city, whose factory, being located ten miles out at Relay, is also still in full blast, turning out large quantities of telephones, district messenger boxes, Skirrow switchboards, resonators, etc. All orders are being attended to with prompt dispatch.

THE REEVES ENGINE COMPANY, New York, whose product has met with such phenomenal success, is now in a position to entertain establishing selling agencies throughout the United States and foreign countries. Its manufacturing facilities have been so materially increased that it is able to make prompt deliveries, and will be pleased to hear from capable people desiring to avail themselves of this excellent opportunity. Its sales office is at 85 Liberty St., New York.

THE "TALKING" SIGN.—The Mason Monogram Company, 280 Broadway, New York, has issued a unique card regarding its electric "talking" signs. The card contains a night view of a store over which is one of these signs. In the card is a slit, under which a circular card is moved about its centre. On being turned words are brought under the slot, reproducing the effects of the actual sign. It is an excellent idea and shows in very compact form just how these signs produce the results claimed for them. The utility of the card is made greater by the addition of a neat little monthly calendar attached to one corner.

TURBINE ENGINEERING COMPANY.—This concern, of West Troy, N. Y., and Whitehall Building, Battery Place, New York, calls attention to its hydraulic power department at the former address. It acts as engineer and contractor for complete hydraulic power plants, and states that its relations with the manufacturers of the equipment used in such plants is of a character that places it in a peculiarly advantageous position for carrying out such work. It takes the contract for the entire plant, with all the consequent benefits to the purchaser dealt with. The officers are: A. M. Young, president; H. G. Runkle, vice-president; M. J. Warner, treasurer; F. A. Curtiss, secretary; L. G. Read, general manager; J. Sturgess, manager of the hydraulic department.

EUREKA TEMPERED COPPER.—The Eureka Tempered Copper Works, North East, Pa., have just issued their 1904 catalogue and price list of their copper and brass products for all purposes. The list is a very complete one and includes commutator bars and commutators for machines of all the standard makes; trolley harps; trolley wheels; brushes; switches, etc., a code word being given for each size and make. Besides this there are several tables of value in making calculations and estimates. At the back of the book are several numbered pages perforated, which are to be torn out and replaced by sheets of corresponding numbers when received from the works. The catalogue is gotten up in an excellent manner, and is well illustrated. It shows great painstaking and care in its production. The Eureka works are among the oldest in the business, and their long experience has placed the concern in a position to produce the best goods possible.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 9, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

750,309. ANNUNCIATOR; Lambert Schmidt, Weehawken, N. J. App. filed Aug. 28, 1901. (See page 365.)

751,440. COMMUTATOR LEAD AND MODE OF MAKING SAME; Charles F. Adams, Pittsfield, Mass. App. filed Aug. 8, 1903. A flat copper strip is folded lengthwise and slit along the fold at one end so that the members may be bowed outward to embrace the conductor, the opposite end going into the commutator bar.

751,441. MEANS FOR PROTECTION AGAINST REVERSE CURRENTS; Leonard Andrews, Manchester, England. App. filed June 25, 1903. Two magnetic circuits are energized respectively by a shunt and a series winding, two secondary windings are arranged to be excited by the magnetic circuits and to operate a circuit-controlling magnet.

751,442. REVERSE CURRENT CUT-OUT; Leonard Andrews, Manchester, England. App. filed June 25, 1903. A closed magnetic circuit carrying two coils and an open magnetic circuit shunting both parts of the closed circuit on which said coils are wound, the open circuit including a reciprocating member which actuates a switch.

751,459. LINE INSULATOR; Cummings C. Chesney, Pittsfield, Mass. App. filed Jan. 14, 1903. An H-shaped insulating support composed of a plurality of insulators set at an angle to each other.

751,460. LIGHTNING ARRESTER; Cummings C. Chesney, Pittsfield, Mass. App. filed Aug. 8, 1903. The earth wire includes a solenoid coil and an air gap, the latter being opened by the energizing of the coil.

751,474. POLE CHANGER FOR DYNAMOS; Isidor Deutsch, Montreal, Canada. App. filed May 14, 1903. Details.

751,501. ELECTRIC TELEPHONE; Ernst Gundlach, Western Springs, Ill. App. filed Nov. 10, 1902. (See page 365.)

751,527. APPARATUS FOR DIVIDING, SEVERING AND SIMILARLY TREATING CLOTH; Alexander Marr, Manchester, England. App. filed June 5, 1903. Electrically heated wires are arranged upon the surface of a drum, and the drum rolled over the cloth to sever it along lines corresponding to the position of the wires.

751,539. RINGING-KEY FOR TELEPHONE-SWITCHBOARDS; Frank R. McBerty, Evanston, Ill. App. filed May 9, 1902. (See page 365.)

751,547. MOTOR CONTROLLER; Francis V. Nichols, Pittsfield, Mass. App. filed June 13, 1903. Improvements directed towards reduction in size and simplicity.

751,549. SYSTEM OF ELECTRICAL DISTRIBUTION; John S. Peck, Pittsburg, Pa. App. filed May 1, 1903. A plurality of compound-wound rotary converters adapted for operation in parallel, a bank of transformers each having a plurality of secondary windings so arranged that the number of rotary converters connected thereto may be varied without varying the compounding effect upon the direct-current circuit supplied thereby.

751,563. DYNAMO ELECTRIC MACHINE; David B. Rushmore, Pittsfield, Mass. App. filed June 26, 1903. The internal shape of the field coil is different from the external shape of the core which it surrounds, to produce ventilating spaces.

751,566. RINGING-KEY FOR TELEPHONE-SWITCHBOARDS; Charles E. Scribner, Chicago, Ill. App. filed May 9, 1902. (See page 365.)

751,571. TIME LIMIT RELAY FOR ELECTRIC CIRCUITS; Harve R. Stuart and Arthur B. Reynders, Wilkesbarre, Pa. App. filed April 11, 1903. A time limit relay for electric circuits, comprising two contact members, mechanical devices for operating one of them to close the relay circuit, electro-magnetic devices for releasing that member, a retarding device and means for varying the length of the path through which the movable member travels.

751,574. ELECTRIC SPARK-PRODUCING APPARATUS; Chester H. Thordarson, Chicago, Ill. App. filed March 10, 1903. Details of construction of a vibrator wherein the breaking of the circuit is accomplished by a sharp hammer-blow, the force of which may be adjusted.

751,581. CONTROLLING MECHANISM FOR ELECTRIC VEHICLES; Frank S. Wahl, Buffalo, N. Y. App. filed Dec. 21, 1901. Details.

751,595. PARALLEL FEEDER PROTECTION; Leonard Wilson, Pittsfield, Mass. App. filed July 16, 1903. A plurality of parallel feeders and a choke coil for each feeder having one winding energized by the current in its feeder and a second winding opposing the first and energized by the sum of the currents in all the feeders.

751,597. ELECTRIC SWITCH; Gilbert Wright and Harold C. White, Pittsfield, Mass. App. filed June 13, 1903. Details of a quick-acting switch.

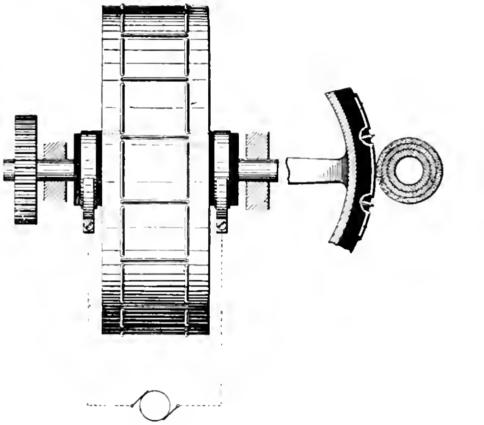
751,598. MEANS FOR CONTROLLING GOVERNOR MOTORS; Gilbert Wright, Pittsfield, Mass. App. filed Sept. 24, 1903. A switch consisting of a handle mounted upon the end of spring plates arranged mid-way between two sets of contacts, so that by hand-manipulation the center plates can be thrown to one side or the other and held as long as desired to impart a corresponding rotary impulse in one direction or the other to a motor.

751,616. MAGNETO-ELECTRIC GENERATOR; Hugh J. Creighton, Anderson, Ind. App. filed May 13, 1903. The magneto is mounted on a base in a manner to yield when inaccuracies of strain occur in the belt.

751,634. RHEOSTAT; George Graybill and John P. Oden, York, Pa. App. filed June 8, 1903. A rheostat for lamp sockets consisting of a rod projecting more or less into a body of granular resistance.

751,638. ATTACHMENT FOR COTTON SEED LINTERS; John W. Harrington, Eastpoint, Ga. App. filed May 2, 1903. A magnetic plate arranged in the throat of the machine to remove bits of iron that may be carried in the body of seeds.

751,654. APPARATUS FOR THE REGULATION OF ELECTRICAL CIRCUITS IN HEATING DEVICES; Willie D. Kilroy, Uxbridge, England. App. filed Oct. 6, 1902. A combined plug and socket operating as a switch in various angular positions.



751,527.—Apparatus for Dividing, Severing and Similarly Treating Cloth.

751,655. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 9, 1901. (See page 365.)

751,664. ELECTRIC INSULATOR; Thomas T. Lyman, Montclair, N. J. App. filed April 4, 1902. An insulator to prevent the formation of electric arcs, composed of asbestos, plaster-of-paris and silicate of soda, vitrified and coated with a waterproofing solution.

751,728. ROTARY SNAP ELECTRIC SWITCH; Monroe Guett, Hartford, Conn. App. filed Sept. 23, 1903. Details.

751,739. INSULATOR; Peter S. Lindal, Edinburg, Pa. App. filed March 31, 1903. Glass plates between which the conductor is held are placed in a box and clamped together by a screw.

751,743. INSULATOR; Joseph M. Mahoney, Boston, Mass. App. filed Dec. 1, 1902. A two-part sleeve having interlocking connections.

751,745. AUTOMATIC SWITCH; Morris Moskowitz, New York, N. Y. App. filed April 8, 1903. Details of a pole-changing switch especially applicable for train-lighting systems in which the generator is subject to frequent reversals in direction of rotation.

751,749. TROLLEY WHEEL; John E. Palmer, Somerville, Mass. App. filed Nov. 14, 1903. Means for retaining the wheel on the wire.

751,750. INDICATING MEANS FOR SNAP ELECTRIC SWITCHES; Charles G. Perkins, Hartford, Conn. App. filed Oct. 29, 1903. A dial supported by and adapted to be rotated on the outside of the cover of the switch.

751,760. ELECTRIC SIGNALING APPARATUS; John E. Stannard, Springfield, Mass. App. filed Feb. 2, 1903. Details.

751,772. STORAGE-BATTERY PLATE; Charles B. Askew, Chicago, Ill. App. filed May 20, 1903.

751,777. FLEXIBLE CONDUIT; Archibald T. Blackler, Malden, Mass. App. filed March 14, 1903. An insulating conduit consisting of a helix composed of smooth, flexible, compact, insulating material, longitudinal strips of a similar character interwoven and one or more longitudinal locking threads.

751,780. ELECTRIC SIGNAL; Harold E. Bradley, Warwick, R. I. App. filed Oct. 3, 1903. The invention comprises the specific devices used in a block system wherein a signal set by one car as it enters the block, is not returned until the last of any number of cars which may also have entered, has passed out.

751,788. ELECTRIC SIGNAL APPARATUS; John M. Golding, Washington, D. C. App. filed July 15, 1903. Means whereby a person desiring to signal another at a different point, may close an electric circuit including the signal at the distant point, which closure will at the same time lock an indicator, which will remain locked until the circuit is broken at the distant point, to notify the sender of the signal that the same has been received.

751,797. CENTRAL-ENERGY TELEPHONE SYSTEM; John Henry Lendi, Chicago, Ill. App. filed Dec. 19, 1900. (See page 365.)

751,803. WIRELESS ELECTRIC APPARATUS ACTING ON TYPEWRITERS; Giuseppe Musso S. Angelo Dei Lombardi, Italy. App. filed Sept. 23, 1902. The electric waves are used to command two disks rotating synchronously at the communicating stations and which are connected with keys of typewriters.

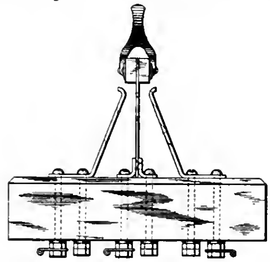
751,816. PROCESS OF WINDING; Arthur J. Strong, Dayton, O. App. filed May 15, 1903. A method of winding wire upon a closed ring.

751,818. ELECTRICALLY-PRODUCED-SOUND INTENSIFIER; Gustaf T. Swenson, San Pedro, Cal. App. filed Dec. 17, 1902. (See page 365.)

751,829. TELEPHONE; Ernest Theodore Billig, New York, N. Y. App. filed Dec. 2, 1902. (See page 365.)

751,830. ARC PREVENTER; Charles E. Blood, Fitchburg, Mass. App. filed Oct. 14, 1903. Air pipes leading to the contacts of the controller are closed and opened at the proper time by the movements of the controller.

751,831. INSULATOR PIN; James H. Bullard, Springfield, Mass. App. filed Aug. 8, 1903. A metal insulator pin comprising a series of webs united near one end and merged into a base at the other.



751,598.—Means for Controlling Governor Motors.

751,839. ELECTRIC HAIR BRUSH; Henry C. Doersch, Nyack, N. Y. App. filed June 1, 1903. Details.

751,854. THERMOSTAT; George D. Hoffman, Chicago, Ill. App. filed May 25, 1903. Details.

751,857. SYSTEM OF ELECTRICAL PROPULSION; Erich Krause, Hoboken, N. J. App. filed Oct. 22, 1903. Solenoids arranged in line with each other and supporting internal rails, cause an armature or car riding upon the rails to be drawn through them.

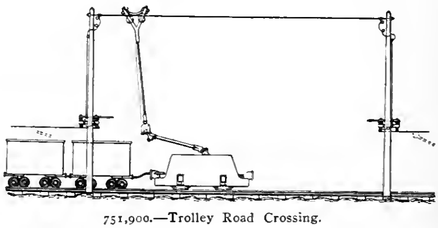
751,886. APPARATUS FOR STERILIZING WATER; Henry Jacques Wessels, Paris, France. App. filed June 22, 1903. (See page 361.)

751,900. TROLLEY ROAD CROSSING; James M. Collins, Byersville, O. App. filed Feb. 2, 1901. At the crossing the trolley wire is raised to an elevation where it will not interfere with crossing traffic and to enable cars to connect with the elevated portion at the crossing, an extension trolley is suspended therefrom and engages with the car trolley while the car moves over the crossing.

751,903. SYSTEM FOR THE OPERATION OF ELECTRIC MOTORS; Arthur C. Eastwood, Cleveland, O. App. filed Sept. 25, 1903. Relates to the construction of the controller for operating the reverse switches and closing the circuit through certain solenoids to cut out the sectional resistance.

751,949. ROAD CROSSING DEVICE; Frank L. Sessions, Columbus, O. App. filed Aug. 8, 1902. A modification of 751,900.

751,974. RAIL CONTACT SHOE AND SUPPORT THEREFOR; George W. Brady and Lawrence R. Jones, Wheaton, Ill. App. filed April 13, 1903. The lips of a straddling shoe which bear against the opposite sides of a third-rail and are hinged and spring-supported, to yield on passing around curves.



751,900.—Trolley Road Crossing.

751,982. SOUND MAGNIFIER FOR RELAYS; Matt A. Hacker, Irvine, Ky. App. filed April 28, 1902. The stroke of the armature is delivered to a diaphragm located at the small end of a megaphone.

751,985. UNDERGROUND CONDUIT INSULATION; John M. Humiston, Berwin, Ill. App. filed April 27, 1903. To diminish electrolysis, sections of non-conducting tubing are inserted at intervals in the metallic tubing.

751,986. APPARATUS FOR PURIFYING LIQUIDS; Otto Kartzmark, Brooklyn, N. Y. App. filed Dec. 26, 1900. (See page 361.)

751,991. CURRENT DIRECTOR; James F. McElroy, Albany, N. Y. App. filed Jan. 28, 1901. A switch having contact fingers in two sets, one used for making and breaking circuit while the other is used for distributing current in two or more circuits.

752,005. ELECTRIC ARC LAMP; Frederick Sindingchristensen, Brooklyn, N. Y. App. filed Aug. 29, 1902. Details of the feed mechanism.

752,008. INDUCTION COIL; Charles F. Splitdorf, New York, N. Y. App. filed July 15, 1902. A thin sheet of hard rubber is wrapped several times around the outside of the primary winding.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, FEBRUARY 27, 1904. No. 9.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, FEBRUARY 27, 1904.

CONTENTS.

INDEPENDENT TELEPHONE UNION.

It is interesting and encouraging to note that the independent telephone companies in Ohio have again drawn together and reconstituted on an active basis their association. Details of their convention last week are given elsewhere in this issue. One of the most striking things about the convention was its evident friendliness toward co-operation, and in this respect the paper presenting a plan of consolidation is worthy of note. It stands to reason that local telephone service to-day, standing by itself, is not of much account, particularly in regions with scattered population; but while recognizing this truth, the local independent companies have often been very slow to give up their isolation and freedom. It is true that great groups have already been formed, but the subject remains a very live and pressing one.

At the Cincinnati meeting last week a plan was proposed for organizing all toll lines and exchange operating companies. The plan is, to say the least, bold and novel. The group organization, or basic unit, would accept only such members as are not engaged in any contract which would be denied them as members. Members would be required to bind themselves to neither sell to nor enter into any contract with any telephone person, other than a member of the organization. The compulsory power of the organization should be in a body of delegates, sitting in a lower and an upper council. Each company should be represented by a delegate, sitting in both councils. In the upper council he should have a single vote, while in the lower council his vote should be in proportion to the assessed value of the property belonging to the company which he represents. This body should levy necessary taxes, the limit being fixed. The tax levy would originate in the upper council. This body should elect a president to administer affairs in vacation. No money should be paid out except by vote of the council. A referee should be elected, who would settle all controversies between members. All district organizations should be members of the central organization. Its powers should be vested in a body of delegates, one from each district. Sitting in the higher council he should have a single vote, while in the lower council he should have a vote equal to the entire vote in the lower council of his district organization. This body should levy necessary taxes, a limit being fixed. No money should be disbursed except by vote of the council. A president and vice-president should be elected by the council. A referee should be elected who would settle all controversies that might arise between district organizations, or between members of different district organizations. The president should appoint with the consent of the upper council an advisory board, consisting of a director of board of trade, director of patents, director of tolls and such others as might from time to time be advisable. The director of the board of trade should arrange a place for the sale of stock and bonds of member companies. The director of patents should look after patents, to see that members are not taking liability in infringements, and also to buy any new patents of advantage. The director of tolls should establish a clearance house to adjust tolls on messages passing from one district to another. This organization should furnish at a small profit to each member metal plates bearing the copyrighted trade-mark and the words which he would be required to place on each telephone.

This was received with favor, and may prove a foundation for alliance. It is a federal scheme following American political lines, but none the worse for that. The question arises as to how far it can be applied to the management of a business or an industry. A simpler way out, apparently, would be the good—or bad—old plan of regular business consolidation; but this is just what so many of the local independent companies want to avoid.

RECOGNITIONS AND REWARDS.

The recent foundation of the Edison Medal in the American Institute of Electrical Engineers has called attention to the limitations which exist in this country to the recognition and reward of distinguished merit. It is true that the universities and colleges can and do confer honorary degrees upon prominent men from year to year, but aside from that we seem to be lacking in this democracy in power to do that which in Europe, as well in France as in the countries where royalty exists, is done by the head of the nation. We have no Legion of Honor, for example; nor have we a Victorian Order. It interested and pleased a great many of us to note the other day that in connection with the high-speed Zossen work the Emperor William has just decorated Mr. Rathenau and some of the engineers associated with those brilliant experiments. It has also gratified many of us to note that the King of Italy has ordered to be put upon the new postage stamps of that country the heads of Volta and Marconi.

In this country, however, we seem to be reduced to the necessity of founding medals in honor of men while they are still alive, and this may explain a practice which in some respects is not without its dangers and disadvantages. The medals which have been founded to assist in perpetuating the names of John Fritz and Thomas A. Edison, as well as to recognize public service and to stimulate ambitious youth, seem to us admirable illustrations of the manner in which the citizens of a republic can assume the functions of royalty. But it is obvious that the practice should not be and could not be carried very far. Yet failing its extension, we venture to suggest the idea, and feel that we are not undemocratic in doing so, that it would be well if some means existed of expressing to a great man in some tangible lasting form other than a brick house or a loving cup the esteem in which his fellow-countrymen held him and his services.

ELECTRIC HOISTING AT FULL ARMATURE EFFICIENCY.

Our Digest columns this week describe a rather ingenious coupling of two motors by which a wide speed variation is capable of being obtained without more than a single line voltage, and without resorting to rheostatic control in the armature circuit. It is well known that the shunt direct-current motor operates very satisfactorily at constant speed with varying torque. When, however, as in electric hoisting, constant torque has to be provided at variable speed, with frequent stopping and starting, the shunt motor is quite unsuitable, and even the series motor suffers both in range and in efficiency. In the Ward Leonard method the ideal control is obtained at the expense of a triple machine.

In the case described, two shunt motors have their armatures clutched together so as to rotate as one shaft. One of the motors has the usual stationary field frame. The other has its field frame mounted so as to be free to rotate. The hoisting pulley is attached to the latter element. The two armatures are kept constantly running during operations, and when the two fields are equally excited, the movable field magnet remains stationary. By varying the shunt field excitations, however, under the control of a single rheostat, the hoisting pulley can be driven at any velocity from half armature speed forward to half armature speed backward, with no sacrifice of armature efficiency, and with only the increased losses due to a doubled plant and doubled frictions.

Such a combination would be likely to lend itself to small elevator work, since the mechanical and electrical connections would be of the simplest character. Moreover, a single armature and commutator of doubled length might be employed, running through two field systems side by side, one fixed and the other movable. This would form a motor with two fields and one armature, and a motor in which there would be one stator and two rotors. The usual starting devices of a shunt motor would have to be provided, together with a field rheostat with the arm connected to line and the two ends of the rheostat connected to the two field windings respectively. Hence, when the arm stood midway, both fields would be equally excited, but moving the arm in either direction, took resistance out of one field circuit, and added it to the other. By placing the motor in the cellar and the differential field rheostat on the elevator car, the speed of hoisting or lowering should be capable of prompt and close regulation, without, appreciably, affecting the speed of the armature in space. The weakest point of the arrangement is, of course, the duplication of the motor parts, the reduction of output per pound of weight and the increased frictional losses when the relatively massive field frame has to rotate.

THE ENERGY OF RADIUM EMANATION.

In a paper presented by Messrs. Rutherford and Barnes at the last meeting of the American Physical Society, as abstracted in the last number of the *Physical Review*, some very interesting data are given concerning the emanations of radium. It seems that radium and its active salts throw off minute material particles perpetually with enormous velocities. At the same time, a gaseous emanation is released, which is supposed to consist of the deëmanated molecules, or the molecules from which the particles have been projected. The deëmanated molecules in the gaseous emanation undergo a change in the course of a few minutes or hours, and release energy in the process. The change results in a material denominated "emanation X." This emanation X undergoes three more changes in succession, each lasting minutes or hours, each change being accomplished by a further disengagement of radiant energy or heat.

The entire process suggests that the radium atom is unstable, and that, at certain periods of its internal activities, it breaks up or disrupts. As in South American republics, revolutionary movements repeat themselves at regular intervals, and at the crisis the entire structure of an atom undergoes reorganization. This reorganization does not occur at a single transition, but continues through several successive stages, each change reducing the internal energy of the atom, and releasing the superabundant energy which is radiated off. How much internal energy is left in the atom when it resumes business on the lowest plane is not known; but the amount of energy apparently given off in the degradation is stupendous to our minds. The paper states that, from the author's results, one gramme of the radium emanation yields in all stages between two millions and twenty millions of greater calories. We are accustomed to regard the energy of coal, released in combustion, as being relatively large. But coal is reduced to mere ashes by comparison with radium emanation, on the above figures. One gramme of coal liberates in combustion about eight greater calories, or something like a million times less than radium emanation.

To put the results another way, a chunk of coal releases, during combustion, enough energy to lift itself about two thousand miles, or say from New York to Panama, vertically upwards against constant sea-level gravitation. A chunk of hydrogen, our most energetic combustible, releases in combustion an amount of energy capable of lifting itself about four times as far, or to a vertical distance (against sea-level gravitation) roughly equal to the distance from New York to Manila. But a chunk of radium emanation, according to the figures given in the paper, yields without any combustion an amount of energy in the process of its evolution that would lift it against sea-level gravitation not only to the sun, but to the orbit of the planet Neptune, the outside fence post of the solar system, and which is about thirty times further from the sun than the earth is.

Assuming that this is all true, the question suggests itself as to whether the radium atom is a favored atom in its initial energy stock; or, whether other more placid atoms, such as zinc and lead, contain unsuspectedly similar stores of internal energy. In other words, is it just the instability of the radium atom that happens to reveal to us this enormous stock of energy, that would otherwise be beyond our present power to discover, and which other kinds of atoms possess it in a similar degree, or is radium the only atom that is so rich and bursts with its own richness? This question awaits reply. There is no answer yet at hand.

It is manifest that if a pound of radium emanation starts off naturally with some dozens of megawatts of heat power, and if other substances possess like stocks of power awaiting liberation, it would only require the discovery of some means of effecting atomic instability in cheaper forms of matter to obtain heat supply on our planet long after coal may have become exhausted.

THE FIELD FOR THE ELECTRIC LOCOMOTIVE.

It is always a pleasant and a profitable thing to hear from those who have been long conversant with electrical work in its most practical form, and we are glad, therefore, to present Mr. H. Ward Leonard's discussion of the electric locomotive question. The questions he raises are not those usually considered in electric traction for the reason that as a rule the tendency in electric railway practice has been toward the rapid dispatch of single cars for fast passenger traffic. As we have more than once noted, this procedure while very valuable within bounds encounters certain other limitations that cannot well be escaped. It is well suited to suburban and interurban work, provided that the traffic does not pass a certain critical density and provided that extreme speeds are not attempted. In the former case every large road has been driven to the operation of trains, perhaps with multiple-unit control to secure acceleration; but still, as trains, which can be run at almost the same working headway as single cars and with much greater carrying capacity. In the latter case the operation of single cars has been definitely proved to be vastly uneconomical of power, by the Zossen tests and by many others. In freight haulage single motor cars are out of the question in work on a commercial scale; and success, as Mr. Leonard clearly shows, hinges on the use of very powerful locomotives hauling as large trains as the grades and the adhesion permit. Speed is a secondary consideration and the whole question is one of cutting down labor and economizing in the dead weights. The longer the train unit under these circumstances, the better will be the economic result.

It is certainly a very striking difference between American and English practice that the train loads for freight in the former should be seven times as great as in the latter, while the discrepancy in costs is nearly four to one in favor of the American roads in spite of higher wages. Of course, part of the difference in train weights must be ascribed to the different lengths of haul, and in general to the magnificent distances which characterize American railroading; but the effect on relative costs is none the less striking. A glance at Mr. Leonard's table shows, however, that the weight of the average American freight train has steadily increased, as indeed the known increase in the capacity of the locomotives would of itself show. That the electric locomotive with all its weight active in adhesion can outhaul a steam locomotive is obvious, and we now know well that electric locomotives can be made of very great hauling capacity. But their use has, up to the present time, been practically barred out by the difficulty of delivering adequate power to them at the voltage hitherto usual. The key to success is obviously the use of a high-voltage working conductor, from which power can be more easily drawn, and this in turn is obviously a case for the use of alternating currents. At the present time the boom in alternating-current railway motors is on, and the old prejudice is for the most part broken down, so that the system can at least be assured of a fair trial. Whether the new commutating alternating-current motors can be made to give good results on very large units such as would be necessary in building freight locomotives of great hauling capacity is an undetermined question. A desperate effort will assuredly be made to fit them for this and every other kind of service, and the results must be awaited before trying to pass judgment.

But in any event the plan proposed by Mr. Leonard more than a decade since, and later elaborated by Huber abroad, certainly offers an entirely practicable means of providing locomotives of any desired power operating on a very simple system of working conductors and possessing in the fullest degree the capacity for easy and perfect regulation now enjoyed by direct-current locomotives. The plan undeniably involves some complication in the equipment of the locomotive, but nothing of a forbidding character; and a locomotive thus equipped has the valuable property of being able to run on almost any sort of distributing system that would be used for any kind of railroading. If it should prove of large capacity the composite locomotive could be run perfectly well from the working conductors which served to feed alternating-current locomotives for local service, or could at termini work admirably upon a third rail system if such a thing survives the irruption of alternating currents. It is a system, too, which can very easily be tried on a railroad for the most part equipped with steam locomotives, and certainly it possesses a flexibility which goes far in making up for its complication. As we remarked in commenting on the paper by Huber published some time since, we should very much like to see the trial made on a commercial scale, and given a full and complete test. The complete success of this or any other form of electric locomotive utilizing alternating current in the working conductors, would result in opening the field of general railway traction at once, and the duel between steam and electricity could then be fought out on its merits. Steam locomotives have now worked up to about the limit of size that can be practically used for railway roadbeds, bridges and tunnels as at present arranged, and the double-header is, as Mr. Leonard remarks, not a very good way out of the difficulty. The time is soon coming when electric freight and haulage must be tried to settle the question of its usefulness, and without disparaging the steam locomotive in the least, we feel that it will have a desperate battle to hold its supremacy. The present attitude of the managements of main steam railroad lines toward the adoption of electricity is far more encouraging and determining than electrical engineers have thus far allowed themselves to believe.

Important Developments in European Electrical Industries.

It would appear from recent statements by the *Frankfürter Zeitung* that the Allegemeine Elektricitats Gesellschaft has bought an interest in Brown, Boveri & Co. It is understood that there was paid for 4,500,000 marks of shares of the Brown, Boveri Co., 3,500,000 marks in "A. E. G." shares, representing at the present quotation of about 210 per cent., a cash valuation of the investment of $1,765,000. These are not treasury shares, however, and no corporate action was taken in this connection; but it is simply a deal with the previous owners of the shares, the right being reserved to the other shareholders to participate in the deal in proportion to their holdings. The new "A. E. G." shares will consequently not become the property of the Brown, Boveri & Co., but on the other hand the "A. E. G." will acquire 4,500,000 marks of Brown, Boveri shares. The action was probably prompted by the desire of the "A. E. G.", which now undertakes the manufacture of turbines, to co-operate with Brown, Boveri & Co., who have been successfully engaged in this field for some time. As is well known, Brown, Boveri & Co. are constructing turbines after the Parsons system, while, in addition to its Riedler-Stumpf system, the "A. E. G." recently entered into an arrangement in America with the General Electric Company with regard to the manufacture of Curtis turbines.

The share capital of the Swiss firm of Brown, Boveri, of Baden, amounts to 12,500,000 francs, on which there was distributed in the last three years dividends of 7, 5 and 10 per cent., respectively. For the current fiscal year the prospects of the company are particularly promising, particularly on account of the large new business of the company in turbine construction.

Indirectly, the "A. E. G." acquires through this exchange of shares an interest in the Brown, Boveri Co. in Mannheim and the "Motor" Company for applied electricity in Baden, the "securities owned" (8,040,000 francs) of the Baden Brown, Boveri Co., being largely composed of these shares.

The increase of capital contemplated by the "A. E. G." will now have to be raised by a further 3,500,000 marks above the originally proposed 22,500,000 marks, so that the total share capital will in the future amount to 86,000,000 marks. This would apparently include the new capitalization due to the amalgamation of the Curtis steam turbine patents and the Riedler-Stumpf patents in the United Steam Turbine Company, of Berlin, for the use of these inventions in Germany, Austria-Hungary, Russia, Holland, Belgium, Sweden, Norway, Denmark, Switzerland and the Balkan States. This company, which, it seems, has been jointly formed by the American and German interests, has a capital stock of $750,000, while a separate company for the actual manufacture of the turbines, which will be undertaken in the workshpos of the Union Electricity Company, is on the point of being constituted with a capital of $1,250,000. Another company for Italy is also to be established to work in conjunction with the Mediterranean Thomson-Houston Company.

Single-phase Third-rail Roads for Indiana.

One of the most interesting and important signs of the times is to be noted in the contracts just awarded in Indiana for single-phase, third-rail roads. The first contract is for the equipment of the Fort Wayne, Decatur & Springfield road, extending from Fort Wayne, Ind., to Springfield, Ohio. On this road the Westinghouse single-phase motor equipment, with induction control, has been adopted, as it was not necessary to use existing direct-current trolley lines in any of the cities which are entered. The Indianapolis & Cincinnati Traction Company, which is constructing a high-speed line between Indianapolis and Connersville, Ind., has given out a contract for the equipment of 53 miles of road with the Westinghouse single-phase, alternating-current railway system. This is to be a high-speed line, largely on private right of way, going ultimately to Hamilton, Ohio, and thus making it possible to give high-speed electric service between Indianapolis and Cincinnati. The third-rail system had been practically decided upon before the advent of the single-phase system. The opportunities for saving in first cost and operation by the single-phase induced President C. L. Henry and Sargent & Lundy, consulting engineers for the work, to reconsider their plans for a direct-current third-rail road with rotary converter sub-stations and to adopt the single-phase. Two 500-kw. three-phase, 25-cycle, 2,300-volt generators were contracted for some time ago, to be used in connection with the third-rail direct-current system, with polyphase distribution. The power station equipment, as regards generating machinery, will remain unchanged. The step-up transformers, which will raise the voltage to 16,500 for transmission, will be connected on the Scott system, so as to give two-phase current on the high-tension line. There will be six static transformer sub-stations, one-half of which will be connected on one phase, and the other half on the other phase. The transformers in these sub-stations will give 3,300 volts on their secondary terminals, which will be the trolley line voltage. This voltage will be reduced by a transformer on each car.

In view of the fact that all cars must operate over the 500-volt direct-current city lines in Indianapolis, rheostatic control will be used instead of the induction control, which would be used were it not necessary to operate over direct-current trolley lines. Both methods of control might be used on a car, but the weight and complication of having two methods on a car are thought to offset the small economy gained by the induction control on the alternating-current portions of the line. One of the chief advantages of the induction control is its economy in starting a car. On the interurban portion of the line, however, the stops will be few, and hence, if induction control were used it would have to be put on simply to gain economy in a comparatively small number of stops. The first contract calls for ten cars, each equipped with four 75-hp motors, with gearing which will give a maximum speed on a level of 42 miles per hour. These cars are intended for local service.

The sub-stations will be approximately 10 miles apart. The trolley wire will be No. 000 copper. There will be no feeders supplementary to the trolley wire. The sub-station transformers will supply 3,300 volts direct to the trolley line.

The consulting engineers estimate that in the equipment of the entire ultimate road of 93 miles from Indianapolis to Hamilton a saving over the former direct-current plans of $500,000 will be effected in first cost. The adoption of this new system involves also little apparatus which would have to be discarded in case the single-phase alternating-current system did not prove to be a success. The generators at the power station, the transmission lines and the motor equipments would all serve equally as well on a 500-volt direct-current system, with high-tension transmission, and to change to such a system with rotary converter sub-stations would necessitate only additional direct-current feeder copper and the installation of rotary converters and step-down transformers at the sub-stations.

Merger of Chicago Electrical Association and Western Society of Engineers.

On the evening of February 19 forty-one members of the Chicago Electrical Association dined at the Albion Café, it having been previously announced that the question of merging the Chicago Electrical Association into the Western Society of Engineers would be fully discussed and voted upon at that meeting. The Western Society of Engineers is an organization maintaining permanent headquarters in the shape of library, reading-rooms and meeting-room, with secretary's office in Chicago. It is composed of all classes of engineers, being in the nature of a general engineering society, with a membership on January 1, 1904, of about 700. According to the plan proposed and agreed upon, members of the Chicago Electrical Association will be admitted to the Western Society of Engineers without the payment of initiation fees. Members of the Chicago Electrical Association will constitute the electrical section of the Western Society of Engineers. The president of the Chicago Electrical Association will become a vice-president of the Western Society of Engineers and will be chairman of the electrical section. The work of the electrical section will be conducted as the association work has been heretofore. The advantages of the plan are that there are a number of men who would be desirable members for both associations, but who would not care to take the burden of joining two different organizations. The electrical association heretofore rented the use of the meeting-room of the Western Society of Engineers. It will now have a home of its own and will secure the benefit of the publication of its proceedings in the *Journal* of the Western Society of Engineers, and also the advantages of the library, reading-room and permanent secretary's office maintained by the Western Society. At the dinner some regret was expressed at the giving up of the name of the Chicago Electrical Association, which has become so well known, but it was the general sentiment that the advantages to be gained by consolidation would more than offset some of the disadvantages.

The Seattle Municipal Light and Power Plant.

By R. E. HEINE.

THE city of Seattle (population 140,000) is at present planning and erecting an electric power plant and transmission system for the purpose of supplying the city with electric light and power. The electric current generated is to be used, first, for street lighting, operating series incandescent and arc lamps, and later on for the operation of alternating-current motors and ordinary incandescent lights. No direct-current distribution is being planned for at present. The system at present includes a generating station near Cedar Lake, about 40 miles southeasterly from Seattle, two three-phase transmission lines and a distributing station at Seattle.

Power will be generated at 2,300 volts, 60 cycles, three-phase. This source of Seattle's water supply, which is carried to the city partly by the Cedar River and partly by a 48-in. wooden stave pipe. The idea of locating a municipal power station at this lake originated with the present city engineer, Mr. R. H. Thomson. The city owns the river for water supply and a greater part of the pipe line, which the transmission line will follow for 28 miles.

About one-half mile below the lake a substantial timber dam has been constructed, and from this a 49-in. wooden stave pipe joined further on to a steel pipe carries the water to a point three and one-half miles below to the site of the present power house. The gross head of water is 610 ft., and the effective head at the turbines is 560 ft. The wooden stave pipe is of fir, $1\frac{5}{8}$ in. thick and has a total length of 15,729 ft. The riveted steel pipe is 48 in. in diameter, the plates are 3/16 in. thick at the upper end and 9/16 in. thick at the power house. The stave pipe is being made at the city's saw mill

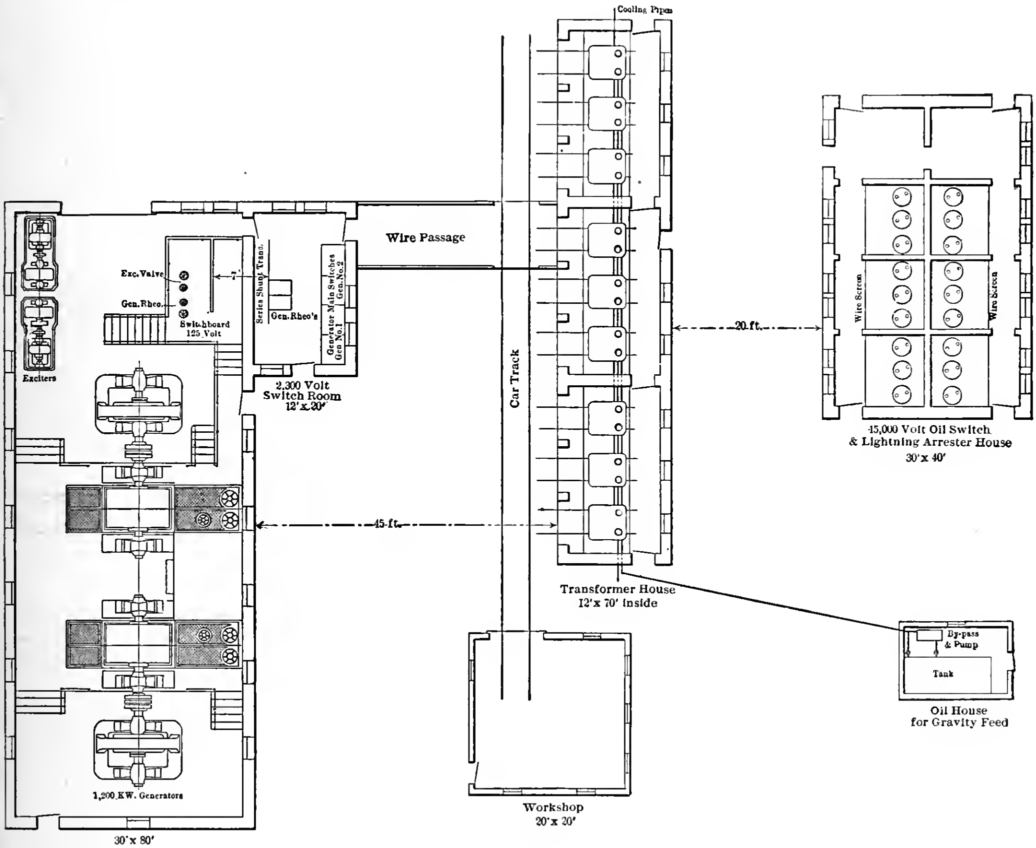


FIG. 1.—GROUND PLAN OF SEATTLE GENERATOR STATION AND MAIN BUILDINGS.

will be stepped up to 44,000 volts and transmitted to Seattle over two three-phase lines. At Seattle the current will be stepped down to 2,200 volts and changed to two-phase.

At the present time the lights and motors in Seattle are operated by two companies, both using a 60-cycle, two-phase system; furthermore, all of the load for the first few years will consist of arc and incandescent lights only. Hence, it was decided to adopt the rather high frequency of 60 cycles per second, and permit a switching of the load from one station to another in case of accident. The distributing station in Seattle will be provided with synchronizing devices, which allow for the supplying of power for the principal circuits during a shut-down of any one plant through accident or otherwise.

The source of water supply, Cedar Lake, is a clear body of water about three and one-half square miles in area situated in the lower Cascade Mountains, 1,535 ft. above sea level. The lake is also the at Cedar Lake and the steel pipe was furnished by the T. A. Gillespie Company, of Pittsburg.

The total available amount of power is 30,000 hp, but at present but 5,000 hp will be developed. In order to utilize the total power additional storage reservoirs are required.

Two Pelton water wheels, of the two-wheel type, will furnish power to the generators. The wheels are direct-connected to the generators, and operate at 400 r.p.m. They are capable of developing 50 per cent. overload and are guaranteed to operate at a minimum efficiency of 80 per cent. at full load. A Lombard governor controls each wheel. Two 125-hp wheels, running at 525 r.p.m., furnish power for the exciters, and are controlled by one Lombard governor.

The generators are standard machines of the Bullock Electric Company, of 1,200 kw output, 2,300 volts, 60 cycles, three-phase, of the revolving field type. The guaranteed efficiency of the generators is 95 per cent. at full load and the regulation is 8 per cent. on non-inductive load, 16 per cent. for a power factor of .9 and 20 per cent. for a power factor of .9, speed and excitation remaining constant. Two generators will be installed at present, but the plant is so arranged that additions may be made without interrupting the service.

The exciters are in duplicate, and of 75-kw capacity, 125 volts, compound-wound. Either exciter is capable of furnishing current for both generators for the lights in the station and for operating the motors in the station. This arrangement keeps one exciter in reserve for emergency service. Fig. 1 shows a ground plan of the station and the surrounding buildings and Fig. 2 gives sectional elevations of the same.

The switchboard at the generating station is placed on an elevated platform at one end of the present building, overlooking the machines. When the entire plant will have been erected it will occupy a central position. The board is made of Vermont marble, and is but 8 ft. long and 90 in. high, containing but four panels, two for the generators and two for the exciters. There are no alternating-current bus-bars and consequently there is no need for any transformer panels. A space of 4 ft. is left between the wall and the board, and all instrument and pilot wires pass down the back of the board, underneath the floor and through a wall to an annex 12 ft. x 20 ft. Here are kept all the switchboard transformers, shunts, exciter and generator rheostats and the electrically-operated oil switches.

The exciter rheostats are controlled by means of a chain and sprocket wheel from the panel, and the generator rheostats from pedestals with hand wheels in front of the panel. This gives an arrangement absolutely clearing the board of all dangerous voltages, and at the same time minimizing the amount of wiring to the panels.

The transformer house is of stone, 70 ft. long and 12 ft. wide on the inside. It is divided into three fire-proof compartments, each containing one bank of three transformers, which are all placed in a single row. A path 4 ft. wide is left the entire length of the house for the attendant; the oil and water taps, oil gauge and water overflow and thermometer are placed along one side of this path, so that observations can readily be made. A concrete pit runs the entire length of the building below the transformers, and in this are carried the oil and water pipes. A large tile opens from this pit below each transformer to drain burning oil in case of fire.

The high-tension leads leave the building through large tiles and are supplied with glass tubes supported by the wire. The glass tubes extend several inches beyond each end of the tiles. There are no high-tension switches in the transformer house. A pilot switch, however, is provided for each bank, so that in case of fire or accident the bank may instantly be cleared on both the high and low-tension side. The electrically-operated switches adapt themselves to this arrangement without adding any complications. Each transformer is mounted on a car resting on a truck by which it can be run into the shop for repairs.

At the same time that it is ideal to have all parts of a generating plant in sight at all times, experience has proven that this may result in the loss of the entire plant. The rapidity with which burning oil spreads and its intense heat, combined with the fact that water merely spreads it, makes it almost uncontrollable when once started. Being "between the devil and the deep sea," it was decided to first reduce the risk of fire and then make everything as convenient as possible under the circumstances. To this end a separate high-tension switching and lightning arrester house was designed. This building is constructed of stone and concrete, 40 ft. x 30 ft. wide. It

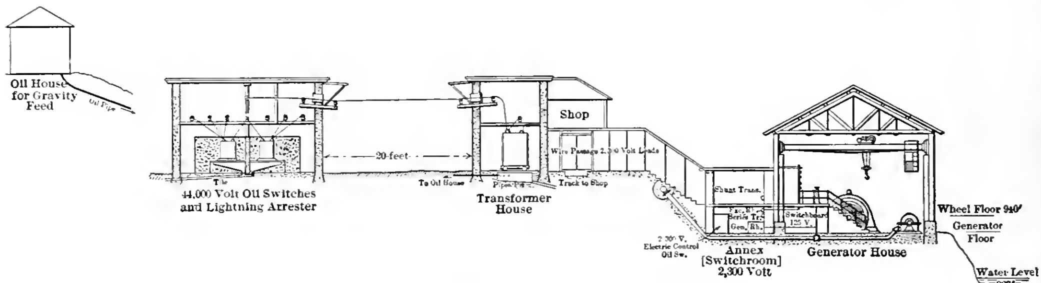


Fig. 2.—Cross-Section of Elevation Generating Station and Main Buildings.

The exciter wheel pipes run directly under the switchboard platform; valves are connected in here and pedestals for their control are placed on each side of the rheostat pedestals.

A motor control on the Lombard governor, operated from the board, places the main water wheels under control from the board. All parts of the plant are, therefore, under direct control of the attendant at the small 8-ft. switchboard, and any operation may be performed almost within arm's reach.

Inasmuch as both generators are of the same capacity as the bank of transformers which it supplies, there is no necessity of interchanging the generators, and bus-bars are not required. Each generator is provided with two main switches, one of which connects it with its own bank of transformers and the other connects it with a spare bank during changes or repairs.

The three ammeters on each generator panel are of the vertical edgewise type, and any unbalancing of any one phase throws that pointer out of the line and makes it more conspicuous. The generator panels contain the usual equipment of line ammeters, field ammeter, switch indicating wattmeter, Lombard governor control button, and pilot switches to control main switches. The integrating wattmeters are not placed on the board, not being necessary for operation. All switchboard instruments are finished in black and polished copper. The exciter panels are of standard pattern, and are equipped with Weston instruments.

From the generator house a passageway carries the leads to the transformer house, which contains nine transformers, each of 400-kw capacity, 60 cycles, 2,300 to 45,000 volts, of the oil-insulated, water-cooled type. These are built by the Stanley Electric Company, of Pittsfield, Mass.

is divided into eight compartments by concrete walls rising to such a height from the ground as to leave room for the two sets of bus-bars connected to the high-tension lines.

In six of these compartments are placed the six triple-pole, 45,000-volt oil switches. Each of these switches is provided with a disconnecting switch to clear the oil switch from the line during repairs. There are no single-pole switches used on the high or low-tension lines. This helps to prevent the unbalancing of the lines, and as one bank of transformers is held in reserve there will be no need of using two transformers in delta connection at any time.

The end compartments carry two sets of lightning arresters (one set for each transmission line) with their disconnecting switches, and from here the lines go out to Seattle. Fig. 3 shows a complete diagram of connections and wiring at the generating station.

The oil is fed to the transformers by gravity from a tank in the oil house, situated on a hill nearby. The oil can be returned if necessary through the same pipe by means of a by-pass and pump.

The lines will be built of cedar poles, 35 to 40 ft. in length, spaced approximately 140 ft. apart. There will be two lines, each carrying one circuit consisting of three No. 2 B. & S. medium hard-drawn copper wires spaced 72 in. between centers in the form of the usual triangle.

As no railway work is contemplated, the two lines will probably be operated in multiple and be so arranged that either one can be quickly disconnected should a short-circuit or ground occur on the line. Much of the country through which the lines pass is covered with fir trees up to 250 ft. in height and damage caused by falling branches will probably make this plan an advisable one. The entire plant, however, is in duplicate and can, therefore, carry separate lighting and motor loads.

One of the lines carries a telephone line of two No. 11 B. & S. hard-drawn copper wires on a 5-ft. cross arm 5 ft. below the cross arms of the power circuit. The transmission lines will be transposed in opposite direction every two and one-half miles, and the telephone line at shorter intervals. The wire for the lines and interior work has been furnished by the Standard Underground Cable Company, of New York.

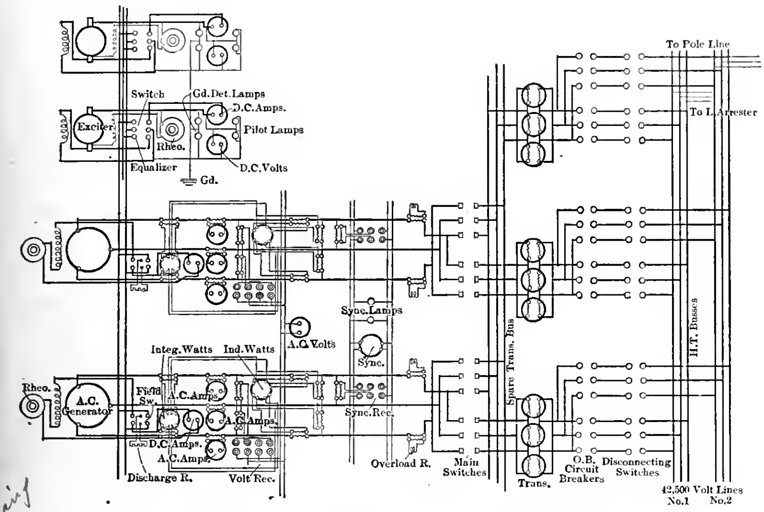


Fig. 3.—Wiring Diagram of Generator Station Main Circuits.

The insulators for the greater part of the system are supplied by the California Electric Company, of San Francisco. They are of the three-part porcelain type, weighing 11½ pounds each. They are 10 in. in diameter and 11 in. high over all.

The sub-station (corner Yesler and Seventh Avenue) will be a fire-proof structure of brick and stone. The high-tension wires will enter on the side of the building and the oil switches, all triple-pole, will be in separate compartments. The transformers are of 600-kw capacity each, in banks of two, changing from three-phase to two-phase at 2,200 volts for distribution. Concrete barriers separate the transformers and a pit with tile drains is arranged below them as in the case of the generating station. A car truck for moving the transformers is also supplied. The transformers are of the water-cooled type, the cooling water being supplied from the city water mains.

The sub-station switchboard, like that in the generating station, is a 125-volt board. The 2,200-volt switches and regulators are placed immediately below the board and are controlled by handles and hand wheels at the board. Only plain 125-volt wiring is on the board, and the panels are polished on the back as well as on the front. From the switches the circuits are run to the "tub" transformers for series arc street lighting and to the overhead and underground systems for other purposes. Fig. 4 shows a complete diagram of connections for the sub-station.

The switchboard is of Vermont marble. One panel is provided for each bank of transformers and carries an ammeter for each phase, a voltmeter receptacle, two levers for operating the four-pole oil switches connecting to either of two sets of bus-bars, and two levers operating the two triple-pole, high-tension oil switches to throw the transformers on either line. As there are no double-throw switches throughout the plant, the load can be transferred without dropping it during transfer.

A somewhat similar panel is provided to tie in with another station in case of line trouble or a shut-down of the plant. This arrangement provides for a transfer to or from the sub-station of 2,000 hp at 2,200 volts. This panel carries, besides the voltmeter, ammeters and oil switch levers, a frequency indicator, which may be connected to either system.

The distributing panels are single-phase, every alternate one being of the same phase. Each carries an ammeter and voltmeter receptacle together with two double-pole oil switches with overload relays by which the load may be transferred from one set of bus-bars to another of the same phase on the other side. Wattmeters are supplied for all of the panels, but are not placed on the board. Emergency switches are provided for on poles near the building by which the entire load may be cut off the building at the receiving station in case of fire or accident.

The entire design and construction of the plant is under the supervision of Mr. R. H. Thomson, the city engineer of Seattle, who has also constructed for the city its present water works system, one of the most successful in the West.

The designing and planning of the electrical work of the plant has been done by Mr. J. D. Ross, electrical engineer of the city, who is in charge of this part of the work.

U. S. Army Wireless Telegraphy.

After experiments for six months the success hoped for was attained over the United States Army wireless telegraph line between Fort Wright, Fisher's Island, and Fort Schuyler, N. Y., a distance of 97 miles. Messages of 1,000 words each were exchanged and read as distinctly as an operator could read a land line, at a speed of 30 words a minute. The line established is intended for use between St. Michaels and Nome, Alaska, where it has been impossible to establish ground lines because during the winter the cables are wrenched away by the ice. Upward of $350,000 has been expended to establish a land telegraph line, but without success.

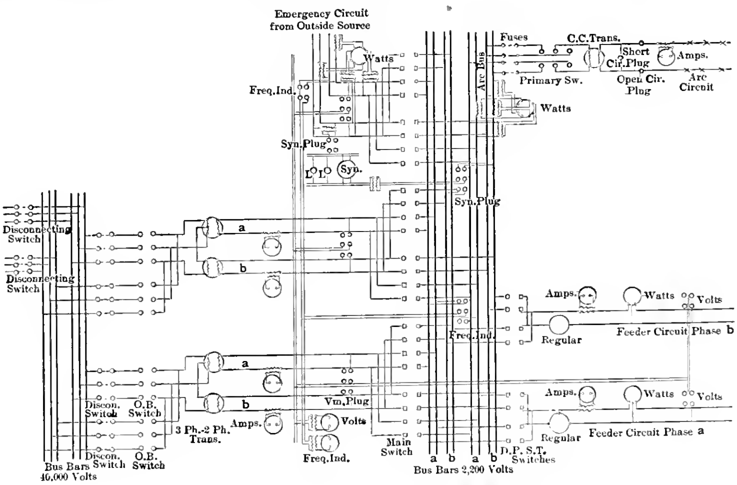


Fig. 4.—Wiring Diagram of Sub-Station Main Circuits.

How Can We Haul by Electric Locomotives Freight Trains Weighing Twice as Much as Those Now Hauled by Steam Locomotives?

By H. Ward Leonard.

FOR many years past the most important problem before the electrical engineers of the world has been the development of an electric locomotive which would commercially replace existing steam locomotives. It is a fact, the significance of which is apparently not appreciated, that the cost of hauling freight is inversely proportionate to the number of tons handled in a single train. For many years I have firmly believed that the principal advantage possessed by electric power when compared with steam power for tractive purposes lies in the possibility of hauling by means of electric power upon existing railways, freight trains very much heavier than can be hauled by steam locomotives. The way to make the maximum net earnings out of a trunk line railway is to keep in every block section a freight train of the maximum possible weight and moving at as high a speed as practicable; for this means that the enormous fixed charges of a railway are distributed over the maximum possible tons of freight and hence the fixed charges per ton mile are reduced to a minimum. In support of these ideas, I have prepared a table, printed herewith, showing the enormous economies which have been made in this country since 1894, principally due to the great increase in the draw-bar pull of the locomotives.

I also give a tabulation below, from which it appears that the average train load in tons on the Pennsylvania Railroad was about seven times as much as the average load in tons for the London and N. W. Railway, these figures being 518 and 72 respectively; while the cost per ton-mile for the Pennsylvania Railroad was only about one-quarter of the cost per ton-mile of the London and N. W. Railway, these figures being .4 and 1.49 respectively.

UNITED STATES STEAM RAILROADS.

	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.
Total number of locomotives (including passenger locomotives)	39,729	38,065	37,245	36,746	36,410	36,338	36,610	36,304
Number of freight cars..............	1,409,472	1,350,258	1,328,084	1,284,807	1,234,972	1,245,640	1,230,798	1,228,781
Freight mileage (ton-miles)..........	148,959,000,000	141,162,000,000	126,991,000,000	114,556,000,000	97,842,000,000	93,885,000,000	88,567,000,000	82,219,000,000
Ratio: Freight ton-miles divided by total number of locomotives.........	3,749,000	3,710,000	3,409,000	3,117,000	2,688,000	2,579,000	2,419,000	2,265,000
Freight train mileage................	505,468,000	513,667,000	534,391	542,824,000	500,326,000	497,248,000	491,410,000	475,789,000
Tons of freight moved...............	1,084,000,000	1,071,000,000	976,000,000	913,000,000	788,000,000	774,000,000	756,000,000	675,000,000
Earnings from freight..............	$1,126,000,000	$1,053,000,000	$922,000,000	$869,000,000	$780,000,000	$770,000,000	$744,000,000	$700,000,000
Earnings from passengers............	$361,000,000	$331,000,000	$298,000,000	$273,000,000	$255,000,000	$265,000,000	$261,000,000	$275,000,000
Number of passenger cars............	27,144	26,786	26,184	25,844	25,654	24,940	26,419	26,357
Passenger train-miles	391,500,000	373,200,000	355,100,000	344,800,000	342,500,000	337,600,000	326,200,000	326,000,000
Number of passengers carried.........	600,500,000	584,700,000	538,000,000	515,000,000	504,100,000	535,100,000	529,800,000	569,660,000
Total miles of track.................	265,992	257,853	250,362	245,238	241,700	238,729	235,031	232,755

EXPENSES PER TON-MILE.	Cents.
L. & N. W. Ry................	1.49
Pennsylvania R. R............	.4
New York Central.............	.4158

AVERAGE TRAIN LOADS.	Tons.
L. & N. W. Ry................	72.25
Pennsylvania R. R............	518.
New York Central.............	387.

AVERAGE EXPENSE PER PASSENGER PER MILE.	Cents.
L. & N. W. Ry................	1.134
Pennsylvania R. R............	1.457
New York Central.............	1.15

It is a well-known fact to those who have given consideration to such matters that the steam locomotive on account of various limitations cannot be made much more powerful than it now is. It is also well known that the most powerful steam locomotives have such extraordinarily high depreciation as to make it very doubtful whether any real economy has been gained by the most recent increases in size and power.

The urgent demand for greater hauling power leads frequently to double heading; that is, the use of two steam locomotives on one train. Each of these steam locomotives can develop, say, 175 hp, but double heading is not nearly so economical, for many reasons, as would be the case with one large locomotive or two locomotives which would perfectly divide the total load between them and which would be, at all times, under simple control by one operator.

When judging the comparative advantages of the various electric systems which have been proposed for railway work, it seems to me that all other considerations must be secondary to the consideration of whether the system has the ability to haul greatly increased train loads over long distance with a maximum of reliability and a minimum of depreciation and with a system of control which will give the minimum investment in power plant and transmission system. I believe that the Ward Leonard system possesses these desirable qualities to a higher degree than any other system yet proposed, and that by means of large locomotives operated upon this system, very great economies can be effected in the cost of hauling freight upon existing trunk line railways, as compared with the best results obtainable by the present steam locomotives.

Time alone can show what the best form of electric locomotives will be for hauling the enormous freight trains, which I think we shall see in the not distant future; but I am convinced that extremely powerful electric locomotives will soon demonstrate their superiority over steam locomotives for long distance freight haulage, and when this fact is conclusively demonstrated, there will follow an industrial revolution, the extent of which seems almost unlimited, and, in comparison with which the electrical work we have thus far seen will appear utterly insignificant.

Removal of Car Tracks.

One of the recent bills introduced in the New York Legislature allows a company to remove its unused rails without impairing its franchise, and to relocate its route with the consent of local authorities so as to meet changing conditions of traffic. At the present time there are said to be a number of miles of street occupied by street railroad tracks laid under valid franchises, upon which the street railroad companies are compelled in self-protection to operate a few cars in order to keep the franchises alive for use in case they should hereafter become important. It is declared to be to the city's interest that the company should be free, with the consent of the city, to remove such tracks in order that the condition of the street may be improved. The fourth bill would allow the removal of such tracks without invalidating the franchises. In New York City, for example, on Amsterdam Avenue there are four tracks, two owned by one company and two by another. One company is said to be quite willing to discontinue the use of its track and use the tracks of the other company, but has been unable to do so, because of the objection of the trustee of its mortgage that if the tracks were removed the franchise would be imperiled.

New York Subway Model.

In the rooms of the Rapid Transit Commission in New York City there is on exhibition an elaborate model of the great work, that is to be shown at the St. Louis Fair. On a massive carved oak table is a miniature New York underground railroad station, brilliant with small electric bulbs. Looking through this the spectator will get a view back into a section of tunnel, equipped with tracks, signal appliances and lights, and with tiny electric trains at intervals. A brass plate on the front of the table explains that this is the New York subway designed by Mr. William Barclay Parsons, chief engineer. In a big showcase, on another oak table, will be exhibited various minerals and curios found below the surface of the city by the subway builders, including cannon balls dug up in Elm Street, ancient coins found all along the line, and even a human skeleton.

A Composite Plant at Bloomsburg, Pa.

By L. S. Levy.

Of the numerous small water powers in the eastern part of Pennsylvania, one that has been utilized to good advantage is that on Fishing Creek, a tributary of the Susquehanna River, flowing into the latter at Bloomsburg. It is on the banks of this creek that the old Irondale Iron Company had its mills. The skeleton of the pig-casting house is still standing; it was almost entirely of wood, as were the two jib cranes that served the casting floor. These cranes, in their bare simplicity, are silent witnesses of the methods of fifty years ago. The old blast house is now occupied by the plant that forms the subject of this notice. The blowing engines were driven by two overshot wheels located in the very pit in which their more modern successors have been installed.

The Irondale Electric Light, Heat & Power Company was incorporated on April 7, 1902, with a capital of $50,000. This company was organized for the purpose of using the Fishing Creek Falls for electric power generation, the existing service being inadequate. The falls are situated about two miles from the center of the town, and about one and a quarter miles above the power house. The old dam at this point was repaired and raised to a height of 15 ft. The im-

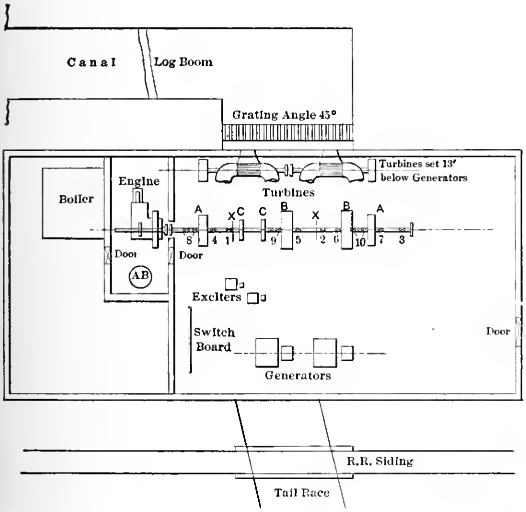


FIG. 1.—PLAN OF STATION.

pounded water is conveyed to the power house by means of the old canal, as the latter required very little repair to put it into good shape.

The power house is a building 108 ft. x 40 ft., and is two stories in height. Only the ground floor is used for power purposes, the object being to rent the upper floor for factory purposes. Reference to the plan diagram in Fig. 1 will show the location of the turbines. There are two horizontal wheels 30 in. in diameter of the Victor type, which operate under a head of 29 ft., and develop 250 hp at a speed of 250 r.p.m. Regulation is effected by means of a Snow governor, which serves both turbines through a countershaft. Power is delivered to the main shaft through Candee 10-ply canvas belts.

As an auxiliary in times of low water, ice jams, etc., a 300-hp engine is installed. This was built by Russell & Co., Massillon, Ohio. It is of the simple automatic type, cylinder 19 in. x 22 in., speed 200 r.p.m. When required for service it is direct-connected to the main shaft through a flange coupling. Steam is furnished at a pressure of 100 pounds by a 300-hp water tube boiler built by E. Keeler & Co., Williamsport, Pa., who also furnished all steam auxiliaries, including a Scranton boiler, feed pump, Hancock inspirator, Burrows damper regulator, etc.

Conditions that had to be met in this station practically dictated the use of a quill shaft. It had to be possible, of course, to operate either generator, or both, from either turbine, or both. These conditions are very handily met, as will be readily understood by reference to Fig. 1. This will give an idea of the layout of the station in addition to the shaft itself. The turbine belts run over pulleys A and A'. These pulleys are mounted on quills 5 ft. 9 in. long and $7\frac{5}{8}$ in. and $6\frac{5}{8}$ in. in diameter. One portion of a 40-in. Hill clutch is mounted on a quill, the other portion of the clutch being, of course, mounted on the inner shaft. Each of the generator pulleys B and B', is 90 in. in diameter, with a 27-in. face, and is mounted on a quill. As

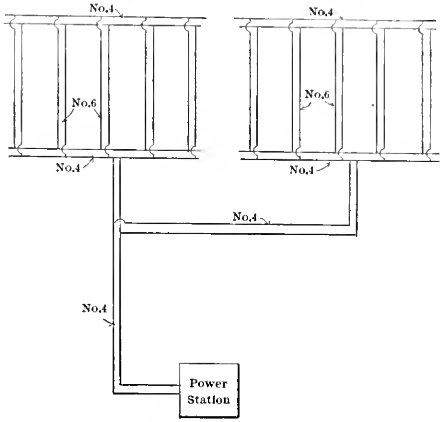


FIG. 2.—DIAGRAM OF DISTRIBUTING SYSTEM.

with the turbine quills, they are connected with the main shaft by clutch couplings. At C and C' are shown the exciter driving pulleys. The pedestal bearings 1, 2 and 3 serve the inner shaft alone: 4, 5 and 6 serve the quill alone, 8 and 9 are double bearings, serving both quill and inner shaft, while 10 has three journals, the outer two serving quills and the center one the inner shaft. At X the inner shaft is divided, the parts being connected with flange couplings. This arrangement has worked very well, and when additions are made to the plant they will be installed in a similar manner.

The generators are Westinghouse two-phase machines of the revolving armature type. They are driven at 514 r.p.m. and furnish current at 2,200 volts and 60 cycles. They are rated at 180 kw, and are guaranteed to stand 25 per cent. continuous overload, with no greater increase in temperature than 40° C. They are excited by two $3\frac{3}{4}$-kw, four-pole generators, either one of which is sufficient for both of the large machines. The main generators have a compound field, but the series winding is used only when the machines are operated in multiple.

The current is carried to the switchboard by wires laid in ducts under the floor. The switchboard comprises three panels—two gen-

FIG. 3.—INTERIOR OF STATION.

erator and one feeder. On each of the generator panels is mounted two ammeters; a recording wattmeter, double-break main switch rheostats, etc. There will be seen on the small framework at the left of the switchboard four instruments; the upper two are voltmeters, while the lower left is a frequency meter, and the lower right one is a synchronoscope. At the bottom of each of the generator panels are three plug receptacles that are used for making equalizing connections between the exciters, and for serving the same purpose for the series winding of the main generators when they are operated parallel.

The distributing system has been carefully worked out along the following plan: Four No. 4 copper wires are carried to the center of distribution, which is at a distance of 3,000 ft. from the station; at that point they branch off, as shown, and are carried for about 500 ft. on the company's own poles. For the remaining 2,500 to the center of distribution the wires are carried on the Bell Telephone Company's poles. Any trouble from induction is avoided by two transpositions. The poles are spaced 120 ft. apart, and on every fifth one a lightning arrester is mounted. Both branches of the circuit running up and down the main street are No. 4; the crosstown lines are No. 6. It will be noted that there is plenty of copper, but the excellent service rendered has well justified the outlay. Customers are well satisfied, and there is no reason why they should

FIG. 4.—CANAL.

not be, for there is very little difference in voltage between one end of the town and the other.

At the present time there are 3,500 lamps connected and there are about 120 being added every week. There is a load of about 50 hp in small motors, and this business is also increasing on account of the cheap rates and the good service rendered. Many establishments in town are using water motors, and these are being rapidly replaced with two-phase induction motors; $30 per horse-power per year is charged for motors, while the lighting rate is still on a flat basis of 30 cents per lamp per month. The plant was installed and is operated under the supervision of Mr. William O. De Witt, a student of the International Correspondence Schools, of Scranton, Pa., and manager of the company. It is due to his courtesy that the writer has been enabled to inspect the plant and gather the particulars given.

British Westinghouse Electric Affairs.

At the fourth annual general meeting of the stockholders of the British Westinghouse Electric & Manufacturing Company, Limited, held in London February 5, Mr. George Westinghouse, the chairman of the company, made some very interesting statements. He said in part: "The orders in hand not executed on January 31, 1904, amount to £1,608,256, the patterns, new tools and special machinery required in the execution of these orders and the large amount of labor involved before any shipments of complete apparatus can be made, require working capital in proportion, and as I said at the last annual meeting in reference to the proposed authorization of 200,000 new preference shares, this additional working capital which your extensive plans have contemplated from the first, is fortunately needed sooner than some of us expected. I may say 'fortunately,' because we have already secured such a volume of business as to justify the profitable use of the additional working capital, which will be required to carry the materials and accounts involved in the execution of existing contracts. Your works at Manchester at present give employment to about 7,000 operatives and the buildings have been so planned that extensions can be made for a comparatively small expenditure of capital, which will generally increase their output. In Australia and New Zealand business generally has greatly improved and our sales show a satisfactory increase during the year under review. Our representatives (Noyes Brothers) have just informed us that owing to developments they have thought it necessary to establish a separate branch office in Western Australia. In South Africa there has been a marked revival in our business during the past year and we have recently arranged for more active representation for extending our connections there, in view of the probable great demand for electrical apparatus for the mines directly the labor difficulty is solved. In India we have made definite arrangements for representation and have recently secured an order for an extensive power installation, besides a considerable amount of apparatus for the mining district. We believe that there is likely to be an increasingly active demand for electrical apparatus from the British colonies all over the world. It must also be remembered that not only do we manufacture for the home trade and the colonies, but under the terms of the agreement in relation thereto we have furnished apparatus for several large orders for the execution of contracts in the territory of other Westinghouse companies, notably on the continent of Europe and in South America, and there are now pending a number of important negotiations. The importance of this relation between the various Westinghouse companies may be illustrated by a quotation from a report just made to me from the manager of the French Westinghouse Company:

"'We have the great advantage of the assistance of the various Westinghouse companies, the value of which it would be difficult to commute; our ability to obtain by cable, at short notice, estimates and specifications of new material to meet new conditions, as evidenced recently by information supplied us concerning single-phase apparatus, places our company in the front rank of continental manufacturing concerns.'

"From the beginning of your operations it has been apparent to your directors that there should be a head or chief executive for your company. Men of the required experience and personal characteristics capable of managing a property and business such as yours are difficult to find. To the selection of a competent chief executive official I have devoted much thought and investigation, and I have the honor of proposing the election, as one of your directors, of Mr. William I. Buchanan, and to your directors I shall propose his election as deputy chairman and managing director of the company. (Mr. Buchanan's appointment was forecasted in the ELECTRICAL WORLD AND ENGINEER several weeks ago.) Mr. Buchanan, who will, with myself, represent the American companies' interests in the British company, has had an exceptional experience in the management of important affairs and I am satisfied that your business will have that constant supervision and direction which are so essential to complete success. A supervision which it will be impossible for me to continue to give to that extent as heretofore, in view of my larger interests in America, though I propose to still give as much time as possible to the further development of your business. The American Westinghouse companies, in return for ordinary shares, which will not receive any dividend until after the preference shares have first had a dividend of 6 per cent., have already rendered a service or given value in excess of the par value of these ordinary shares. They have, with other American friends, already paid about 30 per cent. of the outstanding preference shares and I am now authorized by the Westinghouse Electric & Manufacturing Company to take as many of 100,000 new preference shares at par as may not be taken by the other shareholders."

All the resolutions put to the meeting were carried unanimously.

Muscular N-Rays.

According to advices which were recently received from Paris, Blondlot N-rays have been proved by Professor Charpentier, of Nancy, to emanate from the human body, and more especially from the muscles. To show this, the Professor suggests a little experiment which can be tried by anyone. It is only necessary to take a piece of black paper, part of which has been covered with phosphorescent sulphur, and place it against a muscle in a dark room. The phosphorescence will at once be seen to increase, and the tenser the muscle the greater will be the effect of the "N-rays." The same effect can be caused with any tense body, such as a bent bow, but what the nature of the rays, or emanations, is the Professor has not yet been able to demonstrate.

Service Power Plant of the Louisiana Purchase Exposition.

IN the marvelous development which characterizes the modern exposition, the supply of electricity for lighting the grounds and buildings and for general exhibit purposes, becomes an important consideration. At Buffalo unlimited power was fortunately available by transmission from Niagara, but at St. Louis it has been necessary to construct a service plant which will primarily be depended upon for furnishing a continuous supply of power to the Exposition; the plant thus resembling in the character of service rendered, the ordinary central station.

Other sources of power will, of course, be necessary, as much more power is required than can be supplied by the service plant. Part of this extra power will be supplied by the various exhibit plants and the remainder from the city system of the Union Electric Light and Power Co. It is contemplated that the service plant and the city plant will operate in parallel during periods when both systems are doing the same work. As the intervening distance is considerably over five miles, this will form an interesting feature of the Exposition service.

The character of the service for which the Exposition plant was built includes general arc and incandescent lighting of grounds and buildings; power for operating 2000-hp direct-connected induction motor turbine pumps supplying the cascades with water, and power for general exhibit work. The distribution is at moderately high potential—6,600 volts—and the frequency now universal in extensive power systems—25 cycles per second—is employed. A high-tension underground conduit system connects the service plant with distributing sub-stations located in the various buildings, where current will be stepped down to alternating-current voltages suitable for general distribution, and converted to direct current for motor work. Miscellaneous voltages and frequencies will be supplied entirely by exhibit apparatus.

The design and construction of the service plant has been carried out by Westinghouse, Church, Kerr & Co., the general contract for the entire equipment being awarded to the Westinghouse Electric and Mfg. Co., Pittsburg, Pa. This company has furnished the entire electrical equipment with the exception of two generators, which are to be supplied by the General Electric Company. The entire engine equipment was furnished by the Westinghouse Machine Company. In thus entrusting the execution of this important work to a single engineering concern, it has been possible, through the close co-ordination of interests involved, to secure the most harmonious and appropriate design consistent with the essentially temporary character of the undertaking and the necessity of conforming to a rigid time limit.

The service plant has not been laid out on elaborate lines with a view to combining the diverse characteristics of an exhibit and a service plant. On the contrary, the construction has been simplified as much as possible in order to reduce complication and to provide the greatest reliability and ease of operation. Standard apparatus has been employed throughout, and particular care has been taken to obviate interruptions of service by duplicating the equipment of vital points. The plant is, therefore, an exhibit plant in so far as it is representative of thoroughly modern practice at minimum cost.

LOCATION.

The space reserved for the service plant is located in the western end of the Machinery Building and in the adjoining Steam and Fuels Building; the former containing the electric generating plant and the latter the steam generating plant. The Steam and Fuels Building also contains miscellaneous exhibits of steam boilers, briquette making and gas-producing apparatus.

The location of the electric plant is conspicuous, as it occupies the central aisle of the Machinery Building, about 230 feet of this aisle being reserved for the plant. This space lies midway between the exhibits of the two largest American electrical manufacturing companies, the Westinghouse Electric and Mfg. Co.'s exhibit occupying the southern wing and the General Electric Company's the northern wing of the building. Each company is represented in the generating and switchboard equipment, and the plant is therefore representative.

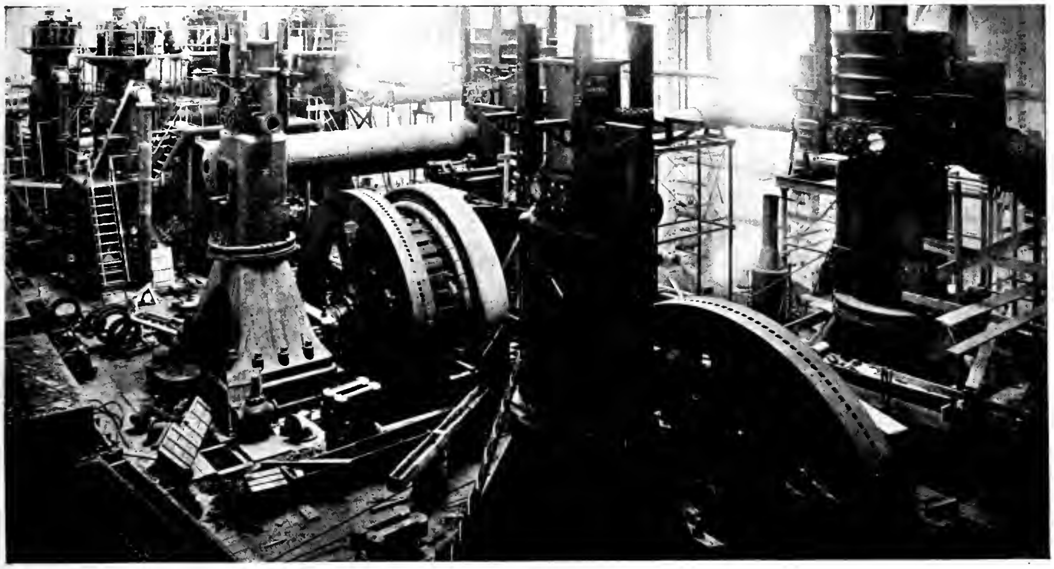


FIG. 1.—GENERAL VIEW OF GENERATING PLANT, ST. LOUIS EXPOSITION.

The main aisle is served throughout its length by several cranes, the runways for which are separate from the building columns. One of these, a 40-ton 3-motor crane, forms part of the plant equipment and was used in its erection.

In the erection of the plant many difficulties were experienced on account of the treacherous nature of the soil, which is made ground on river bottom. All ground had to be piled, not only under the building and machinery foundations, but also under boiler and flue walls, pipe tunnels and overflow conduits.

The buildings, being of temporary character, are naturally of light construction, which introduced further difficulties in providing proper supports for piping. It was found necessary to support the large piping directly from the floor upon steel towers.

The general arrangement of the steam and electric plant is shown in Fig. 2.

GENERATING PLANT.

The main generating plant is of 8,000-kw capacity, in four units of equal size. The plant is served by three 80-kw exciter units, two of which are sufficient to operate the entire plant together with such auxiliary machinery as may be required in the adjacent exhibits, leaving the third unit as a reserve.

Each pair of generating units receives steam from a separate steam line, in turn supplied by a separate battery of boilers, and exhausts into a separate condenser. The entire plant thus consists of two sections practically in duplicate, which may be operated independently or together.

Each generating unit consists of a Westinghouse-Corliss vertical cross-compound engine direct-connected to a 2,000-kw revolving field alternator, the unit operating at 83 r.p.m. The engine is 38 x 76 x 54, indicating 2,883 hp at full load with 27½ pounds mean effective pressure referred to the low-pressure cylinder. The engine has a maximum overload capacity of 5,244 hp under normal conditions of 150 pounds steam and 26 in. vacuum. The overall dimensions of the unit are approximately 32½ ft. in height, 35 ft. in length and 15 ft. width for the engine alone; the flywheel being 23 ft. in diameter. A receiver connects the high-pressure and low-pressure cylinders. The engine is fitted with Corliss valves and "three-quarter" valve gear, with a new enclosed-type governor. Cylinders, valves and pistons are of special close-grained air furnace iron, and cranks, rods and pins are of forged steel, the shaft being forged hollow by hydraulic pressure. The shaft is 31 in. in diameter at the generator and 28 in. at the bearings, which are of the ball and socket self-aligning type. The guaranteed economy of the engines is 13½ pounds per 1 hp at the point of best efficiency. The speed regulation within small limits for paralleling the generators is effected from the switchboard through a motor-actuated weight on the governor lay-shaft, this motor being connected with a switch on the board.

The generators are rated at 2,000 kw at the usual temperature rise. They deliver three-phase current at 6,600 volts directly to a distributing system, without the introduction of intermediate transformers. Fifty per cent. overload may be carried for one hour without injurious heating. The armature frames are arranged to be moved parallel to the shaft in order to provide access to the fields, which are strap-wound, with laminated pole pieces. The guaranteed efficiencies of the Westinghouse unit, based upon measured iron and copper losses, are as follows, on the basis of 100 per cent. power factor: full load, 96 per cent.; ¾-load, 95 per cent.; ½-load, 93 per cent. Each machine, complete with bed-plate, weighs 196,000 pounds, the rotating member having a flywheel capacity of 5½ ft. radius, of 70,000 pounds.

The exciter units are standard Westinghouse engine-type machines, with field frames divided in a vertical plane parallel to the shaft. By separating the two halves of the frame, direct access may be had to the armature for inspection or repair. The guaranteed efficiencies of these generators, also based upon copper and iron losses, are as follows: full load, 91 per cent.; ¾-load, 91 per cent.; ½-load, 90 per cent.; ¼-load, 83 per cent.

The exciters are driven by twelve 20 x 12 Westinghouse compound engines operating at the regular boiler pressure and exhausting into the main condensing system.

The switchboard for the entire generating equipment will be located at the western end of the main aisle upon a raised platform. It will consist of thirty-five panels, four of which will be devoted to the main generators; three to the exciters; two to incoming feeders from the Union Electric Light and Power Company's plant; two are used for load panels, and twenty-four for outgoing feeders. The panels are of blue Vermont marble mounted upon steel framework with non-combustible bus supports and other standard approved fixtures. A duplicate set of bus-bars is employed, each having an individual load panel for totalizing the output. The main current will be controlled entirely by automatic electrically operated oil switches, operated from the main board. Shunt and series transformers are used with all indicating and recording meters. Each main generator panel contains the usual equipment of ammeters and voltmeters, also an indicating wattmeter, field discharging switch, and engine governor motor switch. Time limit relays will also be used for protecting the generator from prolonged short-circuits. The Westinghouse generator panels use a single polyphase indicating wattmeter, while the General Electric panels contain two single-phase indicating wattmeters, together with a recording wattmeter. Black oxidized copper forms the general finish of the instruments. The twenty-four outgoing feeder panels contain similar equipments and a single pair of high tension switches, part being of the Westinghouse hook type and part of the General Electric knife type.

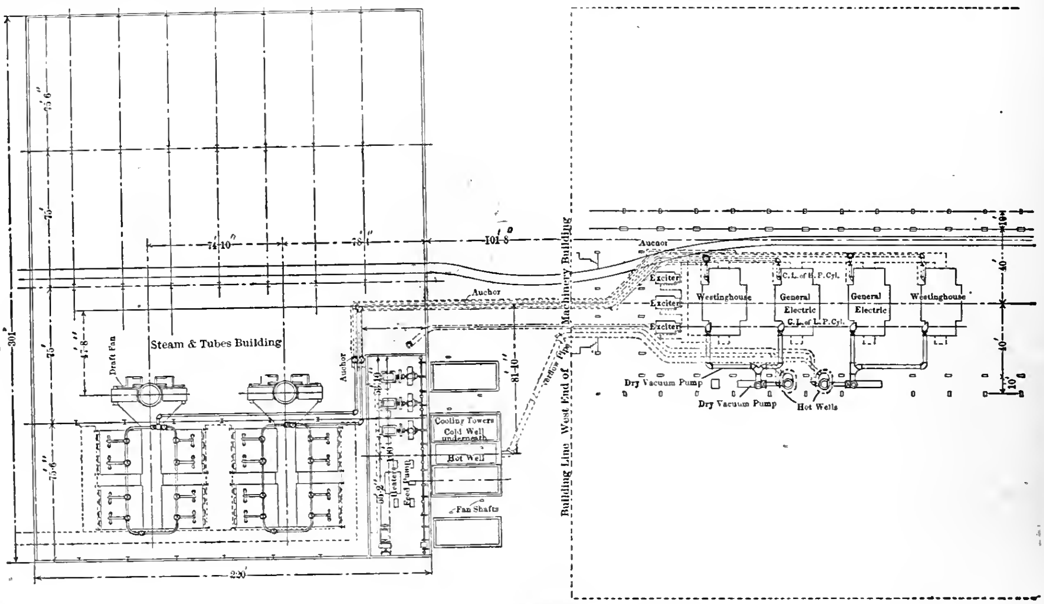


FIG. 2.—PLAN OF STEAM AND ELECTRIC PLANT.

BOILER PLANT.

Conforming with the duplicate construction employed in other parts of the plant, two complete steam generating outfits have been installed, each with independent flues, mechanical draft, steam and feed-water system. The capacity of the plant is 6,400 hp at the standard rating, uniformly distributed between eight batteries of boilers.

Each battery contains two 400-hp Babcock & Wilcox, inclined header, water-tube boilers built into a single setting. The boilers have 42-in. drums hung from a structural steel framework so as to be independent of the setting, thus relieving the brickwork from the stresses due to dead weight and differential expansion. The products of combustion discharge horizontally through the upper part of the setting into a single flue common to each section of the boiler equipment. The boilers are all fitted with Roney mechanical stokers driven by Westinghouse Standard engines, through worm gearing, each stoker engine operating two complete batteries of stokers by means of a shaft extending along the stoker fronts. The boiler plant furnishes steam at 150 pounds pressure without superheat.

Two spur tracks entering the Coal and Fuels Building along the western wall, will be utilized for handling coal and ashes. A complete conveying system, furnished by the Link-Belt Engineering Company, receives the coal from the hoppers located between the track rails, elevates and distributes it among individual bins, each serving one stoker through steel chutes. The system also conveys coal to a storage bunker of about 500 tons capacity, from which the coal may also be drawn for miscellaneous boiler and gas producer exhibits located in the same building. The individual bins in front of the plant boilers are supported by structural steel frames independent of the boiler columns. They each hold about five tons of coal and are circular in form with conical bottoms, the discharge being controlled by wing valves. The chutes conveying the coal to the stoker hoppers are arranged to swing about a horizontal axis in order that they may be swung back into a vertical position to clear the stokers and boiler doors.

Ashes from the stoker grates gravitate into concrete-lined pits, from which they are moved into ash cars running through tunnels beneath the floor. These tunnels connect with the cross tunnel outside the building, which rises to the surface.

The boiler plant is supplied with feed-water from the city mains, after passing through a duplicate set of 4,000-hp Cochrane feed-water heaters using exhaust steam from the boiler house auxiliaries. This heater is mounted 3½ feet from the floor upon a hollow concrete pier reinforced with expanded metal.

The battery of pumps located near the heater supplies the entire plant with feed-water. Two types are represented, viz., duplex outside-packed double-plunger, and the Admiralty type, both of Worthington make. Two of the former type are used, each 9 x 16 x 7½ x 15, and one of the latter, 14 x 10 x 18. These pumps discharge into a ring main in order that they may be operated singly or together, as desired.

MECHANICAL DRAFT PLANT.

Two complete mechanical draft plants have been installed, each serving eight boilers aggregating 3,200 hp, and a duplicate fan is provided for relay purposes.

The flue construction consists of concrete floors and brick ceilings supported by 2¼-in. x 2¼-in. tees which span the space between the rear walls of the boiler settings. As this space is about 10 ft. in width, a row of 4-in. pipe struts with I beam stringers supports these T beams at their centre. The ceiling is finished with two courses of common brick laid flat and flushed with cement This flue leads directly to the fan housings, the joint being sealed with a sleeve formed by angles riveted to the housings.

The fan equipment consists of two 14 ft. 12-blade steel plate fans mounted within a rectangular steel plate housing suitably strengthened with steel sections. These fans are of ¾-housed overhung pattern built from special designs of Westinghouse, Church, Kerr & Co. by the New York Blower Company. The central part of the housing supports the steel plate stack, which is 11 ft. in diameter, the whole resting on a concrete pier. The two fans operate in opposite directions, receiving the flue gases at their centre and discharging the periphery into the central compartment leading to the stack. A deflecting damper hinged at the center of this compartment provides means for isolating the idle fan as well as for insuring a continuous surface for the ascending gases from the fan in motion. The intake of each fan is closed when idle, by a steel plate damper 10½ ft. square, which is hung from rollers and may be shifted from one intake to another by means of a chain and hand-wheel. With the two dampers mentioned, each fan may be operated independently of the other, or if unusual capacity is required, the dampers may be placed in mid-position and both fans operated simultaneously.

Each fan is direct driven by a Chandler & Taylor 13 in. x 14 in. simple automatic high-speed engine controlled by a throttle governor. The fan bearing is supported by a cantilever I beam grillage, and is of the ring-oiling type protected from the heat of the flue gases by a water-jacket.

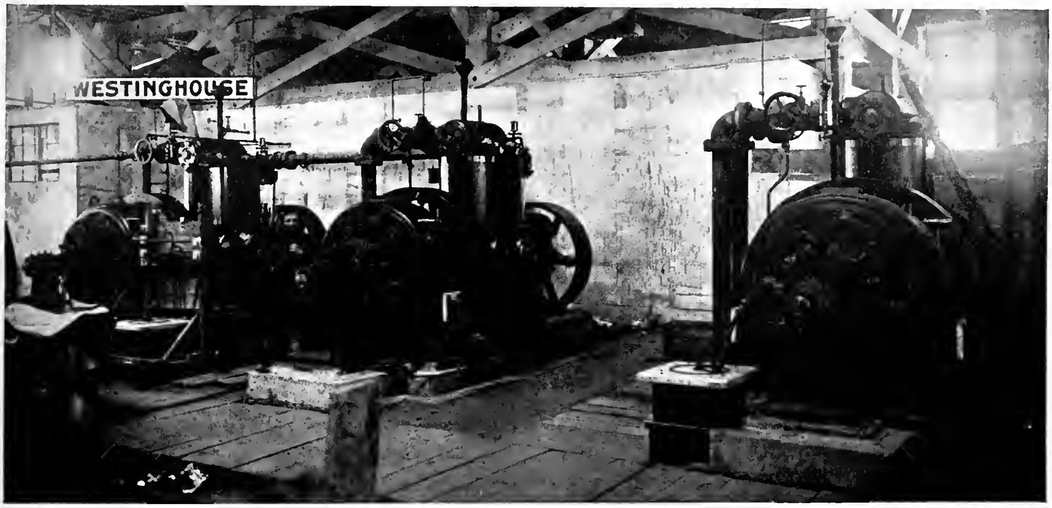


FIG. 3.—EXCITER UNITS.

CONDENSING PLANT.

The two condensing plants are practically duplicates, although each is intended to serve one-half of the engine plant. The condensers, which are 40 in. in diameter at the entrance, are of the Worthington elevated jet or barometric type. They are located in the space between building and crane columns in order to clear the crane. At the junction of the horizontal and vertical lines of exhaust piping is located a cast-iron entrainer which forms a water pocket draining the horizontal line and so directing the passing exhaust steam as to pick up any water collected in quantity in the pipe and carry it over to the condenser in the form of spray. At the top of each exhaust riser is an automatic relief valve which in event of loss of vacuum provides a vent to the atmosphere through a line of vertical spiral riveted pipe extending through the roof. A gate valve at each engine and at the condensers gives complete control of this part of the system. The weight of the condenser is borne by two 15-in. I beams spanning the concrete hot-well, lugs having been fitted on the tail pipe for furnishing the required bearing.

Injection water is supplied through a 30-in. cast-iron main from the pump room, two 20-in. risers leading to the two condenser cones. At this point is located on each condenser a tubular air cooler, around which the injection water circulates on its way to the condenser.

An important part of the condenser equipment are the dry vacuum pumps, the function of which is to extract from the condenser cones the entrained air which would otherwise impair the vacuum. This is drawn from the cone in the form of saturated vapor. The moisture is condensed in the copper tubes of the air cooler, leaving dry air for the pumps. Three pumps are furnished for the two condensers, one of which may be held as a reserve. Two of these are 10 in. x 22 in. x 18 in. of the horizontal rotative pattern, and the third an 8 x 16 x 12 vertical marine type high-speed pump, all of Worthington build. They are supplied with steam from the engine auxiliary piping system and exhaust into the main condensing system. The air discharge is led through spiral riveted piping to the roof.

The overflow water from the two condenser hot-wells is conducted through a 36-in. tile conduit to a concrete hot-well located about 200 ft. distant at the cooling towers. On account of the nature of the soil it was found necessary to support this conduit on piling. For this purpose the entire conduit line was enclosed within a timber trough 2½ ft. x 3 ft. deep, built of 4-in. pine tongued and grooved, this trough resting upon cross sleepers capping the double row of piles. The sides of the trough were reinforced and the structure held together by tie-rods.

COOLING TOWERS.

An interesting feature of the plant is the equipment of the cooling towers for furnishing cold water to the condensers. The arrangement of the battery of towers is shown in Fig. 2. The equipment is of sufficient capacity to supply the entire station, aggregating about 14,000 indicated horse power, including auxiliaries operating upon the main condensing system.

The four towers are identical in size and construction. Each consists of a rectangular brick stack 52 ft. in height, containing ten tiers of wooden gratings occupying 20 ft. of the height of the tower. These gratings furnish the cooling surface of the tower, and are constructed of 3 in. x 6 in. pine timber set on edge four deep, with uniform side spacing. This construction forms a horizontal grating 24 in. in height and filling the entire area of the tower. The ten tiers of grating are at right angles, in order to more completely break up descending streams of water and secure maximum effectiveness of cooling surface. A space of 12½ ft. beneath gratings provides for the introduction of the fans and a corresponding space of 20 ft. above the gratings conveys the vapor above the adjacent building roof and provides some natural draft in addition to that furnished by the fans.

The distributing system of each tower comprises a 20-in. cast-iron supply pipe extending through the walls of the pump room the full length of the towers. This in turn supplies thirty transverse distributing pipes drilled underneath with numerous holes, the entire pipe system being suspended from steel cross beams anchored in the walls. A 20-in. cast-iron main connects the four branches of the towers with the circulating pumps, each branch being controlled by a gate-valve. Underneath each tower is a settling well connecting with a central cold-well from which the condenser water is drawn.

Draft is supplied to each tower by four 120-in. Seymour fans arranged in two pairs, each driven by curved grates formed by wooden strips set on edge so as to permit clear descent of water to the settling-well beneath. All sixteen fans are belted to a jack-shaft with Neptune waterproof belt. This jack-shaft is carried by brackets attached to the building wall, and is driven by an 18-in. x 30-in. x 16-in. Westinghouse compound engine, the strain of the main belt being taken up by a structural steel tower built independent of the building wall.

Injection water for condensers and water for cooling towers is handled by a battery of three 24-in. centrifugal pumps of the Worthington turbine pattern, one being normally used for the two condensers and one for the towers, while the third is held in reserve. Either pump may be replaced by the spare when desired. These pumps are direct driven by 18 x 30 x 16 Westinghouse compound engines and operate upon a head of approximately 45 ft. including suction. Each pump unit is capable of delivering 17,000 gallons per minute under a total head of 50 ft. including equivalent friction head. The output of these pumps may be regulated according to the water required, by means of handwheels at the end of the engine shafts. These communicate with the respective engine governors, the adjustment of which may be changed while the unit is running, and the speed then proportioned to the load. The 24-in. water main supplying the tower is supported by 10-in. pipe columns with intermediate trusses.

PIPING.

Two complete and independent systems of high pressure steam piping have been laid out, one for each of the two main sections of the boiler plant. The four batteries of boilers constituting each section of the boiler plant are interconnected by a 10-in. main and a 4-in. auxiliary line, both in the form of a ring main. No pipe bends are used except on this ring main, the necessary flexibility of the piping system being secured partly by this means and partly by the method of support. Extra heavy Eaton-Cole & Burnham fittings and Chapman outside screw and yoke gates valves are used on all high pressure piping, and standard fittings on the low pressure piping. At the junction of the ring main and the various risers from the boilers, angle valves are used in the case of both the 10-in. and 4-in. mains.

With the location of the valves adopted in the event of rupture of any section of a ring main the trouble may be localized by shutting off the disabled section, the remaining half of the main being kept in service. The use of the ring main also largely facilitates the steam distribution.

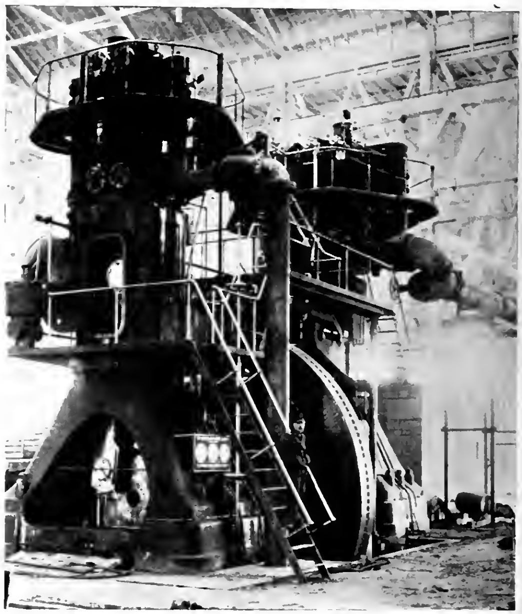


FIG. 4.—ONE OF THE GENERATING UNITS.

Each of the 10-in. ring mains connects with a 12-in. supply pipe leading to the engine room in the Machinery Building. The two 4-in. auxiliary ring mains similarly connect with an 8-in. supply main serving the boiler plant auxiliaries, together with the circulating pump and cooling tower engines. No connection exists at any point between the 10-in. and 4-in. systems; this separation being still more complete by the fact that the auxiliary ring mains are supplied by 2-in. taps into the boiler headers, thus rendering the operation of the auxiliaries quite independent of any break in the main piping system. As a precautionary measure in case of rupture to the 8-in. auxiliary supply line, a 2½-in. duplicate supply pipe also leads to the auxiliary room, so that sufficient steam may be available for operating the boiler feed pumps, thus keeping this part of the plant under control.

At the northwest corner of the auxiliary room, the two 12-in. engine supply lines drop approximately 28 ft. to the level of a pipe tunnel through which they are carried to the Machinery Building, a distance of about 475 ft. in the case of the longest run. The average length of run from the respective ring mains to the corresponding pair of engines supplied, is 464 ft. in one case, and 617 ft. in the other.

The entire high-pressure piping system in the boiler house is drained by a "steam loop" and Holly "gravity return" system, which automatically returns condensation to the boilers. This system not only drains the piping itself, but also the water-pockets in the various valves. Sectional magnesia covering is employed on all high-pressure piping, plastic material of the same composition being used for boiler drum heads and engine cylinders and receivers.

All boiler room auxiliaries, as well as the circulating pump and fan engines, exhaust into two Cochrane feed-water heaters in duplicate, the distribution of the exhaust steam between the two headers being controlled by valves, so that either heater may be replaced by the other one when desired. Both headers are provided with oil extractors at the point where the exhaust enters the heater. These largely prevent the oil carried over in the exhaust steam from contaminating the feed-water. The two heaters are provided in common with an atmospheric relief of spiral riveted pipe leading through the roof.

An unusually symmetrical arrangement of feed-piping is employed. The supply mains are in duplicate and have cross-connections at

FIG. 5.—PUMPS FOR CONDENSER INJECTION WATER.

adjacent batteries through 2½-in. headers. By means of properly located valves, each section may, however, be completely isolated in case of necessity. Ordinarily the feed line to each battery of boilers is controlled by a single valve.

In designing the supports for the various systems of piping, unusual difficulties have been encountered in the absence of facilities for hanging the pipes from the roof trusses, thus making it necessary to support all piping from the ground. In this work wrought-iron pipe columns and trussed pipe-towers have been largely used for carrying the elevated mains where these run clear of the boiler settings.

The problem of expansion in the long run of piping between buildings was solved by providing sufficient swing radius at bends and by anchoring at intermediate points. At the point of entry to the pipe trench, the two 12-in. mains are restrained from horizontal movement by the anchor, and at the corner of the succeeding run, 162 ft. in length, both lines are again anchored, as well as at the beginning of the last section of piping at the engines. At each bend in the steam lines double 90-degree elbows are employed, with short nipples, which form hinge joints through which sufficient flexibility is secured to relieve the fittings of undue strain.

At the points intermediate between anchors, roller supports are used. The weight of the pipe line is carried by 2½-in. wrought-iron pipe extending across the trench with ends set into wood blocks. The elevation of the support may be adjusted by wooden wedges. The steam pipes rest directly upon loosely fitting pipe sleeves which accommodate the expansion and contraction of the pipe line.

CONSTRUCTION.

Construction of the service plant was started about April 1, 1903, and the first main unit was turned over on December 29, 1903. The entire plant is nearing completion and will be available for service well in advance of the opening of the Exposition, in May.

Failure to Deliver Telephone Message.

A novel and interesting question, or rather a new aspect of an old point, was disposed of recently by the Supreme Court of Mississippi, on appeal, when it decided that the Cumberland Telephone & Telegraph Company was not liable for failure to deliver a message, although held so by a lower court. Chief Justice Whitfield remarked: Section 4326 of the Code of 1892 is a highly penal statute, and must be strictly construed. We are clearly of the opinion that the only messages or matter referred to in that section are written or printed messages or matter. The very language of the statute clearly indicates this. The messages or matter the failure to transmit correctly and deliver which subjects the telegraph and telephone companies to the penalty therein provided are declared to be messages "addressed to a person," etc. These messages, it is said, must be transmitted correctly; that is, correctly as written. "To transmit correctly and deliver the same"—that is, the messages or matter so addressed—is the precise language used. It may be true that a large part of the messages or matter handled by a telephone company is orally delivered as the business is actually conducted, but the question is what character of messages or matter this particular statute describes when it provides the penalty for the failure to correctly transmit and deliver such messages or matter. The statute itself is very imperfectly framed as regards telephone companies, for there is a manifest difference in some respects between the nature of the businsses conducted by the two companies, as the respective businesses are actually conducted; and this defect or imperfection in the statute, as it relates to telephone companies, properly calls for an amendment by the Legislature. It is our business to construe the statute strictly as it is now framed, and under the familiar principles of construction applicable to penal statutes we are of the opinion that what took place here is not within the purview of the statute.

As stated in Western Union Telegraph Company vs. Dozier, 67 Miss. 291, 7 South. 326, 'The very expression as to a message delivered to be sent carries with it the idea of a written or printed message'; and so here the very expressions to which we have referred clearly indicate that as to telephone companies, as the law now stands, only those which are written or printed come within the purview of this statute. There was nothing here but a mere call, the object of the call being to secure the presence of parties at the telephone, and to communicate with them as desired. Until the Legislature shall so amend the law as to make it clear that this sort of matter orally delivered and transmitted is meant to be dealt with in this penal fashion, the penalty cannot be recovered.

Service Tests of Motor Wagons.

The Automobile Club of America will hold, during the week beginning April 4, 1904, a service test of motor wagons. The test will be open to motor wagons used for commercial purposes made in the United States or abroad. The classification will be on the basis of dead load carried—all wagons of light weight, whether steam, gasoline, or electric, to operate in the same class. The following classes have been established: 1st. To carry a dead load of 1,000 pounds or under. 2d. To carry a dead load of 1,000 to 2,000 pounds. 3d. To carry a dead load of 2,000 to 3,000 pounds. 4th. To carry a dead load of 3,000 to 4,000 pounds. 5th. To carry a dead load of 4,000 to 5,000 pounds. 6th. To carry a dead load of 5,000 to 6,000 pounds.

With a view of holding a more thorough and practical test than has heretofore been afforded, the wagons will be placed under actual working conditions in the service of the American and Westcott Express companies for one week from April 4 to 9, inclusive, and will transfer and deliver merchandise, produce, baggage, etc., from the various depots of these companies during the entire week.

Awards will be made in each class for the best performance, based on the economy of operation in time and fuel, ratio of paying load, ton mileage, and general reliability and availability for service.

Entry blanks and further information may be obtained from the club secretary, Mr. S. M. Butler, 753 Fifth Avenue New York.

Meeting of the Ohio Independent Telephone Association.

At a three-days' session held at the Grand Hotel, Cincinnati, February 17 to 19, the Ohio Independent Telephone Association was practically reorganized and placed on a substantial basis. For three years, due largely to the financial difficulties of some of the largest interests in the State, the Ohio Independent Telephone Association has been practically inoperative. The meeting in Cincinnati was called for two reasons: To reorganize the association and to aid the independent interests that are working for a foothold in Cincinnati, this being the only large city in Ohio and in the central district without the independent service. Over 200 telephone men were present, including managers of over 100 companies in Ohio, with a few invited guests from points in Indiana and Kentucky, together with a number of the ubiquitous supply men.

A review of the state of affairs in Cincinnati revealed a rather peculiar condition, but a not altogether disheartening one for the independents. The Cincinnati & Suburban Bell Telephone Company has a fair-sized list for a city of this size, and its rates are high. The strong point in its armor is the fact that about 65 per cent. of its stock is owned by local capitalists, who control other public service corporations in the city. The independents are divided; four companies seeking a franchise at the present time. The Queen City Telephone Company, headed by George Bears and Harry Gates, has a capital stock of $1,000,000, and claims to have secured 2,000 subscribers. The Cincinnati Telephone Company is headed by Powell Crosley and George Fletcher, of Toledo, and has no list. The Interstate Telephone Company, headed by S. Kinnon, operates in Kentucky and has lines extending to points opposite Cincinnati. The Fitzsimmons Telephone Company, headed by T. Fitzsimmons and D. J. House, claims to have an operative franchise and has about 200 telephones connecting hotels and business houses in the city. Its efforts to extend its system have been thwarted and the legality of its grant is doubted. At present the applications of all the companies are before the Probate Court. It was the general sentiment at the convention that the rival interests ought to get together and present a solid front. The establishment of an exchange in Cincinnati is of great importance to the independent interests all over Ohio and those of southern Indiana and northern Kentucky, and much development is being hindered by this lack of connection. On the other hand it was also demonstrated to Cincinnati people that they were losing an immense amount of business through lack of connection with the independents. Numerous telephone managers testified that people in their cities were using the independent lines and telephoning orders for goods to other centers. It was alleged that the independents in Ohio have 85,000 telephones, while the Bell companies have only 66,000 telephones, including Cincinnati.

Mr. J. B. Hoge, of Cleveland, representing the Federal Telephone Company, the United States Telephone Company and the Cuyahoga Telephone Company presented the first paper, reviewing in an interesting way various features of the independent telephone movement already familiar to our readers. Mr. Hoge displayed several maps showing the independent toll lines of the Central States and the main trunk lines in the entire United States. Trunk lines extend as far east as Albany, N. Y.; Pittsburg, Philadelphia and Buffalo being connected up. Between Erie and Dunkirk there is a short gap now being filled, but from Erie there are unbroken lines all over Ohio, Michigan and Indiana. Illinois, Iowa, Minnesota and Wisconsin are well supplied and there are lines running down through Missouri and Indian Territory reaching a number of points in Texas. On the Pacific Coast there is considerable development, and some in the New England States.

Mr. Frank Beam, of the Columbus Citizens' Telephone Company, pointed out that the independent movement started in Ohio and that the National and Interstate associations were the outgrowths of the Ohio association, which was organized in 1895. He maintained that the future of the independent movement depended upon the extending of long-distance lines and the connecting up of all independent companies. He claimed that general business conditions were absolutely different from what they were five years ago. Formerly the business man transacted his business by telegraph. Now he calls up his man by telephone and talks with him direct. The inability of the local long-distance company to furnish the desired connection, counted against the entire independent movement in every instance. Through the inability of the United States Telephone Company to extend its toll lines, Mr. Beam stated that his company in Columbus was obliged to turn away almost as much long-distance business as it takes on. Columbus should have at least 35 additional circuits to relieve overcrowded lines to numerous points in Ohio. He urged the various independent managers to offer to take stock in the long-distance company and said that that company would be willing to spend the money invested in the county or locality served by the investor. He said that even under present conditions practically no extensions having been made in three years, the United States Company was earning fine profits and offered an excellent investment. He also urged the Cincinnati people to get together and stated that prominent Ohio companies would undoubtedly be willing to take stock in a single Cincinnati company, because an exchange in that city would aid their business. He said that with independent service, Cincinnati merchants would have five times as many calls as at present and he thought they could well afford to pay the additional $60 per year for another telephone.

Mr. Miller, who has just left the Bell Company after eight years of service, to become manager of the Dayton Home Telephone Company, also urged the importance of extending the long-distance systems. He stated that the Bell people formerly confined their efforts to working the large cities, but they are now building up the toll business. The Bell people now have a large number of men at salaries ranging from $100 to $200 per month, selling long-distance coupons all over Ohio. He claimed that in Columbus alone over $65,000 worth of these coupons had been sold in two months. Dayton, Columbus and other cities were losing the business through lack of connection with Cincinnati. He urged that pressure be brought to bear to induce local merchants to patronize jobbers in other centers than Cincinnati, and he said the Cincinnati merchants would soon awaken to the importance of having independent connection with these people. He thought this plan would be very effective because many of the local merchants are stockholders in independent companies.

Mr. J. B. Rhodes, of Zanesville, presented a paper on "Party Lines." He said that for a modern exchange of say 2,000 subscribers the average cost of construction should not exceed $200 per individual line. If for such a plant the residence rate is $24 per year, the gross earnings would be 12 per cent. of the amount invested. By equipping such a line with four-party service, the investment, including four instruments, should not exceed $230. If a rate of $15 is charged for four-party service, the revenue would be equal to 26 per cent. instead of 12; but as a conservative estimate would place the average number of telephones on a line at 3 instead of 4, this would doubtless in practice be reduced to something over 20 per cent.

The rates for farm line service in Ohio usually range from $1 to $1.50 per month, which, considering the initial investment and the cost of maintenance, yields a smaller return to the stockholder than any other class of service. But for a distance of from five to ten miles from exchanges where troublemen are at all times available, the service can be profitably handled at these rates; but in most counties there are numerous residents in districts more remote, who are equally anxious for service. Many of these districts are from fifteen to twenty-five miles from an exchange, which renders it very difficult and expensive to handle them. From the company's point of view, it would seem that a schedule of rates proportionate to distances should be established; but unfortunately for the company, the farmer in remote territory is not inclined to accept this solution. The most feasible method by which such business may be handled is to allow the farmers in such districts to construct and operate their own lines and provide some equitable arrangement for interchanging business with them. If managers will interest themselves in such development they can usually govern not only the method of operating, but the purchase of apparatus and the character of construction which, if accomplished, will render the service almost, if not altogether, as reliable and satisfactory as that furnished by the telephone company. When arrangements of this kind are made the telephone company should own and operate the necessary switchboards and charge a switching fee that will be sufficient to defray all necessary expense, and yield a reasonable return for the amount of capital invested.

The discussions on this paper were spirited and developed a wide range of ideas as to the most desirable practice. They also demonstrated that in some sections there has been a tremendous growth of farmers' community systems, many of them operating on the co-operative plan.

Mr. Chambers, of Winchester, Ky., said the company had 300 telephones in the country. They put up party lines using six on a line with divided circuits. They charge $5 per year per mile for building and maintaining the lines, dividing the amount among those on a single line. They furnish the telephones for $1 per month.

Mr. Beam, of Columbus, favored a uniform rate. His company has a selective ringing and lock-out system, which is giving good satisfaction with six on a line; rate $15 per year. He urged that some standard form of selective lock-out system be generally adopted and suggested that at the next meeting committees be appointed to work on standardization. He said any system should have 50 per cent. farmers' lines. For individual farmers' lines his company charges $8 per mile in addition to the rate in the town.

Mr. Miller, of Dayton, reported 700 farmers' lines in Clark County. They have seven small exchanges in various corners of the county with trunk lines from each leading to central. The rate to farmers is $1.50 per month. The small boards are in a residence or store and the attendant is paid $20 per month to answer all calls. From six to ten are placed on a circuit and the circuits average three miles. They give free service throughout the county and for city calls as well.

The Franklin County company reported fourteen exchanges in country towns. They charge $24 for business and $12 for residences and $15 for farmers. Six telephones are placed on a line. Free service is given throughout the county except to Columbus. Farmers calling Columbus frequently pay a flat rate of $12 per year additional and have individual service. A charge of 10 cents per call is made to those who call the flat rate people.

Mr. Lasher, of Rutland, represented the Farmers' Mutual Company, which has 2,000 subscribers connected with fifteen small exchanges. Each subscriber pays $2 for initiation fee and pays 15 cents per month towards an operator. He buys his own telephone and builds his own line to connect with the next farmer. Not less than 100 farmers are connected with a board and from nine to sixteen telephones are placed on a line. Each district maintains its own repairs. Free connection is given throughout the fifteen exchanges. The system connects with an exchange at Athens, and a portion of the subscribers have secured connection with the Bell system.

Mr. Resinger, of Gallipolis, told of a farmers' mutual system operating in four counties and connecting with Gallipolis. Over 3,000 farmers are now connected up. Fifteen farmers organize a division, build their own lines, buy their own telephones and install a small switchboard. Each pays 10 cents per month for board service, and they have free service throughout the entire district. The Gallipolis company has made contracts with about 250 of these farmers who build their own lines to the city limits and pay $1 per year, giving them connection in Gallipolis. Outgoing messages are charged 10 cents each. Through these lines others on the mutual system can reach Gallipolis and they pay 10 cents for each message.

Several prominent delegates talked strongly against farmers' mutual systems, as they claimed they were not properly maintained and were a detriment to the independent service. It was the general expression that the company at the county seat should thoroughly cover its own county and that free service should not be extended throughout the county.

Mr. Davis Prewitt, of Winchester, Ky., presented a paper entitled "Consolidation," outlining a plan of organization and union, on a kind of federated basis, with delegates in an upper and a lower chamber.

Mr. J. B. Hoge, in discussing the plan of a central organization, thought that State lines should be disregarded and that in forming divisions the companies should be grouped around large cities. He thought it would be advisable to consider the toll business to various centers and place a company in the division to which it contributed the largest amount of toll business. The plan outlined by Mr. Prewitt brought out considerable discussion and it is probable that something tangible will develop from his ideas.

In the general discussions which followed, W. Gilbert Thompson, president of the association, took occasion to warn the independent managers against making alliances with Bell companies. He stated that the Bell people were now working among the independents and were willing to furnish connection with almost any company, particularly in the vicinity of Cincinnati. At many points in this district they are offering the farmers free connection with the nearby village as well as free connection with Cincinnati.

Mr. J. B. Hoge, of Cleveland, gave the history of the recent order of the Postmaster-General requiring postmasters to subscribe for only that telephone which reached Washington, which of necessity meant the Bell Company. He stated that in view of the strenuous objections made by the independents, this ruling had been modified to the extent that the department would consider upon their merits any applications made by independent companies. A committee composed of F. S. Dickson, Cleveland; Cyrus Huling, of Columbus, and E. L. Barber was appointed to oppose this ruling before Congress, if necessary.

A committee on permanent organization was appointed and in its report it asked that the present temporary organization be continued and that another meeting be held in May, when a permanent organization would be effected. Adopted. The present officers who are continued are: W. Gilbert Thompson, Lebanon, president, and E. E. Knox, Portsmouth, secretary. These gentlemen will act with the committee on permanent organization.

The committee on credentials advised that managers of Ohio, Kentucky and Indiana, and manufacturers of supplies, be admitted to membership. Only Ohio managers to vote on Ohio matters and on election of officers. The matter was left open until the next meeting.

The committee on legislation reported that two bills were now before the Ohio Legislature and advised that the association oppose both of them. House bill 166 provides that telephone companies desiring connection with other telephone companies may secure same, and that the company desiring the connection shall build the connecting link and stand the expense. That the connected companies shall not charge more than they charge their own subscribers. It was claimed that the bill was introduced in the interests of a farmers' system that was endeavoring to force a connection with an independent company on an unfavorable basis. It was the sense of the convention that the bill was indefinite and ambiguous, and it was voted to oppose the bill.

House bill 149 is designed to regulate price and provides that rates shall not exceed $3 for residence telephones and $6 per month for business telephones. It was stated that this bill would not affect any of the independent companies in the State at the present time, but it was pointed out that in cases where manufacturing establishments at a distance from a large city wanted telephone service, the bill would make it possible for them to demand the maximum rate mentioned. It was voted to oppose this bill and delegates were requested to communicate with their representatives to help defeat both measures.

A novel feature of the programme consisted of musical selections between the various papers. In place of the usual banquet a smoker and vaudeville entertainment was given in the banquet room of the Grand Hotel. Friday was devoted to the inspection of exhibits.

A. I. E. E. Meeting.

The regular monthly meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, New York, Friday, Feb. 26, at 8.15 P.M. The following papers will be presented and discussed: "European Practice in the Construction and Operation of High-Tension Transmission Lines and Insulators," by Guido Semenza, Chief Electrical Engineer of the Italian Edison Company, of Milan, Italy; "Conductivity of the Atmosphere at High Voltages," by Harris J. Ryan, professor of electrical engineering, Sibley College, Cornell University, Ithaca, N. Y.

Farmers' Telephones in Winter.

The farmers' telephone was a boon during the recent heavy and unprecedented snows, and many interesting uses are reported in New York State in places where many roads were blocked with drifts over 10 ft. deep. Hemmed in so that they could not see a neighbor for weeks, farmers have been able to converse with their friends and thus keep in touch with the world. In some instances they have reported cases of sickness to the doctor in town and have obtained advice about care of the sick and the administration of such simple remedies as they might have at home. On one of these circuits in Otsego County all the families having telephones have received frequent treats from Mr. William Cushman, a farmer, who last summer bought a fine Edison phonograph. He calls up the families on the circuit and they open the receivers. Then he sets the phonograph up to the transmitter and sets it going. Its records are thus heard over miles of country by a widely scattered audience.

Telephone Transmitters.—VI.

By Arthur V. Abbott, C. E.

The Wilhelm Transmitter.—The Wilhelm transmitter assembled is shown in Fig. 43. It resembles the Ericcson and Stromberg-Carlson by consisting of a brass case 2⅜ in. in diameter x 7/16 in. thick, made of pressed sheet metal. In Fig. 44 the instrument is opened. The diaphragm consists of sheet iron 2 3/16 in. diameter and .018 in. thick, supported upon a blotting paper ring and held in place by two 2-point brass springs .023 in. thick and .105 in. wide. There are two carbon electrodes each ¾ in. diameter. The front electrode is secured to the diaphragm by means of a screw passing through its center and contains eight circular pockets around its circumference. The rear carbon is of the same size and similarly secured to the case by a screw through the center. It, however, has a series of concentric circular grooves. Around the rear electrode is a piece of felt, something like a circular lamp wick, which is tied to the electrode. This forms a capsule which is filled with 15 grains of granular carbon.

Double-Diaphragm Transmitters.—In the archives of the Patent Office a number of devices for transmitters are recorded that seem to possess both originality and merit along lines other than those embodied in the solid backs, but for some unexplained reason few of such instruments have found their way into practice. In fact, the double-diaphragm transmitter forms about the only exception. The principle of the solid back is to provide an immovable anvil on which one electrode rests, in front of which the diaphragm carrying the other electrode is placed, perpendicularly to the direction of the sound waves. In the double-diaphragm models each electrode is placed on a mobile diaphragm, which is set parallel to the direction of the sound waves, and both are expected to vibrate.

FIG. 43.—WILHELM TRANSMITTER ASSEMBLED.

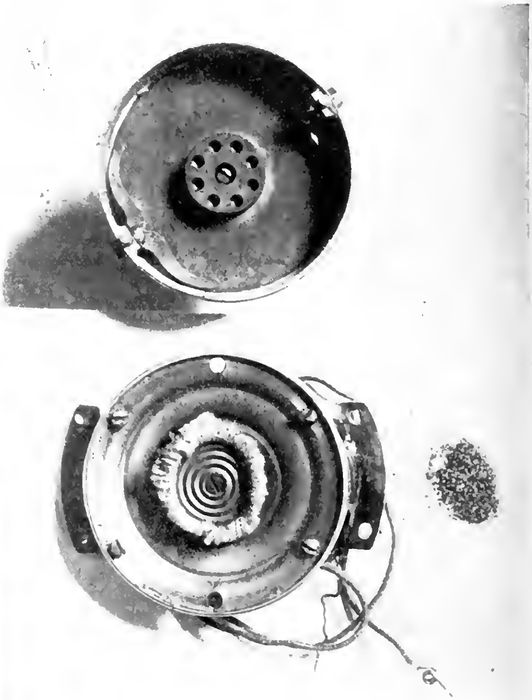


FIG. 44.—WILHELM TRANSMITTER OPENED.

The essential features of most double-diaphragm instruments are illustrated by the model of Fig. 45. There is a drum-shaped case, *A*, to enclose and protect the mechanism, provided with a sound-receiving funnel, *A′*. In the center of the case a ring, *D*, is fixed. On each face this ring is recessed to receive diaphragms *B* and *B′*, which may be of either carbon or metal. To the center of each diaphragm is secured an electrode, *b*, usually of carbon, around which is placed an elastic ring of felt, *b′*, and the space between the electrodes filled with granular carbon. In the model of Fig. 44 there is a septum, or partition, *C*, in the center, and the ring, *D*, is made in two parts, thus this instrument is really two transmitters placed back to back. One battery wire, C^2, runs to the center partition and the other to *C′*, to both diaphragms. There are no damping springs and by making the diaphragms very light and properly proportioning them to the resonant cavity an instrument of great power and delicacy of articulation should be produced.

In Fig. 46 a different design is shown. The two diaphragms, 3-3, supported by the rings 2-2, form the sides of a resonant chamber, into which the sound funnel, 11, opens. The carbon electrodes, 5-5, are bolted to the center of the diaphragms, and surrounded by a flexible fibrous wrapping, 7, while the cavity thus formed is filled with granular carbon. The simplicity and cheapness of such designs is certainly remarkable.

The Fahnestock Transmitter.—The transmitter manufactured by Fahnestock Transmitter Company, represents the latest and in many respects the highest development in transmitter building. The assembled instrument is shown in Fig. 47. There is a base 4 in. long 2 in. wide, to which a swinging arm 6½ in. long is pivoted, that provides reasonable range of motion to the mouthpiece. The base carries the induction coil in local battery instruments. On the end of the arms there is a rectangular chamber 1⅝ in. x 1⅝ in. x ¾ in., which is surmounted by the usual rubber voice funnel. The rectangular chamber contains the talking mechanism. Fig. 48 shows the instrument dissected. There are seven principal parts. The arm, *A*, mouthpiece, *B*, button, *C*, cover, *E*, mouthpiece ring, *D*, and screws, *F*. The end of the arm carrys the rectangular cavity into which the button, *C*, is placed. The cover, *E*, is then set over the button and secured with the screws, *F*. Finally the mouthpiece, *B*, is screwed into the cover, *E*, the ring, *D*, serving to take up any slack. Fig. 47 is a phantom drawing showing the button in place and the circuit connections. The speaking mechanism is shown in detail in Figs. 50 and 51. There is a metallic block, *A*, *A′*, 1½ in. x 1½ in. x 7/16 in. recessed as at *A* on both sides. In each of the inner recesses a disk of mica is placed to which a gold-plated electrode is secured, and which is fastened in place by the ring, *C*, as shown at Fig. 50. Each electrode carries a brass stud to which an aluminum diaphragm is attached. The outside of the diaphragm is shown at *B* and the inside, with an electrode in place at *B′*. Around the edge the diaphragm is dished to fit into the recess cut in the block, *A*. The space between the electrodes is filled with granular carbon and the rings, *C*, squeezed into place, making an air-tight joint. Then each diaphragm is secured to its studs by the nut, *F*. The recess in the block is cut so large that the diaphragms do not *touch anything* except the stud that holds them to the electrode, hence there is nothing to impede or distort their vibration. Finally to prevent the sound waves from affecting both sides of either diaphragm, the joint between the diaphragm and block is sealed with a thick solution of india rubber. From each electrode an insulated wire runs to a screw on the top of the block as at *A'*. These screws connect to leading-in wires shown in Fig. 48. From an acoustic standpoint, instruments of the double-diaphragm type would seem to present many possibilities of which inventors have not as yet fully availed themselves.

The Design of the Microphone.—The essential part of the transmitter is the contact. Some transmitters use metal electrodes, and give excellent results, but on the whole experience is inclined to favor all contacts of carbon, and certainly so far no other substance has been found that is even approximately as good.

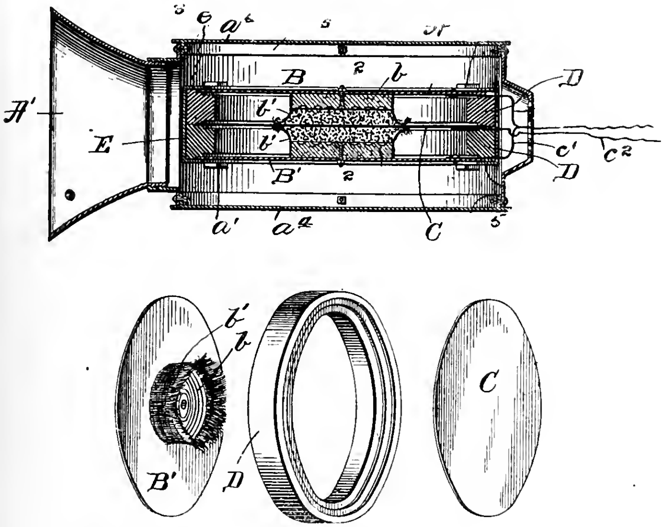


FIG. 45.—DOUBLE DIAPHRAGM TRANSMITTER, MODEL 1. (FULL SIZE.)

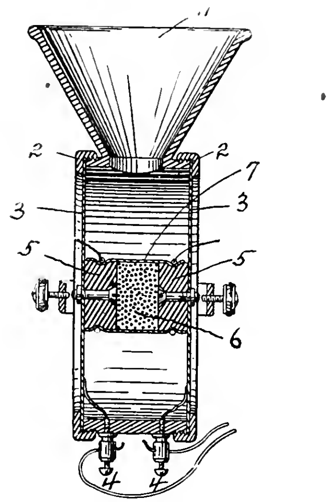


FIG. 46.—DOUBLE DIAPHRAGM TRANSMITTER, MODEL 2. (FULL SIZE.)

FIG. 47.—FAHNESTOCK TRANSMITTER ASSEMBLED.

FIG. 48.—FAHNESTOCK TRANSMITTER DISSECTED.

The most common form of electrodes is a flat carbon plate, ranging from ¼ in. to 1 in. in diameter, and from 1/16 in. to ⅛ in. in thickness. Electrodes should be made of the hardest densest carbon; those which are soft may be greatly improved by repeated boilings in a very dense solution of sugar, after each of which the carbon disc should be placed in a crucible covered with charcoal or carbon dust and heated to a bright red. Many other forms of electrodes have

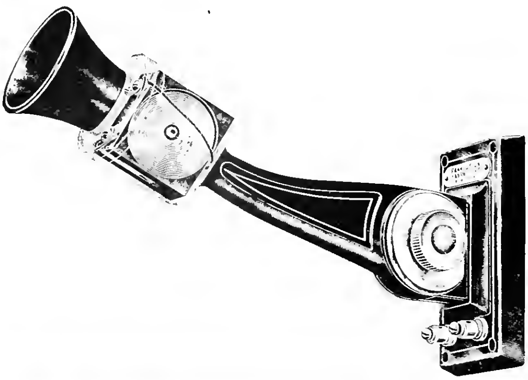


FIG. 49.—FAHNESTOCK TRANSMITTER.

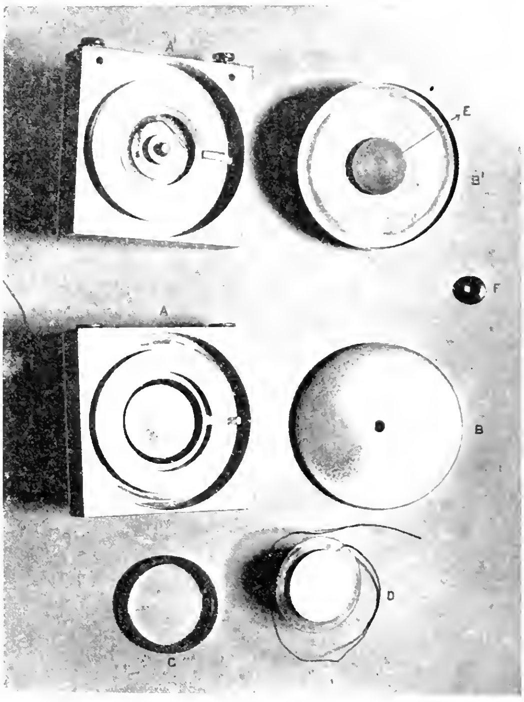


FIG. 50.—THE BUTTON OF FAHNESTOCK TRANSMITTER DISSECTED.

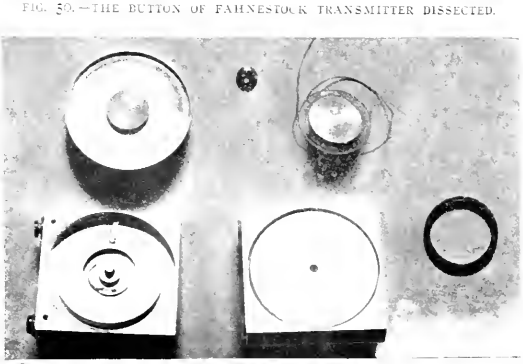


FIG. 51.—DETAILS OF FAHNESTOCK TRANSMITTER.

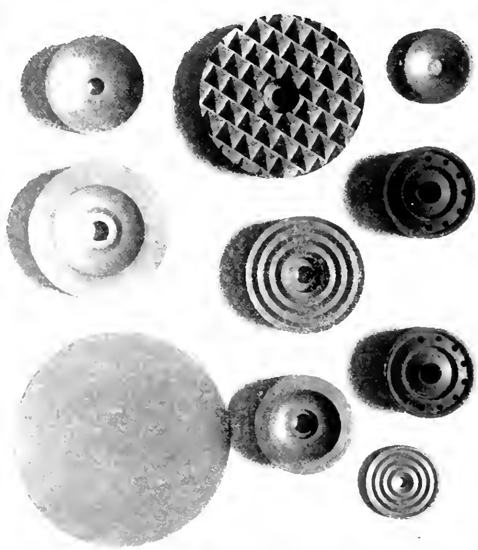


FIG. 52.—CARBON ELECTRODES.

FIG. 53.—GRANULAR CARBON MAGNIFIED.

TELEPHONE TRANSMITTERS.

been tried with varying degrees of success. Some such forms are illustrated in Fig. 52. About the granular carbon itself a cloud of mystery has always hung. But it is after all a simple matter, though to produce the best variety requires some practice. The National Carbon Company and Pinnar, of New York, furnish excellent products. Fig. 53 shows four samples of granular carbon magnified about eight diameters. Samples *A* and *B* are so-called No. 24; that is to say, are sized through a sieve with twenty-four meshes per linear inch. Samples *C* and *D* are No. 50 carbon. Most transmitter builders prefer to have both the electrodes and the granular highly polished. Electrodes can be surfaced by any of the well-known methods of polishing. An excellent way is to use carbon dust on a flat lap, with a final finish of crocus or putty powder. But to receive a remotely satisfactory surface the hardest and densest carbon must be used. With the granular polishing is much more difficult, because the sharp edges of the granules should be as far as possible preserved. In Fig. 53 *A* and *C* are specimens with dull finish and *B* and *D* are polished. One of the most important points is careful sizing as a prevention against packing, for the best preventions against this difficulty are to provide for room around the electrodes; use a thin layer of granular, which has by repeated sifting been sorted till all the particles are as nearly as possible of the same size.

New Telephone Patents.

AN IMPROVED COIN COLLECTOR.

Coin-collecting attachments for public telephone stations have been undergoing great improvement, change after change having been introduced to correct defects which practical service has indicated. The separation of the cash and mechanism compartments to prevent temptation getting the better of the inspectors and the provision of good locks upon the cash compartments were among the early improvements. These were followed by the perfection of distinctive audible signals, and automatic coin return apparatus. The turn now taken is toward the abandonment of audible signals altogether and instead of making the deposit of the proper coin necessary in order that the central office may be signaled at all.

This latter tack is that which has been followed by the American Telephone & Telegraph Company, its coin-collector having been developed primarily at the hands of Messrs. Bullard and Scribner and lately improved by S. J. Larned, of Chicago. It may be well to

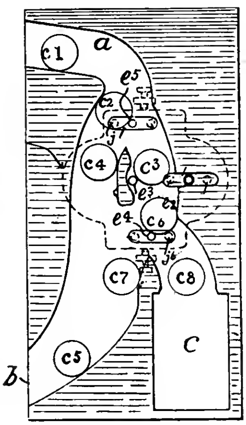


FIG. 1.—LARNED COIN COLLECTOR.

describe the apparatus in its present form, i. e., as it is disclosed in a patent recently issued to Mr. Larned.

The control of a coin is accomplished first by the peculiar contour of the coin slot, clearly shown in Fig. 1, and secondly by three pins, e^3, e^4 and e^5, mounted upon the tilting armature of a polarized electromagnet (outline dotted) and projecting into the coin slot. The various circles marked c^1, c^2, etc., show different positions which a coin may assume, in its course through the machine. The coin, c^1, just deposited rolls down the slot until it strikes the pin, e^5. If this latter is in its normal or unactuated position the coin will be deflected to the left as at c^2, c^4, c^5, and be returned to the depositor at *b*. This coin route corresponds to some error of condition in the apparatus. Such an error would be that of a failure of the user to remove the receiver from the hook. Another would be the failure of current to reach the instrument through any disability of the line or apparatus. Such a disability will prevent the proper signalling of the operator, and it is, therefore, just that a deposited coin be at once returned. This latter feature is one distinctive of the present improvement. Let us suppose, however, that everything is in working order. Then the pin, e^5, will be in the position j^1, the armature to which it is fastened having tilted under the influence of a circuit closed by the rising switch hook. The coin will then fall to the position c^3, where it closes a circuit between pins c^3 and e^2, this a shunt upon a high resistance included in the signal circuit. The reduction of resistance of this circuit consequent upon this shunting action permits the flow of sufficient current to actuate the line relay and signal. When the operator responds in the usual way, the circuit changes permit the armature of the collector magnet to return to the mid-position. This brings pin e^4 in the middle of the slot, obstructing the slot entirely, and at the same time causes pin e^2 to release the coin, which falls to position c^6. The operator now is in communication with the caller. If she succeeds in completing the desired connection a key provided for her enables her to move pin e^4 to throw the coin into the cash box. If, on the other hand, the call fails, the coin can be returned at *b* by the mere sending out of a reversed-current impulse.

NEW SWITCHING KEY.

In Fig. 2 is shown a side view of a combined ringing and listening key for switchboard use, which has been patented by J. S. Goldberg, of Chicago.

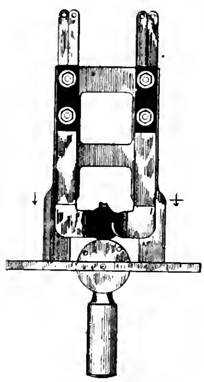


FIG. 2.—GOLDBERG SWITCHING KEY.

Aside from the neatness of design, the most notable feature is the method used for preventing disturbing effects from overtravel of the key plunger when this is being restored to the mid-position. For example, suppose an operator, after "listening in" on a circuit restores her key so that it overtravels. If this is one of the usual keys the middle springs of the ringing part may momentarily, under the influence of the plunger, clear their normal contacts and make a click upon the line. Mr. Goldberg makes his mid-springs on the ringing key much stronger than those of the listening key, so that any energy stored in the cam by the latter will be quickly absorbed by the former. The slight motion which is imparted to the middle ringing key springs is then rendered of no effect, because the line of resistance of the springs is so offset from the line of application of pressure from the cam that a considerable motion of the latter is required in twisting the springs before any outward motion of them away from their contacts occurs. The Stromberg-Carlson Company has obtained this patent by assignment.

DESK STAND SET SUPPORT.

A swinging desk stand support is the subject of a patent which has been granted to J. S. Detrick. This is a counter-weighted shelf support arranged to swing in a vertical plane and suspended in a frame attached to the ceiling. By pull chains the shelf may be swung down for use or pulled up out of the way.

TRANSMITTER HANGER.

A transmitter hanger for supporting switchboard transmitters forms the basis of another patent of recent issue. This hanger is pressed up out of sheet metal. At the top is a cross-bar with perforations through which the cords may be tied. From this two legs project downward, one perforated to be clamped to the transmitter front by the mouthpiece, and the other adapted to be fastened to the rear of the transmitter by screws. The patent for this hanger has been issued to M. Setter, of Chicago, and has been assigned to the American Electric Telephone Company.

Meeting of Wisconsin Independent Telephone Association.

This meeting, held at Milwaukee, on the 10th and 11th of February, was the fifth annual convention of the Independent Telephone Association of Wisconsin. About 75 companies were represented. There were two papers read, one on "Improvement in the Telephone Service," by Prof. G. W. Wilder, professor of telephony in the Armour Institute, Chicago; and one on "Legislative Prohibition of Discrimination in Telephone Rates," by Mr. J. C. Harper, president of the Dane County Telephone Company, Madison. The Green Telephone & Electric Company, of Milwaukee, was suspended from the association as its proprietor, Senator J. H. Green, of that city, had been so actively opposed to all legislation sought for by the independent companies in the State and had labored so hard in behalf of the Bell Company. Resolutions were adopted strongly censuring the Postmaster-General, H. C. Payne, for issuing an order some time ago by which many post-offices throughout the country had been ordered to use only the telephone service giving communication with Washington. A committee of six was appointed to look after telephone legislation at the next session of the Legislature. Nine companies were received as members at the meeting. A committee of three was appointed to arbitrate whatever disputes might arise between companies. A committee of three was appointed to interest the citizens of Milwaukee in the installation of an independent exchange. It was decided to hold the next annual convention in Milwaukee on February 9th and 10th, 1905. The secretary's report showed the continued rapid growth of the independent telephone business in the State, and of the association, which now comprises about three-fourths of the independent telephone interests in Wisconsin. During the past two years 90 new telephone companies were incorporated in the State with $1,500,000 of capital, and to-day Wisconsin has 250 independent telephone companies with an investment of $3,500,000; 1,200 toll stations, 350 exchanges and 35,000 subscribers, of which number 8,000 are rural subscribers.

The following officers were elected for the ensuing year: Richard Valentine, Janesville, president; H. G. Slater, Waupaca, vice-president; H. C. Winter, Madison, secretary and treasurer. Members of the executive committee—C. W. Twining, Monroe; G. Huette, Sheboygan; J. C. Harper, Madison; W. F. Goodrich, La Crosse; Julius Thielman, Merrill; John M. Baer, Appleton; E. A. Miller, Hixton; J. C. Crowley, West Superior.

The Independent Telephone Association of Wisconsin was organized at Weyauwega, March 21, 1900, since which time it has held eight meetings. The objects of the association, as stated in the constitution, are the protection of all telephone interests of common concern to members of the association; the protection of subscribers to telephones and exchanges operated by members of this association; the bringing about of a reasonable charge for tolls and rentals of telephones, so that the telephone may be within the reach of the masses of the people; the bringing about of a complete system of municipal communication and long-distance trunk lines within the State of Wisconsin and in connection with independent telephone organizations of neighboring States.

Iowa Telephone Association.

The eighth annual meeting of the Iowa Telephone Association will be held in Des Moines, Iowa, on March 8, 9 and 10. A large attendance is expected. Following is a list of the subjects that will be presented at the meeting: "The Farm Line Proposition," "Operating a Telephone Plant as a Side Line," "Long-Distance Lines," "Jealousy Among Independent Telephone Men," "Shall We Establish a Clearing House?" "Automatic Apparatus from the Standpoint of Service and Operating Expenses," "Our Business Relations," "Leased Toll Lines," "How Can We Promote Better Feeling Among Toll Operators, Inducing Harmony, Improving our Service, and thus Reducing the Lost Call Record?" "Necessity of Uniformity in Toll Line Service and Rates," "Our Loyalty to the Principles of the Association." There will be an exhibition of apparatus and a banquet.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPH IN THE WAR.—A London news agency has a dispatch from Rome stating that an Italian officer in charge of a wireless station in Tientsin says the Japanese battleships intercepted "Marconigrams" sent by the Russians.

PARIS METROPOLITAN UNDERGROUND.—The receipts of the Paris Metropolitan railways in 1903 amounted to $3,458,165, against $2,152,335 in 1902, several new lines having been opened during the year. The number of tickets issued was 100,107,631, an increase of 37,984,903 during the year.

LIGHTING BOIS DE BOULOGNE.—One of the most extensive and important pieces of park lighting by electricity is to be carried out in the famous Bois de Boulogne by the municipality of Paris. The park will be divided into three sections and the most popular alleys and avenues in each will be illuminated.

WATER PIPE THAWING.—As already noted in these pages, some little work has been done this hard winter in thawing out frozen water pipes electrically. The latest instance is reported from Elmira, N. Y., where, it is stated, electricians in the employ of the local water company have succeeded in thawing out frozen water mains. A positive wire was inserted at one end of each of a one-hundred-foot section and a negative wire at the other end. The current was then turned on and the ice rapidly melted. The mains were six inches in diameter and located in the outlying portions of the city.

LETTER TO THE EDITORS.

Theories in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

SIRS:—This discussion on the theories in wireless telegraphy is rapidly becoming "space-expanding," and I am afraid, correspondingly tedious. The main point now at issue, however, is at last well-defined. From Prof. Fessenden's letter in your number of January 30, it is clear that he holds to the idea of space-propagated waves, while my theory involves surface-propagation.

For the present we will agree to differ on this point, though there are many effects on which it would be interesting to have further information as to Prof. Fessenden's conceptions of the wave formation after it has been distorted in various ways. What, for instance, are the successive changes in the electromagnetic field associated with waves transmitted from England to the Antipodes? For I gather that Prof. Fessenden, like myself, believes in the possibility of communicating between antipodal stations.

The question of quantitative measurements of a kind intended to prove whether the law of inverse squares or inverse distances holds is a very complex one, and if any reliable investigations of this matter have been made it would be very interesting to know exactly under what conditions the tests were made, what readings were actually obtained, what the character of the surfaces over which waves were propagated, and how the calculations were made from the readings. I am not aware of any published results bearing on this point. Those who have attempted quantitative measurements in wireless telegraphy must be aware of many of the considerations which would enter into the question, and how anything like accurate allowances can be made for these in working out the calculations is difficult to see. To take one factor only—how would resistance losses due to imperfect and possibly varying conductivity of the surface, be eliminated? Or does Prof. Fessenden contend that there are no losses of the kind, seeing that he holds there are no currents in the surface of the earth with consequently no C^2R losses?

I do not propose to reply *in extenso* to the letter referred to, but rather to revert to the original point at issue, which is in danger, like Prof. Fessenden's sliding wave theory, of sliding out of sight. In its latest aspect the theory appears to belong to M. Blondel.

Can Prof. Fessenden point out any statements made by him in the published account of what he calls "his theory" appearing in the *Transactions* of the American Institute of Electrical Engineers for November, 1899 (which he refers to in his letter in your issue of October 31 last as the first publication of his sliding wave theory), which differ from mine advanced in May, 1899? I fail to find a single point of difference. I do not say that he did not have the space-propagation idea in mind, but that it is certainly not so expressed, and that, therefore, I am justified in my statement that the theory was first given by me.

Some of Prof. Fessenden's arguments (?) in your issue of January 30 in support of his contentions are distinctly humorous: but, I should think, hardly calculated to throw dust in the eyes of any who may care to follow this discussion closely. I refer more particularly to his remarks on "Lodge Waves" and his "discovery" of a new type of wave.

It is to be hoped that Prof. Fessenden will find time to publish a full account of his many valuable researches in wireless telegraphy, and if these are convincing proof of the correctness of his main views, I shall be the first to acknowledge it: but meanwhile I am content to let the case await further experimental developments, and do not abate my position one iota.

London, England. J. E. Taylor.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Direct-Current Dynamo Design.—Fynn.—Continuations of his illustrated serial. In the present installment he discusses several details of construction of the armature and field coils and makes the following remarks on commutation. The view is still extensively held that in order to obtain perfect commutation, it is necessary to work the teeth and air-gap distances up to very high values. As a matter of fact, the only effect of such a design on the no-load zone commutation is that it goes a long way to prevent an abnormal distortion of the field which might interfere with the commutation, but provided this distortion is guarded against in some other way the air and tooth densities may be as slow as desired without interfering with perfect commutation. Since the commutation depends on the correct variation with time of the intensity of the short-circuit current, the duration of the short-circuit must play an important part in the process, and all those various e.m.f's or differences of potential which prevail during the short-circuit must be taken into consideration. Further, the nature, intensity and variation of the field through which the short-circuited spool travels must be considered. In order to make commutation possible within the no-load zone, with fixed brushes, it is necessary to so choose these various values that the alteration of the commutating field with a varying load does not alter the short-circuit current sufficiently to produce a materially increased or decreased current density under the brush at the end of the commutation. To obtain a very wide range, it will, therefore, be best to so arrange matters as to obtain a little too great a density at no load, and a little too small a density at full load, the permissible limits of deviation from the normal mainly depending on the quality of the brush used, being considerably greater for carbon than for copper brushes.—Lond. *Elec. Rev.*, January 8, 15, 22.

Eddy Current Losses.—Niethammer.—A mathematical article on the calculation of the eddy current losses in the pole shoes and in the armature. By proper design these losses may always be made so small that they can be neglected. Concerning the losses in pole shoes with slot armatures the rule is that the ratio of breadth of slot to air-gaps should be smaller than one to two. This ratio should be the smaller, the greater the speed and the larger the total pole shoe surfaces. The last point is the reason why many firms (especially American ones) laminate the pole shoes of their large machines. He gives a number of formulas for the eddy current losses in armatures.—*Zeit f. Elek.* (Vienna), January 24.

references.

Theory of Alternators.—Pulsig.—The first part of an illustrated article in which the author shows that the well-known circular diagram, representing the action of induction motors, may be applied to alternating-current generators.—*Zeit. f. Elek.* (Vienna), January 31.

Predetermining Magnet Windings.—Malcolm.—An article on the determination of the value of the current required to bring a coil to the working temperature by assuming that that current would in one hour raise the temperature of the coil one-third of the total rise for ten hours, and making the ten-hour rise the criterion of heating. Thus, if the rise in temperature after ten hours in circuit was to be 60°, the author assumes that the current which produces a rise of 20° in one hour will cause the 60° rise in ten hours. This is not always true, of course, but it is near enough for practical work.—*Am. Elec.*, February.

Lights and Lighting.

Permeability of Fog for Light Rays of Different Wave Lengths.—Rudolph.—An account of experiments made in the laboratory in which he found that artificial fog was more permeable for blue rays than for red rays, which is in disagreement with generally accepted assumptions. His fog was of the density 50, i. e., of 50 candles of a source of light only 1 passed through 1 meter thickness of fog; this is, however, not a dense fog (Editorialle). The results cannot have a general value, but depend on the conditions of the experiment. The absorption maximum depends on the size of the drops of fog.—*Phys. Zeit.*, January 15.

Power.

Electric Hoisting Without Loss of Energy in a Rheostat.—Kammerer.—An illustrated description of an electric hoisting system without the use of a rheostat. The peculiar feature of a hoisting operation is that after a starting period of, say, 20 to 30 seconds immediately a breaking period of 10 to 20 seconds follows. The machine is a combination of two shunt motors designed in such a way that by varying the field strength the number of revolutions of each motor can be varied in the ratio of 2 to 3. The pole wheel of the first motor is stationary, that of the second motor can revolve, while the armatures of the two motors are so connected as to revolve together. The two fields may first be equally excited, but in reverse sense; then the armature of the first motor revolves with a certain speed and takes the armature of the second motor along. The pole wheel of the second motor tends to revolve in the opposite direction with the difference of the speeds of the two armatures with respect to their fields. The pole wheel of the second motor will, therefore, remain at rest as long as the excitation of both fields is equal. If, now, the excitation of the first motor is diminished, while that of the second motor is kept constant, the relative speed of the first armature with respect to the first pole wheel increases and the relative speed of the second armature with respect to the second pole wheel decreases. Hence, the second pole wheel will now revolve in space, the first machine working as motor, the second as generator. The first field strength may be so far diminished that the relative speed of the first armature with respect to its field is 50 per cent. above the normal speed; the second pole wheel will, therefore, revolve with one-half the normal speed. To decrease the latter speed again, it is only necessary to increase again the first field excitation. When it is again normal, the second pole wheel is at rest. When the second (movable) field is then decreased, the second pole wheel will begin to revolve in the opposite direction, the first machine now acting as generator and the second as motor; the operation, therefore, corresponds now to an electric brake. It will be seen that the control is very simple, the exciting currents only being varied; after operation has begun, nothing is changed any more in the connections between the armatures and the supply network. The author thinks that this system would be specially suitable for elevators in office buildings and hotels, running at a speed of 1 to 2 meters per second. —*Elek. Bahnen*, January, No. 1.

Electromechanical Coupling.—Gasnier.—A note presented to the French Academy on an "electromechanical" coupling which allows a continuous change of speed from zero to maximum speed, and which is specially suitable when the prime-mover is near the axle to be driven. It consists of a combination of the prime-mover with two dynamos, one running as generator, the other as motor, and both being of a much smaller capacity than the prime-mover, say 1/3 or 1/4. The prime-mover transmits always a certain part of its power directly to the main axle to be driven, while the rest of its power is absorbed by the electrical machine which runs as generator. A train of epicyclic gearing is used in such a way that the main axle is acted upon simultaneously by both the prime-mover and the dynamo which runs as motor. These two machines are separate and may consequently have different speeds. For instance, an epicyclic gearing may be composed of a central toothed wheel and an external wheel with inside teeth, with teethed wheels between the two. The axles of the latter are fixed on a support. The desired result is obtained by connecting each of the three parts (internal wheel, external wheel and support of the middle wheels) with one of the three axles—that of the prime-mover, that of the electric motor and the main shaft, respectively.—*L'Ind. Elec.*, January 25.

Electric Installation in a French Cotton Mill.—An illustrated description of the installation of the Mirecourt Cotton Mill, which is one of the most important mills in France. Electric equipment was preferred to the ordinary mechanical equipment because the tenders showed that the first cost and the cost of up-keep would be smaller and the efficiency higher in the former case. There is a steam-driven 600-hp alternator giving three-phase currents with a frequency of 50 cycles at 400 volts. The motors receive directly the three-phase currents at 400 volts, but the lamps are arranged so that each receives 230 volts. The motors are of the induction type with short-circuited rotor. All the motors for spinning are placed in recesses in the walls to avoid blocking up the passages. The switches and circuit-breakers are placed in iron boxes. For the weaving shed the motor used for the preparing machines is placed in the wall, and the motors which work the looms are suspended from the ceiling; thus no space has been lost. The pulleys for the above-mentioned motors are divided into two parts by a projecting disc, and they drive by means of two belts, one on each side of the disc, the shafts for two lines of looms; this method annuls the sideway pull of the belt and diminishes the friction on the bearings. The switches are controlled by means of levers from the floor level. For starting the installation the alternator is excited by a battery before starting the engine. All the switches are closed, and the alternator is slowly run up. All the motors start at once and accelerate as the engine runs faster. When this is up to full speed the whole factory is in normal running order. The excitation is regulated at the switchboard to give the desired voltage and the battery is replaced by an exciter. Induction motors are believed to be peculiarly adapted to the special conditions existing in the textile industries, in which speeds are required as constant and uniform as possible under varying loads, with continuous working and facility of control. With a working day of 10 hours and a consumption of 1.7 pounds of coal per indicated hp-hour, the electrical system has saved 836 pounds of coal per day, so that for a year of 300 working days and an average price of $6 per ton, a yearly saving of $680 is effected. This system has been in use for about a year, and the cost of maintenance has been found to be practically nothing.—Lond. *Elec. Rev.*, January 15.

Hydroelectric Developments in France.—BLOCH.—A fully-illustrated article on hydroelectric plants in the country around Grenoble, which was the headquarters of the Congress of Houille Blanche (white coal, meaning the utilization of water falls for producing power). The equipment of the different plants is described and the following figures are given for the utilization of hydroelectric power in the Alpine region: aluminum works, 22,536 hp; other metallurgical factories, 20,485 hp; chlorate of potassium works, 9,000 hp; calcium carbide works, 104,466 hp; sodium chlorate works, 13,500 hp; transmission of power and lighting, 48,727 hp; various industries (like paper and pulp mills, cement works, etc.), 19,989 hp; total, 238,703 hp. (A description of one of the Grenoble plants was printed in these columns February 6.)—Lond. *Elec. Rev.*, January 22.

Coal Consumption in Central Stations.—GILES.—A paper read before the Manchester Section of the (British) Institute of Electrical Engineers, concerning the question of handling coal. He says that if the central station is a small one, burning say 50 tons per week, mechanical stokers will show very little gain over hand-firing, unless it is necessary to avoid all smoke or to burn a very small, low-class fuel. In large central stations, however, mechanical stokers are very satisfactory, for not only can a cheaper coal be used than with hand-firing, but the economy of labor in employing these machines, in conjunction with a coal-elevating and conveying plant, may reach sometimes 30 to 40 per cent. over hand-firing. Kennedy considers the following figures ideal for a central station: 10½ pounds of water evaporated per pound of coal, and 8½ pounds of steam at engine per pound of fuel burned. On this basis the author calculates the coal consumption of a modern 775-kw plant, with the following guarantees: Steam pressure at engine, 170 pounds; steam consumption per kw-hour (full load), 21.92 pounds; vacuum, 24 inches; temperature of steam at engine, 450° F. Then the coal consumption will be 2.58 pounds per kw-hour. He gives a list of coal consumption in various British central stations, with indications of the conditions under which the stations are worked. In this list the coal consumption in pounds per kilowatt-hour is highest for Blackpool, 15.4; and Derby, 13.2; and smallest in Bradford, 4.1; Salford, 4.3, and St. Helens, 5. The load factor in these stations is 14.32, 13.36, 20.93, 21.84, and 19.78 per cent., respectively. The influence of the load factor on the load consumption is also shown in diagrams.—Lond. *Elec.*, January 22.

REFERENCES.

Electric Power in Railway Workshops.—DUB AND SUCHY.—An illustrated description of the electric equipment of the railway workshop of Linz in Austria. There are 25 three-phase induction motors used for operating cranes, pumps and drills. With the exception of two, which have a short-circuited armature, all the motors are provided with slip rings. Power is provided by a three-phase generator running at 110 revolutions, and giving 200 kilovolt-amp. for non-inductive load, the voltage being 220.—*Elek. Zeit.*, February 4.

Electricity in British Coal Mines.—A note stating that electrically-driven coal-cutting machines have come largely into use in Lancashire, where experiments have been going on since 1899, with great success. The output per man has been increased and coal is now economically worked which previously had been unworkable at a profit by hand.—Lond. *Elec. Rev.*, January 22.

Turbines.—SCHMIDT.—A long article on the principles and theories underlying the construction of vapor turbines. The theoretical formulæ of mechanics and thermo-dynamics are given, upon which investigations with regard to the turbine must be based in order to obtain useful and reliable results. By means of the formulæ given, the nozzle area and proportions, as well as the bucket velocity, may be predetermined with sufficient accuracy for all practical purposes.—*Am. Elec.*, February.

TRACTION.

Electric Traction on Trunk Railways.—HERZOG.—A profusely-illustrated article in which the author first emphasizes that if ever electric traction is to be introduced on trunk railways, it must be done without any interruption of service, and on the tracks and rolling material, now available, with the exception of the locomotives. The weakest point in electric traction will be the trolley line. The author describes in detail the system of the Oerlikon Company (single-phase transmission, motor-generators on the locomotive, direct-current motors) and dwells at length on mechanical details of construction of the trolley and trolley wire (which, of course, may also be used on locomotives equipped with single-phase motors). The trolley wire is not above the center of the road, but at the side, and the current is taken off by means of a rod curved in a convex form towards the trolley wire and pressed against the latter by means of a spring. This rod is movable in a plane perpendicular to the direction of the train, around a shaft which is placed insulated on the locomotive. Moreover, the position of this rod may be varied in height or in cross-direction either by hand or automatically. The advantages are that the rod adjusts itself to any position of the trolley wire. The current is generally taken from the upper part of the trolley wire, where there is no ice or sleet in winter. The fact that the trolley wire is placed at the side of the road will enable the introduction of the system without interruption of the steam service.—*Elek. Bahnen*, January, No. 1, 2.

Conduit System.—MILLAR.—An abstract of a paper read before the (British) Institute of Civil Engineers, on the electrical reconstruction of the South London tramways on the conduit system. The conduits are 2 ft. deep by 1 ft. 2½ in. wide, and consist chiefly of cement, concrete and cast-iron yokes, the latter spaced at 3 ft. 9 in. intervals, which support the slot rails and form a template to which the concrete panels are moulded. Chambers are formed at intervals of 5 yards for the reception of the insulated supports from which the T-shaped conductor bars supplying current to the cars are hung. These insulators have a porcelain body in appearance like an inverted jar and are protected and secured in an iron cap, which is bolted to the slot rails. The steel rod which carries the conductor bars is cemented inside the porcelain cup, and the actual attachment to the bars is made by means of cast-iron clips, capable of adjustment by means of an eccentric washer. The conductor bars have a sectional area of 2.15 sq. in. They are placed symmetrically in the conduit 6 in. apart, and the minimum air-gap between the conductors and the conduit structure is 2 in. Drainage of the conduit is provided for by connecting it to the sewers at intervals of 60 yards. The slot is ¾ in. wide. The line is divided into ½-mile electrical sections, each section being fed by separate distributors. The current is generated by two 1,500-kw, direct-current sets, the normal voltage at the main station being 625 and on the line approximately 550.—Lond. *Elec.*, January 15.

Electric Traction in Great Britain.—A table giving a large amount of statistical information on the present condition of electric traction in Great Britain; also an editorial on this subject. The number of electric tramways supplied from combined tramways and traction stations is no less than 88 out of a total of 130; that is, over ⅔ of the whole list. Central station engineers endeavor to improve the load factor by adding a tramway load and in some cases an extremely low price is charged for the tramway supply. On the other hand, while public lighting is a useful addition to a tramway station, the peaky private lighting is not. Four electric railways were running at the end of 1902 in Great Britain: the Liverpool Overhead Railway, the City & South London Railway, the Waterloo & City Railway, and the Central London Railway. During 1903 two new lines were opened: the Mersey Railway, and the pioneer, six miles of electrically-equipped Metropolitan District Railway. Shortly the Great Northern & City Railway and electrically-equipped sections of the Northeastern, Lancashire & Yorkshire Railway will be opened. Progress is also being made with the transformation of the Metropolitan District Railway and the building of the tube lines of the Yerkes group. In electric railway, as in tramway work, standardization is now being approached. The main difference between electric railway systems lies in the position of the third rail and as to whether an insulated fourth rail is employed as return conductor. A third rail in the center of the track is unsuitable for heavy railways on account of a low-load gauge and the possibility of pending chains, etc., coming into contact with the rail. Thus the construction, adopted in the four older lines, with the positive conductor rail between the tracks, has been abandoned. The Lancashire & Yorkshire Company has laid an insulated fourth rail as negative conductor between the tracks.—Lond. *Elec.*, January 29.

Trolley Head.—An illustrated description of a trolley head designed to lessen the difficulties of replacing the trolley on the trolley wire, when it has jumped off. It consists of a swivel head of the usual type in most respects, but with the addition of two horns, one on either side of the wheel, which can be elevated for use in replacing the trolley on the wire, and afterwards return to their normal position, housed in the metal ball surrounding the wheel. The horns are actuated by a cord which is carried down to the conductor's platform and which, when pulled, causes the horns to be raised by means of gearing in the trolley head. The reverse motion is brought about by a spring in the head.—Lond. *Elec. Rev.*, January 8.

Trolley Ears.—An illustrated description of a device of an English company to prevent the flashing and hammering at trolley ears, which is due to the fact that the line is swollen out by the overlapping of the ear. This protuberance forces the trolley head down causing it to jam and producing an arc. To prevent this the wire, instead of going straight through, as is usual, is curved upwards for a few inches of its length. The wire is held in position by two plates suitably grooved and bolted together. By this means the ear does not protrude beyond the wire. It is said that experiments have shown the device to be satisfactory.—Lond. *Elec. Rev.*, January 15.

REFERENCES.

Single-Phase Traction.—EICHBERG.—An article illustrated by diagrams in which he first explains some characteristic feature of the Winter-Eichberg motor and then compares it with the Finzi motor, the comparison being in favor of the former especially with regard to efficiency, and power factor, and also weight.—*Elek. Bahnen*, January.

Paris.—PAUL.—An illustrated description of the generating station and conduit system of the General Parisian Tramways Company. The system differs radically from American practice, the chief difference being in the employment, over part of the road, of side conduit which also serves as one of the rails. The slot is rather wide, and at switches it is diverted from the side of the track to the center. As the trolley system is also used, provision is made for removing the plow at certain points.—*Am. Elec.*, February.

Car for Measurements.—BJOERKEGREN.—A fully illustrated description of the equipment of a special car with measuring instruments in order to determine the energy consumption, etc., on the Berlin tramways.—*Elek. Zeit.*, January 28.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Three-Phase Working.—BREW.—The first and second parts of an illustrated paper, read before the Dublin Section of the (British) Institute of Electrical Engineers, on three-phase working, with special reference to the Dublin system. In this city the change-over of the supply from the 2,000-volt, 83-period, single-phase station at Fleet Street, to the 5,000-volt, 50-period, three-phase station at the Pigeon House, situated over three miles distant, could be comfortably effected in something like 20 seconds, whereas the arrangements for accomplishing this result had been maturing for something over two years. There are two 1,000-kw and two 500-kw alternators, giving 5,000-volt, three-phase currents. Since the new station is very near the sea, troubles had been prophesied on account of the direct generation of high-tension currents in the alternators; but the latter have been working continuously for seven months without giving any indication that the sea air disagreed with them. Some data are given on the design, self-induction and capacity of the transmission mains, and the relative advantages are discussed of the use of single-phase and three-phase transformers and delta or star connection in sub-stations. He mentions that in Dublin they had not the slightest difficulty as regards the banking of single-phase transformers in delta or star connection, transformers of 25-kw output sharing the load proportionately throughout the range with transformers of 250-kw output when banked with them delta and star-connected. Between the generating stations at Pigeon House and the central distributing station at Fleet Street, a distance of 3.1 miles, three trunk mains have been laid, each consisting of a three-core, lead-covered paper cable, the section of each core being 0.15 sq. in. The smaller sizes of Dublin sub-stations are connected with the central distributing station by 0.04 sq. in., three-core sub-feeder and spare. The paper is to be concluded.—Lond. *Elec.*, January 22 and February 5.

An Emergency Switch for Central Stations.—THORNTON.—An illustrated article in which the author points out that most modern generating stations for the supply of electrical energy in bulk have one weak spot. In the event of an arc developing at the main bus-bars, it cannot, as a rule, be quickly extinguished without either danger to the attendants or damage to the machines. In some cases it has been necessary, in order to save the board and leads, to break the main exciting circuit. Instead of this the author makes the suggestion that an auxiliary switch should be fitted to the bus-bars from which the generators are excited, so that by this switch all the fields, instead of being broken, can be simultaneously short-circuited. Such a device enables the station to be shut down without shock to any part of the system, the magnetization taking a few seconds to diminish until the voltage required to maintain the arc cannot be generated. As the arc ceases and the bars are cleared, all but one of the main switches can be opened, the field circuit restored and supply re-established.—Lond. *Elec.*, January 15.

Protecting Devices for Generators.—CLOTHIER.—A discussion of the probable cause of the recent fire in the Bristol Central Station and its lessons. As protecting devices for generators he thinks that fuses are bad, since among other well-known reasons the sound machines are likely to be isolated at the wrong time. A really reliable device that would automatically open the generator switches on the reversal of current has long been sought for, but it has been found that while such devices meet the requirements for high-resistance faults, yet in case of low-resistance faults (short-circuit on the armature, etc.), the low potential difference across the shunt coil, on alternating-current systems, renders this apparatus inoperative and useless just at the time when reliability and certainty in action are most essential. He thinks it is better to do without automatic protection and to risk injuring the alternator rather than to cause a complete or even partial cessation of the supply to the consumers. By removing the fuse from existing generator panels, space will be available for the addition of a reverse-current indicator, which, by the glow of green and red lamps, respectively, will show whether the alternator is generating or taking current from the bus-bars. For the barest necessities it is proposed to arrange on the switchboard platform, or at any other convenient place, at least 20 ft. away from the permanent switch gear, a system including an arrangement of connections and switch boxes, one of these boxes being provided for each alternator installed. Each feeder has also a place in one or more of these boxes, the connections being arranged so that each machine can be run independently upon a group of feeders, the number of which will vary according to the size of the machine and feeders. Then in the event of a breakdown placing the entire switch gear out of commission the switch can be rapidly reinstated by the independent running of all machines for the time being on the several groups of feeders which are respectively connected up solid. Arrangements are also made so that, in the event of any single machine being out of commission, the feeders, which were allocated to that machine, may be coupled up to the other generators. The supply pressure may be regulated on the engine stop valve and governor, and indicated by a pair of lamps connected in parallel between the earth terminal and the tapping from alternator armature. The system affords a ready means of isolating for cleaning and other purposes, besides forearming against the complete or partial displacement of the permanent switch gear or connections inside the electric works.—Lond. *Elec. Rev.*, January 15.

English Central Station.—An illustrated description of the municipal plant of Swindon, which is a town of 48,000 inhabitants, in the west of England. The three-wire, direct-current system is used. There are three 200-kw dynamos, with compound winding for traction supply. The series winding is so arranged that the main current can be diverted as required through a shunt and the compounding effect thus varied at will from zero to overcompounding. A balancer is provided capable of dealing with 100 amp. on the middle wire; it can automatically regulate with a load of 50 amp., thrown on either side; a motor-generator is installed comprising a motor in the center with a generator on each side. The motor is of 42 hp and the generators are wound for 220 to 310 volts. It is used for charging the accumulators and for taking current from the three-wire switchboard and supplying it to the tramway board. In the latter case the two outer machines are connected across the three-wire system, and the center one across the tramway bus-bars, so that with this arrangement, one dynamo may be used to supply both lighting and heating. The battery consists of 252 cells with a capacity of 350 amp.-hours. Besides lighting, current is used for motor driving in various factories.—Lond. *Elec. Rev.*, January 15.

Electro-Chemistry and Batteries.

Edison Storage Battery.—A full account of the discussion following Hibbert's paper on the Edison battery. Hibbert, Fleming, Wade, Joly, Cooper and Patchell participated in the discussion. The tests made independently by Janet, Hospitalier, Finzi, Hibbert and Fleming gave practically the same results. Fleming had ascertained by special experiments that there is no local action between the active material and the support; that the active materials used by Edison are insoluble in the caustic potash solution, and that the active material was brought out of the pockets by heavy discharges only to an extremely small extent; while with respect to weight and capacity the Edison battery is not greatly superior to light lead cell, it is so with respect to durability. Joly gave curves on the charging of the battery. In an editorial on the subject it is said concerning the battery "that, although it is not in the least likely to effect a revolution in accumulator traction, there does not remain a shadow of doubt that it has many features which are superior to those possessed by the lead cell. Provided the price is not excessive, the outlook is bright."—Lond. *Elec.*, February 5.

REFERENCE.

Rare Elements.—Lenher.—The conclusion of his article on the properties and commercial applications of rare elements. He first deals with the rare earths and their use in the incandescent gas mantle; vanadium and uranium and their application in special steels; columbium and tantalum, selenium and its behavior when lighted; tellurium; molybdenum and tungsten, and the platinum metals.—*Electrochem. Ind.*, February.

Units, Measurements and Instruments.

Potentiometer.—Fisher.—A description of an improved form of potentiometer which is shown in Fig. 1. The general principle is well known, a storage cell, E, supplying constant fall of potential over $A B C$, where $A B$ is a slide wire and $B C$ a given number of sections of wire, each equivalent in resistance to $A B$. The potential, F, to be measured is connected in series with galvanometer G to the

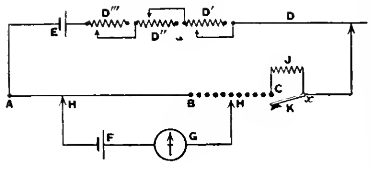


FIG. 1.—POTENTIOMETER.

sliding contacts, $H H$. Among the new features is the use of resistance D, D', D'', D''', of which D is a straight wire, similar to $A B$, and carrying a suitable scale, definitely calibrated in known terms, $A B$ as unit. D', D'', D''' are rheostats, duly calibrated in terms of D and so graded that D' consists of 10 coils each of the same resistance as D. D'' consists of 10 coils each equal to D' in the aggregate, and D''' bears the same ratio to D''. So there are practically two potentiometers, $A C$ and $D D'''$ in series, calibrated and of known value in absolute terms throughout. Another new feature is the coil J, capable of being short-circuited by the key K and having a potential stud, X, with which, when necessary, H can make contact. Preferably, this coil is made nine times the ohmic value of $A C$. The following advantages are claimed for this instrument. It is self-checking for accuracy throughout its range without the necessity of the use of auxiliary apparatus, alteration of, or addition to, connections in use. It possesses means of compensation for any known errors in standards, by which the same are made direct-reading and subsequent corrections eliminated. Higher potentials than at present may be compared direct on the instrument without the use of a volt or a ratio box. The working potential of the instrument may, after standardization, be altered to any value without restandardization, and yet its altered value over any portion of the working part be definitely known. Considerable saving is effected in the cost of necessary additional apparatus, especially in the measurement of current. Greater accuracy is obtained in the measurement of small potentials and in the comparisons for ohmic value of standard resistances. Indefinite prolongation of the lower portion of the scale is possible, enabling thermo-junction temperature measurements to be taken with greater ease and accuracy. Indefinite prolongation of the whole scale is possible with consequently greater range. The whole instrument is alive for measurements, with no dead portion, as in the older form of apparatus. The various applications are described in detail.—Lond. *Elec.*, January 15.

Frequency Measurements.—Hartmann - Kempf.—An illustrated article in which he gives an account of careful measurements of the exactness of his instruments for measuring frequency. The principle is to subject small pieces of sheet steel or steel "tongues" (as used in some musical instruments) to the influence of an electromagnet, which is excited by the current, the frequency of which is to be measured. There is provided a series of such steel tongues of differ-

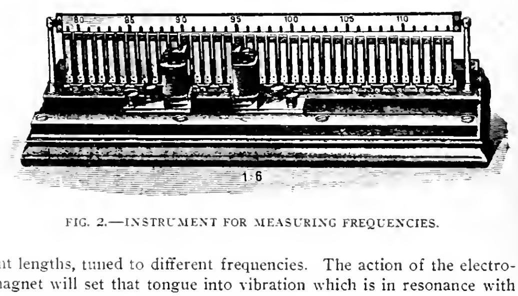


FIG. 2.—INSTRUMENT FOR MEASURING FREQUENCIES.

ent lengths, tuned to different frequencies. The action of the electromagnet will set that tongue into vibration which is in resonance with the frequency of the exciting current. The vibrations of the tongue may be observed either by the eye or by the ear. An instrument of the latter kind is shown in Fig. 2. He found that the wave form of the exciting current or the value of its amplitude did not materially change the result. The applications of the instrument to measurements of the variation of the frequency to the connection of alternators in parallel and to the determination of the speed of the prime-mover are discussed.—*Elek. Zeit.*, January 21.

REFERENCES.

Calibrating Electrometers.—Harms.—While endeavoring to measure the smallest currents through gases in absolute units, he found that it was impossible to determine the capacity of electrometers with sufficient exactness, since the capacity depends to a great extent on the configuration of bodies nearby. He, therefore, did not determine the capacity of a condenser (which, he believes, is a hopeless attempt with the usual methods for capacities below 100 cm.), but measured the induction of one condenser plate on the other by two independent methods. His method is specially suitable for calibrating quadrant electrometers and for determining the capacity of measuring instruments for atmospheric electricity.—*Phys. Zeit.*, January 15.

Flicker Photometry.—Simmance.—A paper in which the author explains the principles of the flicker photometer, as discovered by Root, and describes the Simmance-Abady photometer, which was recently noticed in the Digest.—*Progr. Age*, February 1.

Telegraphy, Telephony and Signals.

REFERENCES.

Tone Test.—O'Brien.—An illustrated article on the tone test as applied to calls completed over long distances and toll lines. Since the adoption of the multiple switchboard in telephone central offices, it has been necessary that some means should be provided whereby the condition of any line connected to the switchboard might be ascertained by any operator. With the advent of the common-battery system it became possible not only to expedite the work of an operator, but also to give to the operators at the switchboard the means of obtaining a more intimate knowledge of the conditions of the connected lines than had heretofore been possible. This end has been very largely accomplished through the use of distinctive test circuits, in which an interrupted current of a certain periodicity is applied to the sleeve of the line jacks in much the same way as the original "busy" test; the effect of this arrangement being that upon testing the line the operator instead of receiving the usual click, hears through her receiver a musical tone of a character depending upon the periodicity of the interrupted current.—*Am. Elec.*, February.

Tramway Telephone System.—An illustrated description of a system of service telephones used in connection with the Dublin tramways. Six three-core cables leaving the power station and radiating out to the various termini are looped in on the way to about 80 feeder pillars and 13 offices or car depots on the various roads. One of the wires is used for the Board of Trade earth voltage test, but the other two are available for telephone service. While maintaining this simplicity of the open-circuit system with only one ringing battery at the power station, it is possible from the power station to ring up a depot, or, when there are two depots or one pair of wires, to ring up either depot without calling the other. It is possible to put into communication with each other any two outlying depots and for the outlying depots to signal to the power station when they have finished speaking through to another depot.—Lond. *Elec.*, January 29.

Telephone Engineering.—Dommerque.—Another article of his serial dealing specifically with the erection of cables.—*Am. Elec.*, February.

Miscellaneous.

REFERENCES.

Electrometallurgy of Gold.—A long article on the electrometallurgy of gold in South Africa from 1897 to 1899, with abstracts of papers read before the Chemical and Metallurgical Society of South Africa, with special reference to the question under which conditions electrolytic precipitation is preferable to zinc precipitation. Butters' paper on the Siemens & Halske process on the treatment of slimes is abstracted at length. Other papers dealt with electrode connections for electrolytic vats, the influence of temperature in the cyanide process, and the application of the theory of ions to the electrometallurgy of gold, and a long discussion of the relative disadvantages and advantages of zinc and electrolytic precipitation.—*Electrochem. Ind.*, February.

Conductivity of Solutions in Alcohol.—Kraus.—First part of a paper on the electrical conductivity of solutions in methyl alcohol in the neighborhood of a critical point. In the present installment the results of measurements are given in form of tables, but conclusions are not yet given. The paper is to be concluded.—*Phys. Rev.*, January.

Microstructure of Metals and Alloys.—Campbell.—An illustrated article in which the author emphasizes that chemical composition should not be considered to be everything, for unless the structure of a metal or alloy is good, the best of materials will not make the finished product anything but a very medium article. Photographs are given of the structure of cast aluminium and electrolytic copper and silver, and Roozenboom's diagrammatical representation of the different alloys of iron and carbon (as function of the per cent. of carbon and of the temperature) is given together with various photographs of the structure of the various alloys.—*Electrochem. Ind.*, February.

New Books.

Elektrische Apparate für Starkstrom. By Georg J. Erlacher. Hannover: Gebruder Janecke. 228 pages, 131 illustrations. Price, 8 marks.

This volume written by a specialist on the subject is devoted entirely to switches, fuses, circuit-breakers, rheostats and, incidentally, switchboards.

Its author thinks that too little is known about these articles, they being considered as side shows by the majority of designing engineers and their manufacture, hence left to empirics. He has, therefore, endeavored to make a critical analysis of the subjects and to deduce from experiments and by calculation trustworthy data to guide others in the same field. While it can hardly be said that he has succeeded in producing a switch, circuit-breaker, fuse and rheostat maker's *vade mecum* to which all will turn, there is no doubt that the book is well worth perusal, and that the reader will profit thereby.

The opening chapter, on switches, after discussing the various forms of contacts, gives tables showing the current density, pressure per square cm., resistance and other data of contacts between flat blades and spring clips of the kind often used in this country and of two forms of the laminated brush contacts extensively employed abroad and beginning to find favor on this side for heavy current work. The tables were made from experiments, and from them are deduced rules for designers. Numerous makes of switches are illustrated.

The high-tension switch section that immediately follows is interesting to the American designer chiefly because of the descriptions of the air blow-out switches made after the pattern of the Siemens & Halske "horn" lightning arresters, of which we have often read, and which seems as sound in principle as it is simple in construction, but of which the reviewer at least has seen no examples in this country. The entire omission of oil break and distant control switches, however, seems strange.

In the chapter on fuses there are sets of curves giving the interrelation of melting points with fuse wire lengths and the mass of the terminals together with curves showing the time required for rupture with different currents. Of commercial forms of open-type fuse blocks, but few are shown and only one make of the enclosed fuses, which are justly so popular here is illustrated, even that one receiving but scant attention. The circuit-breaker section is handled much as the switches were, the major attention being given to two undeniably ingenious types made by Schuckert & Co. and the Society Ind. Telephones, respectively.

Thirty pages are next given over to end cell switches and form an acceptable addition to the exceedingly meagre literature on that subject. The illustrations and detail drawings of heavy current apparatus of this kind are particularly good.

In rheostats the author pins his faith to the form in which resistance wires of nickelin are wound on hollow grooved porcelain spools, the latter being mounted in suitable iron frames. Leads tapped off from the wires run through holes in the side of the spools into their hollow interior and then to the usual contact segments.

Apparently the overload and underload release attachments, whose presence is compulsory here, are not very popular abroad, as but one non-American rheostat so equipped is illustrated. There are, however, numerous types of which we seldom see examples, notably rheostats in which the moving arm is actuated by a screw mechanism to prevent the possibility of starting motors with their aid too fast, and rheostats for use with multiphase motors. There are also some interesting examples of reversing rheostats for the control of crane motors and the like.

As the switchboard section occupies less than a dozen pages of printed matter it may be surmised that it is not very exhaustive. There are a few constructive details in it that are mildly interesting, a few tables of no particular moment and three insipid diagrammatic views of typical switchboards. The volume has its place in a designer's library.

Plans of the Allis-Chalmers Company.

A few weeks ago we gave an outline of the plans of the Allis-Chalmers Company in regard to entering the electrical field, etc. We have now received the following official announcement, signed by Mr. W. J. Chalmers, vice-president:

We beg to notify you that our company has widened its scope of manufacture, and engaged in most important industries. We could not give you the information at an earlier date, as we have only just concluded final arrangements for all the new industries we are to engage in, which we are pleased to enumerate as below: steam turbines, hydraulic machinery, gas engines and electrical machinery.

As regards steam turbines, we have become associated with and form part of the Steam Turbine Advisory Syndicate of England, which is composed of Yarrow Shipbuilding Company, of England; Tweedie (Vulcan) Shipbuilding Company, of England; Willans & Robinson, engineers and well-known engine builders, of England; Mr. Fullager, formerly chief engineer Parsons Steam Turbine Company, of England, now consulting engineer for Steam Turbine Advisory Syndicate, and Allis-Chalmers Co.

Our turbine is of the horizontal type, which is the type Parsons, of England, and Brown, Boveri, of Switzerland, manufacture. We are convinced after an investigation by our engineering staff in Europe and elsewhere extending over a period of two years, that we have a steam turbine that is at least in efficiency and economy equal to the best make of Parsons or Curtis, which are the types most known. We are now prepared to enter into the building of steam turbines of the following sizes: 500, 750, 1,000, 1,500 and 5,000 kw and can, if required, build up to units of 10,000 kw. The largest size that has ever been built of any type of turbine is 5,000 kw. Our license from the Advisory Turbine Syndicate concedes to us all of the United States, Canada and Mexico, with equal rights and privileges in South America, and rights to do business elsewhere in the Western Hemisphere.

We have concluded arrangements with Escher-Wyss & Co., of Zurich, Switzerland, whereby we become the sole licensees for the Western Hemisphere of their famous hydraulic machinery, several types of which have been installed at the Niagara Falls plant of the Cataract Construction Company, aggregating 85,000 hp. Escher-Wyss & Co. have long enjoyed, and still enjoy the reputation of being the best-known manufacturers of turbines in the world. We only mention Niagara Falls as one of the plants employing thousands of horse power installed by Escher-Wyss & Co.

We have bought the American patents, and have become sole licensees for the Western Hemisphere of the Nurnberg Machine Company, Nurnberg, Germany, for their gas engines, and are now prepared to make gas engines up to any required horse power. At the present time we are prepared to build gas engines from 250 to 1,500 hp. These engines are suitable for consumer gas or taking the waste gas from blast furnaces and utilizing same with economy and efficiency. It is in the blast furnace trade that we expect the largest business to result. The engine is not an experiment, but engines of 1,500 hp are now in operation in Germany, and it was after two years' investigation by our engineering staff of the various gas engines, that we selected the Nurnberg, and have engaged in its manufacture. It is a prime mover, either for blowing engines in blast furnaces, or for direct-connected dynamos in generating electricity, or for any other purpose where power is required.

We have engaged in the manufacture of generators, motors and electrical apparatus in all its branches both for stationary and railroad work, power-house installation for transportation purposes and electric lighting. We have engaged to take charge of this department of our business Mr. John F. Kelly, formerly of the Stanley Electric Co.; Mr. William Stanley, of the same company, as consulting engineer, and Mr. John H. Kelman, formerly superintendent of the Stanley Co., as superintendent of this department. In addition we have engaged others of the late Stanley Co.'s staff whose services we can use, and have drawn a further supply from the best electrical establishments in this country and in Europe; so that we are fitted out with a complete engineering staff in every branch of the electrical business, and we believe that Messrs. Kelly and Stanley are recognized in the profession as standing equal to the best.

From the above you will observe that we have entered the field not only in the line of prime movers, embracing reciprocating engines, in which field we have always led, but also with steam turbines, gas engines and hydraulics; and with electrical apparatus combined with any one of these prime movers we are now prepared to estimate upon and accept contracts for complete plants of all description and furnish the best of their respective kinds.

Motors for Yerkes' London System.

The British Thomson-Houston Company, Limited, of Rugby, England, which concern is controlled by the General Electric Company, of New York, has been awarded the important contracts for the motor equipments to be used on the 140-odd miles of underground and surface electric traction system now being constructed in and around the British metropolis by the Underground Electric Railways Company, Limited, of which Mr. Charles T. Yerkes is chairman. Before the decision was arrived at the "B. T.-H." equipments were subjected to an exhaustive test, extending over a period of 12 months and conducted on the Ealing-Harrow section of the Yerkes lines. Four hundred and eighty cars in all will be equipped, each car having motors aggregating 500 hp in capacity. Each motor will be enclosed in a steel case. The value of the contract exceeds $5,000,000.

Exhibits at the Ohio Independent Telephone Convention.

A number of prominent manufacturers of supplies had exhibits of their lines in the corridors and in the parlors of the Grand Hotel.

The Miller Anchor Company, Norwalk, Ohio, showed its popular anchor and auger for setting anchor. G. H. Miller, president, was in charge.

The Kester Electric Manufacturing Company, Chicago, showed solder and soldering pastes and gave out samples of the goods. J. E. Goodwin was present.

The Creaghead Engineering Company, Cincinnati, displayed a complete line of its construction tools, pole fittings, and overhead equipment. T. J. Creaghead, president, and J. H. Creaghead, secretary, were present.

The Cincinnati Railway Supply Company showed a complete line of its rope clips.

The Stromberg-Carlson Telephone Manufacturing Company, Chicago, showed a line of telephones and apparatus. George H. Fister, Columbus, and R. B. Taylor, Louisville representative, were in charge.

The North Electric Company, Cleveland, had quite a complete line of its telephones and showed numerous parts. Several handsomely illustrated booklets were given out. George B. Pratt was in charge.

The American Electric Telephone Company, Chicago, had a number of its latest selective system lock-out telephones in operation and connected with two magneto boards. It also showed a line of instruments and parts. P. J. Eubanks, of Chicago, was in charge.

The Swedish-American Telephone Company, Chicago, showed two magneto boards and a line of instruments and parts. E. B. Overshiner, president; C. H. Macklin, secretary and general manager, and J. A. Russel, were present.

The Kellogg Switchboard & Supply Company, Chicago, showed a number of instruments and parts. A. R. Kratz, manager of the Cleveland branch, was present.

The Eureka Electric Company, of Chicago, showed instruments and material.

THE MONARCH TELEPHONE MANUFACTURING COMPANY, Chicago, was represented by W. H. Trimm, who showed a line of instruments.

THE WESTERN TELEPHONE MANUFACTURING COMPANY showed a 150-line magneto board and a large line of instruments. J. E. Keelyn, Chicago, was present.

THE STERLING ELECTRIC COMPANY, of La Fayette, Ind., was represented by W. E. Doolittle and Fred E. Freers, who showed a line of instruments.

Among other people present were the following: J. B. Magers, Indianapolis Arm, Bracket & Pin Company, Indianapolis; F. M. Kinnerim, the F. Bissell Company, Toledo; A. E. Barker, the Dean Electric Company, Elyria, Ohio; E. F. Kirkpatrick, the McRoy Clay Works, Chicago; W. P. Bowman, W. W. Affleck and J. W. Brooks, John A. Roebling's Sons Company, Cleveland; F. J. Crook, Automatic Electric Company, Chicago; A. A. Anderson, Standard Underground Cable Company; Samuel W. Gliver, the R. M. Gliver Electric Company, Cincinnati; Ernest J. Paradis, the W. G. Nagle Electric Company, Toledo, Ohio; J. A. Kenney, the American Electric Fuse Company, Chicago; G. W. Sebastian, the Sebastian-Leight Manufacturing Company, Ashland, Ky.; George Chandler, the American Steel & Wire Company, Chicago; E. H. Hammond, American Electrical Works, Chicago; R. B. McMeal, "Telephony," Chicago; L. E. Clark, *American Telephone Journal*, Chicago, and George S. Davis, ELECTRICAL WORLD AND ENGINEER.

Low Voltage Generators.

The subject of the design of large current low-voltage generators (say from one to ten volts) has received comparatively little attention in electrical literature. In what has been published unusually low magnetic densities in the poles have been recommended, but this requirement has been disputed. Mr. Charles J. Bogue, 209 Centre Street, New York, has placed on the market a line of low-voltage machines, views of two of which are shown in Figs. 1 and 2, in which the densities at the pole-shanks range from 20,000 gausses to 23,000 gausses in the larger machines. It is held that the best regulating low-voltage machine is a properly proportioned shunt dynamo having as an essential as large a proportion of the magnetomotive force as possible expended in the portion of the magnetic circuit covered by the field coils.

The section of the steel at the pole-shanks is so reduced that from 50 to 60 per cent. of the field ampere turns are expended in the poles. All of the other parts of the magnetic circuit are so proportioned as to get the smallest amount of reluctance possible. Pole-shoes are made very large, having an area from three to four times as great as the sectional area of the pole shank. The armature slots being as narrow as possible, a thin gap may be used. This, in conjunction with the large area pole-shoes, gives an extremely low gap density.

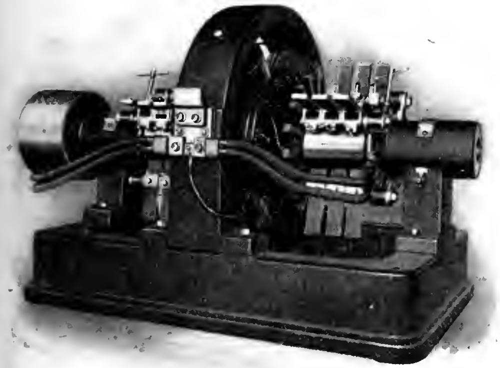


FIG. 1.—LOW-VOLTAGE GENERATOR.

To take the fullest advantage of this low density, special attention has been paid to the exact shaping of the pole-tips so that they shall be over-saturated at their junction with the pole proper. This gives an unusually even density in the gap under all loads, so that all of the line of machines will run from zero load to a heavy overload without any perceptible shifting of the neutral and consequently without sparking.

The armatures are run at a low density (about 6,000 gausses) both to keep down the heating and to take as little of the magnetizing force as possible so as to allow it to concentrate in the poles. The yokes are so proportioned as to have a low saturation, about 3 or 4 per cent. of the field ampere-turns being taken.

The result of the combination of the various features mentioned is a shunt machine which is claimed to regulate on practical work—

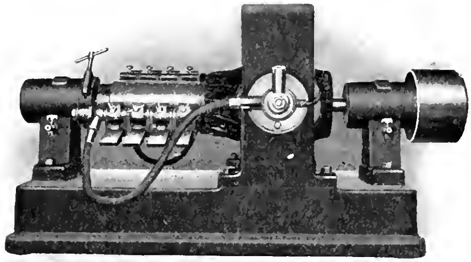


FIG. 2.—LOW-VOLTAGE GENERATOR.

taking into consideration variable brush resistance and variable speed—better than a perfectly compounded machine and better than an ordinary low-density shunt machine.

The mechanical design of these machines is fully up to the most modern requirements, all of the shafts and bearings being large, well fitted and well oiled. The brush-gear has received much thought. While apparently a minor detail, it is really one of the most difficult parts of the entire design. Nice judgment has to be used in this part, for the currents carried are so out of proportion to the size of the machine that the resistance between the commutator and the terminals has to be kept very low. In all sizes of this line of machines the only parts rising more than 40° F. are the commutator and brushes.

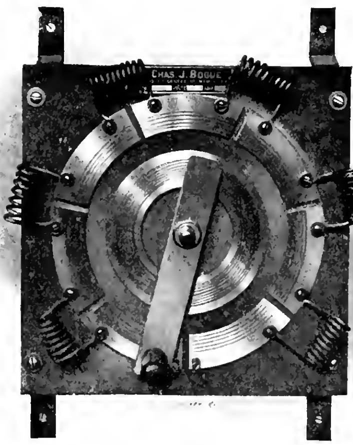


FIG. 3.—FIELD REGULATOR.

While advocating shunt machines for all ordinary work, the maker excludes special cases where it is necessary to keep a perfectly even voltage or to obtain a greater range of regulation than is advisable with a shunt machine. In such cases separate excitation is advised, the fields being wound for either 110 or 220 volts. Five hundred volts is hardly advisable on account of the fact that the greater number of these machines are used in plating or electrotyping establishments, where it is difficult to keep them free from acids, or their fumes, and also from steam, etc.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Depressing tendencies abroad and comparatively poor railway earnings at home affected prices of stocks unfavorably and restricted activity, and the market was dull and lifeless. The slackness of general trade, due to the severe and protracted winter weather, was also a depressing factor. The United States Steel stocks, on the other hand, were relatively steady, and a good effect has been produced by the placing of large orders for rails by various railway companies. There is an impression on "the street" that better conditions will appear in the iron and steel trades and that liquidation in the United States Steel issues has spent its force. Money continues easy. All of the electric and traction securities were depressed and closed with losses, compared with the prices of the previous week. Of the tractions, Brooklyn Rapid Transit and Metropolitan Street Railway closed with net losses of 2⅜ and 1½, respectively, the last prices being 40⅜ and 141¾. General Electric's closing quotation—163—was the week's lowest, the highest being 167. The net loss was 3 points. Westinghouse closed at 159, being a decline of 1¼ points. Western Union, American Tel. & Tel. and American Tel. & Cable are all down, the losses in the order named being ⅛, 2 and ½, the closing prices being 87, 121 and 84¾, respectively. Commercial Cable closed at 192, this being ½ higher than the last recorded quotation. The curb market for outside securities was irregular, with weakness in Brooklyn Rapid Transit 4s and Interborough Rapid Transit. Following are the closing quotations of February 23:

NEW YORK.

	Feb. 16	Feb. 23		Feb. 16	Feb. 23
American Tel. & Cable	81	82	General Electric	166	158¾
American Tel. & Tel	120½	* 118	Hudson River Tel.	..	.
American Dist. Tel.	22	22	Metropolitan St. Ry.	118	114⅝
Brooklyn Rapid Transit	43⅝	38⅞	N. E. Elec. Veh. Trns	..	.
Commercial Cable.	193	..	N. Y. & N. J. Tel.	..	.
Electric Boat	17	..	Marconi Tel.	..	..
Electric Boat pfd	42	..	Western Union Tel.	87⅛	86⅜
Electric Lead Reduction	¾	..	Westinghouse com	160⅛	154
Electric Vehicle	8⅛	..	Westinghouse pfd	175	170
Electric Vehicle pfd	11½	..			

BOSTON.

	Feb. 16	Feb. 23		Feb. 16	Feb. 23
American Tel. & Tel	120¾	120	Western Tel. & Tel. pfd.	80	77
Cumberland Telephone	114½	114½	Mexican Telephone	1½	1½
Edison Elec. Illum	232	234	New England Telephone	119	118
General Electric	165	158	Mass. Elec. Ry	20½	18⅝
Western Tel. & Tel	9	9	Mass. Elec. Ry. pfd	77	74½

PHILADELPHIA.

	Feb. 16	Feb. 23		Feb. 16	Feb. 23
American Railways	..	44	Phila. Traction	..	..
Elec. Storage Battery	..	53	Phila. Electric	..	5¾
Elec. Storage Battery pfd.		53	Phila. Rapid Trans	..	14
Elec. Co. of America	..	7¾			

CHICAGO.

	Feb. 16	Feb. 23		Feb. 16	Feb. 23
Central Union Tel.	..	..	National Carbon pfd	95	97
Chicago Edison	..	..	Metropolitan Elev. com	17	17
Chicago City Ry	162	..	Union Traction	4½	4¼
Chicago Tel. Co.	..	..	Union Traction pfd	29½	29½
National Carbon	27½	25			

*Asked

MICHIGAN STATE TELEPHONE.—The permanent organization of the Michigan State Telephone Company has been perfected. Members of the bondholders committee, Isaac Sprague and F. A. Farrar of Boston and Allen B. Forbes of New York, were present, and with the representatives of the various important interests in Michigan which have become identified with the property, elected the following officers and directors: Directors—W. C. McMillan, T. H. Newberry, John T. Shaw, Henry Russel, Frank J. Hecker, A. E. F. White, Elwood T. Hance, all of Detroit; Lewis H. Withey and Dudley E. Waters, Grand Rapids; N. W. Harris, Chicago; A. G. Farr, Chicago; Isaac Sprague, Boston; F. A. Farrar, Boston; Allen B. Forbes, New York; W. A. Jackson, Chicago. Officers—W. C. McMillan, chairman executive committee; W. A. Jackson, president; T. H. Newberry, vice-president; Elwood T. Hance, secretary; John T. Shaw, treasurer; N. W. Harris, chairman of board; L. C. Krauthoff, general counsel; Elliott G. Stevenson, attorney. The active management will be under supervision of Mr. Jackson, president, and the executive committee, of which Mr. McMillan is the chairman, and constituted as follows: W. C. McMillan, Frank J. Hecker, T. H. Newberry, Dudley E. Waters, Elwood T. Hance, A. G. Farr and Allen B. Forbes.

LIGHTING IN NEW YORK.—The West Side Electric Company which at one time loomed up as a possible competitor of the electric lighting interests of the Consolidated Gas Company is likely to pass into the control of the latter. The West Side Company succeeded in obtaining from the board of electrical control under the Low administration the right to lay wires in the ducts of the Consolidated Telegraph and Electrical Subway Company, but never secured a franchise from the Board of Aldermen. Without such a franchise the company's right to operate was open to question, as the Court of Appeals has decided in a case involving the laying of gas pipes that the Board of Aldermen, directly representing the people, is the only body which possesses the right to grant a franchise for such a purpose. Under the permit obtained from the Board of Electrical Control the company has since occupied a section of the subway, but any attempt to extend operations would probably have resulted in expensive litigation. If the Consolidated Gas Company takes over whatever rights and property the other company may have it will again be in undisputed possession of the electric and gas lighting field in this borough.

NATIONAL CARBON ANNUAL REPORT.—The National Carbon Company, of Cleveland, Ohio, reports as follows for the year ended January 31, 1904:

	1904.	1903.	1902.	1901.
Net earnings	$736,441	$594,371	$586,812	$508,739
Preferred dividends	315,000	315,000	315,000	315,000
Balance	$421,441	$279,371	$271,812	$193,739
Charged off, depreciation, etc.	280,429	256,637	217,745	151,456
Surplus	$141,012	$22,734	$54,067	$42,283

The general balance sheet as of January 31, 1904, compares as follows:

Assets.	1904.	1903.	1902.
Real estate, machinery, plants, etc.	$9,025,000	$9,270,000	$9,200,000
Merch. manufacturing and unmanufact'd	618,227	448,216	418,540
Cash	320,713	162,462	235,473
Cash reserved for betterments, etc.	....	....	65,266
Cash reserved for preferred dividend	78,750	78,750	78,750
Bills and accounts receivable	429,189	364,601	354,842
Total	$10,471,879	$10,324,029	$10,352,870
Liabilities.			
Preferred stock	$4,500,000	$4,500,000	$4,500,000
Common stock	5,500,000	5,500,000	5,500,000
Preferred dividend	78,750	78,750	78,750
Accounts payable	93,570	89,278	141,485
Profit and loss (surplus)	299,559	156,001	132,635
Total	$10,471,879	$10,324,029	$10,352,870

The following have been elected directors of the National Carbon Company: John S. Bartlett, N. C. Cotabish, J. S. Crider, D. D. Dickey, H. E. Hackenberg, Hugh H. Hamill, Webb C. Hayes, Myron T. Herrick, James Parmelee and John P. Wilson.

MICHIGAN ELECTRIC COMPANY, of Detroit, Mich., has gone into the hands of a receiver. The officers are Messrs. J. E. Lockwood, president; G. T. Arnold, vice-president, and E. Bullock, secretary and treasurer. Mr. Lockwood in a letter says: "It is, I judge, hardly necessary for me to state that I regret exceedingly having found it necessary to take this step, but in view of the conditions that have existed for some time past and the conflicting tendencies of our trade on one hand, which was continually growing and requiring larger stocks and larger capital to handle, while the manufacturers, on the other hand, have steadily shortened credits, time of settlement and given best prices to cash customers only, there was no alternative. As we have built up the most valuable electrical supply and manufacturers' agency business in this section of the country and can, beyond doubt, do a large and profitable business if we are placed upon a sound financial basis, with proper capital, I sincerely hope a means of reorganization will be found which will permit the full accomplishment of said possibilities." A meeting of the creditors is to be held in Detroit on February 25.

CENTRAL DISTRICT OF PITTSBURG.—At the annual meeting of the stockholders of the Central District & Printing Telegraph Company of Pittsburg, it was decided to increase the capital stock from $10,000,000 to $15,000,000. The new stock will be issued to stockholders at par as needed. The company is now operating 38 main telephone exchanges, 154 branch exchanges and 251 private exchanges, covering 941 towns and cities outside of Pittsburg. This required 24,960 miles of new wire, making the total 143,363 miles. The earnings of the company for the year were $2,733,926.78, an increase of $567,945.52; net earnings, $742,083.97, an increase of $164,003.47. The company now has a total of 56,734 subscribers.

The officers elected were D. Leet Wilson, president; D. F. Henry, vice-president; J. G. Stoakes, secretary; F. L. Stephenson, treasurer; J. H. Boeggman, auditor; M. H. Buehler, general manager.

CHICAGO RECEIVERSHIPS.—Formal announcement has been made of the retirement of James H. Eckels and Rafael R. Govin from the receivership of the North Chicago Street Railroad Company and of the West Chicago Street Railroad Company. Their successors are John C. Fetzer and Henry A. Blair. Mr. Govin and Mr. Eckels will continue as receivers of the Chicago Union Traction Company. Mr. Fetzer has been added to the Union Traction Company receivership. The changes have given rise to a report that a renewal of franchise negotiations with the city is at hand.

NASSAU LIGHT & POWER.—A special meeting of the stockholders of the Nassau Light & Power Company will be held March 4 at 2 p. m. The purpose of the meeting is to act on the following propositions, viz.: To increase the number of directors; to increase the capital stock from $500,000 to $1,500,000, and to alter the certificate of incorporation of the company.

THE CAMP ELECTRIC CONSTRUCTION COMPANY, 41 West Twenty-fourth Street, New York City, has made an assignment to Mr. W. H. Roberts. The company was incorporated on September 27, 1902, with a capital stock of $10,000. Mr. Charles F. Camp is president.

Commercial Intelligence.

THE WEEK IN TRADE.—The unfavorable effects of the continued cold weather are manifesting themselves in a more pronounced manner, but notwithstanding this state of things a hopeful feeling exists as to Spring trade when the weather becomes more propitious. The mid-Winter weather conditions interfere greatly with transportation and outdoor activities generally. There is noted, however, a fair increase of business in jobbing at leading Western and Southwestern centres, and in leading Eastern markets the best jobbing business so far this year is reported. Railway gross earnings in January showed the first decrease reported since February, 1899, and the first decrease reported in January since 1897. Bank clearings during the week, which was broken by holidays, make a poor showing. Important failures were more numerous, small banks and insurance companies, the latter at Baltimore, contributing largely. The total number of failures for the week as reported by *Bradstreet's* was 231, as against 202 the week previous, and 188 the corresponding week last year. Many of the commodities have established new high records, due largely to war influences. The iron trade is still irregular and weak. Some implement men are, however, buying freely of bars and structural material, and wire and rails are in more request at the West. The other metals are slightly firmer, lead alone being higher than a year ago. Copper stiffened somewhat during the week, but there was no particular increase in the demand for domestic consumption, which continues slow. The tendency of the market, however, seems to be toward lower prices. The closing quotations of the New York Metal Exchange were: Lake, 12½ a 12¾ c.; electrolytic and casting stock, 12⅜ a 12⅝ c. The exports so far this month amount to about 5,700 tons, which is a heavy decline as compared with last month's shipments. Trade in lumber and building materials is slack on account of the cold weather.

THE COPPER INDUSTRY.—Discussing the copper industry and export trade, the *Iron Age* makes the following pertinent remarks: "This country is the greatest producer and the most important exporter of the red metal, and has been occupying an increasingly important position as a smelter and refiner of the raw material from adjacent and distant countries. We exported during 1903 copper ingots, bars, etc., to the extent of 310,729,524 pounds, valued at $41,170,059, and imported 136,707,775 pounds, valued at $17,262,148, a very large part of it in the form of converted bars, which were refined in our seaboard electrolytic refineries. We treated besides considerable quantities of foreign matte and ore. We are, therefore, producing or preparing for the consumption of the leading industrial nations of Europe a very large quantity of raw material. We are sending out year after year great quantities of wire bars, cakes and other forms of copper for rolling mill works, and yet we have progressed very little in the desirable work of substituting for exports of the raw material, shipments of higher forms of the metal. Our exports of manufactures of copper were $2,339,729 in 1903, against $2,092,798 in 1902, and $1,842,336 in 1901. Considerable copper, of course, enters into our exports of electrical machinery, which amounted to $5,104,502 in 1903, as compared with $5,937,643 in 1902 and $5,623,442 in 1901. It goes out in considerable quantities as a part of many other lines of machinery, and of alloys and products thereof. But even in these latter little headway has been made. Thus the exports of brass and manufactures thereof showed $2,063,569 in 1903, as compared with $1,800,312 in 1902 and $2,078,178 in 1901. The copper wire and sheet industry has been established in this country for a good many years. Some of the works are splendidly equipped, and are managed by men who have spent their lives in their technical development. At times these works have captured large orders for cable and electrical wires, but the opinion is expressed so far as rolled sheets and similar products are concerned that our makers have pursued a policy commercially, at home and abroad, which has tended to restrict consumption and hamper the most effective utilization of plant."

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., at a recent special meeting, reorganized the board of directors and elected Mr. Walter Doolittle president; Henry A. Taylor, vice-president, and William Coffroth, secretary and treasurer. The reorganization is in line with the policy recently adopted, it having been decided to increase the capital stock from $150,000 to $200,000 and improve and enlarge the plant. The Lafayette (Ind.) *Times* says: "The Sterling Electric Company, an institution in which all of Lafayette takes pride and which has won a high place among the leading manufacturers of electrical appliances, has of late been trimming its sails to the winds of the commercial world. The installing of telephone plants involves the outlay of large sums of money and the business of operating telephone exchanges has been so profitable throughout the country that bonds or other securities on that class of business were very popular with financial institutions. But when money tightened up in money centers a few months ago, and when the promoters of telephone business and toll lines foresaw that there would have to be a short lull in the general activity of the exchange business, the Sterling Electric Company of this city with characteristic sagacity curbed its aggressive spirit and contented itself with a smaller volume of business for the time being—a policy which was pursued by all the wise heads in the same kind of business. The company here surprised all competitors by the increasing volume of trade, and it has more of the same kind of surprise in store just as soon as the conditions warrant the aggressiveness. The board of directors chosen at the stockholders' meeting consists of William Wallace, Charles Murdock, H. A. Taylor, W. E. Doolittle, C. H. Ankeny, W. R. Coffroth, John Wagner, Jr., John Schnaible and A. F. Ramsey, of Crawfordsville. The officers are: W. E. Doolittle, president; H. A. Taylor, vice-president, and W. R. Coffroth, secretary and treasurer. Mr. Coffroth is the new member of the official family and his ability to manage the very important duties connected with the position will be a further assurance of the continued success of the institution."

EQUIPMENT FOR BALDT STEEL PLANT.—The Baldt Steel Company, which is building a large plant at Newcastle, Del., to be devoted to the manufacture of heavy steel castings for steam turbines, locomotives, etc., has awarded contracts through Jeremiah J. Kennedy, consulting engineer, Exchange Court Building, for a 500-hp generating plant, several motors, etc. There will be one 300-hp and another 200-hp Ball & Wood Corliss valve type engine, direct-connected to 200-kw and 150-kw Westinghouse generators. The 200-kw set will be used for power, and the other outfit for lighting purposes. Two large Newton cold saw machines have also been contracted for. They will be direct connected to Westinghouse motors. Some Detrich & Harvey planers and a miscellaneous outfit of lathes and small tools will also be driven electrically. Eventually the power capacity will be increased to 600 kw. The plant is expected to be in active operation by May 1.

WATSON-STILLMAN PLANT.—Some fair-sized contracts for equipment are about to be awarded through G. K. Hooper, consulting engineer, Bowling Green Building for installation in the plant at Aldene, N. J., to be occupied by the Watson-Stillman Company. The plant was formerly known as the Jackson Architectural Iron Works. It will be considerably remodeled. The existing power equipment consists of a 140-hp Ames engine, belted to a General Electric generator. This outfit will be utilized for generating power for the time being. A number of new motors, however, will be installed, and also a new lighting set.

HEINE BOILER ORDERS.—The Heine Safety Boiler Company's New York office has secured a contract from the Syracuse (N. Y.) Lighting Company for a 2,000-hp plant. There will be three boilers. The America Underfeed Stoker Company of Chicago will supply the mechanical stokers. The Wilkesbarre and Wyoming Valley Traction Company, of Wilkesbarre, Pa., is remodeling its plant and will put in a 1,200-hp—in three units—Heine outfit. The American Blower Company, of Detroit, will install induced draft apparatus. The American Woolen Mills, of Lawrence, Mass., has ordered two 300-hp Heine high-pressure boilers.

THE WESTERN ELECTRIC COMPANY, New York City, will install in Philadelphia two direct-current units, one of 100 and the other of 150-hp, to be furnished by the Ball Engine Company, Erie, Pa.

General News.

THE TELEPHONE.

JASPER, ALA.—Mr. E. M. Cranford, of this place, is organizing a company for the purpose of establishing a telephone exchange in Jasper. The capital stock will be $5000, all of which will be absorbed by local business men.

NEW DECATUR, ALA.—The Morgan County Telephone Company is installing telephones in Decatur. This company has been doing business in New Decatur for about a year, but has been unable to get into Decatur until now on account of the opposition of the Southern Bell Telephone Company.

LOS ANGELES, CAL.—The Supervisors of Los Angeles County granted a franchise to the Monrovia Telephone & Telegraph Company for the erection and operation of lines along practically all the highways traversing the ranchos Santa Anita, San Francisquito, Azusa, Duarte, Potrero Grande and Potrero de Felipe Lugo. The franchise is for 30 years. The rental for telephones is not to exceed $36 a year for business houses, or $24 a year for residences. This franchise is for the purpose of extending the Monrovia local telephone service to the neighboring villages and ranches.

BOISE, IDA.—The Rocky Mountain Bell Telephone Company will extend its lines to Thunder Mountain, and from Sweet to Van Wyck, as soon as the weather is more favorable.

ASH GROVE, ILL.—A new company has been organized here to be known as the Ash Grove Telephone Company.

CARBONDALE, ILL.—The Farmers' League and Community Telephone Company has been incorporated with a capital stock of $2500. The directors are: R. M. Montgomery, James England and others.

CAMBRIDGE CITY, IND.—The Central Union Long Distance Telephone Company will install an exchange in this city.

BLOOMFIELD, IND.—The Home Telephone Company may buy the old telephone system of Worthington. If the deal goes through, a number of improvements will be made and the lines extended.

WABASH, IND.—The Central Union Telephone Company has operated in this city since last May without a franchise. The company was ordered by the Council to secure a franchise by October 1, 1903, or remove its property from the streets. The Council drew up a franchise identical in its privileges and restrictions with that of the Home Telephone Company and the company was given until February 1, 1904, to accept it. The company objected to two features of the franchise. One of these is the time limit of ten, instead of twenty-five years. The other was the restriction of the rate to not more than $1.50 per month. The company insists on having the same rate as charged in other cities the size of Wabash. The Council has given the company an ultimatum to accept the franchise during the present month, after which none will be granted, but instead the company's property will be removed from the streets.

MONROE, IA.—The Reasnor Telephone Company has been granted a franchise in this place.

ELLSWORTH, IA.—The Ellsworth Mutual Telephone Association has been incorporated with a capital stock of $10,000. The incorporators are: John H. Sparhoe, Holden Thompson, O. M. Lyders, Barney Peterson, John O. Anderson, Dan Knudson, F. R. Dalby, John P. Holt and M. H. Brinton.

LOUISVILLE, KY.—An ordinance has been introduced in the Council requiring electric companies to place their wires underground and remove the poles from the streets.

DETROIT, MICH.—The Co-operative Telephone Company, of Detroit, has filed a trust mortgage for $40,000 in favor of the Detroit Trust Company, trustee. The money is to be used in the extension of the system.

ATWATER, MINN.—The Atwater Telephone Company has filed articles of incorporation, the capital stock being fixed at $10,000.

ROLLAG, MINN.—The Rollag Telephone Company has been organized with a capital stock of $25,000 to do business in Clay, Wilkin, Becker and Otter Tail counties.

MINNEAPOLIS, MINN.—The Dale station of the Northwestern Telephone Company, at Minneapolis, was visited by fire due to an outside short circuit, and the switchboard was destroyed. The loss on it and on poles and cables was, it is said, $25,000.

WINONA, MINN.—The Winona Telephone Company and the Tri-State Telephone & Telegraph Company have made a contract between themselves by which the latter company agrees to build a long distance telephone line into Winona from the Twin Cities.

ARBELA, MO.—A new company has been organized here to operate a telephone line. D. B. Cravens was elected president.

ST. JOSEPH, MO.—The Bell Telephone Company will expend about $100,000 in the installation of a central energy system in this city. New switchboards will be erected in the main offices with a total capacity of 5000 subscribers.

CHILLICOTHE, MO.—The first convention of the telephone men in this vicinity was held here last week. The officers of the association are: A. Barnes, of Hamilton, president, and H. M. Patterson, of Meadville, secretary and treasurer. The purpose of the meeting was to devise means for the bettering of communication between the towns of this section. Among those in attendance were: C. D. Mayhugh, of Mooresville; A. Barnes, of Hamilton; H. M. Patterson, of Meadville; J. A. Dalbey, W. B. Dorsey, James Burnett, Ed. Steineral and B. F. Brady, of Braymer, and Jessie Flint and C. M. Thompson, of Cowgill.

SUTTON, NEB.—The Sutton Telephone Company has filed articles of incorporation and elected officers as follows: President, P. H. Schwab; vice-president, A. W. Clark; treasurer, James West; secretary, L. B. Stiner.

RENO, NEV.—The line of the Pacific States Telephone Company has been extended as far as this city. The Rocky Mountain Bell Telephone Company is at present extending its lines westward, and the two systems will meet at Lucin. This will give Nevada and Utah points direct communication with San Francisco.

EGG HARBOR CITY, N. J.—The Egg Harbor City Telephone Company has filed articles of incorporation at Trenton, the capital stock being $10,000.

LONG BRANCH, N. J.—The Postal Telegraph & Cable Company has petitioned the Council for permission to lay an underground cable within the borough.

TRENTON, N. J.—The People's Rural Telephone Company, of Wenonah, Gloucester County, has been incorporated with a capital stock of $50,000. The incorporators are: Warren Atkinson, George Horner, Asa Moore and others.

NEWBURG, N. Y.—It is stated that the Hudson River Telephone Company will place its wires underground in this city. The work will cost about $78,000.

MADISON, N. Y.—The Madison Mutual Telephone Company has been incorporated, with a capital stock of $1600, by L. R. Bridge, A. H. Holland, Soleville, N. Y.; W. W. Edgarton, Jr., Bouckville, N. Y.

HAMMONDSPORT, N. Y.—The Hammondsport & Wayne Telephone Company has been organized by farmers of Wayne and Urbana to build a telephone line between Hammondsport and Wayne village, with several branches.

DURHAM, N. C.—The Interstate Telephone Company, which recently gained sole control in Durham, has raised rates to $2 per month for residences and $3.50 per month for stores.

MARION, N. C.—The Marion Telephone Company recently raised its rates and it is reported that many of the patrons have had their telephones taken out. The company had made improvements on the system.

DAYTON, OHIO.—The Home Telephone Company has decreased its capital from $750,000 to $600,000.

MASSILLON, OHIO.—The Massillon Telephone Company has increased its capital stock from $75,000 to $150,000. Improvements and extensions are contemplated.

PERRYBURG, OHIO.—The Maumee Valley Telephone Company has been incorporated with a capital stock of $15,000. The directors are N. L. Hanson and others.

TONTOGANY, OHIO.—The Tontogany Telephone Company has been incorporated with a capital stock of $10,000. The directors are: Jacob Hoffman, B. F. James and others.

CLEVELAND, OHIO.—A deal has been completed here whereby the Federal Telephone Company sold all its interests in the Citizens' Telephone Company, of Columbus, O., to a syndicate headed by Cyrus Huling, of the latter city.

ZANESVILLE, OHIO.—At the annual meeting of the Zanesville Telephone Company the reports of the officers showed the affairs of the company to be in a healthy and flourishing condition. Officers were elected as follows: F. S. Dickson, president; S. M. Granger, vice-president; J. B. Rhodes, secretary and general manager; R. W. Judd, treasurer.

RAVENNA, OHIO.—The affairs of the Portage County Telephone Company are in an excellent condition, as shown by the report presented at the annual meeting of the company. The company now has 1566 subscribers in Portage County, of which 572 are in Ravenna, 587 in Kent, 221 in Mantua and 186 in Garrettsville. The company has spent $9000 in construction work since March last.

CLEVELAND, OHIO.—The annual meeting of the stockholders of the Cuyahoga Telephone Company was held in this city recently, and all of last year's directors were re-elected. No effort was made to create new business during the year, and an increase of a little more than $10,000 in gross earnings was due rather to the substitution of paying subscribers in the place of those rated as slow collection. President Dickson's annual report shows that the company now has 10,466 telephones in use. He expresses satisfaction at the results of the profit-sharing plan and stated that it would be continued. The company now has a surplus of $15,401.

GUTHRIE, O. T.—A merger of the Pioneer Telephone Company, with headquarters at Guthrie, the Long Distance Telephone Company, of Shawnee, and the North American Telephone & Telegraph Company, of Muskogee, I. T., has been effected. A new charter will be taken out.

ALTOONA, PA.—The Bedford-Fulton Telephone Company and the Extension Telephone Company are to be merged.

COLUMBIA, S. C.—A bill has been introduced in the South Carolina Legislature placing telephone companies under the control of the Railroad Commission.

RICHMOND, VA.—The North Fort Telephone Company, of McDonald's Mill, Montgomery County, has been incorporated with a capital stock of $500 to $5000. Mr. A. P. Bennett is president.

STANDARDSVILLE, VA.—The Swift Run Telephone Company, of Standardsville, has been incorporated. E. D. Ott is president. The capital stock is $1200 to $5000.

PALOUSE, WASH.—The Palouse Deep Creek Telephone Company has been incorporated to construct a telephone line from Palouse to Freese. George H. Sawyer is president. A barb-wire fence will be used for the line until spring, when an overhead line will be constructed.

FOOTVILLE, WIS.—The Footville Telephone Company has increased its capital from $4000 to $10,000.

TURTLE LAKE, WIS.—The City Telephone Company has been incorporated with a capital stock of $2000. The directors are: F. E. Fisk, John Hogan and others.

SPARTA, WIS.—The Western Wisconsin District Independent Telephone Association has been formed here. It embraces all of the independent systems in the western part of the State.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—The Coosa Water Power Development Company, with $250,000 capital, has been formed to develop a water power in Calhoun County, Ala. The Industrial Finance & Trust Company, of Birmingham, is fiscal agent for the new concern. It is said that northern capital is interested in the movement.

LITTLE ROCK, ARK.—The new power house of the Little Rock Railway & Electric Company, in this city, is now in operation. The new power house when completed will cost about $350,000, with its equipment. The old power house will be used for electric light supply.

CORONA, CAL.—The stockholders of the Corona Gas & Electric Company have voted to issue $40,000 bonds for improvments to the plant.

SANTA ROSA, CAL.—A committee has been appointed to select an engineer and draw up plans, etc., for a municipal lighting system. An election will soon be held to vote on issuing bonds for same.

DOWNEY, CAL.—The Downey Electric Light & Power Company has been granted a franchise to use certain streets and highways in and around the village of Downey for the erection of a system of lines and conduits for the transmission of electric light and power. The life of the franchise is to be 30 years, and work on the plant must be commenced within six months and finished in three years. After March 15, 1909, the company is to pay to the county 3 per cent. of the gross receipts.

STOCKTON, CAL.—The City Council has granted R. G. Paddock a franchise for installing a heat and power system in the city, and it is generally believed that he represents H. E. Huntington, who will build an electric railroad from Stockton to Bakersfield at an early day. Only one bid was presented, and upon being opened it was found that Paddock had offered $130. Immediately an ordinance awarding him the privilege was passed. For several days past it had been rumored that other bidders would be present, but it seems that they were not forthcoming. For over a month, there has been quite a lively fight between the Stockton Gas & Electric Company and the American River Electric Company, and prices of electricity were cut to the lowest figure ever made in the State. Then a truce was declared, and while both companies assert that they have not reached any understanding, or combined, it is current report that they are not doing the same cutting of rates that they were.

WASHINGTON, D. C.—Bids will be received March 1 at the Bureau of Supplies and Accounts, Navy Department, for furnishing the navy yards, at Norfolk, Va.; Charleston, S. C., and Port Royal, S. C., a quantity of electric blowers, electric fans, electric traveling crane, railroad track, galvanized sheet steel, pipe fittings, marine cement, etc. H. T. B. Harris, Paymaster-General, U. S. N. Bids are wanted April 12 for electrical supplies. Wm. M. Meredith, Director Bureau of Engraving and Printing, Treasury Department.

VIDALIA, GA.—John W. Wiggins, of Savannah, has secured an electric light franchise in Vidalia, and is now purchasing the necessary machinery in the north.

KEITHSBURG, ILL.—It is reported that the electric light plant owned by T. A. Marshall will be rebuilt.

VIRDEN, ILL.—The Virden Electric Light Company has been incorporated, with a capital of $15,000. J. N. Hairgrove, U. G. Tucker and C. W. Carr are the incorporators.

MOORESVILLE, IND.—The Public Service Company, of Mooresville, has been incorporated, with a capital of $50,000, to build water works and an electric light plant. Directors: Wm. B. Vestal and Jas. S. Hubbard, both of Mooresville.

WHITING, IND.—The Lake County Light & Power Company, of Whiting, has filed articles of incorporation. The capital stock is $100,000. The incorporators are: R. J. Carey and Arthur Young, of Chicago, and Samuel T. Chase, of Lake Forest, Ill.

TERRE HAUTE, IND.—The Terre Haute Electric Light Company is to install a 1000-hp turbo-generator in its new power station on the river front in this city. The apparatus is to be supplied by the General Electric Company, the contractors being Stone & Webster.

RICHMOND, IND.—The Richmond Light, Heat & Power Company has filed a mortgage in favor of the Continental Trust Company, of New York, on its property for $300,000, covering an issue of bonds in that sum which will be sold to meet cost of improvement for the local plant. The company is owned and officered by New York capitalists, and is making a damaging fight against the Richmond municipal plant.

NEW CASTLE, KY.—The Town Trustees have granted a franchise to the New Castle Electric Light, Heat & Power Company.

LOUISVILLE, KY.—An ordinance is to be introduced in the General Council requiring all wires in the downtown district to be placed underground.

NEWPORT, KY.—J. B. Morlidge, City Engineer, writes that the city contemplates constructing a municipal electric light plant. Ten thousand dollars has been set aside by the General Council toward it, and a similar sum will be set aside each year until the entire cost of construction is covered.

BRUNSWICK, ME.—The directors of the Brunswick Electric Light & Power Company, at a special meeting, have voted to install an auxiliary steam plant in the old gas house, which the company purchased some time ago. In the past two or three years there have been several occasions when the present plant has been bothered about securing power. According to the terms of agreement, the Cabot cotton mill has the first call for the water from the upper fall. As the electric light plant derives is power from the same source, when the river is low and the Cabot mill is running, the electric light plant is obliged to shut down. Thus far this year nearly every day the power has been shut off early in the morning, and until 6 o'clock in the evening it has been impossible to get either electric light or power. The installation of a steam plant will insure light and power at all times of the day. Mr. A. Hopkins is superintendent.

SAULT STE. MARIE, MICH.—The Edison-Sault Electric Company has decided to improve the electric light plant.

MARQUETTE, MICH.—Edw. P. Burch, of Minneapolis, Minn., has been selected by the Light & Power Commission to advise with the Commission with regard to the enlargement of the electric light plant.

JACKSON, MINN.—The Council has voted to issue $5000 bonds to improve the electric light plant.

SWEETWATER, MINN.—The citizens have voted bonds for water works and an electric light plant.

STILLWATER, MINN.—R. S. Feurtado, of Chicago, superintendent of the Western Gas & Investment Company, writes in regard to improvements contemplated by the Stillwater Gas & Electric Light Company and the Apple River Power Company, that it is proposed to construct a 20-ft. dam and a 1000-hp electric power plant.

BEELZONA, MISS.—Bids will be received April 5 by the Mayor and Board of Aldermen for constructing an electric light plant and water works.

BURLINGTON JUNCTION, MO.—It is reported that Robt. Crooks will establish an electric light plant here.

HOPKINS, MO.—Chas. Hartness is preparing to put in an electric light plant.

JOPLIN, MO.—The City Council has granted an electric light and power franchise to W. G. Sergeant.

GREAT FALLS, MONT.—Max Hebgen, of Butte, is preparing plans for improvements to the plant of the Great Falls Electric Light & Power Company. The probable cost of improvements is $75,000.

RENO, NEV.—The directors of the Nevada Power, Light & Water Company have decided to enlarge the power plant.

ASBURY PARK, N. J.—The Beach Commissioners have awarded to the A. D. Granger Company, of New York, N. Y., the contract for constructing the electric light plant on the beach for $10,773.

SANTA FE, N. M.—The Capital Light & Power Company is said to have sold its interests to J. C. Bonner & Company, of Toledo, O., and associates. The company announces its intention to establish a power plant on the upper Pecos. Power and light will be furnished to Santa Fe, Albuquerque and Las Vegas. The company will issue bonds to the amount of $300,000, and will begin work in the spring.

VALATIE, N. Y.—It is proposed to construct an electric light plant at a cost of $12,000. R. E. Lasher is Village President.

PENN YAN, N. Y.—At the next annual charter election the citizens will vote on the proposition to install a municipal electric light plant.

WARSAW, N. Y.—The Warsaw Gas & Electric Company has decided to install a new direct-current dynamo, and a new outfit of enclosed arc lamps for street lighting.

ALBANY, N. Y.—The application of the Niagara, Lockport & Lake Ontario Power Company's franchise bill to any city is removed by amendments to the bill adopted by the Assembly Codes Committee in executive session. The amendment strikes out the provision giving the corporation power of eminent domain in any city, and requires consent of the local authorities for the use of any streets or the erection of poles.

MOORESVILLE, N. C.—B. A. Troutman, of Mooresville, is interested in the construction of an electric light plant.

CONCORD, N. C.—The town of Concord is figuring on a new electric light plant to cost about $18,000. The old plant may possibly be bought by the town, however.

CHARLOTTE, N. C.—The Light Committee has decided to recommend that the city make a contract with the new Catawba Electric Power Company, of Fort Mill, S. C., to supply lights at $54 per annum for the first 150 lights and $48 for all over that number. The price paid the Charlotte Consolidated Construction Company at present is $90 per light per year. The new company expects to have power available in four months.

COLUMBUS, OHIO.—An electric light plant is to be provided for the State penitentiary.

ASHLAND, OHIO.—The City Council is discussing the proposition to install a municipal electric light plant.

TROY, OHIO.—The business men of Troy have under consideration the construction of an electric light plant.

LORAIN, OHIO.—The Citizens' Gas & Electric Company, of this city, has decided to construct a new plant, plans for which are now being prepared. The company now uses the plant of the Lorain Street Railway.

CLEVELAND, OHIO.—The Board of Public Service has decided to recommend favorably the entering into of a contract with the Cleveland Electric Illuminating Company for street lighting, at $75 per lamp per year.

ONTARIO, ORE.—E. H. Test and A. N. Soliss have secured a franchise for an electric light and power plant.

UNIONTOWN, PA.—The Masontown Electric Company, of Uniontown, has been incorporated with a capital of $5000.

WYALUSING, PA.—The Wyalusing Light, Heat & Power Company, of Wyalusing, has been incorporated with a capital of $10,000.

YANKTON, S. D.—The city may buy the electric light plant or build a new one.

WEBSTER, S. D.—Between $2000 and $2500 will be expended for improvements to the electric light plant.

FARMERSVILLE, TEX.—The Farmersville Mill & Light Company has been organized here with a capital stock of $50,000.

BATSON, TEX.—The Sour Lake Light & Power Company, of Sour Lake, is preparing to extend its transmission line to this place for the purpose of furnishing light and power here. The current will be brought here from the Saratoga station of the company, situated about five miles distant.

BIG SANDY, TEX.—The large dam of the A. K. Seage Box Company across the Big Sandy near here is to be immediately repaired and the water power thus obtained is to be used for generating electricity for lights and power for this town. The A. K. Seage Box Company can give information. This company also contemplates establishing a water works plant here.

ELLENSBURG, WASH.—The citizens have voted to issue $20,000 bonds for an electric light plant.

PROSSER, WASH.—The Prosser Falls Land & Irrigation Company has petitioned for a franchise for an electric light plant.

SPOKANE, WASH.—Samuel Storrow, chief engineer Northwestern Gas & Electric Company, Los Angeles, Cal., writes that it is proposed to develop the power of the Walla Walla River. The probable cost of the work will be $250,000.

LAFARGE, WIS.—The Lafarge Electric Company has been incorporated, with a capital of $6000.

BURLINGTON, WIS.—It is proposed to construct a municipal electric light plant for both street and commercial purposes here.

The Electric Railway.

GREELEY, COL.—The Greeley & Northern Railroad & Utility Company has filed articles of incorporation, with George H. Sethman as general manager. The company is organized for the purpose of building an electric road through northern Colorado from this city to a connection with the Burlington Railroad. The power plant of the company will also be utilized in furnishing this city with electric light. The electric system will be over 25 miles in length.

AUGUSTA, GA.—At the annual meeting of the North Augusta Companies, of Augusta, Jas. U. Jackson was re-elected president of the Augusta Railway & Electric Company; the Augusta & Aiken Railway; the North Augusta Electric & Improvement Company and other development companies. Chas. G. Goodrich was elected vice-president of the Augusta Railway & Electric Company.

BOISE, IDA.—I. W. Anderson and associates, of Philadelphia, have acquired by purchase the system of the Boise Transit Company, and articles of incorporation of the new company have been filed. Mr. Anderson is president of the company, and Charles A. Hutchinson, of this city, will act as general manager. Improvements and extensions of the system will be commenced at once.

NEW YORK, N. Y.—President E. A. Maher, of the Union Railway Company, has applied to the Board of Aldermen for franchises to effect 13 new connections, including the right to cross several bridges into Manhattan, thus effecting a more perfect physical relationship with the Metropolitan system.

DALLAS, TEX.—Parties who propose to construct and operate an interurban electric railway between Dallas and the town of Waxahachie, Tex., have submitted a proposition to the Commercial Club, of this city, which, if favorably considered, will insure the consummation of the project. The distance is about 30 miles. The secretary of the Commercial Club, Dallas, can give information.

Obituary.

MR. E. A. GAY.—Mr. Eugene A. Gay, receiving clerk of the Western Union Telegraph Company in Albany, died suddenly of pneumonia there on February 23. He was one of the best-known telegraph operators in this State, and was in charge of the Western Union branch office in the old Delavan House during the famous political campaigns between 1860 and the time of the Delavan's destruction. He was a brother of Ward Gay, the artist.

MR. J. M. FORBES.—Mr. J. Malcolm Forbes, widely known as a patron of light harness racing and as a yachtsman, died on February 19 at Milton, Mass. Mr. Forbes had been suffering from an internal malady for about a week. Two operations, performed as a last resort, failed. Mr. Forbes was nearly sixty years of age. He was for many years a heavy shareholder and a director in the American Bell Telephone Company and other properties. He was formerly Commodore of the Eastern Yacht Club, and in former years actively participated in the defense of the America's Cup. American Telephone & Telegraph was weak on the Boston Stock Exchange on news of Mr. Forbes' death.

MR. J. A. ROCHE.—Mr. John A. Roche, one of the leading officers of the Otis Elevator Company, died suddenly in Chicago, on February 10. He was born in Utica, N. Y., August 12, 1844, and after graduating from the high school, removed to New York, where he learned the trade of a pattern maker. He went to Chicago in 1869 and became a dealer in machinery, and for many years was the Northwestern representative of the firm of J. A. Fay & Company, of Cincinnati. He entered politics in Chicago, and was elected mayor on the Republican ticket, holding office from 1887 to 1889. After retiring from office he became vice-president of the Crane Elevator Company and later the managing director of the Otis Elevator Company. From 1893 to 1897 he was the president of the Lake Street Elevated Railroad Company and was widely known amongst electrical men in the west.

MR. FRANCIS FORBES.—We regret to note that Mr. Francis Forbes, member of the law firm of Forbes & Haviland, died suddenly from pneumonia at his home in New York City, on February 18. He was born in Rochester, N. Y., and graduated from Rochester University in 1865. After spending some time in study in France, he entered Columbia Law School, from which he was graduated in 1870. He represented this country at the International Convention of Industrial Marks in Madrid in 1890, and later at Brussels in 1897. He was a member of the State Constitutional Convention in 1894, and was recently appointed a delegate to the International Convention of Jurists at the World's Fair at St. Louis. He belonged to the University and Lawyers' Clubs. Mr. Forbes leaves a widow, daughter of the late Robert Bonner, two sons, and two daughters. Mr. Forbes had from time to time a good deal to do with electrical and mechanical patent litigation, and was an active and liberal member of the New York Electrical Society for a great many years.

MR. JACOB HESS. —Mr. Jacob Hess, for many years a leader in New York Republican politics and a member of the last bi-partisan Police Board, died on February 19 at his home in Manursing Way, Rye, N. Y., where he had lived for months in comparative retirement. Mr. Hess was born in Hesse-Darmstadt in 1847, but was brought to this country when only two years old. After a brief course in the common schools he became a butcher's boy in Washington Market, New York City. He embarked in business for himself as a commission dealer in meats in West Washington Market when he was nineteen years old, and was said to have accumulated $100,000 when he made his first start in politics, in 1874, being elected Assemblyman. The next year he was elected Alderman at Large. He declined the nomination for Sheriff in 1876. Mayor Wickham in 1877 appointed Mr. Hess a Commissioner of Schools. Mayor Cooper appointed him Commissioner of Charities and Correction in 1879, and he was elected president of the board. He served until May, 1885, when he retired, being made a member of the new Board of Electrical Control two months later. He became president of that also, during a very important period, and held office until Tammany came into power in 1898. Mr. Hess' only son, Seymour Griswold Hess, a young man of great promise, died at his father's house in 1897, a short time after his graduation from Columbia University.

Personal.

MR. W. MARCONI is expected, it is said, to leave Europe for America on March 23 on the Italian man-of-war "Carlo Alberto."

MR. FRED SARGENT, the consulting and designing electrical engineer, has sailed on a trip to Europe, to be gone some weeks, during which time he will study power plant development there in its latest illustrations.

MR. LOUIS J. MAGEE, who represents the Allegemene Elektricitats Gesellschaft in this country as resident director, has been quite ill with bronchitis and detained at home by illness. We are glad to record his recovery.

MR. JOSEPH JEFFERSON, the veteran distinguished actor, has just celebrated his 75th birthday by becoming president of an electric light and power company at West Palm Beach, Fla., where he has large property interests.

MR. H. SHINOMWIA, of the department of communication of Tokio, Japan, arrived in New York last week by steamer from England, en route for home. He has been abroad for over a year studying the postal and telegraph services of Europe.

MR. R. O. HEINRICH, of the European Weston Electrical Instrument Company, of Berlin, is expected shortly in this country, where a great many old friends will be glad to renew their acquaintance and intimacy. It is now some years since he returned to Europe.

MR. FREDERICK A. WALDRON, hitherto superintendent of power and plant for the Yale & Towne Manufacturing Company, has opened offices as consulting engineer at Stamford, Conn., to advise on matters relating to the construction, arrangement and equipment of power plants.

MR. CHARLES L. BROWN has associated with him his brother, Mr. Stuart H. Brown, and has incorporated his electrical contracting business at Chicago under the name of the Brown Electrical Construction Company. The new concern has taken offices in suite 505-6-7, Ellsworth Building, Dearborn St.

MR. C. H. NORTH, president and general manager of the North Electric Company, of Cleveland, O., was a recent visitor to New York. Mr. North has done a great deal for the cause of rural telephony, as well as in the invention and perfection of apparatus. His connection with telephony dates back to the beginning.

MR. GEORGE W. FOWLER, who for several years past has been connected with the engineering department of the C. & C. Electric Company, has resigned his position with that company and will hereafter be associated with Mr. George D. Beinert, the electrical contractor, with offices in the Bible House, New York City.

MR. N. S. HOPKINS has severed his connection with the Fort Wayne Electric Works, where he had charge of the direct-current motors and generators, as engineer. He had previously spent three years at Schenectady and five years at the Lynn factories of the General Electric Company, as designing engineer on numerous lines.

MR. W. B. POTTER, head of the railway department of the General Electric Company, has sailed for the West Indies, in search of health and warmer weather. He has been struggling for some weeks past with incipient grip and pneumonia, but would not let go until the doctors and his associates insisted he must break away, or pay the penalty.

WHITEHEAD, SUMNER, HARKER & COMPANY announce the formation of this concern, with headquarters, as machinery merchants and exporters, at 196 Deansgate, Manchester, England. The firm comprises Messrs. James P. Whitehead, Bertram Sumner, John Harker and Julien Prêcheur. Arrangements are being made for branch houses and agencies.

MR. JAMES T. MAXWELL, general agent of the Philadelphia Electric Company, has, we regret to state, had the deep misfortune to lose his wife. Mrs. Maxwell was well known to many in the electrical field, having attended the conventions of the Association of Edison Illuminating Companies with her husband, and having made many friends and acquaintances at such times.

MR. G. M. ABBOTT.—The stockholders of the Cincinnati, Newport & Covington Street Railway Company have elected George M. Abbott to succeed Henry Burkhold on the board. This company is a subsidiary concern of the Cincinnati, Newport & Covington Light & Traction Company. It is said that Mr. Abbott will also succeed Mr. Burkhold as a director of the latter company.

MR. W. L. HODGES has been appointed sales manager of the National Battery Company, with offices at 253 Broadway, New York, and has resigned his position with the Audit and Appraisement Company of America. Mr. Hodges, it will be remembered, was for some time associated with Dr. Louis Duncan and was particularly active in telephone work in Philadelphia.

MR. G. H. KIMBALL, of Buffalo, N. Y., has requested us to state in his behalf that in regard to our recent article on proposed electric power transmission work at Omaha, he did not serve as an arbitrator in connection with the matter as intimated, and that he was in no way connected with it after the late days of August, the arbitration being held three or four months later.

MR. CHARLES LANG has resigned his position with the Wheeler Condenser & Engineering Company, after ten years' service with that company. During that period Mr. Lang advanced from office boy to purchasing agent, and later entered the company's engineering department. He is at present considering a number of excellent offers from several sources, and in the meantime is taking a much needed rest.

MR. W. J. BAUGHMAN, who for two years was superintendent of the Stanley Electric Manufacturing Company's factory at Pittsfield, Mass., and who more lately had been made head of the production department, has succeeded Mr. J. H. Kelman as superintendent, on the latter's resignation. Mr. Frank R. Whittlesey, head of the purchasing department, has succeeded Mr. Baughman as head of the production department.

PROFESSOR HIMSTEDT, of the University of Freiburg, Germany, has continued investigations as to the existence of radium in nature, and has extended those formerly made of rain water and of the soil with reference to the presence of radium. He has arrived at the conclusion that radium occurs more frequently in our surroundings than has heretofore been suspected. According to his experiments, all natural springs of water and also the petroleum wells possess a heavy gas, whose radiations are similar to, and probably identical with, radium.

MR. C. G. Y. KING, a well-known member of the engineering staff of the Chicago Edison Company, has been visiting the east to deliver a series of lectures on the new steam turbine plant of that corporation, accompanied by a fine series of lantern slides. The first lecture was delivered in New York City before a large gathering of General Electric representatives. Mr. King then went on by invitation to Boston and there delivered the lecture twice on a single day, once before a similar gathering and once before the Massachusetts Institute of Technology.

MR. W. R. GARDENER, assistant treasurer and manager of the Pittsfield, Mass., Electric Company, has been writing in a clear and popular way lately to the local papers, explaining the nature of electrolysis and its cure. There has been a good deal of interest in the subject locally, owing to the fact that some underground cables of the New England Telephone & Telegraph Company had needed overhauling, apparently on account of the electrolytic action of stray current from the Pittsfield trolley system.

MR. ANDREW CARNEGIE.—Mr. Carnegie has added another lot to the site on Thirty-ninth St. which he acquired last year for the united engineering societies. The house at 33 West Thirty-ninth St. was conveyed by John Thacher to Robert A. Franks, who is Mr. Carnegie's representative and has taken title for him to the adjoining houses, 23 to 31 West Thirty-ninth St. The abutting property at 32 and 34 West Fortieth St. is held by the Engineers' Club. The stated consideration in the transfer recorded was $1,000. For some of the other Thirty-ninth St. houses Mr. Carnegie paid $110,000 each.

MR. ADELBERT P. HINE, superintendent of the Coe Brass Company plant of the American Brass Company, has been made general superintendent of all the plants. Mr. George Braham, who has been assistant superintendent of the Coe Brass Company, has been made superintendent, and Mr. William E. Besse assistant superintendent. The purchasing for all the American Brass Company's plants is now done by the American Brass Company at their Waterbury office. Mr. F. L. Adams, formerly general manager of the Holmes, Booth & Haydens Company, has been made assistant purchasing agent of the American Brass Company.

MR. CHARLES WIRT, vice-president of the Wirt Electric Company, of Philadelphia, sailed last week on the steamer "St. Paul" for England, to be a month in that country. His health has been very poor lately, and he hopes to build it up during this vacation. While in London he will stay at the Grand Hotel, and make a study of the electrical situation. The Wirt Electric Company has recently arranged to have a new building erected for them in Philadelphia, at the corner of Pennsylvania Railroad and Germantown avenue. The new shop has been specially designed for their work, and will be up to date in all particulars.

MR. D. M. LORD.—The Chicago papers recently devoted much space to the growth of the advertising business as a whole, and that of Lord & Thomas in particular, owing to the retirement of Mr. D. M. Lord, the senior member of the firm, who leaves active business life with a competence. The business has been one of the most aggressive and progressive of its kind in the country, having in recent years been under the active management of Mr. A. L. Thomas, who has succeeded Mr. Lord to the presidency and will continue at the head of the firm. Mr. C. R. Erwin, the new vice-president, has been connected with the company for 20 years, and is therefore a veteran in the field; associated with him and Mr. Thomas is Mr. A. D. Lasker, the secretary and treasurer. To give some idea of the growth of advertising as a whole, it might be stated that in two years the business of Lord & Thomas alone has increased one million dollars in the billing, and in the one month of January in 1904 this house has booked $750,000 in advertising contracts.

Trade Notes.

THE WESTERN TELEPHONE MFG. CO. has leased quarters in the Atlantic Building, 42 West Jackson Boulevard, Chicago, Ill., and will move its factory and office to that address March 5.

THE A. ROSENBERG COMPANY, of Baltimore, makers of water motors, water fans, etc., advises us that it was not affected by the recent great fire there, being beyond the zone of conflagration.

THE ELECTRIC APPLIANCE COMPANY, Chicago, announces that it has added to its already immense stock of electrical supplies a complete line of trolley cars and wheels, and is prepared to quote on railway overhead material.

THE WILLIAM TOD COMPANY has recently opened a New York office at 29 Broadway, and placed it in charge of Mr. George F. Woolston. The company is builder of Corliss and medium-speed engines for all electrical work in lighting and railway plants, etc.

THE NEW NOVELTY COMPANY.—J. M. Stafford, F. J. Meyers and others have organized and incorporated the New Novelty Company, with offices in Vincennes, Ind. The company will manufacture electrical burglar and fire alarms, fire escapes, double-cylinder gas engines and electrical apparatus.

FAIRBANKS, MORSE & CO., Franklin and Monroe streets, Chicago, have issued a new edition of their catalogue on hoists and mining machinery operated by gas, gasoline, crude oil or producer gas. They also make a complete line of machinery operated on steam, including both flat friction and geared hoists. Copies can be obtained on application.

BULLOCK IN BALTIMORE.—The recent fire in Baltimore destroyed the offices of the district manager of the Bullock Electric Manufacturing Company. Temporary quarters have been located at 303 Cortlandt St., that city, where all inquiries should be addressed. The office is working with its full force, and is ready to take care of all business offering.

"ARKLESS" FUSES, formerly made by the McBride Manufacturing Company, are now controlled by the Horton-Massnick Company, of 11-23 Detroit, Mich. These fuses with flexible terminals are used regularly by the Detroit Edison Illuminating Company in furnishing its patrons with free fuse renewals; and nearly all the old dangerous open-link fuses in Detroit have been replaced by "Arkless" cartridge fuses.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued a new catalogue, No. 19,038, covering resistance units of its manufacture. Three new types of resistance units are catalogued, with tables of capacities and resistances. A cut is shown showing various methods of mounting these resistance units for telephone, telegraph work, etc. Those interested can receive copies of the catalogue by applying for it.

THE S. R. SMYTHE COMPANY, of Pittsburg, Pa., represented in New York City by Dr. Oskar Nagel, 90 Wall St., has just issued a catalogue on suction gas producers for gas engines, showing the simplicity and advantages of the construction and the economy in fuel attained by such apparatus and practice. These producers are built in units from 5 to 150 hp, and yield 1 hp hour per pound of coal, no boiler or gas holder being required.

SMITH STORAGE BATTERY COMPANY, of Binghamton, N. Y., has just issued in neat form Catalogue No. 2, devoted to its Smith storage battery for lighting, power, automobiles, etc. This battery is in some styles of the tray type, *i.e.*, has its plates horizontal, with plates formed from rolled lead of concentric circular gridding. The battery is fully illustrated and described, in both the horizontal and vertical types. The catalogue is most interesting.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports an extremely gratifying business on American Circular Loom non-metallic flexible conduit, on which it has been and is still quoting some extremely low prices. The company states that the trade generally throughout the country has been quick to take advantage of these prices, and that it has received some very large orders. The company urges that those of its trade who have not already done so, should make it a point to write for quotations on this class of goods.

MR. E. B. LATHAM.—Among the evidences of the growth of foreign business, one of the amusing incidents is the shipping of fans in midwinter. The early part of February E. B. Latham, of New York, sent to Shanghai, China, 200 of the well-known Tuerk alternating-current ceiling fans manufactured by the Hunter Fan & Motor Company, of Fulton, N. Y. That export business creates an almost all-the-year-'round manufacture is illustrated by this shipment at the particular season of the year, and during such phenomenally cold weather.

CROCKER-WHEELER FLYERS.—The Crocker-Wheeler Company, Ampere, N. J., has issued a set of 17 flyers on the subject of machine tool equipments, which will be of interest not only to electrical men but also to machine tool users. One of the flyers discusses at length the subject of electric drive for machine tools with methods of variable speed control, the others being devoted to examples of applications of Crocker-Wheeler machines for such purposes. The flyers are fully illustrated with views of the various classes of machines considered.

TRAIN LIGHTING.—Col. J. T. Dickinson, vice-president of the Consolidated Railway Electric Lighting & Equipment Company, general offices Hanover Bank Building, New York, is authority for the statement that the Consolidated Company has more of its "Axle Light" equipments of electric car lighting in use on the best cars constituting the finest trains of leading railway lines than all other systems of electric car lighting combined. He also claims that the chief mechanical officials of several of the great railway systems in the country, where a large number of "Axle Light" equipments have been in service for the past few years, have concluded that the system is the cheapest to install and maintain and the most efficient system of electric car lighting ever yet devised. Each car carries its own independent electric car lighting apparatus, ready for immediate and constant use, no matter in what service the car may be placed.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 16, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

750,829. VERTICALLY-SWINGING SUPPORT OR SHELF; Jacob S. Detrick, Baltimore, Md. App. filed Sept. 9, 1903. (See page 403.)

750,845. SWITCHING APPARATUS; John S. Goldberg, Chicago, Ill. App. filed Nov. 26, 1902. (See page 403.)

751,081. COIN-CONTROLLED TELEPHONE APPARATUS; Sherwood J. Larned, Chicago, Ill. App. filed Dec. 3, 1903. (See page 403.)

751,228. CABLE-HANGER; Richard H. Villard, New York, N. Y., and Herschel P. Copeland, Jersey City, N. J. App. filed Aug. 5, 1902.

752,037. ELECTRIC TRAIN SERVICE; Melvin D. Compton, New York, N. Y. App. filed Dec. 2, 1901. The speed of a generator driven from the locomotive axle is varied by throwing disks of different diameters into and out of engagement by means of pneumatic pistons which are controlled automatically by the condition of the current in the various circuits of the system.

752,048. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed Oct. 23, 1903. A friction-compensating coil for producing a field for the armature, and switching mechanism for including more or less of said coil in circuit.

752,059. SYSTEM FOR OPERATING STOCK BOARDS; Geo. S. Gallagher, New York, N. Y. App. filed April 29, 1903. Stock quotations are printed upon tapes that are moved across the face of a quotation board.

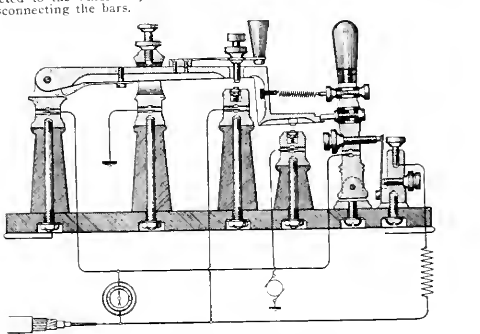
752,081. CAR SIGNAL; Geo. M. Lane, Brooklyn, N. Y. App. filed May 14, 1903. Details.

752,084. RAILROAD SIGNAL; John K. Leedy, Roanoke, Va. App. filed Nov. 10, 1902. Details.

752,097. AUTOMATIC STARTER FOR ELECTRIC MOTORS; William C. O'Brien, Baltimore, Md. App. filed May 4, 1903. Details.

752,121. TROLLEY FINDER; Elisha S. Stitt, Newton, Mass. App. filed Oct. 17, 1902. A guiding fork for the wheel arranged to be held in operative position by tension on the cord.

752,125. PANEL BOARD; Hans O. Swoboda, East Orange, N. J. App. filed Dec. 22, 1902. Switches comprising two blades are arranged between the bus bars, one blade being connected to one bar while the other is connected to the other bar, the movement of the switch thus connecting and disconnecting the bars.



752,158. Key for Cable Testing.

752,127. RAILWAY SWITCHING AND SIGNALING APPARATUS; John D. Taylor, Buffalo, N. Y. App. filed Jan. 12, 1901. Details of a locking mechanism for the signals.

752,139. TROLLEY CATCHER; William C. Young and Johnson McMahon, Buffalo, N. Y. App. filed June 1, 1903. A spring normally under tension is released when the trolley wheel leaves the wire to contract and draw the pole downward.

752,150. ELECTRIC SELECTIVE SYSTEM; Julien A. Gehrung, St. Louis, Mo. App. filed Feb. 8, 1902. A series of sending keys adapted to send varied impulses of different polarities, a series of selected magnets having correspondingly graded electromotive forces and two groups of interdepending circuit closers arranged parallel with opposing pairs operatively connected to single selective electro-magnets.

752,158. KEY FOR CABLE TESTING; William B. Hale, Chicago, Ill. App. filed April 29, 1901. A key having a number of contacts connected with the generator, the line and the testing instrument, are operated in succession and in combination with a detent lever to obtain the test.

752,168. DYNAMO ELECTRIC MACHINE; Hans Holzwarth, Hamilton, O. App. filed Nov. 21, 1903. Radial spaces between the armature plates communicate with the interior of a hollow shaft through which air is directed for ventilating purposes.

752,184. HANGER FOR TELEPHONE-TRANSMITTERS; Michael Setter, Chicago, Ill. App. filed May 8, 1902. (See page 403.)

752,192. ELECTRIC SWITCH; Charles C. Badeau, Swissvale, Pa. App. filed Aug. 12, 1903. Certain improvements in that class of overload switches in which the rupture of the circuit is effected in a body of oil.

752,236. ELECTRIC GENERATOR; Hans Liebreich, Boston, Mass. App. filed June 29, 1903. Means for demagnetizing the field at a proper time to prevent the retarding effect of continued cutting of the line of force in the field.

752,345. ELECTROMAGNET; James C. Keller and Otto F. Kadow, Cleveland, O. App. filed May 23, 1903. A ring-shaped magnet in two parts, one of which is hinged to the other, while their free ends in moving towards each other, move a lever to accomplish certain functions.

752,357. PROCESS OF ELECTRICALLY HEATING ARTICLES; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 5, 1902. A process for baking carbon bars, in which the bars are alternated in an oven with material which is normally a poor conductor but which becomes a good conductor under heat. The current is first passed through the non-conductor which becomes gradually heated and communicates its heat to the carbon bars.

752,358. PROCESS OF HEATING ARTICLES BY ELECTRICITY; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 5, 1902. A modification of the preceding invention.

752,374. AUTOMATIC CHECK DEVICE FOR TROLLEY CORDS; Seth F. Buckland, Springfield, Mass. App. filed April 22, 1903. A spring-drum and ratchet arrangement for retracting the trolley cord.

752,376. ELECTRIC BRUSH HOLDER; De Witt C. Cookingham, Cleveland, O. App. filed Oct. 15, 1903. Details of construction.

752,391. ELECTRIC MOTOR; Christian Fleischmann, Bloomfield, N. J. App. filed June 24, 1903. Commutation is shifted by rotating the field magnet instead of the brushes.

752,251. AUTOMATIC TELEPHONE SYSTEM; John K. Norstrom and John J. Brownrigg, Chicago, Ill. App. filed June 28, 1901.

752,405. TRANSFORMER; Charles B. McCurdy, Warren, O. App. filed April 24, 1902. Certain improvements in transformers intended for use in connection with a three-wire system.

752,408. ELECTRICAL APPARATUS FOR PRODUCING SOUND SIGNALS; Charles H. O'Brien, Augusta, Me. App. filed Nov. 1, 1902. A diaphragm is caused to produce a sound by the action of the core of an induction coil and of a permanent magnet inside of the core, the two combining to produce a loud sound which can be used for signaling purposes.

752,419. HIGH TENSION THERAPEUTIC ELECTRODE; Manuel R. Rodrigues, Brooklyn, N. Y. App. filed June 3, 1901. The electrode is a body of insulating material having the terminal of the conductor embedded in it to avoid the painful sensation of a direct application of the current.

752,431. AUTOMATIC SIGNALING APPARATUS FOR INCUBATORS OR HOTHOUSES; Horace B. Ault, Newmarket, Tenn. App. filed July 20, 1903. Details.

752,437. OVERHEAD TROLLEY GUIDE; Charles W. Burkehead, Madisonville, O. App. filed Aug. 16, 1902. A guiding fork constructed to perform its function whether the wheel is running forward or backward on the wire.

752,456. RECEPTACLE AND ATTACHMENT PLUG; Hubert Krantz, New York, N. Y. App. filed Oct. 24, 1903. Details.

752,460. FIRING MECHANISM FOR SHIPS' GUNS; Ludwig J. Mautner, Vienna, Austria-Hungary. App. filed June 4, 1903. An automatic firing device which depends for its action upon the incline of the ship with respect to the position of the object.

752,493. MOLDING CASE FOR USE IN ELECTROTYPING AND PROCESS OF MANUFACTURING SAME; William H. Welsb, Collingswood, N. J. App. filed Oct. 13, 1903. A molding case obtained by casting an impressionable composition, coating the said composition with flour of copper, forming an impression in the composition, then subjecting it to a black-leading machine and finally to an electrolytic bath.

752,501. TROLLEY HANGER; Montraville M. Wood, Schenectady, N. Y. App. filed Aug. 8, 1903. A cup-shaped nut that holds the clip in place, is provided with a locking device to prevent it from turning.

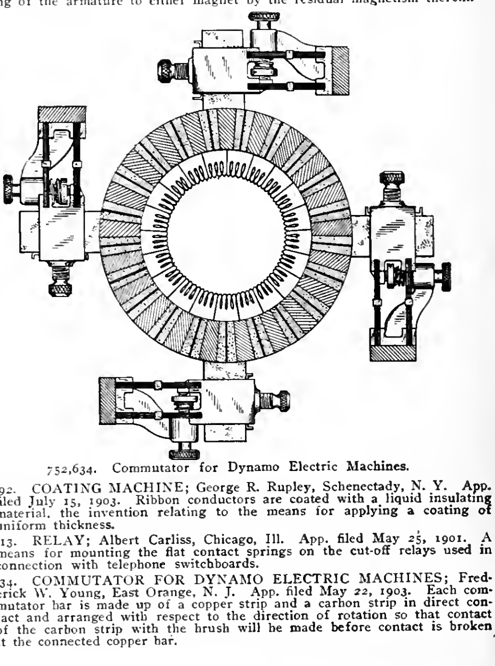
752,528. PROTECTIVE MEANS FOR ELECTRIC BOOSTERS; Maxwell W. Day, Schenectady, N. Y. App. filed July 6, 1903. The combination with a booster and its driving motor, of a circuit-breaker located in the main supplying both of them and having its tripping coil in the motor circuit only.

752,531. ELECTRIC SWITCH; Warren K. Dodge, Manhattan, Kan. App. filed Oct. 23, 1903. Details.

752,544. ELECTRICAL DEVICE FOR SHOCKING HORSES; James A. Giles, Elberton, Ga. App. filed Sept. 24, 1902. A magnet with a circuit extending to electrodes on the harness.

752,552. AUTOMATIC CIRCUIT-BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed Nov. 28, 1898. Details.

752,590. MAGNETIC CLUTCH APPLICATION; John Riddell, Schenectady, N. Y. App. filed July 27, 1901. In a clutch of the kind described in the previous patent, this invention provides a device for preventing the sticking of the armature to either magnet by the residual magnetism therein.



752,634. Commutator for Dynamo Electric Machines.

752,592. COATING MACHINE; George R. Rupley, Schenectady, N. Y. App. filed July 15, 1903. Ribbon conductors are coated with a liquid insulating material, the invention relating to the means for applying a coating of uniform thickness.

752,613. RELAY; Albert Carliss, Chicago, Ill. App. filed May 25, 1901. A means for mounting the flat contact springs on the cut-off relays used in connection with telephone switchboards.

752,634. COMMUTATOR FOR DYNAMO ELECTRIC MACHINES; Frederick W. Young, East Orange, N. J. App. filed May 22, 1903. Each commutator bar is made up of a copper strip and a carbon strip in direct contact and arranged with respect to the direction of rotation so that contact of the carbon strip with the brush will be made before contact is broken at the connected copper bar.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, MARCH 5, 1904. No. 10.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

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ELECTRICAL WORLD AND ENGINEER.

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Foreign Countries, within the Postal Union	6.00
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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, MARCH 5, 1904.

CONTENTS.

THE CAREER OF A TECHNICAL PAPER.

The relentless march of time necessarily brings with it anniversaries which serve as milestones in the history of institutions, as well as of men and nations, and it is a natural and appropriate thing that note should be taken of such occasions. These anniversary seasons and periods are not only enjoyable but useful, and even when sad may carry with them some lesson or stimulus. It sometimes happens that these memorial occasions are of interest chiefly to the person most directly concerned, but in the case of a journal, for example, whose sphere of activity and influence may be co-extensive with the boundaries of the art it represents, and even overpass them, it is believed that an anniversary such as that which is celebrated by ELECTRICAL WORLD AND ENGINEER this week is one of which other people would like to be reminded. In fact, the number of friends who have contributed reminiscences and words of congratulation to the present issue may be taken as an indication that the event is regarded as one constituting part of the history of electricity and its development in the United States; and proving that whatever good work the journal has done or has attempted to do in its thirty years of existence has not gone unrecognized by a generous and sympathetic public.

The record of this journal in its humble beginnings; its changes of name and habitat, its absorptions, amalgamations and consolidations; its notable growth and other aspects, is a fitting epitome or summary of the electrical art as a whole which it has sought to mirror and to foster. This journal began its career in 1874 as the *Operator,* founded as an organ of a very modest character for telegraphers, but it was no sooner started than it saw new opportunities in the coming developments of electricity, so that in 1876 the telephone was hardly invented before the *Operator* began to discuss it. In the same way it noted also the beginnings of electric lighting, and in the year 1882 published a series of articles on the subject which were recognized as doing a great deal to educate engineers and the public in the principles and adoption of the new illuminant. The year 1882 saw also the first issue of *The Electrician,* which seventeen years later, in another guise, was destined to be consolidated with the *Operator,* also under another name.

In January, 1883, the little telegraph journal became *The Operator and Electrical World,* but its growth throughout the earlier part of that year was so rapid it was realized that it would be better to make a further change, and on April 28 the current was subdivided and *The Electrical World* began its separate career. The next year, 1884, witnessed the electrical exhibition in Philadelphia and the electrical congress there, both events giving a great stimulus to the art, and the same year saw also the foundation of the American Institute of Electrical Engineers, the organizing circular for which was issued by the editors, and from the offices, of *The Electrical World.* At that exhibition also a great stimulus was given to the use of electricity in printing, by the use of an electric motor there, with which some 70,000 copies of the paper were printed. In 1888 *The Electrician* became *The Electrical Engineer,* but remained a monthly until 1890, which witnessed its first weekly issue. In 1894 *The Electrical World,* which had been published in the familiar old folio style, still favored by some weekly journals, adopted its present quarto style, which has been found much more convenient by readers and which had always characterized *The Electrician.* A period of absorption and consolidation now set in, the *Electric Railway Gazette* being absorbed in 1896, while in 1899 the consolidation took place of *The Electrical World* and *The Electrical Engineer,* the change of ownership and management being accompanied by the adoption of the title Electrical World and Engineer, under which for the past five years the journal has been conducted.

This in brief, and not touching on many points of interest, is the record of the journal as a publication and business. A word or two may be added with regard to the personnel of the institution, omitting those at present connected with it. On the business side and also in regard to a great deal of the editorial work, the papers which have gone to make up the present journal enjoyed the energy, activity and sound business acumen of such men as Messrs. W. J. Johnston, G. M. Phelps, C. E. Stump and F. R. Colvin. The editorial staff, impressing upon the various journals the stamp of high ability, sound judgment, strict impartialty and the conscientious discharge of journalistic duty, has included such men as F. L. Pope, C. O. Mailloux, Louis Bell, C. J. H. Woodbury, Joseph Wetzler, J. E. Woodbridge, R. W. Pope, N. S. Keith, H. W. Frye, G. H. Stockbridge, C. T. Rittenhouse and C. T. Child. Several of these men, some of whom have passed away, distinguished themselves not only by editorial skill, but by accomplishment in other fields of electrical endeavor, and their work constitutes in large measure whatever of strength and importance this publication may now possess as the recognized leader in electrical journalism.

Thirty years is perhaps a long time in the life of a journal, especially in the technical field, but is not a particularly long period in any art. Electricity, however, is unquestionably quite young as compared with other branches of science and industry, and as one looks back over the past thirty years it is hard to believe that any period of equal duration could be more closely crowded with glorious life and achievement than has been the era 1874-1904. But should coming years hold in them potentialities and accomplishments in electricity greater than any that have been known in the past, it is hoped and believed that the Electrical World and Engineer and those who conduct it will be found adequate and faithful to every demand that may be made upon them in the production of a fearless, progressive, authoritative and independent journal.

Side Lights of History.

In preparing to issue an anniversary number celebrating the close of its thirty years of continuous existence and beginning its fourth decade, the Electrical World and Engineer believed that while it was unnecessary and superfluous to recapitulate seriously the whole marvelous record of the period between 1874 and 1904, it might do something that would be of lasting value and interest by giving space to the ideas and reminiscences of some of the men who had been leaders as thinkers and workers during the time named. The events connected with the evolution and development of modern telegraphy, the telephone, the arc light, the incandescent lamp, the electric motor, the electric railway, electric lighting, electric heating and other branches, are pretty familiar to-day and may be found in the books. But there is still unwritten a great deal of personal history and reminiscence which must in days to come constitute for the historian and the student much of the material that will be most valuable in re-creating the actual atmosphere and events surrounding those great inventions at the time of their birth and during their struggles for foothold and supremacy.

The editors of this journal deem themselves fortunate to have been able to bring together within the pages of this present issue so large a volume of personal recollections and data belonging in the class which the French call happily *memoirs pour servir,* and having that charm and fascination which must always attach to autobiography. It will be seen that these articles cover all the great inventions of the period and that many of them present facts under new illumination. It might indeed be urged that a single issue embracing the contributions of such well-known captains as Edison, Tesla, Sprague, Coffin, Griffin, Kennelly, Bell, Anthony—to name but a few—has by that very reason a unique permanent value. Such articles are, indeed, side lights of history, but they are something more, especially when thus brought together in celebration of a specific anniversary in the art which has seen such wonderful and unparalleled expansion during the past thirty years. The Electrical World and Engineer is proud to present the contributions of these friends, whose presence in its pages at such a time it regards as a mark of good will and esteem; and it takes this opportunity of acknowledging its deep appreciation, as well as of expressing its sense that it is thus pledged to even greater effort in the future.

The Portrait Supplement.

In connection with its present anniversary issue, the Electrical World and Engineer has thought that it might be interesting to give in one group the portraits of some typical leaders in the thirty years of American electrical development included in its own lifetime, namely, 1874 to 1904. This period misses narrowly the creators of the telegraphic era in America, but includes the pioneers in every other branch, as well as one or two men who may be regarded as bridging the gap between the old world and the new of electrical development. It is thought, therefore, that the Supplement to this issue will be found of more than general interest, and that while it is likely to be preserved for its intrinsic value, it will also serve to suggest a few timely thoughts as to the scope and variety of the modern science and its applications. Electricity has laid hands upon so many departments of life and has affected so many branches of industry, finance and commerce, it is no longer possible to find its leaders or its heroes in one separate class or group of men. The field has already become so wide and so large, it is only possible in such a supplement as is here presented to include leaders who are typical and alongside whom might be placed others with propriety, pre-eminent in their own group or class, were it not for the claims which other categories have for consideration and inclusion.

In the field of pure science one would certainly select and name first of all Prof. Rowland, honored abroad even more than in his own country, yet even he did not disdain to work on the utilitarian side of electricity and to take out patents. With him might well be classed Dr. Pupin as representing the present physical and educational sides of electricity, himself also an inventor and patentee of no mean order. As between the old school of telegraphy and the modern school of electrical engineering there would seem to be little in common, for Edison is the only connecting link between Gray and Farmer, of the earlier period, unless we take into account F. L. Pope, who doubtless had higher claims as the typical electrical journalist of the last century. Farmer again belongs not only to the telegraphic stratum or branch, but is connected with the new dynamo days through Weston, who also exemplifies the evolution of the modern electric lighting and power art out of the prior electroplating practice. It is true, of course, that in a broad sense the telephonic group of inventors ought to be considered as lineal descendants of the telegraphers, but there is no question that such men as Bell and Blake have dealt with an altogether different set of problems from those which confronted Morse and House; and that in the telephonic engineering done by Carty and his colleagues there is no parallel whatsoever to be found in any other branch of electrical engineering.

It is the electric lighting period which introduces us to a great group of notable men and brings to the front the large manufacturers typified by such brilliant examples as Coffin and Westinghouse, the first of whom, however, has devoted his energies entirely to the financial development and industrial exploitation of the art, while Westinghouse has further claims to consideration as a designer and inventor. Here again he links with Wheeler as a manufacturer, engineer and inventor, while Wheeler has the further distinction of laying the foundations broadly and liberally of the Institute Library and of thus setting in motion the forces which have of late brought electrical engineering in closer touch with the older professions than ever before. In the electric lighting field, Edison at once comes to the front again as he does in those of telegraphy and telephony; while shoulder to shoulder with him stand such masters as Brush, Thomson and Wood, the work of each man being that of a successful pioneer. Edison again forms a starting point in regard to the electric railway art, going back also to Farmer and embracing men whose names will be even more widely known in the future than that are to-day, such as Sprague and Van Depoele. In the manipulation, transmission and distribution of current beginning with this modern period of electric light and power, are associated again most intimately several who have already been mentioned and others in the group, such as Stanley, Steinmetz, Scott and Shallenberger, the last of whom indeed might well be considered along with Weston, Thomson and Edison in the invention and perfection of measuring instruments. Quite in a class by himself from his advanced and daring work and predictions as to the future, is Tesla, although he ranks high already chiefly through his successful efforts to render alternating current available for power and transmission purposes. Going back to the earliest days of electrical development on the chemical line of advance, one must include such men as Farmer, Edison and Weston, but these would not be chosen as typical of the latest period; and it is for this reason that in this group places of honor are given to such men as Hall, Cowles, Acheson and Bradley, although the last two named have further claims to consideration; one as a pioneer in the electric lighting field, and the other as a most fertile and progressive inventor of dynamo electric apparatus.

But even when all this has been said, and a fair ascription of credit has been made to these men and the colleagues or branches whom they represent, a great deal of work is left untouched of equal value and importance in rounding out the availability of electricity to the public. It is for this reason that portraits are presented of such men as Leonard, inventor and engineer in many fields, and particularly prominent in that of resistances and electric heating. Other vital lines of work are typified by Pearson as a designer of central power plants; Insull, not only a manufacturer but a typical central station manager supplying current in enormous volume for every public necessity; or Kellogg, also an inventor, but conspicuous chiefly as a manufacturer and as a typical figure in the wonderful independent telephone movement which has been one of the leading electrical features of the present century, and has affected very other branch of electrical industry. Last but not least, comes Fish, typical in every way of the prominent part played by the legal fraternity in electrical development from its very beginning, and himself one who has contested more causes of tremendous importance in the electrical field than any other man living or dead, while again necessitating consideration as the business head of the greatest telephonic system in the world.

It is easy to imagine the substitution of other men for some of those whose portraits are presented in this Supplement, especially if undue weight is given to the claims of some particular field or branch of electrical industry over the others. The attempt has been made, however, to select men who, individually and collectively, may be taken to stand for the sciences and arts to which they have devoted their lives and whom their associates agree in honoring as typical leaders in the past thirty years of American electrical development.

A Campaign of Publicity.

It always seemed to us, as well as to a great many other people, that the advertising pages of any paper are one of its most interesting and instructive features; and this idea is particularly true with regard to technical and trade papers from the fact that so much apparatus is therein illustrated and described. The manufacturer in his own space in the advertising columns is practically at liberty to show what he likes and say what he likes with regard to his apparatus, and very often he first puts on view there with all its claims the device or appliance for which superiority over everything else in the same field is asserted. It thus happens that the advertising pages of such a journal as the Electrical World and Engineer throughout a term of thirty years and such a period as that which it celebrates in this issue, present an invaluable picture of the industrial development of the time, one that could not possibly be overlooked or neglected by any person who would later seek to make himself acquainted with what had been done in the industry. From the first advertisement inserted in the pages of the old *Operator* down to the current issue of its lineal successor, the Electrical World and Engineer, with its 196 pages of advertising in the single issue—high-water mark in electrical advertising in America—the stream of history is unbroken, and all the points of advance are sharply and strikingly defined. We would not like to say that if the reading pages were omitted the art could still be reconstituted from these advertising pages, for that would overlook the great development of engineering theory and scientific research out of which inventions grow; but it is nevertheless a statement capable of being sustained that every great outburst of inventive activity has made a clear and indelible imprint in those advertisements.

This is one aspect of the question of advertising, but there is another which is of vital importance to the manufacturer, and that is the success which should attend his efforts to reach the public and to market his goods. We must therefore take it to be a conceded fact that the notable extent to which the advertising pages of this journal have been used as a means of influencing trade has been found justified by those who have spent their money so liberally to secure publicity. And from the past we would derive a cheerful augury as to the future, for it is to-day better understood than it ever was at any time during the last thirty years that publicity must be sought scientifically, persistently and liberally. Each new development in electricity has required means for reaching the attention of a new set of customers, but the great broadening out of the area of contact with the public thus necessitated has, we believe, found this journal ready for the test and equal to it. In fact, it is no presumption to say that in some respects and very often this journal has had to advocate causes that appeared like forlorn hopes, and to keep hammering away at developments which it seemed would never "arrive." But as Mr. Ayer has pointed out in his interesting article, it has been strange how few of the electrical inventions up to date have failed to justify the hopes of their partisans and promoters, and this we feel must be attributed in very large measure to the publicity and advertising that has been secured.

If we were to want a justification of our point of view we could desire no better proof than the article which Mr. Arthur Warren has recently contributed to one of the New York dailies. This gentleman, as is well known, was for some years past at the head of the advertising bureau of one of the largest electrical corporations in this country, and his whole article is an insistence upon the necessity of advertising and the remarkable gains which follow judicious expenditures. As he says, "There was a time when good wine needed no bush; when great industrial concerns scorned publicity; but competition has changed the conditions in the last half-dozen years." Every one familiar with the field of industrial development must recognize the truth of this, but it seems to us that very few men yet, in the electrical field, realize how largely their business could be built up beyond its present figures by aggressive campaigns of publicity. As Mr. W. F. White points out elsewhere in his suggestive remarks on the growth of the sale of current, the gross receipts from the use of electrical energy for all purposes do not exceed at the most $2 per capita per annum in our largest cities, and he insists that such figures can be increased four or five fold. We believe with him that they can, but it will not be done without methods of publicity far exceeding in boldness and vigor anything yet witnessed by ourselves or our readers.

The Loading of Telephone Circuits.

We give this week an account of the most recent work accomplished in the direction of improving and extending telephonic communication by the aid of the Pupin system of inductive loading of telephone circuits. The work is evidently in steady progress. It is clear, however, that in spite of all benefits thus far derived, or immediately in sight, we must not expect to talk from New York to London, or to Brisbane, Australia, just yet. Every year makes the need of loaded conductors more apparent. The cities are building out into the country and extending their limits. They insist, and the very necessities of construction likewise insist, that the telephone wires shall go underground. As soon as the wires go underground the added resistance and capacity of the cables greatly reduce the volume and clearness of the telephonically-transmitted speech. A few miles of underground cable are harder to talk through than a thousand-mile air line from New York to Chicago. The loading of underground circuits comes to the rescue under these circumstances, and mitigates the difficulties with the stretches of cable in the limits of terminal cities. No doubt it will some day be necessary to load all underground telephone wires, as a matter of standard practice and general necessity.

Electric Railway Growth.

It is an extraordinary fact, for which we have never seen any adequate or satisfactory explanation, that the electric railway—the latest comer amongst the great electrotechnical industries which grew up during the past century—has far exceeded in importance and magnitude of investment the others which preceded it. It is also a singular fact still remaining to be elucidated that the industries have been successively larger in the order of their creation and progression, telephony being in excess of telegraphy, electric lighting larger than either of them, and the electric railway the biggest of the lot. In fact, according to the authentic figures now available, the electric railway with a capital investment of $2,500,000,000 is more than equal to all its predecessors put together, which at the most could hardly be set down for much beyond $1.750,000,000—itself no slight item.

Our present issue contains amongst its memorial and reminiscent articles, several dealing with the crude and humble beginnings of the electric railway industry in the United States now represented by such an enormous aggregate of capital. We are able to present from those who actively participated in the stirring events of the 80's, very interesting stories as to what was done on the early Daft, Van Depoele, Sprague, Bentley-Knight and other pioneer roads of the period. We are sure that anyone who reads those articles, as all doubtless will, would hardly believe it unless they knew it to be so, that from such unpromising commencements has been built up the art which at this moment has begun to claim also for its own the vast domain that has previously acknowledged only the sceptre of steam. The figures, for example, which General Griffin, himself one of the pioneers, gives in his article, are simply astounding, for the same man who made the first governmental report on the subject is able also to tell quietly, almost as a matter of course, how from 100 cars electrically equipped in '87, a total of 55,000 cars electrically equipped has been reached in 1903; while the outfit per car has advanced from 10 hp up to 2,250 hp each for the electric locomotives on the New York Central system.

It is interesting also that our present issue should contain two such unusual articles as that by Mr. Frank J. Sprague on his own work and the outlook for the future, and that on the Ward Leonard pioneer work, on single-phase traction, which now beckons so hopefully as one of the means by which the heavier work ahead has to be done. The two points of view presented in these two articles are most striking and interesting. To us they do not suggest the idea of conflict at all, but rather proclaim the flexibility and resourcefulness of electricity with its two forms of current, the direct and the alternating; one of which has already done such magnificent work, and the other of which justifies such sanguine expectations as to its accomplishments in the near future. The discussion by Mr. Sprague of the features of advantage and utility in connection with the direct current is singularly timely and most felicitously put, and we know that it will enjoy the attention it so well deserves.

THE NEWER ARTS.

The contents of the present commemorative issue of this journal deal largely with the electrical arts now in prosperous existence and with the stages by which they have successively been brought into being. The very number and magnitude of these industries created during the past thirty years make us wonder a little as to what may be the newer arts and industries which the next thirty years will see in the electrical field. Prophecy is rather dangerous and difficult in regard to electricity where so many things crop up unexpectedly, but there are those who are willing to try their hand, as for example, Mr. Tesla, whose article alone would give distinction to our current number, by its bold vaticinations. If all he says and believes were to come true, there would indeed be a crop of new arts to stagger the world with.

Aside from prophecy, however, and the results that might be reasonably expected from such progressive work as that with radium, it would seem that there is reason for hope attending developments within the immediate range of practicality. Wireless telegraphy is certainly proving itself capable of becoming a great industry, and opposed to that we have the bright promise of long-distance and submarine telephony. In the domain of heavy work there is every reason to believe that telpherage may build up an industry equalling in the actual amount of hard work done whatever is now accomplished in street railways. Electric heating is also showing itself capable of indefinite extension, as evidenced by the remarkable plant which we described recently in the Government Printing Office at Washington. There would also seem to be hope in electric canal haulage, and certainly some in the transportation of mail and other matter through tubes in city streets and from one part to another of our huge modern office buildings and factories. These and other fields to occupy, to say nothing of the conversion of the steam railroads, stretch before the eager electrical engineer. Particularly in electrochemistry and electrometallurgy, as pointed out in the admirable article by Dr. Roeber, may we expect to see new and valuable arts arise. But even if no new developments impended, the growth of wire telegraphy, of telephony, of electric lighting and power, and of street traction, as well as of other well-established arts, would provide abundant occupation for every man now enlisted under the electrical banner.

THE LIGHTING OF THE FUTURE.

It is with no prophetic instinct that we would seek to forecast the immediate future of the art which has won so great a place in the thirty years past, nor do we propose to indulge in iridescent dreams of what may come to pass if the hopes of inventors are fully realized. We wish merely to point out some of the salient facts that confront us as auguries of work for the next generation. To view the situation soberly, neither electric lighting nor any other single form of artificial illumination touches deeply the roots of human life and industry. The world would wag on in about the same old fashion if petroleum or coal gas, acetylene or electric light were forgotten. The abolition of any one of these would be, save for those immediately concerned in its production, a transition phase of fashion, and bring us back to early dinner hours. Of all known illuminants, electric light is easily the first from a hygienic standpoint, since the light is produced without sensible combustion. This virtue and its excellent color value conspire to give it a very strong hold on public favor, but as regards the former characteristic, few people are willing to pay, when in good health, any considerable price for hygienic conditions, and as regards the latter, it is fully equalled, for instance, by acetylene. In the last resort, therefore, the battle of illuminants resolves itself into a contest for economy, modified only by the dictates of fashion and external appearances. At the present time, electric lighting has the upper hand of its competitors, but it can retain it only by constant fighting. It has, of course, certain strongholds from which it cannot easily be driven, although the open field as a whole is for anybody's winning.

At the present time the electric arc is by a very perceptible amount the cheapest all-around illuminant, and this fact is the strongest ally of incandescent lighting. For, while cheap gas in mantle burners can undoubtedly beat out the incandescent lamp, candle for candle, in mere cost, it cannot meet the arc on even terms, and if the consumer is deaf to all arguments based on hygiene and color blind to boot, the central station still holds a trump card in the arc. The intensing mantle burners in their various forms can beat out the arc indoors, so far as price is concerned, but are at a disadvantage out-of-doors, and require some species of local plant which works to their disadvantage in the matter of convenience. It is safe, then, to say that the electric arc will keep a strong position among illuminants for a long time to come, and that it will be steadily improved along lines which are already blazed out. It is in the field of incandescent lighting that the fiercest battle will rage. In spite of all the experimental work of the past few years, the glow lamp retains its supremacy, and its reign is not yet even seriously threatened. Until the Nernst lamp runs without attention, and the vapor lamps cease to be green, these, the most promising recent innovations, will be seriously handicapped. Evidence goes to show that no amount of talking will persuade the general public that green is a desirable or becoming color for lights—or make it so. If argument could blind the eye to that uncanny shade, the mantle burner would long since have had the glow lamp "in chancery" in spite of every effort at defense. Let the vapor lamp once escape from the color difficulty, and it will immediately assume a most commanding position in the art, even if it should only be available in rather large units of great intrinsic brilliancy.

Two things we need in electric lighting for the immediate future. One is a lamp of moderate power, moderate intrinsic brilliancy, good color and high economy to replace or supplement the present glow lamp. The other is a very efficient lamp of almost any power and brilliancy, with plenty of red and yellow in its spectrum, and capable of operating when fully enclosed, and practically without attention. The first form of lamp has its obvious uses laid out in advance. The second would be almost equally valuable to the art, and could be utilized for indirect lighting with the greatest advantage. If the arcs with composite carbons could only be enclosed and run without attention, they would fill the bill exactly. But no form of arc yet devised can advantageously be employed as a concealed illuminant, and, however efficient, it is easily beaten out by the glow lamp for interior illumination. Almost any kind of illuminant will answer out-of-doors provided it does not require too much attention, but for the regular work of interior lighting the incandescent lamp fully holds its own, inefficient as it relatively is. Which of the suggested improved lights is likely to appear first, no one can tell; perhaps both may come together. The chances seem a little better for the first named than for a light of high power; and the futile efforts which have thus far failed to obtain either are evidence enough of the difficulty of the problem. Lacking these improvements, the best hopes of electric lighting lie in the skilful use of the illuminants that are now available, in a careful adaptation of means to ends, and in a realization that illumination is not a haphazard business where all the light that can be paid for is the proper amount to use. On the contrary, light improperly employed is not only useless but harmful, and one light well placed is better than two misplaced. If one can make ten common glow lamps do the work of fifteen as now used, he has scored as great a success as if he had installed a new form of two-watt lamp. The final test of lighting is light.

Civil Engineers to Stay Out.

The American Society of Civil Engineers, as the result of its ballot vote taken recently and canvassed this week, has decided not to join with the other national engineering bodies of the country in accepting Mr. Andrew Carnegie's gift of $1,500,000 to be devoted to creating a magnificent engineering home and center in New York City. The vote was decided by 1,134 against 662 for acceptance, or a majority of 472 against the plan. The Society has a membership of about 2,500, from which it would appear that no fewer than 700 members abstained from voting, or were indifferent to the matter.

It will be remembered by our readers that as an immediate result of the library dinner of the American Institute of Electrical Engineers held in February last year, Mr. Carnegie gave $1,000,000 to the four principal national engineering societies, namely, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Institute of Electrical Engineers, as well as to the Engineers' Club, a social organization including members from all bodies: this money to be devoted to the erection of a building or buildings where all these bodies could be adequately housed. The Engineers' Club already had land on West Fortieth Street facing the new Lenox Library, and Mr. Carnegie immediately proceeded, therefore, to acquire land on Thirty-ninth Street so as to enable the proposed building for the engineering societies and the new building of the club to be placed in convenient juxtaposition. Up to the present time he has spent in the vicinity of $600,000 in thus acquiring land for the benefit of the four engineering bodies named, three of which as well as the Engineers' Club, have already accepted Mr. Carnegie's gift.

A reconsideration of the plans and the fact that if the Civil Engineers came in quarters would be needed for not less than 12,000 professional men and for societies all of which are growing rapidly, determined Mr. Carnegie to increase his generous offer; and with characteristic promptness and liberality he added half-a-million dollars to the sum which he had originally designated, intimating as he did so that his great aim and ideal in doing this was to foster fellowship and promote union and harmony amongst the engineering professions; so that all while maintaining their individuality could work together for the common good. As will be seen, however, the Civil Engineers, who already have a house of their own on West Fifty-seventh Street, have now decided to stay there alone and isolated, although as their recent annual meeting proved, it is much too small for their purposes, so that the very meeting at which the ballot vote was decided upon had to be held in the Carnegie Lyceum adjoining.

Our readers are well aware of the fact that immediately following the announcement of Mr. Carnegie's gift a conference committee of fifteen was formed with three members from each of the five bodies interested. It would appear from this vote that the delegates of the Civil Engineers are no longer authorized to participate in the proceedings of the conference committee. Mr. Carnegie and the three societies, which have already voted to accept his gift, and which, with the Engineers' Club, number some 8,000 or 9,000 members, will possibly have to change their plans and adjust them to the conditions which have arisen from this action of the Civil Engineers. It is needless to say that the attitude of the members of the Civil Engineers who voted against what are regarded as broad, common interests is viewed with deep regret by electrical engineers, who looked forward eagerly to closer co-operation with the Civils, but who find some consolation, however, in the fact that after all less than half the members of the society recorded an unfavorable vote. The results of this action will be followed with the greatest interest by engineers all over the world.

In the meantime, the American Institute of Electrical Engineers, realizing that whatever might be the course of events, it would have to call upon the generosity of its members in order to be able to assume new liabilities and larger responsibilities in safety, has, with its wonted vigor, lost no time in getting itself into a position where it could command resources of its own at least equal to those of any other society. During the past few weeks, therefore, its Land, Building Fund and Endowment Committee has gone to work, and from perhaps not more than a hundred of its members it has already secured donations and pledges of $40,000. When it is considered that the membership is 3,000, it will be seen that the committee is warranted in its hope of raising at least $150,000 from the members; and not less than $50,000 to $100,000 is expected from the corporations and manufacturers in the industry benefitted by the Institute work. The Institute thus fairly expects to be in a financial position equal to that of any other kindred society, and adequate to the purchase of land for any kind of a building Mr. Carnegie may put on it.

The Chicago "Tech." Dinner.

The Northwestern Alumni of the Massachusetts Institute of Technology held a dinner February 27 at Chicago, which proved to be an affair of considerable electrical interest. Mr. V. R. Lansingh, the well-known illuminating engineer of Chicago, who is secretary of the alumni association and made the preparations, had a surprise in store. When the guests entered the banquet room at the University Club they found it illuminated with six 750-cp Cooper Hewitt mercury vapor lamps. This was the first opportunity the majority of those present had had of testing the qualities of the mercury vapor lamp for general interior illumination. The lamps were turned off during dinner, but were turned on again by way of introduction to the after dinner remarks of Professor W. E. Goldsborough, who told of some of the new things in the electrical line to be at the coming St. Louis World's Fair. The mercury vapor lamp in several forms, he said, was to be one of the new features. He spoke of some decorative lighting in colored lights which would be different from the decorative lighting of previous expositions. Wireless telephony, he said, was another new feature that would probably be shown, and several of the new single-phase alternating-current railway motors would be on hand.

Reception Committee for the Congress.

President Bion J. Arnold, of the American Institute of Electrical Engineers, has appointed the following general reception committee for the International Electrical Congress this year: John W. Lieb, Jr., chairman, 55 Duane street, N. Y.; Calvin W. Rice, vice-chairman, 348 Central Park West, N. Y.; E. G. Acheson, E. K. Adams, William A. Anthony, A. H. Armstrong, J. C. Barclay, Alex. Graham Bell, Louis Bell, Charles S. Bradley, N. F. Brady, C. F. Brush, H. W. Buck, George Bullock, H. S. Carhart, J. J. Carty, C. A. Coffin, C. D. Crandall, F. B. Crocker, H. L. Doherty, Alex. Dow, Louis Duncan, Gano S. Dunn, Thomas A. Edison, Charles L. Edgar, W. C. L. Eglin, R. A. Fessenden, S. D. Field, Frederick P. Fish, B. Gherardi, W. E. Goldsborough, Hammond V. Hayes, Carl Hering, Peter Cooper Hewitt, J. W. Howell, C. R. Huntley, Samuel Insull, D. C. Jackson, William J. Jenks, Francis W. Jones, John F. Kelly, A. E. Kennelly, W. A. Kreidler, H. Ward Leonard, Herbert Lloyd, T. D. Lockwood, John Martin, T. C. Martin, J. H. McGraw, E. L. Nichols, R. B. Owens, F. S. Pearson, W. A. Pearson, F. A. C. Perrine, Ralph W. Pope, W. V. N. Powelson, Charles W. Price, M. I. Pupin, Samuel Reber, E. W. Rice, Jr., A. L. Riker, E. B. Rosa, Charles F. Scott, Samuel Sheldon, Frank J. Sprague, William Stanley, C. P. Steinmetz, L. B. Stillwell, H. G. Stott, F. H. Taylor, Charles A. Terry, Nikola Tesla, Elihu Thomson, Calvert Townley, W. D. Weaver, George Westinghouse, Edward Weston, Schuyler S. Wheeler, J. G. White, W. F. White.

Coming Electrical Meetings in Chicago.

The electrical section of the Western Society of Engineers (formerly the Chicago Electrical Association) will hold a meeting March 18 at its rooms in the Monadnock Building, for the discussion of the "Electrical Opportunities in Chicago." George A. Damon, who will be the leader of this discussion, has sent out inquiries for reports from 100 of the best-known young electrical men of the city, inquiring as to education, training, opinions as to what constitutes the best preparation for an electrical career, and other matters throwing light on the subject. Mr. Damon has received replies from a large per cent. of those from whom this information was asked, which would indicate that the subject is one of general interest and one which will be productive of an interesting meeting. The Chicago branch of the American Institute of Electrical Engineers will have a meeting for the discussion of the single-phase alternating-current railway motor on March 8, at the rooms of the Western Society of Engineers.

Electric Lighting in the City of Benjamin Franklin.

By W. C. L. EGLIN.

FIG. 1.—STACK 275 FT. HIGH.

THE city of Philadelphia comprises an area of over 129 square miles, and the demand for current comes from all quarters of the city. Formerly, there were 27 companies with 18 different operating companies distributed throughout the city and suburbs, each of the companies operating on an entirely separate and independent basis by reason of its franchise, and thus preventing a consolidation of organization and operation similar to other large cities. The distribution of current by these various companies included practically all of the methods used commercially, viz.: direct current of 500-volt two-wire, 110-volt two-wire, and 220-volt three-wire systems; also single-phase alternating current, two-phase alternating current, and three-phase alternating current, with frequencies of 60, 66, 125 and 133 cycles. The voltages of the alternating-current feeders were 1,000 to 1,200 and 2,000 to 2,400 volts. The total number of consumers of these various companies was over 13,700, using 13,973 series arc lamps, 3,758 incandescent lamps, both direct current and alternating current, 16,000 hp in motors, and 494,000 incandescent lamps. The total equivalent connected load in 16-cp lamps was 878,000. The yearly kw-hours manufactured at these various stations were 59,405,970, divided as follows: Incandescent and power, 35,081,545; arc, 24,324,425. It was such a system that had to be unified and harmonized.

In the consolidation of a number of electric lighting and power properties, the first essential is a uniformity in the supply of current to the various consumers. Conditions existing in Philadelphia were similar to those in other large cities in which are located a number of small plants, some supplying alternating current and some direct current—those supplying alternating current having a voltage differing somewhat from the latter. Before, therefore, effectual consolidation could be made of the operation of these plants, attention was given to the distributing system; and after a careful study of the situation it was decided to adopt the two-phase 60-cycle alternating-current distributing system for most of the territory, and the direct-current, 220-volt, three-wire system for the principal business section of the city. This simplified the generating station as it required only one type of generator to supply directly all of the alternating current, and indirectly the direct current by means of high voltage alternating-current motors and 300-volt direct-current generators.

The entire distributing system was reconstructed so as to obtain a uniform primary and secondary distribution, and change the single-phase to two-phase circuits. All primary circuits were arranged for voltages ranging from 2,200 to 2,400 volts, and secondary, from 110 to 120 volts. Tie lines were installed between the various distributing centers, these tie lines being operated at 5,500 volts, which is the voltage of the generating station.

After the completion of the plans for the distributing system, a careful survey was made of the property on both the Delaware and Schuylkill Rivers to obtain a site for the main generating station. After examination of the properties obtainable, preliminary plans were made showing the ultimate capacity to be obtained on the properties. These plans were submitted to Mr. John T. Windrim of the firm of James H. Windrim, Architect, Philadelphia, Pa., who prepared the plans of the first section of the building. In selecting the site for the main generating station it was essential that enough ground be obtained to admit of an increase of at least ten times the first necessary equipment, so as to take care of any increase in capacity required for the large growth of the business during a period of years.

The site finally selected is, for many reasons, probably ideal. The total area is about nine acres, extending from the Schuylkill River front a distance of 1,304 ft. without being divided by streets. The actual distance from the central station to the center of the load district is about three miles. This property is bounded on the one side by the Pennsylvania Railroad and on another by the Baltimore & Ohio Railroad, and on the other side by Christian Street, a broad and well-paved street.

For the reasons above mentioned, it was decided to design the station on a sectional plan in order that it could be extended in one direction to the end of the building lot, each lineal foot of station giving a proportionate increase of switchboard, engine room, boiler room and auxiliary capacity. This necessitated that all of the apparatus be laid out in parallel lines, and the crossing or mixing of various classes of apparatus prevented by careful attention to details.

The first section of the building was located 360 ft. from the river in order to admit of an arrangement of coal storage at both ends of the complete plant. Fig 8 shows the survey plan of the property. It will be seen that this property is somewhat triangular, and that the width of the property increases eastward. The first section of the building was naturally located nearest the river.

The generating station consists of two buildings, one a boiler room and the other an engine room arranged with a number of mezzanine floors for switchboard galleries. The smoke-stack was placed outside of the building, first, to avoid taking up space in the building required for boiler purposes, and, second, the space was available outside and could be utilized to no better advantage.

The first work was arranging the foundations of the building, and the intake and discharge water conduits for condensing purposes. It was decided to arrange the intake and discharge conduits triangularly and construct them of concrete which would fulfill the function of foundations for the division wall between the engine room and the boiler room. The reasons for establishing this location was that water is required in both the engine and boiler-room

FIG. 2.—GENERAL VIEW OF CHRISTIAN STREET STATION, PHILADELPHIA.

buildings, and connections could readily be made to both sides of this conduit. The placing of the conduit in any other location would necessitate carrying the foundation for the columns of the building on either side down to a lower depth, thus increasing the cost. The arrangement of the conduits permitted of the desired capacity with minimum depth of excavation. The two lower intake conduits are each 7 ft. in diameter and joined with cross-connections of 4 ft. at frequent intervals. The discharge conduit is elliptically shaped, being 12 ft. in height by 8 ft. wide. Connections to the intake conduit are made by walls so that the intake pipes can be dropped down and be continuously submerged. The top of this conduit was entirely covered with 20-in. I-beams; and at the points where the columns rest, additional I-beams were placed across those upon which the bolsters rest, so that the load was distributed uniformly over the entire length of the conduit.

On account of the elevation of the ground towards the east, it was decided to make the engine room floor at the street level towards the middle section of the building, so that in the first section of the building there would be no basement, the basement being on the ground level about 6 ft. above high water.

It was decided to install as a unit generator the largest size to be obtained commercially, although at first a unit of one-half size was installed so as to operate economically at the light loads during the period of the growth of the load on this section. For these reasons 5,000-kw units were decided upon as the standard, and 2,000-kw units were installed as the half unit. Both of these units have an overload capacity of 50 per cent. for two hours.

The General Electric generators are revolving field, two-phase, 6,000 volts, excitation being provided by motor-generator sets. The motors, which are of the induction type, are wound for 6,000 volts, two-phase, the direct-current generator being wound for 300 volts.

A small steam exciter set is used in the event of the station being unable to obtain current from tie lines when starting up. These exciters are placed on the engine-room floor. On the first mezzanine floor are placed the direct-current switchboards for exciters, the oil switches, and the series and potential transformers. On the second mezzanine floor are the reserve oil switches, one of which is always in series with the switch on the floor below, and is also used as a selector switch for each of the bus-bars, the bus-bars being arranged in separate concrete compartments on the upper mezzanine floors, and the controlling board being located on the second mezzanine floor.

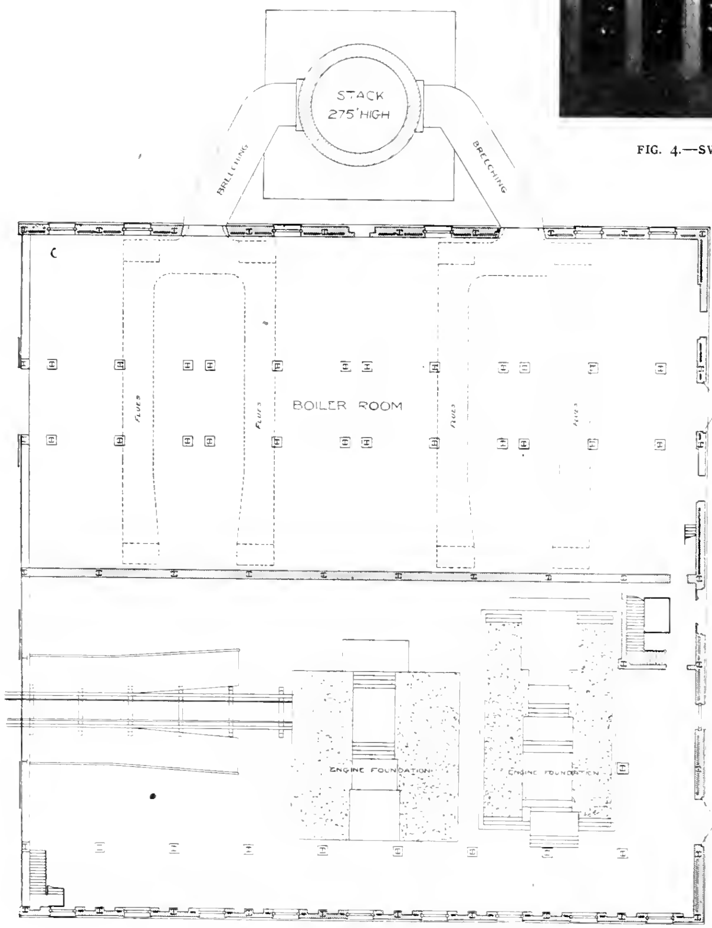


FIG. 3.—BASEMENT PLAN OF POWER HOUSE.

The boiler-house building consists of an arrangement for double-decked boilers with coal storage above the boilers and a common ash floor for both floors of boilers. The basement or ground floor is arranged to receive all of the ashes, each boiler being provided with a cast-iron sectional ash pit, and connections can be made between the combustion chamber and the ash pit for the ready removal of refuse material. On the side adjoining the engine room is situated a pump room in which are located the tank, pumps, boiler feed pumps and feed water heaters. The basement has a height of 18 ft., which admits of the use of almost any type of auxiliary apparatus without crowding. The flues of the first boiler room floor also pass through the basement to connect with the chimney, thus leaving the boiler room clear of any obstructions.

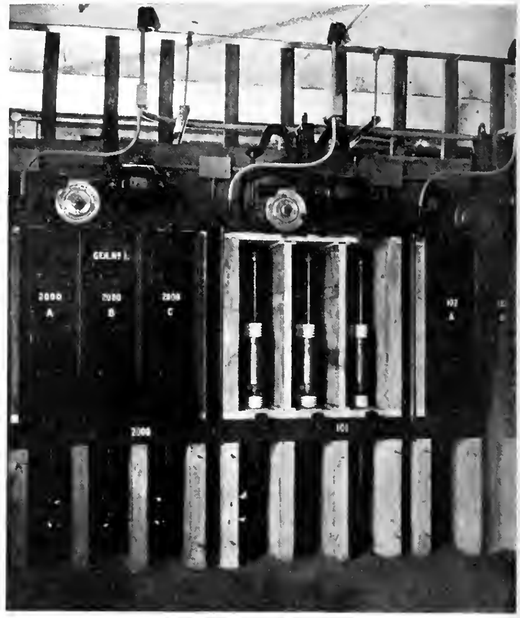


FIG. 4.—SWITCH COMPARTMENT, FIRST GALLERY.

In the first section of the building will be installed 32 boilers approximately 630 hp each. These are arranged in batteries of two, and are so set that all walls may be easily examined. The boilers are equipped with a complete double system of feed water supply, the first from the hot water feed water system, and the second by individual injectors for each boiler connected with tanks, placed above the boilers—the injectors being intended for emergency use only. Special care has been given to the installation of the feed water piping, fittings being avoided whenever possible, and bent brass pipe used.

Coal is supplied by means of chutes arranged close to the columns, the spout being bent in order that the coal can be dumped on the center of the floor should it be required.

The second boiler room is a duplicate of the first boiler room with the exception that the flues pass up and through the coal-bunker floor to reach openings in the stack, provided at this point.

The coal-bunker is divided into pockets, first to admit of the flues passing across the building; and second, to prevent fire from being communicated from one portion of the coal-bunker to an-

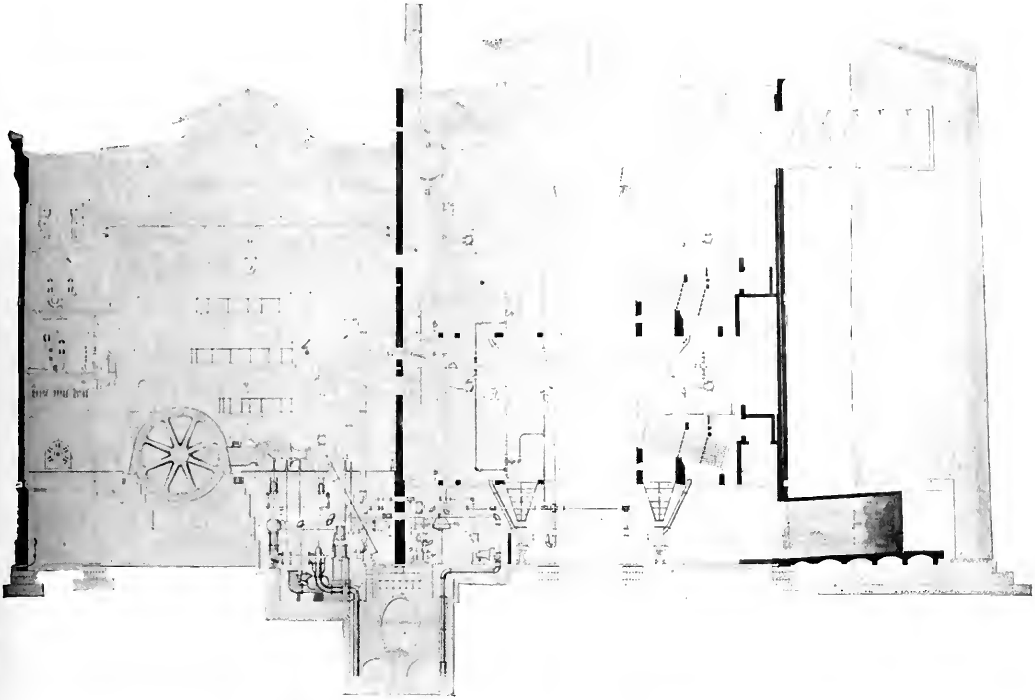


FIG. 5.—CROSS-SECTION VIEW OF STATION A, CHRISTIAN STREET, PHILADELPHIA.

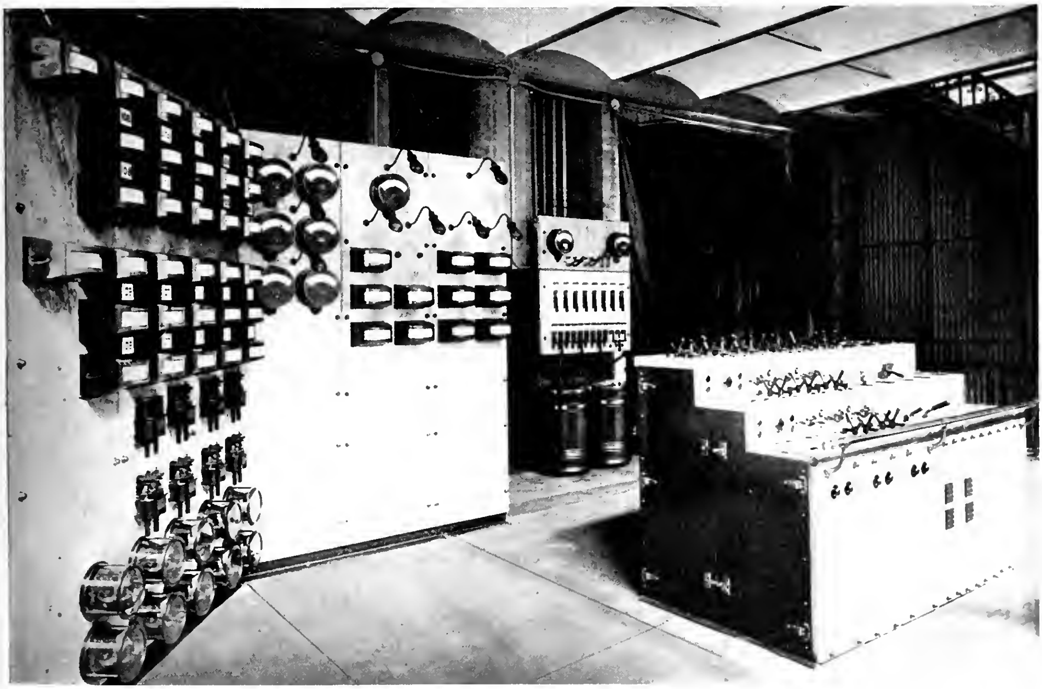


FIG. 6.—OPERATING TABLE AND FEEDER AND INSTRUMENT PANELS.

ELECTRIC LIGHTING IN THE CITY OF BENJAMIN FRANKLIN.

other, thus entirely obviating the danger from this cause. Should the coal ignite from any cause, the pocket could immediately be drained on either of the boiler-room floors.

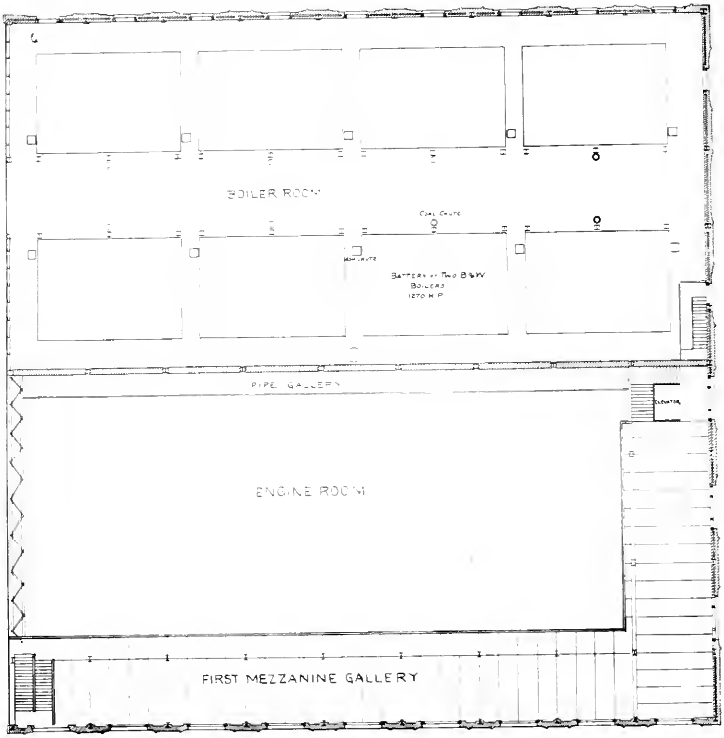


FIG. 7.—FIRST FLOOR PLAN OF POWER HOUSE.

tween the coal-bunkers and the roof is provided with a liberal number of copper louvres so as to admit of ventilation. Each space above the flue-crossing is provided with a "Star" ventilator. All stairways are metal, and strict attention has been given to making the building as nearly fire-proof as practicable. All the doors between the engine room building and the boiler room building are standard Underwriter fire-proof doors.

The engine room building, which fronts on Christian Street, is similar in external appearance to the boiler room building, both being built of red stretcher brick and the general design consisting of large panels arranged between the structural steel columns, this being an inexpensive but ornamental design. The panels in the boiler room building are partially bricked up and the engine room walls are almost entirely utilized for windows, making a very light engine room. The engine room is further provided with a lantern extending along the engine room proper. The lantern is laid with wired glass, the glass overhanging the removable ventilating sash, so that in the event of a heavy wind or rain storm it is not necessary to close the ventilating sash.

All of the metal work exposed to the weather is covered with sheet copper, including the cornices and rain spouts, it being the intention that the building is to be as permanent and lasting as possible. The engine building is lined with light-colored enameled brick to six feet above the engine floor, the other part being buff color.

The mezzanine floors are provided with heavy solid balustrades, which prevent material from dropping through, and would admit of these floors being enclosed should it be found desirable. The switchboard and all its appliances are arranged in the various mezzanine floors on the Christian Street

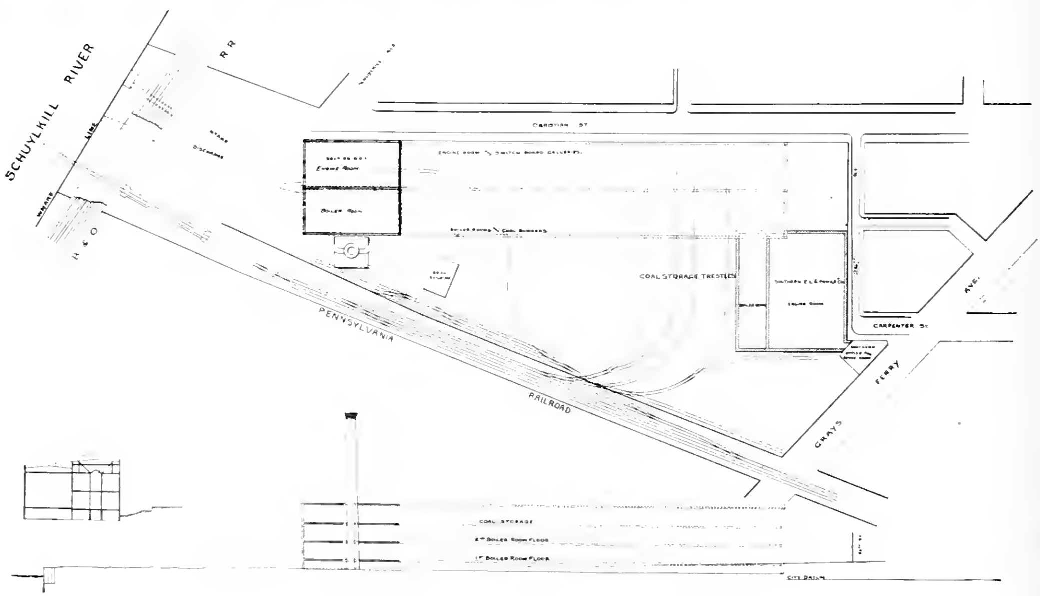


FIG. 8.—PROPERTY PLAN, PHILADELPHIA ELECTRIC COMPANY.

Coal is delivered to the coal-bunker by means of two bucket elevators at the end of the building and distributed by two horizontal conveyors running above the coal-bunkers. The space be-side. The floors on the end facing the river are used for offices, storerooms and executive purposes.

Referring to the floor plan, it will be noted that in the boiler-room the boilers are first arranged in batteries of two, and the batteries facing each other are connected to steam pipes which in turn feed the main header which is located on a division wall on the engine room side. This main header is arranged zigzag fashion; one section joins two batteries on one floor, rises and joins two batteries on the floor above. In this way the expansion and contraction of the main header is taken care of, and the line is always exposed to view. All joints are readily accessible, as permanent iron galleries are arranged parallel with the steam pipe.

FIG. 9.—DIRECT-CURRENT AND EXCITER SWITCHBOARD.

The condensing apparatus is arranged on the boiler room side of the engine room and the auxiliaries are placed in the basement, this position making them adjacent to the auxiliaries for the boiler room, but separated from them by the division wall. They are, however, readily accessible on account of the doors placed for this purpose.

The 2,000-kw unit is driven by a cross double-tandem compound Wetherill Corliss Engine. The 5,000-kw unit is driven by a combined vertical and horizontal double-compound Reynolds-Corliss engine built by the Allis-Chalmers Company. The condenser for the 2,000-hp unit is of the jet type, and for the 5,000-kw unit is a Weiss injector condenser.

Special effort has been made to simplify the installation of the cables and electrical equipment and to keep the steam and electrical equipment entirely separate from each other, so that the steam pipes shall not cross the electrical conductors or vice versa. Cables immediately upon leaving the generators enter a terra cotta conduit and are conducted through continuous terra cotta conduits to the terminus. There are two sets of cables which should receive consideration, first the cables running from and to the generators, and second, the feeder cables leaving the station.

The feeders are distributed along the entire length of the Christain Street side. These cables are arranged in groups of six, and enter separate manholes distributed along the street front of the building, so that there is no bunching of cables in any manhole. The first conduit laid consisted of twenty-four 3½-in. terra cotta conduits. Drawings were prepared showing the layout of each cable from the station to the sub-station. The manholes were designed specially so as to admit of easy access to the cables, and at the same time protect the cables in the event of either gas explosions in manholes or short-circuits of adjacent cables. The manholes are of octagonal shape, and are provided with soapstone shelves which fulfill the function of supporting the cable and acting as a barrier, so that a short-circuit in one cable cannot be communicated to its neighbor. The conduit is spread at the point of entering the manhole so as to bring the end of the duct in line with the shelf upon which the cable will rest. This prevents any sharp bends and admits of cables being installed in a safe and convenient manner.

The station terminal of the cable is on the ground floor and consists of a series of concrete cells, the cable being provided with a pot-head at this point and spreading from a three-conductor cable to single-conductor cable. In these compartments are placed single-pole disconnectors. These disconnectors are similar to knife-switches without handles, and arranged to be opened with a detachable rod. The object of these disconnectors is to enable the cable department to know that current is not thrown on the cable when out of service and under repairs. Immediately above these compartments are placed static discharge devices which consist of an arrangement of spark gaps and graphite resistances similar to lightning arresters. They are protected by means of a small enclosed fuse and are enclosed in cases to keep out the dust. From these compartments the cable enters a terra cotta conduit which passes through the engine-room wall, is then exposed to the first mezzanine floor, and enters the concrete compartments leading to the oil switches and to the transformers, both series and potential.

The arrangement of the switchboard is in three tiers. First, automatic switches, or what might be called the operating switches; second, the reserve switches, which are placed above on the bus-bars, which occupy the highest tier. The intermediate tier consists of two oil switches, one of which is connected to either bus-bar, so that at all times two oil switches are in series.

Connections to the bus-bars are made with disconnectors similar to those used in cable compartments on the ground floor, so that it is unnecessary to remove any bolts or fastenings to disconnect any line from the bus-bars or from the outgoing feeders. This arrangement also enables the generators to be connected to any point of the bus-bars, minimizing the amount of copper used for that purpose. All of the switches are of the remote control type, an operating table being placed on the intermediate gallery.

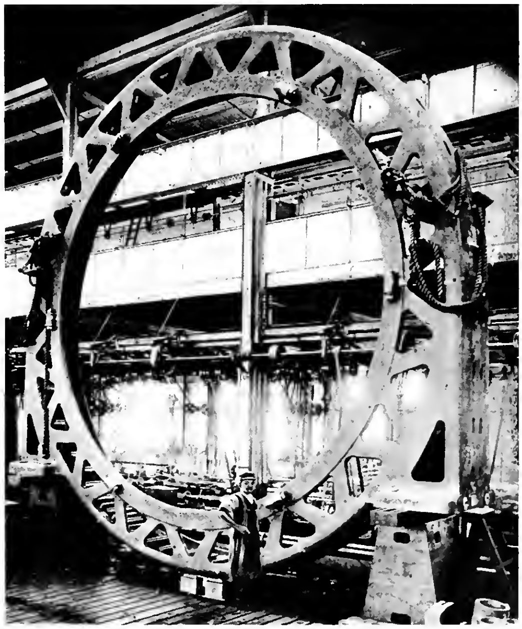


FIG. 10.—ARMATURE FRAME OF 6,000-VOLT GENERATOR.

The oil switches and high-tension bus bars are all arranged in concrete and soapstone compartments. As each switch section is a unit, and practically all of the units are similar, the concrete type of construction permitted the same moulds being used for building up all of the compartments. The switches were set sufficiently high from the floor to enable easy access to the base of the switch and prevent sharp bends of the cable. On the back of the switch compartments on the first gallery are arranged the transformer compartments, which are of similar concrete construction and separated by means of a concrete wall. Provision has been made to ventilate all of these compartments so that in the event of an arc being formed, the flame will pass out through the vents, striking the division wall, and cannot be communicated to any of the other compartments.

The transformer compartment contains two series transformers and one potential transformer. The cases and frames of all of the transformers are grounded with heavy copper strips laid in the concrete. This copper strip is also connected to angle irons set in the concrete to which the various transformers are attached. One of the series transformers is used to operate the automatic switches by means of time, limit relays, and the other furnishes current for various indicating and recording instruments.

The potential transformer is of 600 watts capacity and is large enough to supply all pilot lamps and all indicating and recording instruments required.

All of the secondary wires from these transformers and the low-tension direct circuit supplying the motors operating the oil switches are installed in iron armored conduit, so that there are no exposed wires either high-tension or low-tension in the switchboard construction. All of the concrete compartments are provided with fireproof doors; and as the operating switchboard is entirely low-tension, being either the secondaries from the transformers or direct current supplying the operating motors, there is no danger from any cause to attendants, as in the event of failure and breaking down of the transformer the high-tension current is grounded through the strips provided for that purpose.

This table is arranged in steps similar to the keyboard of an organ so as more clearly to define the various groups of switches. Each feeder is controlled at this point by means of three switches, one automatic switch and two selector switches. These switches are provided with pilot lamps which indicate the position of the switch. The instruments are located on an instrument board immediately in front of the controlling table and upon this are mounted for each feeder a pilot lamp which indicates the number of the feeder, an ammeter and a recording wattmeter on each phase of the feeder. The generator control consists of the three switches. In this case all of the switches are hand-operated, no automatic switches being used on the generators. The main switch is controlled by a different type of handle to distinguish it from the selector switches. These are placed at the top of the table so as to be out of the way. On the next step is a switch to open the field circuit of the generator, and the switch for varying the speed of the engine for synchronizing. The lower step contains the field rheostat and synchronizing plugs. On the front of the table are the switches controlling the exciter sets. The indicating instruments on each generator are pilot lamps, voltmeters, ammeters and indicating wattmeters.

The instrument board is arranged with generator instruments and exciter instruments parallel to the control table, and the feeders are arranged on an offset at an angle of 45°, which concentrates the instruments and assists the vision of the operator as well as enabling him to differentiate between the different classes of instruments.

Cincinnati A. I. E. E. Local Meeting.

The February local meeting of the Cincinnati branch of the American Institute of Electrical Engineers was prefaced by a dinner at the Grand Hotel, at which 53 persons were seated. The meeting was held in the hotel auditorium, at which Mr. W. A. Blanck, of the Arnold Electric Power Station Company, read a paper on "Single-Phase Railroads." After outlining the various systems which have been tried—the synchronous motor driving a generator mounted on the train, the induction motor as a subdivision of this, the Arnold system of induction motor and air compressor combined, the alternating-current series motor, the repulsion induction motor as developed by Steinmetz and Schuler, and lastly the repulsio nseries motor of the Union Electric Company, of Berlin—Mr. Blanck took up the subject of controllers, car wiring, trolley bow and line construction. He then took a typical sixty-mile road equipped both by the present system of alternating-current generator with rotary converter, sub-stations and the system using transformer sub-stations and 3,000 volts on the trolley line. Comparing item for item he showed that the direct-current system giving the same service as a single-phase system costs 32 per cent. more than the alternating system. The paper was thoroughly discussed. At the next meeting it is hoped to have a paper on steam turbines.

The Development of Alternating-Current Work in America.

By Charles Appleton Terry.

Your request for reminiscences concerning the development of the commercial alternating-current system carries one's thoughts back to the early eighties when, though the direct-current system was in fairly extensive use, the alternating current had yet to receive the serious consideration of our engineers. Looking back over this period, the names of a few individuals stand out with peculiar prominence.

It is needless to say that the personality of Mr. Westinghouse is most conspicuously interwoven with the entire development of this system. When the work of Gaulard & Gibbs was first brought to his attention, he engaged the services of one of the most prominent of the electrical engineers of that time, Franklin L. Pope, a man whose quiet, forceful work aided greatly in the successful introduction of the alternating system to a skeptical public. Mr. Pope possessed an extraordinarily resourceful mind and a retentive memory stored with useful facts and apt information. His rare sense of humor and genial kindness of manner were combined with a persistence of will and untiring studiousness which had rendered him a recognized authority upon all electrical subjects; and to-day his publications upon telegraphy and kindred subjects are valuable works of reference. His railway signalling inventions had brought him into close association with Mr. Westinghouse, and it thus came about that in February, 1886, as a direct result of experiments made with the Gaulard & Gibbs system at Pittsburg in 1885, Mr. Pope went to England commissioned by Mr. Westinghouse to secure the American rights to the Gaulard & Gibbs system. Throughout the formative period of the system, Mr. Pope was closely identified with the patent and scientific matters involved.

The rapid march from the experimental plant of 1885, to the commercial plant installed at Buffalo in November, 1886, was largely to the credit of the engineering ability of Shallenberger, Stanley and Belfield. Within a year thereafter sixty-five plants were sold, representing a total generating capacity of 125,000 incandescent lamps. Almost immediately a strong opposition to the alternating system was developed by the partisans of the direct-current system, an opposition which though gradually lessened did not cease until the commercial advent of the rotary transformer or converter which wedded the two systems.

In the earlier days the alternating system was at first seriously handicapped by the lack of a meter and a power motor. In April, 1888, Shallenberger, while experimenting with an arc lamp, noted a peculiar action of a small coiled spring which accidentally lodged on the brass flange of the magnet spool; the spring slowly turned about its longitudinal axis. From this accidental circumstance Shallenberger within a month developed his alternating-current meter, which for nearly ten years was the principal recording meter for this system, the only other commercial one being that devised by Prof. Elihu Thomson, who also made important inventions in the alternating-current field.

The requirement of a motor was met by Tesla's discoveries, the public announcement of which was nearly coincident with the indedependent discovery of Shallenberger and the publication of Ferrari's work along similar lines. Tesla's discoveries, however, included the polyphase system, which lent itself more perfectly to the distribution of large power units.

There still remained the requirement of a power motor adapted to railway service, and this is now being met by the assured single-phase motors of Lamme and Steinmetz.

It would seem that as a result of this perseverance of those interested in the alternating-current system, the perfection of the detail apparatus and the growing appreciation of its possibilities, the handicap now rests upon the shoulders of the direct-current system rather than upon that using the current which Shallenberger once described as "the electric current as God gave it to us."

The Transmission of Electric Energy Without Wires.

BY NIKOLA TESLA.

IT is impossible to resist your courteous request extended on an occasion of such moment in the life of your journal. Your letter has vivified the memory of our beginning friendship, of the first imperfect attempts and undeserved successes, of kindnesses and misunderstandings. It has brought painfully to my mind the greatness of early expectations, the quick flight of time, and, alas! the smallness of realizations. The following lines which, but for your initiative, might not have been given to the world for a long time yet, are an offering in the friendly spirit of old, and my best wishes for your future success accompany them.

Towards the close of 1898 a systematic research, carried on for a number of years with the object of perfecting a method of transmission of electrical energy through the natural medium, led me to recognize three important necessities: First, to develop a transmitter of great power; second, to perfect means for individualizing and isolating the energy transmitted; and, third, to ascertain the laws of propagation of currents through the earth and the atmosphere. Various reasons, not the least of which was the help proferred by my friend Leonard E. Curtis and the Colorado Springs Electric Company, determined me to select for my experimental investigations the large plateau, two thousand meters above sea level, in the vicinity of that delightful resort, which I reached late in May, 1899. I had not been there but a few days when I congratulated myself on the happy choice and I began the task, for which I had long trained myself, with a grateful sense and full of inspiring hope. The perfect purity of the air, the unequaled beauty of the sky, the imposing sight of a high mountain range, the quiet and restfulness of the place—all around contributed to make the conditions for scientific observation ideal. To this was added the exhilarating influence of a glorious climate and a singular sharpening of the senses. In those regions the organs undergo perceptible physical changes. The eyes assume an extraordinary limpidity, improving vision; the ears dry out and become more susceptible to sound. Objects can be clearly distinguished there at distances such that I prefer to have them told by someone else, and I have heard—this I can venture to vouch for—the claps of thunder seven and eight hundred kilometers away. I might have done better still, had it not been tedious to wait for the sounds to arrive, in definite intervals, as heralded precisely by an electrical indicating apparatus—nearly an hour before.

In the middle of June, while preparations for other work were going on, I arranged one of my receiving transformers with the view of determining in a novel manner, experimentally, the electric potential of the globe and studying its periodic and casual fluctuations. This formed part of a plan carefully mapped out in advance. A highly sensitive, self-restorative device, controlling a recording instrument, was included in the secondary circuit, while the primary was connected to the ground and an elevated terminal of adjustable capacity. The variations of potential gave rise to electric surgings in the primary; these generated secondary currents, which in turn affected the sensitive device and recorder in proportion to their intensity. The earth was found to be, literally, alive with electrical vibrations, and soon I was deeply absorbed in this interesting investigation. No better opportunities for such observations as I intended to make could be found anywhere. Colorado is a country famous for the natural displays of electric force. In that dry and rarefied atmosphere the sun's rays beat the objects with fierce intensity. I raised steam, to a dangerous pressure, in barrels filled with concentrated salt solution, and the tinfoil coatings of some of my elevated terminals shriveled up in the fiery blaze. An experimental high-tension transformer, carelessly exposed to the rays of the setting sun, had most of its insulating compound melted out and was rendered useless. Aided by the dryness and rarefaction of the air, the water evaporates as in a boiler, and static electricity is developed in abundance. Lightning' discharges are, accordingly, very frequent and sometimes of inconceivable violence. On one occasion approximately twelve thousand discharges occurred in two hours, and all in a radius of certainly less than fifty kilometers from the laboratory. Many of them resembled gigantic trees of fire with the trunks up or down. I never saw fire balls, but as a compensation for my disappointment I succeeded later in determining the mode of their formation and producing them artificially.

In the latter part of the same month I noticed several times that my instruments were affected stronger by discharges taking place at great distances than by those near by. This puzzled me very much. What was the cause? A number of observations proved that it could not be due to the differences in the intensity of the individual discharges, and I readily ascertained that the phenomenon was not the result of a varying relation between the periods of my receiving circuits and those of the terrestrial disturbances. One night, as I was walking home with an assistant, meditating over these experiences, I was suddenly staggered by a thought. Years ago, when I wrote a chapter of my lecture before the Franklin Institute and the National Electric Light Association, it had presented itself to me, but I had dismissed it as absurd and impossible. I banished it again. Nevertheless, my instinct was aroused and somehow I felt that I was nearing a great revelation.

It was on the third of July—the date I shall never forget—when I obtained the first decisive experimental evidence of a truth of overwhelming importance for the advancement of humanity. A dense mass of strongly charged clouds gathered in the west and towards the evening a violent storm broke loose which, after spending much of its fury in the mountains, was driven away with great velocity over the plains. Heavy and long persisting arcs formed almost in regular time intervals. My observations were now greatly facilitated and rendered more accurate by the experiences already gained. I was able to handle my instruments quickly and I was prepared. The recording apparatus being properly adjusted, its indications became fainter and fainter with the increasing distance of the storm, until they ceased altogether. I was watching in eager expectation. Surely enough, in a little while the indications again began, grew stronger and stronger and, after passing through a maximum, gradually decreased and ceased once more. Many times, in regularly recurring intervals, the same actions were repeated until the storm which, as evident from simple computations, was moving with nearly constant speed, had retreated to a distance of about three hundred kilometers. Nor did these strange actions stop then, but continued to manifest themselves with undiminished force. Subsequently, similar observations were also made by my assistant, Mr. Fritz Lowenstein, and shortly afterward several admirable opportunities presented themselves which brought out, still more forcibly, and unmistakably, the true nature of the wonderful phenomenon. No doubt whatever remained: I was observing stationary waves.

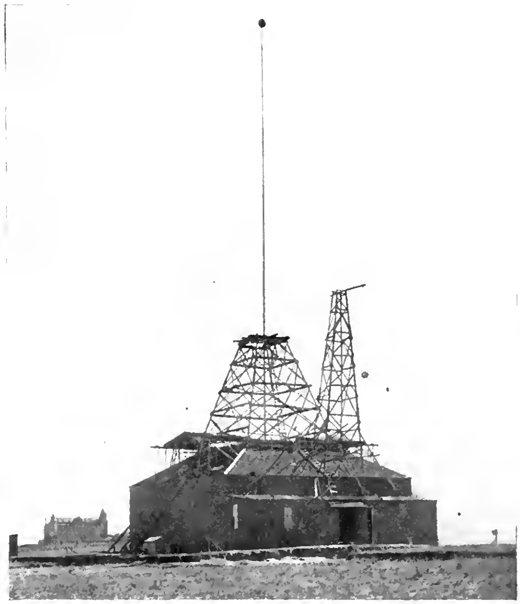


FIG. I.—TESLA EXPERIMENTAL LABORATORY, COLORADO, ERECTED SUMMER OF 1899.

(Discovery by Mr. Tesla of the Stationary Waves in the Earth was Here Made.)

As the source of disturbances moved away the receiving circuit came successively upon their nodes and loops. Impossible as it seemed, this planet, despite its vast extent, behaved like a conductor of limited dimensions. The tremendous significance of this fact in the transmission of energy by my system had already become quite clear to me. Not only was it practicable to send telegraphic messages to any distance without wires, as I recognized long ago, but also to impress upon the entire globe the faint modulations of the human voice, far more still, to transmit power, in unlimited amounts, to any terrestrial distance and almost without any loss.

With these stupendous possibilities in sight, with the experimental evidence before me that their realization was henceforth merely a question of expert knowledge, patience and skill, I attacked vigorously the development of my magnifying transmitter, now, however, not so much with the original intention of producing one of great power, as with the object of learning how to construct the best one. This is, essentially, a circuit of very high self-induction and small resistance which in its arrangement, mode of excitation and action, may be said to be the diametrically opposite of a transmitting circuit typical of telegraphy by Hertzian or electromagnetic radiations. It is difficult to form an adequate idea of the marvelous

FIG. 2.—TESLA CENTRAL POWER PLANT AND TRANSMITTING TOWER FOR WORLD TELEGRAPHY, WARDENCLYFFE, LONG ISLAND, N. Y.

(Tower is a pyramid having eight sides; smallest dimensions across base, 29 meters; height, 47 meters; total height from ground to top, 57 meters; cupola on top, 20 meters diameter.)

power of this unique appliance, by the aid of which the globe will be transformed. The electromagnetic radiations being reduced to an insignificant quantity, and proper conditions of resonance maintained, the circuit acts like an immense pendulum, storing indefinitely the energy of the primary exciting impulses and impressing upon the earth and its conducting atmosphere uniform harmonic oscillations of intensities which, as actual tests have shown, may be pushed so far as to surpass those attained in the natural displays of static electricity.

Simultaneously with these endeavors, the means of individualization and isolation were gradually improved. Great importance was attached to this, for it was found that simple tuning was not sufficient to meet the vigorous practical requirements. The fundamental idea of employing a number of distinctive elements, co-operatively associated, for the purpose of isolating energy transmitted, I trace directly to my perusal of Spencer's clear and suggestive exposition of the human nerve mechanism. The influence of this principle on the transmission of intelligence, and electrical energy in general, cannot as yet be estimated, for the art is still in the embryonic stage; but many thousands of simultaneous telegraphic and telephonic messages, through one single conducting channel, natural or artificial, and without serious mutual interference, are certainly practicable, while millions are possible. On the other hand, any desired degree of individualization may be secured by the use of a great number of co-operative elements and arbitrary variation of their distinctive features and order of succession. For obvious reasons, the principle will also be valuable in the extension of the distance of transmission.

Progress though of necessity slow was steady and sure, for the objects aimed at were in a direction of my constant study and exercise. It is, therefore, not astonishing that before the end of 1899 I completed the task undertaken and reached the results which I have announced in my article in the *Century Magazine* of June, 1900, every word of which was carefully weighed.

Much has already been done towards making my system commercially available, in the transmission of energy in small amounts for specific purposes, as well as on an industrial scale. The results attained by me have made my scheme of intelligence transmission, for which the name of "World Telegraphy" has been suggested, easily realizable. It constitutes, I believe, in its principle of operation, means employed and capacities of application, a radical and fruitful departure from what has been done heretofore. I have no doubt that it will prove very efficient in enlightening the masses, particularly in still uncivilized countries and less accessible regions, and that it will add materially to general safety, comfort and convenience, and maintenance of peaceful relations. It involves the employment of a number of plants, all of which are capable of transmitting individualized signals to the uttermost confines of the earth. Each of them will be preferably located near some important center of civilization and the news it receives through any channel will be flashed to all points of the globe. A cheap and simple device, which might be carried in one's pocket may then be set up somewhere on sea or land, and it will record the world's news or such special messages as may be intended for it. Thus the entire earth will be converted into a huge brain, as it were, capable of response in every one of its parts. Since a single plant of but one hundred horse-power can operate hundreds of millions of instruments, the system will have a virtually infinite working capacity, and it must needs immensely facilitate and cheapen the transmission of intelligence.

The first of these central plants would have been already completed had it not been for unforeseen delays which, fortunately, have nothing to do with its purely technical features. But this loss of time, while vexatious, may, after all, prove to be a blessing in disguise. The best design of which I knew has been adopted, and the transmitter will emit a wave complex of a total maximum activity of ten million horse-power, one per cent. of which is amply sufficient to "girdle the globe." This enormous rate of energy delivery, approximately twice that of the combined falls of Niagara, is obtainable only by the use of certain artifices, which I shall make known in due course.

For a large part of the work which I have done so far I am indebted to the noble generosity of Mr. J. Pierpont Morgan, which was all the more welcome and stimulating, as it was extended at a time when those, who have since promised most, were the greatest of doubters. I have also to thank my friend, Stanford White, for much unselfish and valuable assistance. This work is now far advanced, and though the results may be tardy, they are sure to come.

Meanwhile, the transmission of energy on an industrial scale is not being neglected. The Canadian Niagara Power Company have offered me a splendid inducement, and next to achieving success for the sake of the art, it will give me the greatest satisfaction to make their concession financially profitable to them. In this first power plant, which I have been designing since a long time, I propose to distribute ten thousand horse-power under a tension of one hundred million volts, which I am now able to produce and handle with safety.

This energy will be collected all over the globe preferably in small amounts, ranging from a fraction of one to a few horse-power. One of its chief uses will be the illumination of isolated homes. It takes very little power to light a dwelling with vacuum tubes operated by high-frequency currents and in each instance a terminal a little above the roof will be sufficient. Another valuable application will be the driving of clocks and other such apparatus. These clocks will be exceedingly simple, will require absolutely no attention and will indicate rigorously correct time. The idea of impressing upon the earth American time is fascinating and very likely to become popular. There are innumerable devices of all kinds which are either now employed or can be supplied, and by operating them in this manner I may be able to offer a great convenience to the whole world with a plant of no more than ten thousand horse-power. The introduction of this system will give opportunities for invention and manufacture such as have never presented themselves before.

Knowing the far-reaching importance of this first attempt and its effect upon future development, I shall proceed slowly and carefully. Experience has taught me not to assign a term to enterprises the consummation of which is not wholly dependent on my own abilities and exertions. But I am hopeful that these great realizations are not far off, and I know that when this first work is completed they will follow with mathematical certitude.

When the great truth accidentally revealed and experimentally confirmed is fully recognized, that this planet, with all its appalling immensity, is to electric currents virtually no more than a small metal ball and that by virtue of this fact many possibilities, each baffling imagination and of incalculable consequence, are rendered absolutely sure of accomplishment; when the first plant is inaugurated and it is shown that a telegraphic message, almost as secret and non-interferable as a thought, can be transmitted to any terrestrial distance, the sound of the human voice, with all its intonations and inflections faithfully and instantly reproduced at any other point of the globe, the energy of a waterfall made available for supplying light, heat or motive power, anywhere—on sea, or land, or high in the air—humanity will be like an antheap stirred up with a stick: See the excitement coming!

The Beginnings of the Incandescent Lamp.

By THOS. A. EDISON.

IN response to the kind suggestion of the ELECTRICAL WORLD AND ENGINEER that the celebration of its completion of thirty years of existence affords a fitting opportunity to recall the beginnings of the incandescent lamp, I am glad to put on record a brief personal narrative of the details connected with what was to me a very interesting period of electrical development. The occasion is not only a reminder of the rapid flight of time, but of the fact that since 1874—the year of the quadruplex, by the way—all the great modern departments of electrical industry have sprung into vigorous being. We telegraphers have a right to claim this journal also as part of our contribution to the art.

My experiments on carbon began in 1876, when I had the idea of making carbon wire, etc., for various electrical and chemical purposes. Even at that early time Messrs. Charles Batchelor and E. H. Johnson were with me, and we saw quite a business ahead in carbon novelties. I had familiarized myself with the properties of carbon, particularly that made from paper and Bristol board, and this led on very naturally to my work on the carbon telephone or microphonic transmitter, early in 1877. In the fall of that year I was pretty well through with studies and inventions in that line, but had several other ideas that I wanted to work up. One of these was the subdivision of the electric light, and I began experimenting with that purpose. My records and the voluminous testimony in litigation, now happily long past, show that in the fall of 1877, about September, strips of carbonized paper were tried as an incandescent conductor suitable for use in lamps, and the work was followed up until January of 1878, when the general excitement over my invention and exhibition of the phonograph out at old Menlo Park frustrated serious or continuous work for a time, in any other direction. In fact, my health gave way under the strain, and in July I broke away for a Western trip as far as California.

Of course my mind was turning the subject over, and when I got back in August we immediately went at it again. Around October and November Batchelor made a great number of paper carbons, at least 50, from tissue and other kinds of paper, coated over their surface with a mixture of lampblack and tar, rolled up into the fine long form of a knitting needle, and then carbonized. These we put into circuit and brought up to incandescence in vacuo; although they would last but an hour or two. We tried a great many experiments with paper carbons, wood carbons and some made from carbonized broom corn. What we desired at that date, and had settled our minds upon as the only possible solution of the subdivision of the electric light, was that the lamps must have a high resistance and small radiating surface. About December, 1878, I engaged as my mathematician Mr. Francis R. Upton, who had lately studied under Helmholtz, in Germany, and he helped me greatly in calculations of the multiple arc problem. Our figures proved that the lamp must have at least 100 ohms resistance to compete successfully with gas; for if the lamps were of low resistance the cost of the copper main conductors would be so great as to render the system uneconomical and commercially impracticable. In this direction we tried platinum also; and when working on incandescent platinum we had procured a Sprengel mercury pump and had ascertained that we could thus get exceedingly high

FIG. 1.—FIRST PHOTOGRAPH TAKEN BY INCANDESCENT LIGHT.

(Reproduction of Photograph taken by Mr. Edison at his Menlo Park Laboratory at midnight about Dec. 20, 1879, by the light of three of his first electric lamps. The portrait is that of Mr. Charles Batchelor.)

vacua. It occurred to me that perhaps a "filament" of carbon could be made to stand in the sealed glass vessels or bulbs, which we were using, exhausted to a high vacuum. Separate lamps were made in this way independent of the air pump, and in October, 1879, we made lamps of paper carbon, and with carbons of common sewing thread, placed in a receiver or bulb made entirely of glass, with the leading-in wires sealed in by fusion. The whole thing was exhausted by the Sprengel pump to nearly one-millionth of an atmosphere. These filaments of carbon, although naturally quite fragile owing to their length and small mass, had a smaller radiating surface and

FIG. 2.—VIEW OF EDISON LABORATORY, MENLO PARK, N. J.

(Showing buildings and outdoor circuits lighted by incandescent lamps, December, 1879.)

higher resistance than we had dared hope. We had virtually reached the position and condition where the carbons were stable. In other words, the incandescent lamp as we still know it to-day, in essentially all its particulars unchanged, had been born.

We began immediately to make vacuum pumps and to produce these paper filament lamps on them. During that November we made perhaps as many as 100 of such lamps, and the same month saw us plunged deep in experiments and inventions on dynamos, regulators, meters, circuits, etc., all just as necessary to the success of the art as the little lamp itself. Some of those paper filament lamps had a remarkably long life. Each yielded from 12 to 16 cp and they were burned on chandeliers until they gave out. The average life was about 300 hours. One of them lasted 940 hours and another 1,350 hours, so that commercial success and a new industry were already well in sight.

But I was not quite satisfied as to paper, or even with the more regular and homogeneous wood fibre filaments, and thus came to take up bamboo. We happened to have a palm leaf fan on one of the tables. I was then investigating everything with a microscope, so I picked it up and found that it had a rim on the outside, of bamboo, a very long strip cut from the outer edge. We soon had that cut up into blanks and carbonized. On putting these filaments into the lamps we were gratified to see that the lamps were several times better than any we had succeeded in making before. I soon ascertained why and started a man off for Japan on a bamboo hunt. Before I got through I had tested no fewer than 6,000 vegetable growths, and had ransacked the world for the most suitable bamboo. The use of bamboo was maintained for many years until other processes dealing with such material as cellulose had been perfected. We tried even at the earliest moment of success a number of experiments and things afterwards taken up again or followed through, as for example, burning the paper filaments in a vacuum charged with inert gas; and a little later, in 1880, we also "flashed" the filaments with gasoline vapor.

The furore that followed the announcements from Menlo Park as to the successful subdivision of the electric light in a commercial incandescent lamp will be well remembered by many of the readers of this. The feasibility of such a thing had been denied by some of the greatest minds in electricity, but here it was; and along lines that have endured to this day. The best story at the time was given to the world by the New York *Herald* in December, 1879, and on Christmas Day I had already lighted up my laboratory, my offices, two or three houses about one-fifth of a mile from the dynamo plant and some twenty street lights. On the last day of the year some 3,000 people flocked out to Menlo Park to see it for themselves —and the rest everybody knows.

It is interesting to note that in addition to those mentioned above I had around me other men who ever since have remained active in the field, such as Messrs. Francis Jehl, W. J. Hammer, Martin Force, Ludwig Boehm, not forgetting that good friend and co-worker, the late John Kruesi. They found plenty to do in the various developments of the art, and as I now look back I sometimes wonder how we did so much in so short a time. Early in the spring of 1880 I lighted up for Mr. Villard the Oregon Steam Navigation Company's steamer *Columbia,* and it was not long before the Edison plants began to multiply. Meantime lamp making took on large proportions in two factories of mine, one at old Menlo Park and the other at Newark, and much of my energy was being devoted to cheapening the price of the lamp as well as increasing its life and its candle-power per watt. I am told that upon a moderate computation the production of incandescent lamps in this country since my first success has reached a total of 250,000,000 lamps, or not less than 10,000,000 a year for each of the 25 years. Essentially, the lamp has remained structurally the same ever since 1879, in the elements then demonstrated to be essentially vital and necessary to commercial success.

The Success of Loaded Lines in Telephony.

Upon the announcement of Dr. Pupin's invention, successfully applying self-induction to the improvement of telephone lines, there was much sensational talk in the daily newspapers and elsewhere concerning the use of the invention in telephoning across the Atlantic. The possibilities of such a brilliant project were so attractive that little attention has been given by the public to very important but less sensational applications of Dr. Pupin's work. Accounts of experiments with Pupin coils in Germany and of the successful patent litigation there in their behalf, have been given in these columns from time to time. In this article, we give an account of some of the important steps which have been taken in this country looking to the introduction of the new form of telephone conductor.

Following quickly upon the purchase of the Pupin patent by the Bell interests, overhead lines were loaded from New York to Chicago and to other points in the West. Although a great deal of valuable experimental data has been obtained, the extension of the loading of overhead lines has not been continued. Unforeseen difficulties in the nature of cross-talk and leakage effects were encountered, and while they are not sufficient to prevent ultimately the extension of the system to overhead lines, they have called attention to a number of features in line construction which must be attended to before complete success in overhead loading is attained. A vast amount of work in overcoming these temporary difficulties has already been done, and although many points still require investigation, it is safe to say that this phase of the problem presents no difficulties which are insuperable and which cannot be expected to yield to patient and intelligent research.

In the loading of underground cables, a great deal of important and successful work has been accomplished, particularly in the neighborhood of New York City. From Cortlandt Street to Newark, N. J., a distance of about ten miles, there are working successfully 50 pairs in No. 19 B. & S. gauge cable, equipped with Pupin coils. Each of these circuits when loaded gives a talking equal to that which would be obtained through six miles of the No. 19 gauge cable unloaded. These 50 pairs have been in satisfactory service since August, 1902. From Cortlandt Street to Elizabeth, N. J., a distance of seventeen miles,. 50 pairs of No. 19 gauge conductors are also equipped with Pupin coils, and are giving satisfaction. The talk obtained over these seventeen miles of loaded cable is equal to that which would be obtained through about seven miles of the same kind of cable unloaded. From the central office in Brooklyn to Far Rockaway, Long Island, there is a cable of No. 19 gauge, partly underground and partly overhead. This cable is about eighteen miles long, and talks as well when equipped with Pupin coils as would eight miles of standard cable of No. 19 gauge operated without coils. From the Brooklyn central office to Jamaica, L. I., there is a standard cable of No. 19 gauge, twelve miles long, provided with Pupin coils. This cable talks as well when equipped with the coils as would six miles of the same kind of cable without the coils. From Cortlandt Street to Fordham, in the Borough of the Bronx, a distance of fourteen miles, there are fifty pairs of conductors of No. 16 B. & S. gauge equipped with Pupin coils. The talk through these fourteen miles of No. 16 gauge cable equipped with coils is as good as that which is obtainable through four and a half miles of No. 19 gauge standard cable without coils. From Cortlandt Street to Kingsbridge, in the Borough of the Bronx, a distance of fifteen miles, there are 50 pairs of No. 13 B. & S. gauge conductors in an underground cable equipped with Pupin coils. The talk through these fifteen miles of cable thus equipped with coils is equal to that which would be obtained through three miles of standard No. 19 gauge cable without coils. In all of these cases the conductors are being used satisfactorily for commercial business, and the results obtained are a splendid practical demonstration of the value of Dr. Pupin's theoretical work.

Although ocean telephony is not yet an accomplished fact, the application of loading to suburban trunk lines in the neighborhood of large cities has already proved to be of very great importance. All of the electrical principles involved in the problem of ocean telephony apply to that of underground land lines, and the fact that in those lines such successful results have been obtained has led some of our prominent engineers to express themselves most hopefully with reference to the ocean telephone cable.

Prior to the work of Dr. Pupin, there was no generally recognized method of overcoming the electrical difficulties presented by the problems of ocean telephony. Prof. Pupin has shown how to overcome these electrical difficulties. As the problem now stands, it is mainly a mechanical one, and consists in incorporating into an ocean cable at suitable intervals coils of iron and copper having the proper inductance. Looking at the problem broadly, it seems safe to say that greater mechanical difficulties than this have been overcome and that there is good reason to hope that during the life of the Pupin patent, we may witness the operation of a high speed ocean cable which would permit not only of the transmission of speech, but what would probably be more important, the successful use of high speed telegraphy across the Atlantic.

The effect of the Pupin invention upon long distance land lines is one which has been the subject of much debate. While there is no doubt that the art of loading has already greatly extended the effective range of underground telephone cables, it is a great mistake to assume that with the Pupin invention, the universal placing underground of telephone trunk lines is practicable. At the present time and for many years to come, the most important function of the invention will be to provide suitable underground circuits for the suburban trunk lines in the neighborhood of our great cities and to permit of "long distance" wires being placed underground for short distances within the great cities.

Notwithstanding the Pupin invention, the most practicable way of operating such long distance lines as that from New York to Chicago is to carry them overhead, except for short sections of loaded cable at each end. If it were attempted to place such lines underground throughout their entire length or even in the various intermediate towns and villages which they travers, the economies of long distance telephony would disappear and the public would be deprived of a most valuable adjunct to its commercial enterprise.

To the use of subscribers' lines extending to the central office the Pupin invention has no practical application. These lines are usually but a mile or two in length, and do not permit of being economically loaded.

The Development of Industrial Electrochemistry.

By Dr. E. F. Roeber.

While of all branches of electrical engineering electrochemistry has been the last one to achieve commercial successes on a large scale and may justly be considered to be still in the first phase of its industrial development, yet its fundamental principles were long exactly known (electrolytic action-Faraday's law, electrothermic action-Joulean heat). Moreover, at the beginning of the nineteenth century the very first experimental applications of the newly discovered electric current were of an electrochemical nature. Shortly after the primary battery had been invented by Volta, Nicholson and Carlisle succeeded in decomposing water by electrolysis, and in 1807 Sir Humphry Davy delivered his famous lecture on some chemical agencies of electricity. Yet (to quote from the recent Bradley patent decision) "Davy's experiments were permitted to lie dormant during seventy-six years of intense activity," and in general the progress in the development of industrial electrochemistry and electrometallurgy was extremely slow for a long period. In fact, thirty years ago, when the first issue of this journal appeared, there did not exist any electrochemical industries, with the single exceptions of electroplating and primary battery manufacture.

It is now not difficult to see what held the development of industrial electrochemistry back. In nearly all electrochemical and electrometallurgical processes the cost of the electric power is a large fraction of the total cost of operation, often 25 per cent. or more, and even up to 90 per cent. Cheap electric power is, therefore, the fundamental requirement for the economical working of an electrochemical process, in exactly the same way as it is for electric lighting, traction and power purposes in general. Before the advent of the dynamo, the primary battery was the only available source of the electric current, if we except a limited use of the thermo-pile, and its limitations are obvious. The operation of a primary cell meant and still means essentially oxidation of zinc. When zinc changes from the metallic state into bivalent ions, 1.22 grams are oxidized, according to Faraday's law, for every ampere-hour; we know that, with all possible combinations of zinc with other materials in a primary battery, we never get much more than 2 volts, and if we assume the useful e.m.f. to be 1 volt (which is very fair for such an estimate), then every kilowatt-hour produced means the oxidation of 1.22 kg (or 2¾ pounds) of zinc. This is the theoretical value which really represents a minimum of actual consumption; moreover, it does not include the cost of the other materials in the cell, nor the cost of construction and attendance; but it is sufficient to indicate the inherent limitations of the zinc primary battery.

So long as primary cells were the only commercial sources of electric current, the applications of electrical engineering were thus necessarily restricted to those cases in which a very small amount of power only is required. That is especially the case in telegraphy, and, in the field of electrochemistry in those cases of electroplating in which a soluble anode is used of the same metal which is to be deposited upon the cathode. Here the voltage required at the terminals of the plating bath is consumed in overcoming the internal resistance only, which may be made small, and, therefore, the power may also be insignificant.

It is quite natural that after the dynamo had made its commercial appearance, electric lighting and the mechanical applications of electricity, such as traction and power transmission and distribution, first attracted the inventive talents of electrical engineers. Nevertheless, as we were reminded by the recent Institute dinner to Mr. Edison, the incandescent lamp is now only 25 years old. It is, therefore, not surprising that our electrochemical industries are still young, since their development depended rather on chemists and metallurgists, who were attracted by the possibilities of the application of the electric current which had proven to be such a manageable and thoroughly reliable agent in other fields of engineering.

The following sketch naturally does not aim at completeness, and no attempt will be made to give details of processes. The object is rather to bring out some general principles which have manifested themselves all along during the development of the electrochemical industries—Leitmotives, to borrow a word from Wagner's operas. At the same time, we will try to arrive at a convenient classification of the whole subject. One general subdivision of all electrochemical processes and phenomena into two large classes offers itself. In the first class electrical energy is consumed to produce chemical effects, while in the second class chemical energy is changed into electrical energy. Thus, the second class comprises the whole field of primary cells and storage batteries, while in the first class we have all those more or less novel processes which are now mostly thought of when one speaks simply of electrochemical and electrometallurgical industries.

Chemical effects may be produced by means of electrical energy in various ways. We can change the electrical energy into heat, which is then consumed in producing the desired chemical effect; or we can change electrical energy into chemical energy directly by electrolysis; or we may use a combination of both methods; finally, a fourth method of producing chemical effects is by passing an electric discharge through gases. Before giving a cursory review of applications of these various principles, a general remark should be made on the nature of chemicals produced by such methods.

Many of these processes consume a considerable amount of electrical energy. In the discussion of furnace processes from the ordinary chemical point of view, we may, of course, say that the energy is expended to produce a certain temperature which is required to start the process. This, however, does not tell the whole story. We expend a certain amount of electrical energy which is lost while the process is going on. What becomes of it? If the process is conducted under fairly economical conditions most of the electrical energy is changed into chemical energy and is stored up in this form in the chemicals produced.

In other words, if an electrochemical process requires the expense of an appreciable amount of electrical energy, then the products of the process possess a higher content of chemical energy than the starting materials. This explains why electrochemical methods give us substances of strong chemical affinity. Moreover, these substances represent in a sense a storage of energy, which at the same time enables one to ship readily the stored energy to a point where it may be wanted. Two examples may explain this.

Aluminum does not occur free in nature and its separation from its compounds requires a considerable amount of energy. If we electrolyze aluminum oxide dissolved in a bath of fluorides, we get aluminum and oxygen; the formation heat of Al_2O_3 is 392,600 calories; hence, according to Thomson's rule (which is fully good enough for this purpose) we must apply at least 2.8 volts at the terminals of the cell. This voltage, multiplied by the coulombs passed through the cell, represents the electrical energy which is changed into chemical energy. That is what Hall does in producing aluminum in his cell. Now, we may ship the aluminum somewhere and may then allow it to combine again with oxygen to form back Al_2O_3. Then we get back our energy in the form of most intense heat. This is what Goldschmidt does in his thermit process. (Of course, he loses the energy which is required to reduce the iron oxide in the thermit; but this is small, compared with the formation heat of Al_2O_3.)

In the Union Carbide Works in Niagara the energy of the Falls, after conversion into electrical energy, is stored in form of chemical energy in calcium carbide. As long as we keep it separate from water, the calcium carbide represents a storage of a distinct amount of energy. We can afterwards use it for the production of energy by generating acetylene from the carbide and water and using the acetylene for lighting; and we may do this anywhere, since the carbide can be easily shipped.

These two examples, while simply given to illustrate the energy point of view, are also suggestive as to what we may expect from future electrochemical developments. The achievements of the past have given us new methods of storing and transmitting energy; they have enormously cheapened the production of known substances, like aluminum, and have given us new substances of great commercial usefulness.

In this respect the industrial development of the electric furnace is very instructive. As the pioneers of electric furnace work, the two brothers, Eugene H. Cowles and Alfred H. Cowles, have highly distinguished themselves, especially in the production of aluminum alloys. For the industrial development of the resistance furnace, the highest credit is due to the persevering work of Edward Goodrich Acheson. The extended laboratory researches of the French professor, Moissan, have thrown much light on the production of carbides.

The distinction between arc and resistance furnaces is so familiar that it is unnecessary to dwell on it here, nor shall details of design be discussed. But we may record the gradual change of the purpose to which the electric furnace is being put in practice. In the early days the intention was to produce as high a temperature as possible, and the result was the foundation of entirely new industries, like those of calcium carbide, carborundum and artificial graphite. For the production of these substances temperatures were required that could not be obtained by any other means but the electric furnace. In more recent years the intention has been rather to design furnaces so as to allow exact regulation of the temperature, and the electric furnace has thus been found suitable for reactions which do not require abnormally high temperatures.

The effect of regulating exactly the furnace temperature is very instructively shown by the example of treating a mixture of silica and carbon, which has been one of Acheson's fields of special research. By changing the conditions (by an appropriate design of the furnace so as to meet the special conditions of each case) it is possible to produce any one of the following substances: Carborundum, "white stuff," graphite, silicon, siloxicon.

The abnormal boom of calcium carbide in Europe, which naturally led to overproduction, resulted in various European furnace plants, originally erected for carbide, becoming free for other purposes. In looking for new processes it seems that nothing has more attracted the interest of European electrometallurgists than the possibilities in the electrometallurgy of iron and steel. Actual success has been achieved in the production of special steels (tool steels, crucible steel). A very great variety of arc and resistance furnaces have been developed for this purpose and in all of them care is taken to prevent contaminations of the bath from the carbon electrodes. Of special interest in connection with this latter point is the use of a resistance furnace, based on the induction principle, the fused steel forming the single secondary turn of a transformer, no electrodes whatever being used in this case.

While the above processes are all purely electrothermic, the most notable example of a combination of an electrothermic with an electrolytic process is the manufacture of aluminum. The electrolyte from which the aluminum is deposited is a solution of alumina in a bath of fluorides, and its discovery which made the manufacture of the cheap aluminum of to-day possible is due to Charles M. Hall in this country and to P. L. T. Héroult abroad; both arrived independently of each other at the same solution. By a recent court decision the electrothermic side of the process was held to be covered by the internal heating patent of Charles S. Bradley. What the electrochemical method of manufacture has done for aluminum is perhaps best indicated by the fact that the price of one kilogram was $250 in 1855, against 50 cents now. The Pittsburg Reduction Company has now something like 22,000 hp in operation for the production of aluminum, and it is evident that the greatest efforts are to be made to push the use of aluminum for all possible purposes.

Other examples of a combined electrolytic and electrothermic reaction are the production of metallic sodium by the Castner process of electrolyzing fused caustic soda, and the Acker process of producing caustic and chlorine by electrolyzing fused sodium chloride with a cathode of molten lead.

While the Acker process is the latest and one of the most carefully developed processes for the electrolytic production of caustic and bleaching powder, it is by no means the only one, since there is an abundance of processes in which an aqueous solution of sodium chloride is electrolyzed. We thus come to the class of purely electrolytic processes. Of course, Joulean heat and a certain electrothermic effect is here not absent, simply because it is impossible to avoid it. But it is generally so small as to be neglected, and, in fact, there are many cases in which it is necessary to make it small, since the output would be decreased by increased temperature.

One preliminary remark may be made on electrolytic processes in general. An electrolytic cell represents an electrochemical system and it is mostly possible to arrange it in such a way that when electrolysis begins we get the products which we want. But when electrolysis is continued we have no longer our original electrochemical system and the products of electrolysis may no longer be pure; we may now get something we do not want. The first condition that must be fulfilled for the successful working of an electrolytic process on an industrial scale is to have the conditions good at the start, to begin with pure solutions and to maintain them pure during electrolysis. As F. Haber says, everything can be accomplished with pure solutions; nothing with foul solutions. In many cases in which a process looked promising from the experiments made on a small scale in the laboratory, it turned out to be afterwards a failure on a large scale, because the electrolyte soon became impure and its purification required expense and the overcoming of difficulties which had not been expected in advance. The same fundamental principle of the working of electrochemical processes is expressed by D. H. Browne in a slightly more general form when he asserts that the keynote of success in electrolysis is to keep initially good conditions permanently good. Close experiment will almost always reveal the proper conditions under which certain work can be done, but the continuance of these conditions is attainable only by continual vigilance.

To return to the electrolysis of an aqueous solution of sodium chloride, the products of electrolysis are caustic soda and hydrogen at the cathode and chlorine at the anode. This is what is wanted if our final products are to be bleaching powder and caustic. But if we did not remove the caustic soda and chlorine from our cell we would have a new electrochemical system. The catholyte would then be a mixture of caustic soda and sodium chloride and the ions of caustic soda would participate in the conduction of the current and hydroxyl ions would travel towards the anode and produce new reactions. New reactions of a secondary nature would also be started by the mixing of the chlorine and caustic in the solution, due to diffusion and convection currents. It is thus clear that since our electrochemical system has changed we get new products which we do not want. The technical problem is, therefore, to keep the anodic and cathodic products of electrolysis separate from each other. It has been solved in three essentially different ways.

The first is to separate both compartments mechanically by a diaphragm. As an early pioneer of diaphragm processes, E. A. Le Sueur has been active in this country. The largest American plant using a diaphragm process (that of the Dow Chemical Company) is situated in Midland, Mich., while various diaphragm processes are in successful use in numerous paper and pulp mills, notably in New England.

The second general method is to keep the anodic and cathodic liquids separate from each other by making use of their different specific gravities (Glockenprocess, gravity process). This method is specially interesting as one of the comparatively few cases in which scientific research (in this case the determination of the transport numbers of the ions) has finally led to a new industrial process. While this process is in successful operation abroad, it has not yet been introduced into this country.

The third general method is to eliminate the sodium ions which are discharged at the cathode by alloying them with the mercury cathode. This process in the form developed by Hamilton Young Castner and C. Kellner is in use on a large scale in Niagara Falls. The elimination of the sodium from the cell by alloying it with a fused lead cathode in the Acker process is, of course, quite analogous.

In the manufacture of caustic soda and bleaching powder by electrolysis of sodium chloride, the electrolytic methods, sketched above, had to compete with one of the most firmly established chemical industries. The outcome of the war between the old chemical and the new electrochemical methods has been a victory for the latter, although the financial returns have been comparatively small, on account of the demoralization of the market.

While in the production of caustic and chlorine the purpose is to separate and maintain separated the anodic and cathodic products, just the reverse is the case when we want to obtain bleaching liquors or hypochlorites, since they are produced by a reaction between the chlorine and caustic. For this purpose it is evidently necessary to have the electrodes near together and to aid the above reaction by stirring. Several forms of hypochlorite apparatus are in use abroad, but have not yet found any extended use in this country. By modifying the conditions of operation, it is possible to produce chlorate, the main points being the use of a moderately high temperature and precautions for preventing reduction. This example shows how completely the results of a reaction may be changed, by varying the conditions, and it emphasizes the necessity, pointed out above, of carefully maintaining the original conditions of the system unchanged during electrolysis, if we invariably want to get the same results.

In electroplating, the problem is to have always a sufficient number of the metallic ions to be deposited, in close proximity to the cathode. The tendency of the current is to impoverish the solution near the cathode. This tendency must be counteracted. Stirring the solution and revolving the electrodes are suitable means and care must be taken to obtain proper corrosion of the anode which has to supply new metallic ions to replace those deposited at the cathode. There are now more than 1,200 electroplating establishments in the United States and in recent years a tendency has manifested itself to give up the old rule-of-thumb methods and to work according to exact principles.

Of much greater industrial importance, however, is the kindred art of electrorefining. In 1879 an experimental copper refining plant was in operation for a short time at Phoenixville, Pa., but the first commercial copper refining in America was erected in the early 80's. This is the Balbach works in Newark. To-day there are in operation in this country ten electrolysis refineries with a total daily copper output of 764 tons, or 279,000 tons per year. At the same time 27,000,000 ounces of silver and 346,020 ounces of gold are recovered per year in these refineries. (Ulke.)

There is a very peculiar difference in the details of operation of the different refineries. Two plants use the series arrangement of electrodes, all others the multiple system. There is a considerable difference in the current density used; of two plants in the West, in close proximity, one uses 40, the other 12 amperes per square foot. The list of variations in the method of operation could be easily enlarged. In other words, the art of copper refining is far from being standardized. Since it is known that for a number of years the different refineries have very carefully and systematically studied the best conditions of operation in their own case, the difference in the methods of the different refineries may be attributed to a difference in the given conditions in each case. If this is so it emphasizes the complexity of the economical working of even so simple an electrolytic problem as copper refining.

Recently the Betts process of lead refining has aroused very great interest. The essential point is the electrolyte, which is a solution of lead fluosilicate, containing an excess of fluosilicic acid. It is easily prepared from inexpensive materials, it conducts the current well and it dissolves other metals but lead only in very small quantities. The last point is of great importance in view of the fundamental requirement that the solution should remain pure during operation. In a similar way, for copper refining the possibility of continually renewing the electrolyte is essential.

The Wohlwill process of gold refining is in operation at the Philadelphia Mint, using an electrolyte of gold chloride, rather strongly impregnated with free hydrochloric acid. The addition of the free hydrochloric acid in this case, like that of fluosilicic acid in the Betts process, is necessary to produce the proper corrosion of the anode and to maintain the electrolyte in its original condition. Much special study has been devoted in recent years to the question under what conditions dense solid cathodic deposits of metals are obtained. The simple method by which, in the case of lead, Betts overcomes all difficulties in this respect—by providing a reducing action, practically accomplished by the addition of gelatine or glue—seems very encouraging.

As the reverse case of electroplating, we may consider the electrolytic stripping of metals. The production of tin from tin scrap has achieved considerable commercial success, first in several plants in Germany, from where it was recently imported to this country. An interesting similar process, although of much less industrial importance, is the method of Burgess, which was used in bicycle manufacturing works for removing the thin layer of brass on the surface of the frames by electrolysis, with a sodium nitrate solution as electrolyte. This example is mentioned to show how electrochemical methods may be applied to details in various manufacturing processes and may effect an important economy of labor.

In their application to the metallurgy of gold, the use of electrolytic methods has been confined to the cyanide process, as far as commercial success has been obtained. Electrolytic precipitation has been used successfully in the Siemens & Halske process in South Africa, although side by side with zinc precipitation. The latter method is nearly exclusively used in this country. But it should not be overlooked that the latter method is also essentially an electrochemical phenomenon. Chemically pure zinc is inactive as a precipitating agent. What is needed is commercial zinc containing small particles of impurities, or specially prepared zinc couples, like zinc-lead. Thus, while with electrolytic precipitation we have the source of the electric current outside of the precipitating vat, we have with zinc precipitation an immense number of small short-circuited galvanic couples in the precipitating vat itself.

In the production of metals from ores, much research has been devoted to the problem of getting copper and nickel from the Sudbury ores. The late Dr. Hoepfner did highly valuable pioneer work in this line, but full commercial success was obtained by David H. Browne, who, in working out his process in which chlorine passes through an ingenious cycle, paid proper attention to the fundamental requirement that pure solutions must be provided and maintained.

An interesting and novel electrometallurgical process which, however, has not yet attained industrial importance, is Salom's reduction of lead from galena by direct cathodic reduction.

That class of processes in which chemical effects are produced by discharges through gases is the youngest in the development of industrial electrochemistry. Commercial success has been achieved abroad with the production of ozone from air and the subsequent use of ozone for sterilizing water. If the cost is not prohibitive, there should be a commercial future for such processes in this country. Great interest has been aroused by the Bradley-Lovejoy process for the fixation of nitrogen from the air. The process is still in its experimental stage and a successful issue would have a revolutionary effect in many branches, particularly in agricultural chemistry. The variety of possible methods is indicated by the utilization of the silent discharge in ozonizers, while Bradley and Lovejoy produce arcs, but so finely subdivided as to give a large surface for small energy.

This cursory review does not nearly exhaust the subject of producing chemical effects by electrical means, but it is hoped that it gives at least a general idea of the achievements of the past and of the possibilities of the future, together with some general principles which should always be kept in mind in connection with this subject. We may be permitted to treat even more briefly the reverse problem, that of producing electrical from chemical energy.

There is not much to be said concerning primary batteries. Their limitations, if zinc is used as "fuel," have been pointed out above. The problem has, therefore, been to substitute carbon for zinc and to devise a "carbon cell." The effect would be commercially far-reaching. At present we burn the coal in connection with boilers, steam engines and dynamos and thus produce electrical energy by a roundabout method, with a low efficiency, since the efficiency of the steam engine is limited by the principles of thermodynamics. There would be no such limitations with a carbon cell. But the trouble is that such a cell is still a dream. Theorists and "practical men" have attempted the solution of the problem, but have equally failed.

On the other hand, storage battery engineering has passed with success through an extremely active career and the outlook is bright for the future. As early as 1856 Gaston Planté began his extended investigations on the formation of the lead accumulator. His method was purely electrochemical. Starting with metallic lead sheets, he submitted them to the action of the electric current in dilute sulphuric acid. But since the cell had to be charged and discharged a great many times, his method of formation required a very long time and was expensive. The technical problem was, therefore, to shorten the time of formation.

Faure abroad, and Brush in this country, devised in the early 80's an improvement of the Planté cell, which consisted in mechanically applying active material to a conducting support. They thus produced instantly a plate, the manufacture of which by the Planté process, would have required several months. Immediately afterwards an extreme activity began in storage battery invention, the goal being to avoid the claims of the Brush patent. The outcome was a modification of the original electrochemical Planté formation by replacing the electrolyte of pure dilute sulphuric acid by an oxidizing electrolyte. Moreover, purely chemical formation without any current was also found practical.

Along these general lines the successful lead battery of to-day was developed. The number of United States patents on this subject is legion, but the patents generally refer either to details of construction or to composition of the electrolyte for formation. Storage batteries have found very extended use in direct-current central stations and sub-stations. In fact, stationary batteries for such work represent at present 75 per cent. of all the storage batteries manufactured, and for this purpose the position of the lead cell seems secure.

In recent years, however, the possibilities of electric automobilism have encouraged inventors to search for a battery of light weight and small size. The use of lead was considered as essentially unsuitable for this purpose. The researches were mostly made along the lines of alkaline batteries. Finally the aim was the design of an "oxygen lift" cell, with potassium or sodium hydroxide as electrolyte and electrodes simply undergoing oxidation and reduction and insoluble in the electrolyte in all states of oxidation. Several inventors have worked along this line, among them Jungner. But commercial success was first attained by Thomas A. Edison with his nickel-iron battery, which, it seems, will have a field of its own, especially for automobile work.

A Quarter Century of Electric Lighting.

By Dr. Louis Bell.

The growth of a new art is a startling phenomenon. The familiar manufacturing enterprise of a nation may, under normal conditions, be expected to keep pace with the growth of the population in numbers and in wealth and save for commercial disaster now and then, or for artificial stimulus by governmental action, to move forward at a fairly regular rate. But the irruption of a new art like electric lighting is a very different matter. It grows in response to a law of demand that bears no definite relation to anything and while, of course, this growth is affected by local causes and by the conditions of general prosperity, it depends largely upon intrinsic factors in the art itself, the effect of which cannot be predicted, but becomes visible in the fullness of time.

One may study the phenomena of such growth as a pure matter of statistics, but while such an examination may, like other statistics correctly show effects, it fails utterly, as statistics usually do, in showing the causes which produce them. Cause and effect can be correlated, but only by studying the circumstances which are concurrent with the figures. The relations between figures and facts are far too complicated to be self-evident.

Starting then with the broad facts that less than twenty-five years ago incandescent lighting by central stations began, and that to-day the whole business occupies nearly 3,700 stations, represents an investment of more than half a billion dollars, and draws a gross yearly income of nearly ninety million dollars, it is worth the while to attempt to trace the reasons for so prodigious a growth and the factors which have gone to produce it.

In that quarter century the population of the country has increased about 80 per cent., and few large industries have greatly exceeded this rate of growth; but electric lighting starting from absolute non-existence has risen to an industry of the first rank in the face of strong competition from other illuminants, and what is more, in the face of a cost which throughout its whole early history was undeniably higher than that of any other illuminant. It has made its way through the operation of favoring factors other than economy, ranking as a luxury rather than a necessity, and only within a few years being able to meet competition on the simple basis of cost. These facts are very unusual in the history of a great industry and deserve careful consideration. They are the more extraordinary when one considers that for some years electric lighting was not only upon the whole the most costly but the least reliable form of illumination, was fought viciously by the fire underwriters, suffered from ferocious internecine strife among its exponents and had been a very Gettysburg of patent litigation.

When late in 1879 the incandescent lamp appeared as a commercial possibility, the arc lamp had already been for some years in slowly increasing use both here and abroad, mostly for small private installations, for the quite sufficient reason that the largest arc dynamos would handle but a few lamps, not enough to cut any figure at all for anything but the smallest plants. Nevertheless it was perfectly evident that the arc had come to stay. It had the inestimable property of giving white light in the form of a very intense and powerful unit. Before the electric arc came into use, lights of similar power were practically non-existent, and the arcs could therefore give a brilliancy of effect previously unknown. This fact of itself accounted for their rapid growth in popularity and when their accurate rendition of color values is taken into account it is small wonder that they made a sensation. The Jablochkoff candle, practically the earliest commercial form of arc, was, in spite of its limitations, altogether remarkable in the quality of the illumination given, and, in fact, would be difficult to surpass in this particular. It is interesting to note that it has continued in limited use even up to the present time.

The arc lamp therefore did the pioneering for the incandescent lamp. It educated the public to the appreciation of the importance of color values in illumination, drew once for all a line between weak illuminants and powerful ones, and caused all eyes to be turned to electricity as the coming source of illumination.

Then came the incandescent lamp in response to the demand for smaller electric lights. The subdivision of the electric light was the problem of the day, and very fortunately this problem was solved by the glow lamp instead of by arcs of small candle power, which could not then have been, and, in fact, never since have been, satisfactory illuminants. The incandescent lamp nearly equalled the arc in rendering color values, and enormously surpassed it in convenience and steadiness.

It was far less economical than the arc and was not for some time on public circuits able to compete with gas, but it made its way by reason of its better color, its steadiness and its freedom from vibration of the air, and from overheating. These good qualities carried it ahead in spite of all opposition. It is hard to realize to-day how much these gains meant in interior illumination, but they were fully realized at the time and they unquestionably won the day for electric lighting. Looking over some ancient history recently the writer came across a printed letter reporting results from one of the early isolated plants, that in the Pemberton Mills, installed in October, 1881. Although in this case two 4 ft. gas jets were replaced by each "A" lamp of 16 alleged candle power, a great improvement was noted in the conditions of illuminations, especially with regard to color vision in work on colored fabrics, and in the purity of the atmosphere. Further, it was shown that the cost of the electric light, including interest and depreciation at 12 per cent. and lamp renewals at a dollar apiece, was less than the cost of the gas for the burners replaced by more than a half.

One smiles nowadays at the idea of replacing two 4 ft. gas jets by one 16-cp lamp, but the fact of doing so was a valuable lesson in illumination, proof that a steady light, good in color, can actually with positive advantage replace lights of greater gross intensity, but lacking these two things.

A good many people who ought to know better have not learned this lesson yet and still foster the idea that illumination intrinsically bad can be made good merely by increasing its quantity.

The incandescent lamp practically won its way through quality, for only under rare conditions could it at first show economy over gas at the prices generally current. Once introduced and appreciated it was rapidly pushed ahead. It was a thing to advertise in one's business and to brag about to one's neighbors, and its use thus spread with the added momentum due to fashion. With it came increased use of arc lamps, partly in competition, but still consistently backing up the public demand for bright light and more of it. Pretty bad some of those early arcs were, too, but they did what gas never had done—they really lighted large areas effectively by dint of sheer brilliancy. Between the arcs and incandescents there was awakened a demand for public electrical supply, though, by a strange freak of fate, the arc and the incandescent systems, beautifully fitted to supplement each other's work, fought like cat and dog, damning each other with an ingenuity of objurgation that would be worthy of a unique position in profane history. Apparently this mutual abuse served simply to make violent partisans, and both systems flourished. Forward steps were rapid, and on the one hand arc machines carrying a respectably large series of lamps soon came into use, and the carbons, at first horribly bad, were so improved as greatly to better the steadiness of the light. On the other hand, the incandescent lamps were greatly improved in manufacture so that their useful life was largely increased, the bamboo filament was fashioned into as good practical working form as its nature permitted, and the invaluable three-wire distribution was brought into wide use. In large cities incandescent lighting was giving good account of itself in competition with gas, but it was not yet able on account of the inherent limitations of a low pressure distribution to work advantageously in the smaller places where absence of competition from gas would give it an advantage. At the present time more than three-quarters of the central stations are in such places and have the field to themselves.

Desperate efforts were made, with indifferent success, to build up an incandescent lighting business on arc circuits. Such lights have never been wholly satisfactory even for street lighting, and the danger of high potential wires kept them for the most part out of buildings. The greatest impetus that the art of electric lighting received after the invention of the incandescent lamp was the introduction of the alternating-current transformer system in 1885, when the first plant went into operation in Great Barrington, Mass. The next two years saw the system put into practical shape, and thereafter the growth of small stations was startlingly rapid. The number of new plants started in 1885 was but 55, the next year it was 100, the next 147, the next 160, and in 1889 it arose to 208. A large part of this activity was represented by small alternating-current plants. Bad as they were from our modern standpoint, their old 50-volt lamps did good service, for they were far easier to turn out successfully than the more delicate 110-volt lamps of the direct-current system. It is interesting to note that in some of the very earliest Edison plants 8 and 10-cp lamps were freely used, but difficulties of manufacture and the customary gas standard of 16-cp soon forced the small lamps out of use only to reappear years later.

Meanwhile, arc lighting had prospered, machines capable of operating forty lights or so in series had come into use; the lamps were of far better quality than before; and, reinforced by the power of working an incandescent system with alternators, the old arc stations took on a new activity. With the alternating system, too, came alone by stress of competition, various improvements in incandescent lamps, including the flashing process now universally used, and Mr. Weston's structureless cellulose filament, now, after various modifications, in universal use. These improvements are the basis of scientific lamp manufacture, and the fierce fight that was waged between the natural and artificial filaments now seems a curiout bit of ancient history. The first ten years of central-station lighting, with their ferocious strife of "systems" were years of tremendous progress, and desperate competition, often unwise and injurious, but serving to keep the art moving forward and strengthened its hold upon the public.

Fortunately, the one great improvement in gas lighting, the introduction of the incandescent burner, had not yet come to active service, else electric lighting would have had a far harder struggle for existence than it actually found. And when the incandescent burner actually did come into competition with electric lighting, its life was so uncertain and its color so vile that it made small headway until electric lighting was in better shape for hard fighting. Even now, in spite of repeated alleged improvements, the color of the incandescent gas lamps is ordinarily so bad as to put them at a hopeless disadvantage.

But better things were in store for electric lighting. The war of "systems" drew to a close by the crippling of some combatants and honorable truce among others. The electric railway had come to strengthen the hands of the electrical industries in general, and the troublesome problems of alternating-current distribution, of proper insulation for machinery and for lines, and of machine design, were being rapidly threshed out. There is no absolute dividing line between the old and the new, but about 1890 electric lighting took a firmer hold and began the period of its most effective growth.

The period was not signalized so much by brilliant discovery as by the application of sound common sense. The first step of importance was the introduction of large dynamos, generally direct-coupled. Although direct-coupling had been tried by Edison in the very beginning of central station work, dynamo design was not then far enough advanced to ensure success, but these later direct-coupled units revolutionized the central station business, simplifying problems of distribution, improving regulation, increasing station efficiency, and generally putting incandescent electric lighting on an economical and business-like basis. Arc lighting, too, was proceeding on broader lines with larger units, and presently came the successful constant potential arc, putting it in the power of the incandescent lighting station to do all classes of business over the one network. This unification was perhaps the most important step that has been taken in central station practice, and it immediately gave electric lighting an economic lift that was very quickly felt. It became possible to put prices at a point that attracted business, and in the early nineties not only was building active, but there was an extensive course of rebuilding and change of equipment which really inaugurated the modern period of electric lighting.

About ten years ago the idea of unification of service was extended to alternating-current practice by the introduction of polyphase apparatus. The first applications were to power transmission plants, which did not in themselves affect the lighting industry very greatly; but a little later the very extensive adoption of polyphase transmission in central station working via sub-stations rose to great importance in increasing the facilities of the large urban plants. At the present time more than 60 per cent. of the total dynamo capacity in the central stations of the country is in the form of polyphase and other alternating-current generators. The introduction of these big modern alternators has enabled conditions of good regulation to be maintained on alternating-current distribution systems, and has, by improving the service, greatly stimulated incandescent lighting on such systems. The substitution of large transformers feeding secondary mains for the house-to-house distribution has also had a most important effect in improving business and in increasing station economy so as to give more encouraging financial returns.

Arc lighting was much less stimulated by these changes than was incandescent lighting, for the alternating arc has never obtained a firm hold upon public popularity. Nevertheless, about 30 per cent. of all the arc lights are to-day operated by alternating current, a proportion which is due to secondary rather than to primary causes. The incandescent lamp has undergone in these years a far less extensive evolution than the arc lamp. It is now pretty nearly the same thing that it was ten years ago, save that improvements in manufacture have rendered the product somewhat more uniform. Chief among these we must reckon the almost universal use of the squirted cellulose filament and the introduction of the chemical method of final exhaustion. Various efforts have been made to introduce incandescent lamps of about double the usual voltage. The difficulties of construction of such lamps, their relatively low efficiency and the ease with which an alternating distribution at the usual voltages is effected constitute ample reasons for the small use of these high-voltage lamps; while the vigorous objections of the fire underwriters have discouraged any extensive exploitation of them.

The greatest change of recent years in general lighting has been the introduction of the enclosed arc lamp, which has worked a revolution in indoor lighting at constant potential as well as in street lighting. It has on the whole stimulated incandescent lighting, however, by raising the common standard of brilliancy, and by aiding in the unification of service. Considerably more than half the arc lights in use are enclosed, the bulk of the open ones being used for street lighting by companies not yet quite ready to undertake re-equipment. Of the alternating arcs more than nine-tenths are of the enclosed type, a result due almost to necessity. The introduction in recent years of series alternating arcs fed from constant current transformers is responsible for most of the use of alternating-current arcs, and practically all such are enclosed.

Through all these years of progress the incandescent lamp has held its own and has grown in relative popularity. The same virtues that gave it its start in life have kept its fortunes in the ascendant. With all its failings in points of efficiency it is to-day, as it was in the beginning, the best available illuminant in point of quality and general usefulness. Within very recent years determined efforts have been made to obtain other electric lamps of equally good qualities and of higher efficiency, but up to the present these efforts have not been crowned with success. The Nernst lamp, most admirable in some respects, is at its best in competition with the arc rather than the incandescent lamp, and is still a rarity, not yet seriously to be considered in the grand total of electric illumination. The mercury arc, another recent candidate for lighting honors, has little yet to show in the way of results, and its color is so hopelessly bad that unless remedied by some very radical step, the lamp will entirely fail of material usefulness as a general illuminant. If the public could be educated up to the point of liking the color of the mercury arc, it would already have welcomed the incandescent gas mantle to the exclusion of nearly everything else.

The incandescent lamp is then to-day as it has been all through its history, the mainstay of modern illumination so far as interior lighting is concerned. It may in due season be supplanted by something better, but that something will have to be equally steady and simple and convenient and good in color. At the present time there are nearly twenty million incandescents in lighting service from central stations in this country alone—how great a harvest from the seed time of 1879! Electric lighting has won its way into the front rank of American industries, and there it is likely to stay. Its full history cannot be written apart from that of the country's industrial growth with which it has more than kept pace.

The Development of Industrial Photometry.

By Prof. C. P. Matthews.

The science of photometry from an industrial and commercial standpoint has passed through two periods of marked stimulus. These periods have been contemporaneous with the development of the gas industry and the development of the electric light, respectively. The development of the incandescent lamp with the necessity of careful candle-power ratings, especially, has resulted in improved photometric methods. Apart from the growth and improvement of the science due to the causes just mentioned, there has been a more or less steady improvement in the physical laboratories of the world.

Notwithstanding the great improvement that has been made both as regards accuracy and speed, it must be said that until quite recently there has been a widespread tendency to regard photometric results as of very doubtful accuracy. People have grown to look askance at all candle-power measurements. Unfortunately, there has been much to justify this scepticism. Photometric results have been widely at variance. Three causes have contributed to this condition. (1) The lack of a satisfactory primary standard of light. (2) The failure to take into consideration the many sources of error in the actual process of measurement. (3) In many cases the fluctuating character of the thing to be measured. The question of a standard of light cannot be dealt with here. It may suffice to say that while the problem of a satisfactory primary standard seems far from solution, the matter of preparation and distribution of carefully-prepared secondary or working standards is being well taken care of. The Electrical Testing Laboratories in New York are prepared to issue seasoned and standardized glow lamps, which yield a candle-power in close accordance with the Reichsanstalt standards. The National Bureau of Standards at Washington is prepared to certify the standards in terms of the same unit. The action of the American Institute of Electrical Engineers, provisionally defining the British standard candle as 1/.88 Hefner units has done much to relieve the situation of doubt and uncertainty.

With reference to the errors that creep into the actual process of measurement, it may be said that, although photometry is simple in theory, it requires no little skill and judgment on the part of the operator. The science has undoubtedly suffered from the idea more or less prevalent that almost anyone can make photometric measurements.

As to the third cause of inaccuracy, it may be said that in many cases the attempt is made to measure the candle-power of a source which fluctuates in brightness in the measured direction between wide limits. Ordinary arc light photometry furnishes a good example of this. It will readily be seen that attempts to assign a fixed value to a quantity so varying as the light emitted in a given direction from the arc, would yield discordant results unless the readings are extended over a long period.

The photometry of artificial light sources may be considered under two heads: (1) Ordinary photometry, or such as deals with the integral brightness of the source; (2) spectro-photometry, or such as deals with the distribution of the brightness throughout the spectrum. Only the first-class of measurements will be taken up in this article. In considering the measurements that fall under the head of ordinary photometry, it is evident that the subject might properly be taken up under more than one classification.

We will first consider the subject from the standpoint of the relative accuracy of the results obtained. In this respect we may distinguish (1) work requiring and receiving the highest possible experimental skill. Under this head would come the study and comparison of the various primary standards of light. Naturally, in such work the highest obtainable accuracy must be aimed at. Every condition affecting the problem in hand must be studied with a view to ascertaining its importance and the correction for or the elimination of its effect. (2) Work requiring careful and conscientious measurement, but not necessitating the same degree of skill as that just mentioned. Under this head would come preparation of secondary or working standards of light in the shape of carefully seasoned and tested glow lamps. Thanks to the constancy which can be obtained in a set of carefully intercompared lamps, it is altogether possible to maintain a temporary standard of light with all necessary accuracy. Indeed, it has been shown by Sharp that copies of the arbitrary standards set up in this way can be produced with considerable greater accuracy than it is possible to secure in maintaining the best primary standard known to-day. An indefinite number of these copies can be made and placed in the hands of those requiring working standards of light. Thus, pending the development of an invariable primary standard, we shall at least be in fair accordance as regards our working standards of light. And furthermore we shall have the means at hand through the National Bureau at Washington of checking our standards at any time.

The subject of ordinary photometry may also be subdivided according to the character of the measurements. These may be either unidirectional or integral. Early photometric measurements were entirely of the first class. Experimenters were content with candle-power in a single direction, usually horizontally and normally to some specified aspect of the source. For example, the candle-power of a gas flame is understood to be the result of a measurement made in a direction normal to the broad side of the flame. A similar measurement was applied to earlier forms of the incandescent lamp. Measurements of this kind are necessarily a basis of all curves of candle-power distribution, and hence are an invaluable aid to the study of artificial light sources.

The simplest example of the second-class of measurements is the determination of the mean horizontal candle-power of an incandescent lamp by making a photometric setting while the lamp is spun on a vertical axis. Lamps are rated commercially to-day by this method. Obviously, the method is applicable to any source which can be rotated at the required speed without altering its light-giving value. The determination of the mean spherical candle-power of a light source at a single setting furnishes another example of an integral measurement. By means of the apparatus developed by the writer, it is possible to make the spherical measurement with all the ease and celerity obtainable in the simplest photometer setting. Moreover, the accuracy of such measurements is as great as that to be secured in the longer and more laborious methods. It is not, perhaps, out of place to say that a form of the apparatus less expensive than that originally put out is now being introduced.

The Unchangeableness of the Three-Wire System.

By Charles L. Edgar.

I do not suppose that, in the history of the world, there has ever been an industry which has shown such tremendous growth in a quarter of a century as that with which your paper has to do. To say that you not only have kept the pace, but have actually made the pace many a time is, I think, a compliment which is your due. You are to be congratulated on your work and we are to be congratulated that our industry has such a paper.

On looking back over the years there is, in my mind, one thing that stands out above all others, and that is the unchangeableness of the Edison three-wire system of distribution. If we look back to 1883 and go over the plans of the Sunbury station, especially its switchboard connections, its feeder system and its distribution of mains, we will see that it is an exact duplicate, in miniature, of what is now being used in the large cities of the country. Changes due to the enormously increased quantity of current have been very great, but the fundamental principles laid down by Mr. Edison a quarter of a century ago are still recognized to-day in designing all comprehensive systems of distribution. It is perfectly true that instead of locating small steam stations at regular intervals throughout the city, as was done in the early 80's, we are manufacturing our electricity at high tension at a distance and transmitting it to what are now called sub-stations, but from that point on the quarter of a century has changed only the details; the principles are the same. Even in details, the changes are less than one would imagine. The feeder regulator has given way to the multiple bus; the mains have become larger and the feeders, relatively speaking, fewer, as time has gone on. The wires have been taken down off of poles and put underground; the catch box of to-day is an exact duplicate, in theory, of the distributing pole of the Sunbury days. It is merely underground, carries more current and has a few more refinements. The low-tension switchboard of the modern station of to-day was designed in 1882 and has only been multiplied a hundred times. So we could go on, item by item, and a whole book could be written, all going to show that in the wonderful advance which has been made in an industry which is to-day one of the most prominent in the world, the three-wire system stands unchanged—a monument to the genius of Mr. Edison.

The First Electric Street Car in America—1884.

BY E. M. BENTLEY.

ON July 27, 1884, an Associated Press dispatch was sent out from Cleveland, Ohio, as follows:

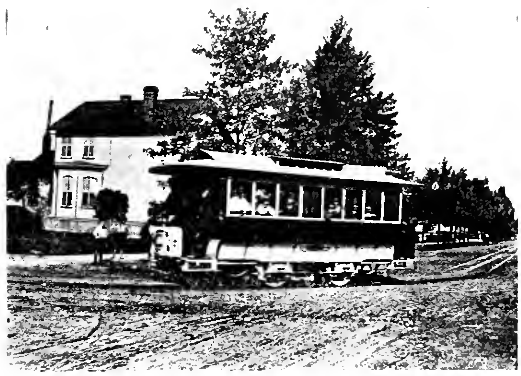
"The first electric railroad for public use in America went into operation in this city yesterday in connection with the East Cleveland Street Railroad Company, which has just completed a mile road. The experiment was so successful that the company expects to change its entire system, comprising over 20 miles, into electric roads. The Bentley-Knight system was used and the current was carried on underground conductors laid in conduits like those of cable roads. The cars were started and stopped and reversed with the greatest ease. Any number of cars up to 15 can be run at one time on a single circuit and from one machine, which is a result not attained by any of the European systems now in operation. The success of the new road has made a great sensation in both street railroad and electrical circles, and is expected to greatly extend the field of electrical development, as well as enhance the value of street railroad properties."

The occasion for this enthusiastic dispatch—which is not without some prophetic truth—was a single electrically-driven street car, that had for many years traveled up and down the streets of Cleveland behind two car horses, such as are now happily obsolete. Going back fifty years or more, we find many instances, both in this country and abroad, of scientific toys, comprising a small motor mounted on a truck and supplied with battery current through the track rails. Indeed, the advent of the battery as a source of current gave rise to many suggestions which we have only seen realized in recent years. Prior to 1884 Mr. Edison had also constructed his well-known pioneer roads at Menlo Park, N. J., one in 1880 and the other in 1882, in both of which one track rail had served as the outgoing and the other as the return conductor of the circuit. Mr. Daft had also been experimenting, having operated a short length of track on the pier at Coney Island in 1884, while in 1883 he made a few trips with an electric locomotive drawing a passenger car on the Mt. McGregor Railway near Saratoga. He, too, employed the track rails for his respective conductors. Indeed, he once took out a patent on an electric railway, in which the novelty lay in the low potential which he purposed to use; 30 volts was the upper limit of his low potential and the rails were to be "practically uninsulated." This is mentioned in passing to indicate what a blank wall of inexperience confronted the early experimenters. Mr. Edison was then dreaming principally of a high-speed road from New York to Philadelphia and Mr. Daft's efforts were in the same direction. Many other projects of that date seem even more preposterous in the light of our present knowledge.

Mr. Knight and myself, perhaps more than others at that time, were impressed by the fact that the immediate need for electric railways was in the city streets, and that the use of one rail as a positive and the other as a negative conductor, or even a live third rail, was not feasible for this purpose. There was also an active agitation then in progress against overhead wires, and so we undertook at once the development of our ideal, namely the conduit system, or, as it is now usually known, the underground trolley, quite unconscious that we were extremely premature.

The street car track of those days was simplicity itself, and it was several years before the average street railway superintendent could be brought to believe that an electric car deserved anything but the worst piece of track on his road. The ties were first laid down 5 ft. apart and upon them were placed the two longitudinal wooden stringers 6 or 8 in. in depth and upon the stringers were spiked strap rails, weighing 35 or 40 pounds to the yard. The switches were merely cast-iron plates inserted at the branching points of the track. There was a prejudice against movable tongues on switches. In some of the more elaborate roads tongues were employed, operated by a tilting table, the horses walking on one side or the other of the table to throw the switch, but more commonly the horses would be turned to one side or the other of the car to drag it laterally across the switch plate to make it take one or the other of the two branching tracks. An objection gravely urged against electric cars was that there would be no horses to pull the cars sideways at the switches or to walk on the tilting table. This track construction, although universally used, deteriorated rapidly. The surface of the stringers, being alternately wet and dry, soon rotted and invariably rotted in spots so that the flexible strap rails quickly assumed a wave form, and the light cars, with their short wheel bases would go bobbing along like a ship at sea. The outfit of the repair gang was correspondingly simple, comprising an adze, a crow-bar, a sledge hammer, a bag of spikes and a bundle of "shims." It was an easy matter to pry off a rail, adze off the rotten surface of the stringer, lay in a "shim" and spike the rail in place again. I have referred to this matter to indicate the nature of the conditions encountered by the pioneers of the electric railway, it being manifest that electric railroading on a track of this description was no easy matter. It was, however, but typical of many other difficulties besetting the situation.

It was on a track of this kind, along a section of the line of the East Cleveland Street Railway Company, that the car in question was first operated. The route began on what was then known as Garden Street, two blocks west of Wilson Avenue. From Garden Street it turned into New Street, and then into Quincy Street, and was at first about a mile in length, but was soon after extended across the Cleveland & Pittsburg Railroad tracks and thence along Quincy Street to Lincoln Avenue. The conduit was of wood, excepting about 100 ft. at the crossing of Wilson Avenue, which was of iron. Rectangular cast-iron yokes were set on the ties and outside of the yokes were two-inch planks, set on edge to form the sides of the conduit, while similar planks formed the top, with a slot having an original width of three-quarters of an inch. Inside the conduit



FIRST ELECTRIC STREET CAR, CLEVELAND, OHIO.

were the conductors, formed of channel bars about four inches apart and supported on insulators projecting from the wooden side walls of the conduit and entering the groove in the rear of the channel bars. On this crude line of construction there were worked out several curves, also the branches for a turnout and for one spur track and—most difficult of all—a railway crossing through the Cleveland & Pittsburg tracks. The current for the road was supplied at first from a Brush arc light machine, No. 7, driven by a 25-hp engine in the car barns at Euclid Avenue, a quarter of a mile away, and to one old gentleman, a director of the road, it was a constant source of wonder that, after throwing the switch, it took such a short time for the current to come from the car barns to the road. The first car was equipped with another Brush arc light dynamo, No. 6. It was suspended directly underneath the center of the car body, the shaft extending across the car. On the driving end of the shaft were two pulleys, each having a series of half-inch grooves in its face and from these pulleys belts of coiled steel wire extended in opposite directions to counter-shafts on each end of the car, which, in turn, were similarly belted to the axles. This mode of gearing had been the outcome of considerable experiment, and it must be said that, for a few days, the operation was all that could be desired, there being no slippage of the belts, while there was a yielding spring start which was easy and agreeable. In the course of a week or two, however, the springs were breaking with a loud report, at the rate of about one an hour, and, until the passengers got used to it, there was a serious commotion among them each time that it occurred. At first the breaks were at the couplings, but when this was finally overcome the wire itself began to give way, indicating that, for steady work, the duty was too severe, crystalization of the wire resulting in a short time; nor could it be obviated by any kind of wire then available. The belts were, however, kept going until a second car was equipped with a different transmission scheme. On this car the motor shaft was equipped with a friction wheel made of discs of strawboard solidly compressed. Outside of this pulley and around it were grouped three similar pulleys, one of them larger than the other two, and outside of the three was a shell, the four pulleys having a sort of eccentric compression against the shell, without strain on the bearings, and the shell was mounted on a separate shaft and connected by link belts to the car axle. This device likewise worked well for a time, but one day the friction wheels began to slip under a heavy load, developing flat spots at once and the usefulness of the contrivance was at an end. A third car was then equipped with spur gearing, the body of the gears being built up of paper like a paper car wheel. By this expedient the noise of the gearing—which had been one of the reasons for not employing spur gears at first—was deadened to a satisfactory degree. The motor shaft had a speed of 1,500 and we could find at that time no precedent for the use of spur gearing at that speed. In this third car the motor was carried by a separate truck, its shaft lying longitudinally of the car and gearing with a parallel counter-shaft, which drove the two axles by bevel gearing. This eliminated for a time the difficulties involved in the mechanical transmission between the motor and the car.

The regulation of the motor and its reversal was extremely simple so long as we were working with a constant current, it being only necessary to move the brushes around the commutator both for reversal and for speed adjustment. From the brush-shifter a rod extended to each end of the car where, by means of a simple lever, the entire control of the car was secured. We had, at the outset, been possessed with the idea that the cars might be operated in series with a constant current, a scheme which was quickly abandoned by us, although a few years later Mr. Short, in Denver, made a brave attempt to operate such a system and succeeded in running six or seven cars in that manner. It should be said that the series arrangement was our plan for long-distance and high-potential work, though we gave it a brief, but unsuccessful, trial on our Cleveland road. Lest the new generation wonder how street car motors were to be operated in series, I give here a diagram of our circuits:

RAILWAY MOTORS IN SERIES.

Mr. Short, on the other hand, used the form devised by Fleeming Jenkin, who was the first to propose the series system. The line was divided into sections shorter than the length of the car with a spring jack between each section and its neighbor. On the car was a plow, as long as the car, and serving, in effect, as a plug for the jacks, taking into a jack ahead before leaving the jack in the rear.

After giving up the idea of constant-current operation, there followed a long chapter of experiments for the working out of motor-regulating devices for constant potential, which culminated in the contrivance of a regulating rheostat of sheet-iron plates in superficial contact, such as was afterwards used by the Thomson-Houston Company up to the time that the series multiple method was brought into use, about 1892. It should be remembered that constant-potential circuits at 500 volts were then unknown, and that there was little or no precedent for the control of motors of the size needed for railway work, even on 100-volt circuits.

Another source of serious tribulation was the plow for maintaining connection between the car and the conductors in the conduit, this problem being intimately associated with the matter of the bad roadway, which at that time appeared to be indispensable. It seemed necessary to anticipate that a car would jump the track at least once a day, and, whatever the future might have had in store, it was then an absolute requirement that a car should be permitted to leave the track as frequently as it desired without wrecking the plow. This point having been established, we met the situation by means of a plow so constructed that it could be thrown out through the slot at any point and so hung on the car that it would be tripped and swung up out of the conduit, if it encountered any obstruction such as the end of a loosened plank on the conduit, or if it should bind in the slot when the car went off the track. Manifestly, the requirement that the plow should be capable of coming out through the slot imposed limitations on the size of its parts and in consequence there was liability of breakage while, moreover, with such insulating materials as were then available to the art a "ground" was not unknown. It was only after the art was so well advanced as to make it reasonable to expect a car to stay on the track, that the construction of a substantial and reliable plow became feasible. It was some years, however, before electric cars were deemed worthy of having a new track laid for them. It was considered their duty to travel on any old track that might happen to be already on the ground. It may be mentioned that the "plow" originally received that designation from the fact that in one of our earliest schemes, which fortunately was never attempted in practice, the top of the conduit was made up of hinged sections that were to be lifted as the car proceeded by means of a device which was naturally designated as a "plow," a name which has since clung to it.

The success of this road, as a factor in actual service, was really greater than might have been expected. At first the passengers coming up from down-town transferred to the electric car and were taken by it to the end of the route, while, after the third car was in use, it took the horse cars through as trailers. A week or ten days of uninterrupted service would be followed by several days of repair work. The object of the enterprise was, however, to test out the value of different devices by subjecting them to service conditions, and not to do the actual work of the railway. Winter running was particularly uncertain, but we demonstrated the ultimate possibility of it to our satisfaction. The road was operated for over a year, but the construction was, in its nature, temporary. Besides the wooden conduit, the streets through which we ran were sewerless, and about to be torn up, while we were then unprepared to replace the wooden conduit with a steel one or to provide the additional material required for a permanent plant, even if it would have been commercially warranted in that location. There were also people who could not be brought to believe that a Brush arc light dynamo was not an ideal railway motor, or was susceptible of improvement for that or any other purpose. In consequence we had to continue the development of the conduit system elsewhere—at Providence, at Allegheny City and finally at Boston, where it met its rival, the overhead trolley, and came to grief, not to revive again for ten years.

At the "Lab" Twenty-Five Years Ago.

By A. E. Winchester.

Good friend, receive the heartfelt and sincere congratulations of the humblest of the old-timers upon the attainment of your prime and hearty age of thirty years crowned with success, and the fact that you are looked forward to weekly with warm welcome wherever "currents" and "watt-berries" grow. May success abide permanently with you! Is it possible to give adequate expression to thoughts that flash through the mind of one trying to briefly review what science and electricity have wrought within the past quarter century? A history of untold volumes telling of man's great deeds of evolution and revolution. Did time and space permit, the task would be too great for me.

Looking from a window in the South Norwalk municipal electric works, I see a man in the distance; how slowly he walks, how small he looks. Viewed outwardly, how insignificant is man, after all. Divested of intellect, he is the most helpless of creatures. But endowed with reason, his physical weakness is not seen; he is master of all living things, and nature's forces respond to his touch. Electricity by his will has changed, within our memory, from a dreaded mystery to the most useful and familiar agent of our commercial and social existence. When, as a green run-away school-boy, I entered the budding Edison interests, every one connected with the meager science knew, or seemed to me to think they knew, all there was to know about the applications of electricity. It happened that I was soon assigned to do some work for Mr. Edison at the laboratory. I will never forget the sensation of awe that I felt as I stood gazing at the "old man," as he was called in endearment by his boys. He with characteristic unconsciousness worked away on his feeder-and-main scheme, without seeing me, until some one slapped him on the back and shouted in his ear, "Say, Tom, don't you see that chap wants to talk to you?" "Then why don't he talk?" was the ready reply, accompanied by a keen glance,—and after reading my credentials, a friendly smile. A grimy hand was shoved out to me. That was many years ago, but I will never get over being proud that a hand of mine shook the hand of Edison. Something about me, perhaps it was my modesty—I was still new to the business—reminded him of a story which had to be told before further operations could proceed. It was a good one, one of his "specials;" I remember it well, because others have since tried to work it off on me as original goods. Maybe I will whisper it as a familiar reminiscence of the "old man" sometime later, where the ventilation is good. When I left the laboratory that night, my hat fitted snug upon an expanding brow. I knew it all—all about filaments, lamp construction and the theory of sub-divided current. I thought I did, and was rather "chesty" to my less favored associates. However, the shrinking process came to my rescue in due time, and I have kept shrinking ever since, until now you can't find my little glim among the great lights of to-day.

But those early days brimmed full of exciting experiences, failures often and triumphs occasionally, but big ones when they came—lamps without life, others with too much, "shorts" that would not burn out, and armatures a-plenty that would, as the old boys can well remember. The bitter and the sweet of those times will never be tasted by those more recent in the field, because the days of the "rule of thumb," "cut and try" and "guess again" have passed out of operative electricity, and things are done right the first time now, because those old fellows of years ago found out how. The old-timers hewed their way up from the wilderness of obscurity to light, and left a broad path behind them reaching high up on Mount Progress to the zone of success for future generations to follow upward also, unhampered by doubts.

The Progress of Telegraphy During the Past Thirty Years.

BY WILLIAM MAVER, JR.

WHEN one regards the vast extent of the present-day applications of electricity, it is difficult to believe that thirty short years ago—less than the one-third of a century—the chief, indeed it may almost be said the only, important use of that force was in its application to electrical telegraphy. Yet such was the case. In the year 1874 the dynamo-electric machine, that revolutionizer—in fact, the creator—of many of the industrial arts of the greatest magnitude, was known, it is true, and the fact that it was reversible had already been discovered—a discovery that ranked as one of the most important of the nineteenth century. But its use was then very limited, and the crudity of the machine at that time is well exemplified by the manner in which the manufacturers of the period graded its capacity, namely, by saying, in all seriousness, it was equal to so many Bunsen cells; that it would take so many horse-power to drive it, or that it would heat a platinum wire of a certain length and thickness. The latter method of defining current strength, it may be noted, was also resorted to by the earlier experimenters as a means of designating the strength or capacity of Leyden jars. (*Query.*—Thirty years hence will some retrospective or reminiscent writer have occasion to note that the manufacturers of 1904, in all seriousness, defined the output of their generators of electromotive force as so many kilowatts, 90 per cent. efficiency, etc.?)

To show more clearly the progress of electrical telegraphy during the past thirty years, it may be advisable to refer briefly to the state of that art at that time or shortly prior thereto. Up to 1872 all overland wires, as well as the long submarine cables in this country and elsewhere, were worked single, as it is termed; that is, but one message was sent at a time over one wire. In this country the Morse manual telegraph system was, with the exception of the House and the Phelps printing telegraph systems, the only one in operation. The speed of transmission by the Morse manual method was from 20 to 40 words per minute, depending on the skill of the operator. The speed of the Phelps printer was about 50 words per minute. In Europe the systems most in vogue were various types of needle and dial telegraphs, together with the Hughes printer. The Atlantic cables were in operation, working at a speed of from 10 to 12 words per minute. In Great Britain the Wheatstone Automatic was working singly at the rate of 80 to 100 words per minute. Galvanized iron wires of No. 4, 6, 8 and 9 gauge, were used exclusively for overland purposes, and primary batteries, such as the Callaud or the Grove, were the only sources of e.m.f. employed on telegraph lines.

In 1872 a most important advance in the art of telegraphy was made in the application of the condenser to the Stearns duplex, which duplex had been introduced two or three years previously on the telegraph lines of this country. This invention by making it feasible to send two messages at once over one wire, doubled the capacity of all through overland wires on which it was applied; and it was not long thereafter before the duplex principle was successfully employed on the Atlantic and other long cables.

In the meantime Edison was assiduously working to perfect a quadruplex system of telegraphy by which four messages might be simultaneously transmitted over one wire, and in 1874 his efforts were rewarded with success. This achievement practically quadrupled the capacity of the through overland wires and thereby added thousands of miles to the existing facilities of the telegraph companies and governments employing it. It has been said by a recent imaginative writer that the quadruplex system sprang fully equipped in one night from the inventor's brain. The present writer has a clear recollection of rumor current at the time that the perfecting of the quadruplex was the result of many weeks and months of arduous toil, during many nights of which the inventor, when he slept at all, slept on the floor or on a bench beside the apparatus.

By the application of the duplex principle to the Atlantic cables the capacity of each cable has been doubled. This is likewise true of the land circuits on which the Wheatstone automatic system is employed. So that to-day, with other refinements in the art of submarine cable working, including the automatic transmission of messages, the capacity of an Atlantic cable is now about 22 words per minute in each direction. In Great Britain the capacity of a circuit employing the Wheatstone automatic system is now from 200 to 400 words per minute, depending on the length and other conditions of the circuit, in each direction.

During the past 30 years a number of rapid automatic telegraph systems have been tested in the United States, notably about 12 or 20 years ago, when more than one company was engaged in exploiting certain chemical and other automatic telegraph systems, to be operated at from 800 to 2,000 words per minute. But from various causes these systems were not permanently adopted, and the lines built for them were absorbed by companies operating on the manual Morse system. In Europe, within the past few years, several rapid automatic telegraph systems, capable, it is claimed, of transmitting messages at the rate of several thousand words per minute, have been tested; but it is not known that such systems have as yet gone into actual operation. The matter of rapid automatic telegraph transmission versus the Morse manual method, which later is practically the only one employed in America, Australia, New Zealand and largely in Europe and Great Britain, is a vexed question. There are those who consider that the retention of the Morse manual method is an evidence of backwardness on the part of those employing that system. But it should not be overlooked in this relation that the manual Morse method has of recent years gained ground in Great Britain and Europe generally, to do which it had to displace the one-time, almost generally employed, needle and dial systems. Furthermore, in Great Britain, where automatic telegraphy has been for many years in constant operation, and where, in fact, chemical automatic telegraphy had its birth, automatic telegraphy is to-day confined to the comparatively slow-speed Wheatstone system, which system is, it may be remarked, in great measure but a refinement of the Morse manual method of transmission.

On the continent of Europe the needle telegraph is still somewhat extensively employed. In France the Baudot synchronous printer, by which four messages are simultaneously transmitted over one wire, is now utilized on all the important through circuits, and affords a capacity of about 110 words per minute to each circuit. In this system, as well as in the case of the Hughes printer, which is also employed largely in Europe, the message is printed on a paper strip as received.

In this country the Buckingham printer, which operates at a speed of about 100 words per minute, in each direction, is employed on circuits from 500 to 1,000 miles in length. By this system messages are printed in page form on the ordinary telegraph blank as received. Two other important page-printing telegraph systems, namely, the Murray and Rowland, are now being experimented with in this country and Europe.

An important innovation in the method of preparing messages may be mentioned in the case of the Buckingham keyboard perforator, which was initially designed to prepare messages for transmission by this system, but which is now also used to prepare messages for transmission by the Wheatstone automatic system, employed on a number of circuits here, almost to the entire exclusion of the mallet method of preparing the messages. The keyboard method more than doubles the rate at which messages may be prepared for automatic transmission as compared with the mallet or hand-perforator. As an instance of this, it may be noted that one operator has perforated 850 messages in 11 consecutive hours by the keyboard perforator.

Among other developments of electrical telegraphy in the last 30 years has been the Delany synchronous system, which transmits four to six messages at once on one wire. This system has been employed in Great Britain for some years. The messages are transmitted manually at the ordinary rate. Another exceedingly valuable invention of recent years is that of Van Rysselberghe, by means of which it is possible to telegraph and telephone over the same wires at once; that is, while the two wires of the telephone circuit are being utilized for the transmission of speech on long-distance wires, both wires may at the same time be employed for ordinary telegraph purposes. In this country many telephone circuits are, by means of this system, operated also as telegraph wires. On the other hand, the telegraph wires of the country are used exclusively for telegraph purposes, but little effort having been made, it would seem, to utilize telephony as an adjunct to the regular business of telegraphy, which has long been an occasion of some wonder to the writer, although he is not unmindful of the difficulties of the matter. It should, however, be added in this relation that some of the telegraph wires of the railway companies of this country are utilized for simultaneous telegraphy and telephony. As long ago as 1890 the writer connected up the first set of apparatus for this purpose in the New York office of the telephone company for an experimental circuit between that city and Philadelphia.

As soon as the dynamo-electric machine was shown to be a practical source of e.m.f., it was quickly employed by the telegraph companies for that purpose, the first installation of which was made in the Western Union building in 1880. Since then primary batteries have been entirely dispensed with in all the large telegraph offices, dynamo machines or storage batteries replacing them. In 1884 the extensive employment of hard-drawn copper wire was begun by the telegraph companies, and its use has continued up to the present time, although large quantities of iron wire are still used in the telegraph service.

Still another obvious improvement in the telegraph service that has taken place in this country within the last decade is the general use of typewriters by the operators for the reception of business. This is not only more satisfactory to the public, but is a boon to the operators employing the typewriter, as it reduces the work of transcribing the messages to a minimum. Another recent improvement in this direction is the use of the typewriter keyboard as a transmitter of messages by the Morse alphabet; depression of a key effecting the transmission of dots and dashes corresponding to the letter represented by the key so depressed.

In one respect, however, it must be noted that within the last eight or ten years there has been a falling off in the efficiency of one branch of the telegraph service in this country, namely, that of the quadruplex system. This falling off in the efficiency is due to disturbances caused by the proximity of the wires of electric traction and other high-potential systems, and other causes, which appear to impair the operation of what is termed the "second" side of the Edison quadruplex system. Whether these causes of impaired efficiency will be overcome remains for the future to determine.

After all, the progress of electrical telegraphy in the past 30 years will perhaps best be shown by a comparison of the amount of wire then in operation for telegraph purposes, and by the number of messages then annually transmitted, with the mileage of telegraph wire now in use and the number of telegraph messages now transmitted annually. In 1874 there were perhaps not more than 150,000 miles of telegraph wire in this country; to-day there are over 1,000,000 miles of such wire in service, a large portion of which is either duplexed or quadruplexed. Thirty years ago not more than twelve or fifteen million telegraph messages were annually transmitted over the telegraph wires of the world. Now probably over 300,000,000 of messages of all classes are transmitted every year. This large volume of business is the more noticeable when the amazing growth of the telephone service is considered, and one is led to wonder what the extent of the telegraph service might have been had the telephone not appeared on the scene; for, while in many cases the telephone acts as a feeder for the telegraph, it is idle to pretend that the former does not in multitudes of instances take business that would otherwise have gone to the telegraph. In connection with the number of messages handled by telegraph, it may also be pointed out that within the last 15 or 20 years many of the largest users of the telegraph in this country have leased wires from the telegraph and telephone companies for private use, over which wires hundreds of thousands of messages are transmitted which do not appear in the public record as business transacted.

A record of the progress of telegraphy, however brief, could not, of course, be complete without reference to wireless telegraphy, the advent of which within the past five years has excited more popular interest than any means of transmitting intelligence to a distance that has been evolved within half a century. That art is now feeling its way and it will probably soon reach a substantial basis. Thus far many of the promises concerning its scope have not been fulfilled. It has hitherto fallen far short of providing transatlantic telegraphy, but its field of usefulness as a means of communication between vessels at sea and between vessels and the mainland is enlarging daily. Already it has demonstrated its value in many important instances, and with its increasing application to a larger number of vessels, to lighthouses, lightships, etc., its utility will be at least proportionately enhanced.

Fads in Engineering Practice.

By S. T. Dodd.

It is generally understood that engineering practice is dictated by engineering formulas, or practical commercial and financial considerations, and it might be supposed to be free from those waves of sentiment which often control masses of men in politics or religion, or which we call fads when we encounter them in the region of art and literature. It is very interesting to note, however, that the development of engineering practice is often accompanied by sudden revulsions which are not always guided by the best engineering considerations.

An instance of such revulsions is seen in the sudden demand during the last year for turbo-generators. Less than two years ago the discussion of a paper before the American Street Railway Association at Detroit, showed that there was a general timidity among operating men, as well as engineers, in regard to accepting the turbo-generator as a suitable unit for railway and power work. Engineers have not, up to the present time, had a very wide experience with turbines under fluctuating power loads, but the engineering profession in general seems to have gone to the other extreme in its acceptance of the turbine as a satisfactory and final form of prime-mover.

A representative of one of the large manufacturing concerns said to the writer the other day: "The country has gone turbo-crazy and hardly any consulting engineer dares to advocate reciprocating engines for fear he would be considered behind the times." While all the experience we have had up to date seems to indicate that the claims of advocates of the turbine are fairly borne out by practice, it hardly seems that this experience is sufficient to justify the sudden unanimous and overwhelming relegation of the reciprocating engine to the realm of out-of-date apparatus which the present tendency would seem to indicate.

Another fad which is based on still less valid considerations is the demand for increased sizes of cars on interurban electric roads. Ten years ago the first interurban cars on the Akron, Bedford & Cleveland Railroad weighed about 19 tons loaded, and had a seating capacity of 40 passengers. Since that time the technical press has been continually advocating the advisability of operating interurban roads along the lines of steam railroad practice, and some managers appear to have understood this as an advocacy of steam railroad cars for interurban railway service.

At any rate, we have noted, from time to time, in manufacturers' notices or descriptions of new roads, the increasing size of cars. The greed for greater seating capacity has increased the length of the cars to 45, 50 or even 60 ft. over all, the increase of weight of body necessary for rigidity, the introduction of hot-water heaters, air brakes, multiple-unit control, and the various paraphernalia of modern equipment has forced larger sizes of motors, greater weights of trucks and size of axles, and finally those of us who are conservatively inclined doubt very seriously whether, excepting in an advertising sense, the increased earning capacity of a 50-ton interurban car driven over tracks at 60 miles an hour with 500-hp of motors under it really justifies the increased first cost of the equipment, or the increased watt-hours per passenger carried, which are necessary to operate it under the conditions of grades and stops which we have to encounter.

It is refreshing occasionally to meet, as the writer did recently, a sane railway manager, who admits that his new interurbans are not proving the money-earners that he had expected; that his road has built up the resident population along his line; that with his increased stops he finds it pays him to reserve his new cars for limited and special runs, while he operates his old cars on the regular runs, and who says that when he is next in the market for equipments, he will go back to smaller cars and equipments with which he can make his frequent stops and keep his schedule without forcing the excessive fluctuations of loads on his power house and sub-stations which his new cars are demanding.

The writer believes that the modern demand for large size and excessive speeds of interurban electric cars is in the great majority of instances a fad which is not justified by considerations of economy or good engineering. One of the most annoying features of this development is the tendency of unscrupulous or ignorant promoters of new electric railway propositions to fill their prospectuses with specious arguments based on apparently accurate data of existing roads. Our reputable engineers are called on continually to combat such projects which show an earning power based on cars nearly equal in weight to Pullman sleepers running at speeds which are an engineering impossibility with any reasonable stops and grades, while the capacity of the equipment, the first cost and operating expenses are figured on the basis of existing roads operating cars of medium weights at reasonable speeds and giving satisfactory service to the territory they serve.

To-day we are confronted by the promise of a new fad. Any one who is familiar with the electric railway situation in the Middle West cannot fail to be impressed that the widespread interest which has been excited by the alternating-current motor. Speculation is rife among engineers as to whether we have not arrived with it at the solution of voltage limitations and distribution troubles incidental to our present practice on suburban and even on city lines. It is seriously questioned whether it would not pay to scrap existing apparatus and replace it with alternating-current railway equipment. The writer does not wish to be understood as saying that there is not a great field for the alternating-current, single-phase railway motor, or that the field which it will open will not be one that is as yet practically untouched by electric railway apparatus; but he does seriously question whether, except in special instances, existing electric roads could be advantageously improved in economy by the substitution of alternating-current equipments for their present apparatus. Electrical apparatus, like the rest of mankind, "is of a few days and full of trouble," and whether the maintenance and operating expense of alternating equipments will be less than direct-current equipments can only be decided by extensive experiments.

In the meanwhile, the time is now ripe for a careful conservative discussion of the engineering, commercial and financial questions bearing on the advantages and disadvantages of alternating-current railway equipments on interurban roads running over highway or private right-of-way, as we know them to-day. As the writer sees the situation, such a discussion at the present time and a clear understanding of the principles involved would save in the near future a considerable investment in costly experimentation on some propositions, the result of which, on general principles, might have been expected beforehand.

Expansion and Changes of Electric Light and Power Systems.

By ALTON D. ADAMS.

EXPANSION of electric systems has been accompanied by constant changes in the character and relation of station equipments and the connected loads. Perhaps none of these changes have been more notable than those in the relations of connected loads to station capacities and operation. During the first decade of electric lighting from public systems the combined capacity of street lamps and commercial lamps and motors was generally less than the capacity of the generating apparatus in stations to which they were connected. This condition continued up to about 1890, but since that year the lamps and motors supplied with energy from public electric systems have shown an almost constantly increasing excess of capacity over that of the generating stations to which they are connected. An illustration of this fact is found in the figures for total generating and connected capacities in the electric lighting systems of Massachusetts in each year, from 1888 to 1900. On June 30, 1888, the total capacity of dynamos in all the electric lighting stations of Massachusetts was 6,842 kw, and on the same date the lamps and electric motors of all sorts connected to these stations had a combined capacity of 6,117 kw. Twelve years later, on June 30, 1900, the generating capacity of the stations had increased to 68,941 kw, or to 10 times the like capacity for the earlier year.

During the same period the combined capacity of lamps and motors supplied from these stations rose to 96,650 kw, or 15.8 times the connected capacity in 1888. The total capacity of connected apparatus was 89.40 per cent. of the station capacity in 1888, but every subsequent year showed an increase of this per cent. and it stood at 140.19 in 1900. In 1888 the maximum load of electrical supply stations might well be the entire connected load of the systems, and as a matter of fact this was often substantially the case. In 1900 a little more than two-thirds of the capacity in lamps and motors connected to the systems was sufficient to tax the generating equipments to their full rating. For example, see the following table:

Kilowatt capacities of dynamos and connected loads of lamps and motors for electrical supply stations in Massachusetts:

Year of June 30.	Dynamo capacities.	Capacities of lamps and motors.	Per cent. of lamp and motor to dynamo capacities.
1888	6,842	6,117	89.40
1889	10,074	9,599	95.28
1890	15,244	14,458	94.84
1891	18,593	20,441	109.93
1892	21,188	25,701	121.30
1893	26,953	30,178	111.96
1894	31,749	38,522	121.33
1895	33,256	44,592	134.00
1896	40,226	54,850	136.35
1897	45,461	64,501	141.88
1898	50,490	73,028	144.63
1899	63,020	83,943	133.20
1900	68,941	96,650	140.19

The great increase of capacity in connected loads compared with dynamo capacities has been made possible mainly by three important factors. These are storage batteries, residence lighting and motor loads. Storage batteries have operated directly to cut down the required capacities of dynamos by carrying a considerable portion of the maximum load. The ultimate effect of storage batteries has obviously been to lengthen the hours of daily and yearly operation for generating apparatus. What storage batteries have done indirectly, residence lighting and motor loads have done directly by demands for energy at times of day when street and business lighting was not required. The increase of average electrical loads since 1888 has probably not been as rapid as the rise of connected loads. This conclusion follows because lamps in residences are in use a smaller average number of hours daily than lamps in business houses, and from the fact that electric motors, though often operated more hours per day than lamps, often run on loads much below their rated capacities. Maximum loads find their limits not in connected lamps and motors, during recent years, but in the capacities of station dynamos and storage batteries. In 1888 the capacity of all connected lamps and motors was less by 10 per cent. than that of the station dynamos by which they were supplied. In 1900 these lamps and motors had a capacity 40 per cent. greater than that of station dynamos.

Storage batteries had not begun to play their part in electrical supply to any considerable extent in 1888, and dynamos alone represented the entire capacity of stations. To have given electric stations capacities the same relation to connected loads in 1900 that they had in 1888, these capacities must have stood at 108,109 kw in the later year. This could have been done with storage batteries capable of discharging during a period of two to three hours at the rate of 39,168 kw, but the capacity of the batteries actually in use seems to have been much below these figures. Though the increase of average loads has fallen behind that of connected loads, it may well have exceeded the rise of maximum loads as indicated by battery and dynamo capacities.

Within electric stations changes have been going on not less marked than the relation of dynamo capacities to outside loads. From 1888 to 1894 the number of engines in the stations of electric lighting systems rose with the sum of their capacities, though not at so rapid a rate. This was the era of comparatively small high-speed engines, each belted to one or two dynamos. During these six years the number of engines rose from 149 to 347, or to 2.3 times that of the former year. Meantime engine capacities went up from 11,515 to 54,729 hp, or 4.7 times the earlier capacity. At the beginning of this period the average rating of each engine was 77 hp, and in 1894 this rating stood at 157 hp. In other words, not only the number of engines, but also their average horse-power more than doubled between 1888 and 1894. Beginning with 1895 a marked change in the engine situation set in. In this year the number of engines showed a decline for the first time during the entire period, though there was a small increase of capacity. This effect was probably due in large part to the introduction of comparatively large engines direct-connected to their dynamos. In 1895 the number of engines in electric lighting stations throughout the State was 319, and stood at 343 in 1900, having touched its highest point, of 352, in 1899. Meantime, the total horse-power of these engines went up from 55,548 in the earlier to 80,115 in the latter year. This increase of engine capacity carried the average horse-power per engine up from 174 in 1895, to 248 in 1900. During the twelve years between 1888 and 1900 the number of engines was multiplied by 2.3, the average horse-power by 3.2, and the total horse-power by nearly 7. Dynamos in electric lighting stations began to decline as to numbers after 1893 and again after 1897, having gained nearly 50 per cent. between these years. In 1897 the figures for dynamos had advanced to 975 from 348, in 1888, but by 1900 this maximum had fallen to 827. Total dynamo capacities exhibit an unbroken advance from 1888 to 1900, and this is also true of average capacities, except for the years of 1896 and 1897.

Numbers and capacities of engines in private electric lighting stations of Massachusetts:

Year of June 30.	Number of engines.	Total horse-power of engines.	Average horse-power of engines.
1888	140	11,515	77.3
1889	199	18,752	94.2
1890	254	27,199	107.0
1891	280	34,453	123.0
1892	309	41,499	134.3
1893	333	50,739	152.3
1894	347	54,729	157.7
1895	319	55,548	174.1
1896	325	60,868	187.1
1897	340	64,527	189.8
1898	348	66,468	191.0
1899	352	77,439	219.9
1900	343	80,115	248.1

From 1888 to 1900 the number of dynamos grew from 348 to 827, or to 2.4 times the former figure. Meantime, average dynamo capacity was multiplied 4.3 times, and total capacity of dynamos in lighting stations ten times. As in the case of engines, the reduction in the total number of dynamos, in spite of rapidly rising combined capacity, was largely due to the substitution of direct-connected for smaller belted units. In dynamos and engines now used to carry much the greater part of lighting and stationary motor loads, the reduction of numbers has been much greater, and the increase of average capacities more marked than the table indicates. This fact results from a practice by which, when large direct-connected units are installed, the smaller engines and dynamos formerly used are retained for occasional service.

Numbers and capacities of dynamos in private electric lighting stations:

Year of June 30.	Number of dynamos.	Total kilowatts of dynamos.	Average kilowatts of dynamos.
1888	348	6,842	19.6
1889	458	10,074	22.0
1890	635	15,244	24.0
1891	647	18,593	28.7
1892	723	21,188	29.3
1893	846	26,953	31.8
1894	659	31,749	48.2
1895	669	33,256	49.7
1896	816	40,226	49.3
1897	975	45,461	46.6
1898	892	50,490	56.6
1899	889	63,020	70.9
1900	827	68,941	83.3

An extreme illustration of this point may be noted in the case of the Boston Edison Company. For the year of 1900 this company had in its stations 38 engines and 76 dynamos. As a matter of operation, however, all except a very small part of the energy output of the company during that year was developed at one of its stations by 7 engines and 12 direct-connected dynamos. Two marked changes took place between 1888 and 1900 in the ratio of total dynamo to total engine capacities. To bring out these changes the kilowatts of total dynamo capacity in each year are reduced to horse-power by division with the factor 0.746. Comparing the horse-power capacities of engines and dynamos for the year of 1888, it seems that the latter was only 79.6 per cent. of the former.

The ratio of dynamo to engine capacity fell from the figure just named to 68.4 per cent., in 1892; from this point it rapidly rose to 115.3 per cent. in 1900. These changes have, no doubt, had an important influence on the efficiencies of electric stations. At best, dynamos must operate during quite a portion of their running time on much less than full loads, and this is especially true when few, if any, storage batteries are in use as was the case in 1888 to 1892. If dynamos at full load require only 68.4 per cent. of the rated capacities of their engines, these dynamos on their actual average loads probably require much less than one-half of the power than engines can deliver when working at their points of highest efficiency.

A result of these conditions can hardly fail to be a low efficiency of operation. The marked rise in the ratio of dynamo to engine capacities since 1892 has been mainly due to two causes: the extended use of water power with electric stations, and a better proportion of dynamo to engine ratings. Since the year just named, the proportion of dynamo to engine ratings has increased by $(115.3 - 68.4) \div 68.4 = 68$ per cent. While a part of this increase has been due to the extended application of water power, it seems that a still larger part is the result of better proportions between engines and their driven dynamos. It might be expected that the gradual substitution of large direct-connected units for belt-driven dynamos would work a reduction in the ratio of dynamo to engine numbers.

Ratio of dynamo numbers and capacity to engine numbers and capacity:

Year of June 30.	Horse-power of all dynamos.	Per cent. of dynamos to engine capacity.	Average number dynamos to each engine.
1888	9,171	79.6	2.3
1889	13,504	72.0	2.3
1890	20,434	75.1	2.5
1891	24,923	72.3	2.3
1892	28,402	68.4	2.3
1893	36,130	71.1	2.5
1894	42,558	77.7	1.9
1895	44,579	80.2	2.1
1896	53,922	88.5	2.5
1897	60,403	93.6	2.8
1898	67,680	101.8	2.5
1899	84,477	109.0	2.5
1900	92,414	115.3	2.4

The retention of old machines, however, has held the ratio of dynamos to engines between 1.9 and 2.8.

Changes in the relative capacities of arc lamps, incandescent lamps and motors that went to make up the total connected loads have been second in importance only to the combined increase of these loads. In 1888 the capacity of loads connected to electric lighting stations was 2,631 kw for arc lamps, 2,872 kw for incandescent lamps, and 614 kw for motors. Arc lamps thus represented 43 per cent., incandescent lamps 46.9 per cent., and motors 10 per cent. of the total connected capacity. In marked contrast with these figures, the total connected load for 1900 was made up as to capacity of 9.6 per cent. in arc lamps, 62.2 per cent. in incandescent lamps, and 28 per cent. in motors.

Kilowatts of connected lamps and motors in each year:

Year of June 30.	Total for arc lamps.	Total for incandescent lamps.	Total for motors.
1888	2631	2,871	614
1889	3530	4,646	1,422
1890	3999	7,735	2,723
1891	4747	10,443	5,250
1892	5638	14,577	5,485
1893	6233	17,097	6,848
1894	6640	22,937	8,944
1895	6925	26,742	10,924
1896	7485	33,435	13,930
1897	7811	40,371	16,318
1898	7938	46,159	18,930
1899	8501	52,702	22,740
1900	9342	60,175	27,133

During the twelve years in question, the total connected load grew to 15.6 times, the arc load to 3.5 times, the incandescent load to 20.9 times and the motor load to 44.1 times that at the beginning. For the year of 1900 arc lamps represented only 0.22 times, while incandescent lamps had 1.3 times and motors 2.8 times their per cent. of total connected capacity in 1888. Between 1888 and 1900 arc lamps lost 33.4 per cent. of connected load capacity. Of this loss, incandescent lamps gained 15.3 per cent. and motors 18 per cent. of the total connected capacity. Arc lamps show an uninterrupted decline in their share of the total load capacity during the entire period. Incandescent lamp capacities either gained or held their own up to 1898, except for the year of 1891.

Per cent. of total load capacity in arc lamps, incandescent lamps and motors for each year:

Year of June 30.	Per cent. in motors.	Per cent. in arc lamps.	Per cent. incandescent lamps.
1888	10.0	43.0	46.9
1889	14.8	36.7	48.4
1890	18.8	27.6	53.5
1891	25.6	23.2	51.0
1892	21.3	21.9	56.7
1893	22.6	20.6	56.6
1894	23.2	17.2	59.5
1895	24.4	15.5	59.9
1896	25.3	13.6	60.9
1897	25.2	12.1	62.5
1898	25.0	10.8	63.2
1899	27.0	10.1	62.7
1900	28.0	9.6	62.2

Since 1898 incandescent lamps have lost 1 per cent. in their ratio to total connected capacity. In contrast with arc lamps, electric motors show a continuous rise in their per cent. of total connected capacity for every year, save 1892 and 1897. During the four years between 1888 and 1892 the ratio of arc lamps to total load capacity was reduced one-half, the like ratio for electric motors more than doubled, and incandescent lamps gained 10 per cent. on total capacity. In 1888 the capacity of connected incandescent lamps was a little greater than that of arcs, and nearly five times the capacity of motors. In 1900 arc lamps supplied less than one-sixth, and motors a little under one-half as much of the connected load as incandescent lamps.

In 1894 the capacity of incandescent lamps and motors connected to electric stations was 31,881 kw. while the total dynamo capacity was 31,749, so the connected load exceeded the generating capacity at stations by more than the 6,640 kw of arc lamps. By the middle of 1895 the connected load exceeded the dynamo capacity by more than the kilowatts of connected motors. For all except one of the five following years the sum of capacities of arc and incandescent lamps has been greater than the dynamo capacity. In 1900 the excess of connected loads over dynamo capacities was 27,709 kw. The existence of these facts brings out strongly the tendency during the decade to broaden out the loads of electrical systems over a larger part of each day.

Differences of kilowatt capacities of connected lamps and motors and the capacities of dynamos at electric stations:

Year of June 30.	Kilowatts excess of connected load.	Kilowatts excess of dynamos.
1888	......	725
1889	......	475
1890	......	786
1891	1,848	...
1892	4,513	...
1893	3,225	...
1894	6,773	...
1895	11,336	...
1896	14,624	...
1897	19,040	...
1898	22,538	...
1899	20,923	...
1900	27,709	...

That there was great expansion in the amount of electrical service during the period under consideration is certain; but it is no easy matter to determine just how much the sales of electrical energy went up. Measured by total energy income, electrical service increased from a value of $1,908,394 in 1890 to $5,622,556.43 in 1900, or to 2.94 times the former amount. This increase of income, however, cannot be taken as a true measure of the rise in amount of electrical energy supplied, because, as has been shown elsewhere, there was a consiedrable decline of prices during the decade. If, on the other hand, the kilowatts of connected capacity in lamps and motors are taken as a direct measure of the energy supplied in each year, the result will be in error, because the yearly output of energy per unit of connected capacity in lamps and motors has declined during the period. Since prices for electrical energy have declined, the increase of energy sold must be greater than the increase of energy income. It follows that the sales of energy in 1900 were more than 2.94 times the like sales in 1890. The kilowatt capacity of all connected lamps and motors was 6.68 times as great in 1900 as in 1890, but the ratio of energy outputs must have been somewhat less than this number for these two years. It thus seems clear that the kilowatt-hours sold by electric lighting systems were somewhere between 2.94 times and 6.68 times as great in 1900 as they were in 1890. With constant prices per kilowatt-hour, the income per kilowatt capacity of connected lamps and motors would vary directly with the number of hours of yearly service for each connected unit at its full capacity. As prices have, in fact, been falling, the hours of yearly service for each unit of connected capacity have not decreased as fast as the income per unit of this capacity. In 1890 the energy income of electrical systems was $131.99 per unit of capacity in connected lamps and motors, but for 1900 this income fell to $58.17, or 0.44 of the like income in the former year. From this it appears that the average yearly hours of service for each kilowatt of connected capacity were more than 0.44 times as great in 1900 as in 1890.

Income from sales of electrical energy per kilowatt of capacity in connected lamps and motors:

Year of June 30.	Total energy income.	Income per kilowatt capacity.
1890	$1,908,394.00	$131.99
1891	2,432,869.15	119.01
1892	2,947,199.64	114.65
1893	3,427,576.84	113.59
1894	3,693,056.92	95.86
1895	3,794,060.41	85.08
1896	4,148,681.71	75.63
1897	4,467,146.60	69.25
1898	4,775,316.07	65.39
1899	5,046,412.75	60.11
1900	5,622,556.43	58.17

Energy income per kilowatt capacity of arc lamps, of incandescent lamps and of motors, connected to electrical supply systems:

Year of June 30.	Income for arc lamps.	Income for incandescent lamps.	Income for motors.
1896	$226.15	$57.98	$37.13
1897	224.66	52.54	36.20
1898	228.30	50.39	33.64
1899	212.68	47.64	31.98
1900	199.90	48.46	30.90

Arc lamps, incandescent lamps and motors show widely different yearly incomes per kilowatt of their connected capacities. In 1896 the $226.15 received for each kilowatt of capacity in arc lamps was 3.9 times the $57.98 received per like capacity in incandescent lamps, and 6.1 times the $37.13 received for each kilowatt of connected motors.

For the year of 1900, when one kilowatt of capacity in arc lamps earned $199.90, the same capacity in connected incandescent lamps earned $48.46, or 28.2 per cent. of the amount received from arcs, while one kilowatt of connected motor capacity brought an average income of only $30.90, or 15.4 per cent. of the income from the same capacity in arcs. The high rate of earning capacity shown for arc lamps is, no doubt, due in part to higher prices for this than for the other classes of service. A more important reason for the higher income per unit of capacity in arcs exists in their longer hours of average yearly service, compared with incandescent lamps and motors. It should be noted that arc and incandescent lamps usually operate at about full capacity when in service, while for motors this is not true. Motors usually operate more hours daily than do incandescent lamps, but during much of the time carry only fractions of their rated loads. It seems probable, however, that the hours of service for motors, reduced to terms of full rated load, would probably be as great in number as the hours for incandescent lamps. To compute the capacities of the electric lamps here considered, 60 watts are allowed for each commercial incandescent lamp, 90 watts for each incandescent street lamp and 400 watts for each arc lamp of any sort, in every year. It is believed that these factors are sufficiently near the truth to warrant the foregoing conclusions as to kilowatts of capacity in connected loads.

Thirty Years of Telegraphy and Allied Arts.

By Francis W. Jones.

The achievements of brains, capital and labor in the domain of electricity, to which subject this journal has been devoted for thirty years, would be impossible to review even as a condensed summary in a single special number of it, unless it were unduly enlarged to the proportions of a library. Such a complete review, however, is unnecessary, as the Electrical World and Engineer during this period is accessible, and its records of passing events have been very full and accurate. These records have had much more than a passive value: they have been continuously most potent aids and stimulants to its readers who were employed in the application of electricity to some useful purpose, and invaluable to teachers engaged in imparting correct information to pupils. It is only by comparison that an idea is formed of dimensions, and no doubt its review will bring into bold relief the astounding developments of the thirty pregnant years during which it has been our good fortune to live.

At the time this journal started, electricity was only utilized for telegraphy, fire alarm systems and for house bells. True, that up to 1874, sporadic attempts had been made to establish an electric light, dating back to Volta's great invention of the Voltaic battery, notably by Deleuil and Archereau in 1841, Dubosq, 1846, Staite, 1847, Cassagnes and Thiers, 1855, and last, but no least, Gramme in 1870: but at that time it had not doffed its swaddling clothes. The Electrical World and Engineer has had the privilege to record many notable inventions.

In 1874 there had been laid, in various countries, 215 cables of a total of 47,000 miles. Many were unworkable. Now there are 266,153 statute miles of working deep-sea cables, and the speed of transmission which, in 1874 was about 15 words per minute through an Atlantic cable, has now reached 47.4 words per minute over the Anglo 1894 cable 2,132 miles long, and 40 words per minute over the Commercial's 1894 cable 2,491 miles long. These number of words per minute have been more than doubled by use of the duplex upon each of the cables named: the duplex (which was introduced since 1874) being able to more than double the speed, because no switches have to be turned nor keys opened, and the readable character of the signals greatly improved by the employment of automatic transmission.

In this country, the growth of the telegraph during thirty years cannot be accurately stated. The Western Union Telegraph Company in 1874 had 175,735 miles of land wires, in addition to which were a few thousand miles of wires owned by railroads and small competing companies. In 1904 there are over 1,400,000 miles of aerial wires, not including railroads, devoted to commercial use in the United States.

In 1877 the telephone began its development, which has been phenomenal, and it has practically supplanted the telegraph in all urban communication, besides creating a tremendous business of its own, both urban and interurban, peculiar to its extreme simplicity and absence of skill in operation.

Notwithstanding the introduction of the telephone into the field of telegraphy in 1877 in this country, the mileage of telegraph wires has grown 1,200,000 miles, with an increase in ordinary telegrams of about 50 millions. Great improvement has been effected in the character and stability of poles, fixtures and wires, until now the cutting off of the principal commercial cities from each other by storms is rarely experienced, whereas, thirty years ago, it was a frequent occurrence for the telegraph company to forward large packages of delayed telegrams by train to points beyond the breaks caused by winds and sleets.

The development of Edison's quadruplex system, which is largely used, Baudot's and Delany's multiplex synchronous systems for land wires, are notable matters of record. These systems afford the present maximum traffic possibilities over a single wire, unless we except the older automatic system of Wheatstone, which has only a limited use both here and abroad. Gradual and important improvements have been made in all classes of apparatus, in wiring and switching systems.

No imagination can picture what this journal will record in 1924, on the occasion of its semi-centennial celebration or jubilee.

I have not alluded to the birth of the Edison phonograph, the first public exhibition of which I had the honor to make at 455 Madison Street, Chicago, from July 3 to 9, 1878, and then in the other largest Illinois cities; nor of the Edison incandescent lamp and the wonderful system of distribution developed at Menlo Park in 1879 and the early part of 1880. I had the honor also of being the expert employed by the syndicate of capitalists behind Edison in the early fall of 1880, to advise them if the lamp, with the carbonized cotton filament, would probably warrant them putting up money to go into competition with gas. Although my humble advice was favorable, I confess I had no dream that within twenty-four years the lamps would outnumber the stars over the entire civilized globe. Not even such a thing was foreshadowed in the then current numbers of this journal.

The Diversity of Electrical Development.

By Schuyler Skaats Wheeler.

It is not possible, in my opinion, to point out any one event of special separate importance connected with the electrical developments during the last thirty years, which is the period covered by the existence of your journal, inasmuch as so many wonderful things have been accomplished. In fact, the lifetime of your paper covers the entire electrical era.

I believe that electricity's wonderful industrial advance is particularly due to the invention and development of many different things, which though entirely dissimilar, have co-operated remarkably in stimulating the use each of the other.

The incandescent lamp, the dynamo, the constant potential system, the motor, the telephone, the telegraph, electric traction, wireless telegraphy, the turbine, the remodeling of all kinds of machinery for the use of the motor—who can say which of these has been the most important? I believe that each one has been important and that all of the others have been promoted by its success. By its drawing the public attention to the facilities of electricity, all of the others have been promoted by its success. In other words, I think that the field of electrical industries is remarkable for the extent to which inventions and successes that have nothing to do with other inventions have helped the latter by adding to the advancement of the entire field.

Our industry has one peculiarity which I think is interesting, namely, the remarkable extent to which the layman feels compelled to hold aloof from active participation in its practical work, believing that he is incapable of coping with so mysterious a subject. The fact that the industry as a whole has now become one of the leading departments of human endeavor, being one in which immense capital and millions of people are employed, makes it general and not a limited specialty, and yet all outsiders and many of those actually employed by it, feel that they can have very little to do with the practical part, a condition which I believe does not exist in any other line of work that has reached similar magnitude. On a pinch anybody will repair a steam or gas pipe. Who will repair an electric wire?

The Place of the Storage Battery in the Art.

By Charles Blizard.

In response to your kind intimation, I beg to express the opinion that the improvements embodied in the storage battery of to-day—most largely responsible for the conspicuous position it fills in the electrical field, are those which enable it to successfully withstand the high rates of discharge and to give satisfactory life and service in the hands of attendants who are not battery experts.

Without the ability to meet sudden excessive demands for power, the storage battery could not fill the requirements of several classes of application in which it is now prominent; and it would also lose much of its value as a reserve. If it could be successfully operated only by those who had especially fitted themselves for its care, its field would be comparatively limited.

Not until the storage battery had fully demonstrated that it possessed these essentials to success did its use become general. The lack of these qualities was the heaviest handicap on the storage battery of fifteen years ago.

Improvements recently made in the storage battery will further increase its life and reduce the amount of attention required.

A Review of Twenty-Five Years of Telephony.

By ARTHUR VAUGHAN ABBOTT, C. E.

THE latter part of the nineteenth century, and the first quarter of the twentieth, may be called the "Age of Transportation," because during this period greater changes in the arts of intercommunication have occurred than during any previous epoch. These improvements have been accomplished by the aid of electricity, and this agent is further responsible for a completely new method of intercommunication which has already revolutionized modern business, and bids fair to be even a more potent factor in the future. This is the art of *selling conversational facilities* or *telephony*. The ELECTRICAL WORLD AND ENGINEER was about two and a half years old when at the Centennial Exposition of 1876, the telephone was "born." In the beginning it was regarded as a mere mechanical toy, curious perhaps, but of no practical value. To-day, in the United States, there are over three million telephone subscribers, whose daily conversations, over the wire, aggregate twenty millions, while the world numbers twice as many more. In the business of "conversation traffic" hundreds of millions are invested, tens of thousands of employees daily engaged, and thousands of companies find their sole occupation.

Like other enterprises having a scientific basis, there have been two phases of development—the engineering aspect, and the commercial one. From the engineer's standpoint the invention of the magneto telephone formed the keystone upon which all subsequent development rested, and while too much cannot be said of the genius of Professor Graham Bell in solving the problem of the electrical transmission of speech, many other inventions were necessary to render the telephonic systems of to-day possibilities. While the magneto proved itself so efficient a receiver that the original model survives, it failed as a transmitter, and the second step was the invention of the carbon battery transmitter of Edison and others. In this electricians broke away from the idea of utilizing the feeble energy of vocal sound waves as the source of power, and supplied

The Telephone.

THE proprietors of the Telephone, the invention of Alexander Graham Bell, for which patents have been issued by the United States and Great Britain, are now prepared to furnish Telephones for the transmission of articulate speech through instruments not more than twenty miles apart. Conversation can be easily carried on after slight practice and with the occasional repetition of a word or sentence. On first listening to the Telephone, though the sound is perfectly audible, the articulation seems to be indistinct; but after a few trials the ear becomes accustomed to the peculiar sound and finds little difficulty in understanding the words.

The Telephone should be set in a quiet place, where there is no noise which would interrupt ordinary conversation.

The advantages of the Telephone over the Telegraph for local business are

1st. That no skilled operator is required, but direct communication may be had by speech without the intervention of a third person.

2d. That the communication is much more rapid, the average number of words transmitted a minute by Morse Sounder being from fifteen to twenty, by Telephone from one to two hundred.

3d. That no expense is required either for its operation, maintenance, or repair. It needs no battery, and has no complicated machinery. It is unsurpassed for economy and simplicity.

The Terms for leasing two Telephones for social purposes connecting a dwelling-house with any other building will be $20 a year, for business purposes $40 a year, payable semiannually in advance, with the cost of expressage from Boston, New York, Cincinnati, Chicago, St Louis, or San Francisco. The instruments will be kept in good working order by the lessors, free of expense, except from injuries resulting from great carelessness.

Several Telephones can be placed on the same line at an additional rental of $10 for each instrument, but the use of more than two on the same line where privacy is required is not advised. Any person within ordinary hearing distance can hear the voice calling through the Telephone. If a louder call is required one can be furnished for $5.

Telegraph lines will be constructed by the proprietors if desired. The price will vary from $100 to $150 a mile; any good mechanic can construct a line; No. 9 wire costs 8½ cents a pound, 320 pounds to the mile; 34 insulators at 25 cents each; the price of poles and setting varies in every locality; stringing wire $5 per mile; sundries $10 per mile.

Parties leasing the Telephones incur no expense beyond the annual rental and the repair of the line wire. On the following pages are extracts from the Press and other sources relating to the Telephone.

GARDINER G. HUBBARD.

CAMBRIDGE, MASS., May, 1877.

For further information and orders address

THOS. A. WATSON, 109 COURT ST., BOSTON.

FIRST CIRCULAR EVER ISSUED FOR TELEPHONE BUSINESS.
(Reduced Fac Simile of Original in Possession of T. C. Martin.)

the transmitter with a battery, capable of furnishing energy, employing the sound waves simply to actuate a releasing mechanism to regulate the battery discharge. The use of a battery necessitated some means whereby its circuit could be closed and opened whenever the telephone was placed in, or out of service. To rely upon a manual switch, dependent on the fallible memory of the subscriber, was impractical and the invention of the *"hook switch"* made the commercial use of the battery transmitter possible.

The next problem was a sub-station signal, for at best the voice of the receiver was too feeble to attract attention. Batteries and vibrating bells gave no end of bother, but the *"magneto bell"* and *"hand generator"* have proved so satisfactory a solution that no one proposes a better. Growing demand showed electricians that the time was at hand when the lines of many users must be concentrated at a single point. How to quickly and surely interconnect various wires became the next question, which was answered by the invention of the *"spring jack."* From time to time improvements in methods of jack manufacture, or economy of space, have arisen, but the jack as a piece of apparatus has survived unchanged, nor does it seem that the near future will offer any substitute.

Soon it became impractical to place before a single attendant a sufficient number of jacks to care for all lines of even a small territory, so section after section of switchboard was required. To connect the wires in one with those of another, local circuits were devised, but this rendered operating slow and cumbersome. The invention of the *"multiple switchboard,"* whereby the line of every subscriber is carried through a multiplicity of jacks so that each attendant can reach the line of every one, marked a vital advance.

For the first decade, the wire plant consisted solely of aerial grounded lines of iron wire, but its objectionable magnetic characteristics, together with rapidly increasing introduction of other electrical industries made it imperative to improve the conducting system. First came the invention *"hard drawn copper wire,"* rendering it possible to build open wire lines of much better conductivity, having no objectionable magnetic characteristics; and the substitution of the complete *"metallic circuit"* removed inductive difficulties. Then came the *"paper cable"* into whose leaden embrace two or three hundred circuits can be packed in a space of four or five square inches, and as a sequence the *"underground conduit."*

To economize installation expense several stations were connected to a single line, but transmission limits were soon reached, as it was impossible to talk through the impedance of the bell magnets. The *"bridging bell"* wound to give too great an impedance to sensibly divert the high frequencies of voice currents, enabled ringers to be placed as shunts and made the *"party line"* a success.

For many years, at the central office, the old-fashioned drop reigned supreme as the subscriber's signal, but presently the demand for quicker service required a means more salient, and completely automatic, and the *"incandescent lamp"* and *"bridging board"* replaced the old series multiple. The local battery presented a stupendous problem. In Greater New York upwards of a hundred thousands stations exist. Consider the task of making eight hundred thousand or a million battery renewals per annum in one city. The solution was the *"common battery"* system, whereby each central office supplies electricity for all subscribers.

With the growth of the art came the demand to talk over greater distances. Boston must speak to Chicago and San Francisco; New York desires to talk with London, but the electrical characteristics of even the most heavily coppered aerial lines place the barrier to commercial transmission at about 1,000 miles of open wire, while but a fraction of this distance through submarine cable is practical. To the electrical engineer there is no such word as "fail," and the *"loaded line"* in which objectionable inductance is made to counterbalance and neutralize equally destructive capacity, has produced a circuit whereby even trans-oceanic telephony seems within grasp.

Turning from the engineering to the business aspect, the sagacity which has constructed the present telephone system is equally wonderful. The fundamental patents of the magneto telephone were secured by the original Bell Telephone Company, which through various organizational permutations and combinations has been known successively as the American Bell Telephone Company and the American Telephone and Telegraph Company. The original policy was to control the manufacture of telephonic apparatus, and to rent the same to those who desired to use it. So the parent company succeeded in building up in nearly all our cities and in many European ones, operating corporations whose business it was to *sell service*. As to the policy pursued there may be many, and very honest differences of opinion; to err is human. It would be impossible to expect such an organization to conduct for a quarter of a century its business to the liking of every one, but, however, much one may disagree with many of the methods adopted, no one can fail to admire the skill and tact which conceived and executed the plan that successfully welded together hundreds of diverse organizations.

It was natural at the outset to adopt the plan of renting telephonic instruments, and if the early idea of only leasing them had been adhered to, allowing those who obtain them to serve themselves, the flat rate charge would be legitimate. But telephone companies became operators. They not only manufactured apparatus but furnished service, so now the supply of apparatus is but a small portion of the real business. What the telephone company offers is the transportation of intelligence. To charge each subscriber $50 per year for a telephone is as absurd as for a railway company to charge each of its freight customers $1,000 per year for a locomotive. One of the most significant steps in telephonic policy is the adoption of "measured service," whereby the subscriber is billed at a certain rate for every message transmitted. To-day the unit of charge is the call. That this is more equitable than any flat rate system is obvious, but it is equally plain that the call is not a true unit. It is unfair to charge a man who talks ten minutes the same price as one who talks one. It is equally unfair to charge one customer the same rate for a message transmitted one mile as is made to another who talks ten miles. Toll service early recognized this fallacy and toll charges are based both upon mileage and time. While to adopt a similar system for ordinary city exchanges may tax the ingenuity of the auditor, it is a reform which sooner or later will appear.

Half a dozen years ago the fundamental patents expired, and the field became open to all. Stimulated by the success of telephony, hosts of inventors and investors hastened to avail themselves of the opportunity. Naturally all who had from time to time disagreed with the policy of the older company arrayed themselves upon the other side; some thousands of "Independent" organizations have appeared, and several hundred "Independent" manufacturers of apparatus are at work. Within a decade the number of telephonic subscribers have been quintupled, of which the "Independents" claim about half.

What of the future? First and foremost is the certainty that the enormous growth of the past will continue, though probably at a decreasing rate. In the United States there are upwards of twenty million families, and at least five million places of business, making a total of twenty-five million opportunities to install telephones. Of these about one-eighth are now equipped; the others must be provided for, and it will tax the resources of manufacturers, operators and financiers to do it.

During early telephonic days the art was entirely experimental. It was necessary to expend millions of dollars in learning how telephone exchanges should be built. To-day many of lessons have been learned, apparatus is rapidly becaming standardized, telephonic engineers know what and how to construct. Consequently, annual allowances for maintenance and depreciation can be reduced, with a corresponding decrease in the cost of service. Improvements in manufacturing methods cheapen apparatus with a similar result, and as the price for telephonic intercommunication falls, the zone over which telephones may be distributed extends. As more and more people obtain telephones, the telephonic habit grows, for traffic breeds traffic. To-day no business house can afford to be without a telephone and shortly no residence can, so he who runs may read the prophecy for the future.

A significant tendency is the adoption of mechanical appliances in the operating room. The lamp signal removed the manual drop. Machine ringing has relegated the manual ringing key to the scrap heap; self-ejecting plugs are possibilities, and many inventors have proposed, and with some degree of success, operatorless exchanges. In a general way the tendency of the telephone company is to relieve the subscriber of all work and to concentrate every function in the exchange. This appears incompatible with the automatic switchboard, which necessarily must inflict a greater burden upon the subscriber. But the automatic exchange may, and probably will, have a certain and very wide field. To expect the business man to operate a series of levers, or dials to call a subscriber, when he can pick up a receiver and tell his private exchange operator just what he wants, is folly. It is equally foolish to require the Chinese laundry, the corner grocery and the tenement house to pay the rate required by the service needed on Wall street or Broadway. It appears quite possible that some form of automatic exchange may be devised, which will be installed in certain zones of the larger cities, and be entirely adequate for the smaller towns and villages. Such automatic exchanges will work in conjunction with manual exchanges in such a manner that service may be graded to fit the customers to which it is addressed. This is as logical a proposition as for a railway to run Pullman cars, day coaches and immigrant trains. But it would be equally illogical to force all passengers into one train. The service must fit the customer.

The field of the telephone is by no means exhausted. The Electrical World and Engineer has suggested the telephonic transmission of money orders; witnesses are examined and depositions taken telephonically; it is veraciously reported that several engagements and some marriages have thus been consummated; but so far there have been no divorces and no executions by it; so there are yet many opportunities to develop the business in ways perhaps now unexpected.

A keen competition is often regarded as a business blessing; and, so far, telephonic competition has been by no means an unmixed evil. But telephony differs from other commercial undertakings. Usually a wholesale business is cheaper per unit than a retail one, but such is not the case in telephony, for the cost per subscriber in a 10,000 line exchange is greater than in one of 1,000 subscribers. It would not be considered desirable to have two rival post offices, and telephonic service resembles postal service. If there are two telephone companies in one city, either both must interchange messages, or else the subscribers, to get complete facilities, must have two telephones. If the latter, installation costs are doubled, for there are twice as many sub-station instruments, and twice as much wire plant. Hence the cost of service is augmented, for in the end the community pays all the costs and all the profits of running two companies. What shall the solution be? Is it to be municipal or governmental operation like the post office? Will legislation force all telephone companies to interchange all messages? Shall a Utopian state of affairs arise in which one company will so adjust rates as to pay reasonable operating expenses, legal interest on unwatered capital, and no more? or may some form of co-operative ownership be devised in which each subscriber is a stockholder and annually receives any surplus over operating expense? *Quien Sabe.*

The Evolution of the Enclosed Arc Lamp.

By L. B. Marks.

The enclosed arc lamp of commerce dates from the year 1894. For fifteen years prior to that time the open arc held sway. A glance at the arc lamp statistics shows that there was a sudden turning point in the evolution of the arc lamp. The enclosed arc, as if by magic, ousted its predecessor and gave a remarkable impetus to the introduction of arcs, particularly on constant potential circuits.

The question has often been asked, "What was it that brought about this sudden introduction of the enclosed arc lamp?" Was there any new discovery or invention that made possible what formerly had not been accomplished? Surely a host of inventors, both in the United States and abroad, had experimented with the enclosed globe arc lamps ever since the earliest days of arc lighting. The records of the Patent Office will attest this fact. There are some who think that the enclosed arc lamp is simply an outgrowth of the development of carbons—that if we had had a satisfactory carbon in the early days of arc lighting, the open arc would never have held sway so long.

Now, as a matter of fact, satisfactory carbons were on the market continuously for many years prior to the advent of the modern enclosed arc lamp. The price of these carbons was naturally higher than it is now, but not prohibitively high. In some of my work in arc lighting years before the first commercial enclosed arc made its appearance I employed very pure carbons that were admirably suited for use in the modern enclosed lamp. These carbons were manufactured in this country and were sold at a price not exceeding the present price of good imported carbons.

Those who are familiar with the steps in the evolution of the enclosed arc lamp of commerce know that this type of lamp was made possible by the discovery that when an arc is enclosed in a small globe having suitably restricted air inlet, a long arc of abnormal voltage may be steadily maintained by a small current—a condition impossible in free or open arcs. This discovery was followed up by the construction of a lamp that would strike a long arc and maintain it under the proper conditions. Herein, then, lay the secret of the modern enclosed arc lamp. Broadly speaking, that secret was not in the carbon, but in the arc. The solution of the problem, therefore, involved, first, a method of operation, and, second, an apparatus for carrying out that method. So far as the records go, neither the method nor the apparatus was known to the world prior to the year 1893. Once these features were given to the art, the commercial enclosed arc lamp became an accomplished fact.

The First Commercial Electric Street Railway in America.

WHAT a marvelously brief period has sufficed to establish electrical power in full possession of the field of urban passenger traffic, receives a striking illustration in the fact that to a man, to-day but in his fortieth year, belongs the honor of having personally guided the first electric motor for street traffic put in practical commercial service in this country.

The event which marked an epoch in the solution of the problem of the application of electricity to the purposes of passenger traction occurred in the city of Baltimore and the man who stood at the controller of the first practical electric locomotive taking its power from the now familiar third rail, was Guy M. Gest, now a prominent electric subway contractor of New York and Cincinnati, who prizes above all other honors he has won in a career devoted to the development of electric subway work, his undisputed right to the title of "The Father of Motormen," who in spite of his youth now numbers his "sons" by the hundred thousands. The very name "motorman," now so convenient and familiar, had not yet been

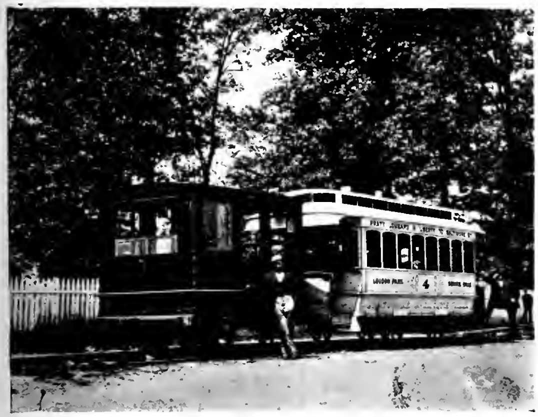


FIG. 1.—DAFT ELECTRIC STREET RAILWAY LOCOMOTIVE.

invented when Mr. Gest piloted the first train of electrically-propelled cars through the streets of Baltimore, his function on that historic occasion being described in the newspapers of the day as that of "engineer."

In connection with this historical performance it is interesting to note that the third rail from which the car derived its power, while laid on the surface between the wheel tracks was so protected from any accidental external contact as to make it practically identical in principle with the modern conduit system supplanting in urban practice the overhead trolley wire, which was the immediate successor of the original third-rail device, thus offering another example of the familiar tendency to a reversion to first principles.

To Mr. Thomas C. Robbins, General Manager of the Union Passenger Railway of Baltimore, belongs the credit of having first recognized the possibility of the successful application of electricity to the solution of the problem of street car propulsion and it seems to have been peculiarly appropriate that the practical demonstration of the correctness of Mr. Robbins' judgment should have been made in the same city which witnessed the first practical test of telegraphy, on May 1, 1841, just forty years earlier. It is also appropriate that the first practical electric motor should have borne the illustrious name of "Morse," the inventor of the electric telegraph.

Electric traction had not yet emerged from the stage of experiment when Mr. Robbins cast about for some efficient substitute for horse power in the operation of his lines and his attention was first called to the startling possibilities of electricity by the performance of a lilliputian exhibition railroad that formed one of the amusement features of Coney Island in the summer of 1884. He consulted with Mr. Daft, the inventor for the Daft Electric Company, of Greenville, N. J., who went to Baltimore, and after a careful examination of the road, declared that there could be no question

FIG. 2.—WYETH SWITCH, DAFT THIRD-RAIL ROAD, BALTIMORE.

of the entire practicability of Mr. Robbins' plan. A contract for the installation of a power plant and the construction of motors was at once entered into, and while two motors were under construction in the shops of the Daft Electric Company at Greenville, under the supervision of Mr. G. W. Mansfield, a power house was erected, adjoining the car stables, equipped with a 75-hp engine and a 50-hp dynamo. The preparation of the track and the laying of the protected third rail and wire connections were undertaken under the direct personal supervision of Mr. H. A. Foster, of the Daft Company. How well the whole work of construction and equipment was performed was fully attested by the complete success, not only of the first trials, but of the subsequent operation of the road. Simultaneously with the completion of the power-house and the track the Daft Company was ready to put into service the pioneer motor, or car, as it was more usually termed in those days, the "Morse" and its companion the "Benjamin Franklin."

There is a quaint flavor of simplicity attaching to the description of this historic machine published in the *Morning Herald* of Baltimore of August 10, 1885, which makes it well worthy of reproduction. Referring to the wonderful "electric engine" the reporter who attended the trial writes: "This is a plain little caboose,

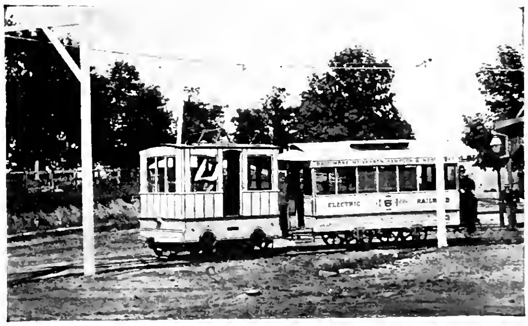


FIG. 3.—DAFT UNDERRUNNING TROLLEY, BALTIMORE, MD.

weighing, with armature, only 4,500 pounds. It is about 8 ft. long and 4 ft. wide and the roof is only 9 ft. from the ground. From the center of this motor, which has been named the 'Morse,' hangs a little brass wheel called the 'contact wheel.' It runs entirely on the center rail, taking up the current of electricity and conveying it into the armature in the forward end of the motor. The current of electricity is administered to the center rail from the dynamo generator in the engine-house by means of copper wires When the contact wheel takes it up from the center rail the armature at once becomes 'excited' and the motive power is transmitted to the axle by means of gearing, and the wheels of the motor are thus thrown into motion. Through the outside wheels the current is then returned to the dynamo generator, thus keeping up a continuous current along the entire length of the road." With the view of reassuring the good people of Baltimore against any suggestion of danger from the mysterious new power the reporter continues: "The electric current is low-tension and no danger of shock will result to man or beast if the rails are touched in crossing or with the bare hands. In the latter case the result is only a slight tingling sensation."

The "Morse" was equipped with a compound series motor rated at only 8 hp. with single-reduction gears; regulated by a primitive form of controller. She was shipped from the shops of the Daft Company at Greenville on June 10, reaching Baltimore two days later, and so advanced were the preparations at the power-house that it was possible to conduct the first private trial of the new motor on the following day, the result giving every augury of the complete ultimate success of the plan. Various details, inseparable from the launching of a pioneer enterprise, remained, however, to be adjusted, and it was not until August 9, at one o'clock a. m., that time being selected in order to avoid popular excitement that would have attended the first appearance of the motor, that the first actual trip over the line was made, under conditions that only varied from those of actual practical service in the fact that the passengers carried, twenty-nine in all, were confined to officials of the railroad and of the construction company and to representatives of the press.

One of the pictures herewith illustrates what must be regarded as one of the earliest and most interesting attempts to use an overhead trolley contact as an alternative to the third rail and as a means of getting by crossings. At one side of the track a series of brackets were erected on poles, the arms being of pine 3 x 4. From these gas pipe was suspended by means of a U-shaped insulator. The contact brush to this overhead trolley consisted of a laminated series of sheet iron, some 6 x 8 in. wide clamped together and fastened to a wood trolley pole, the base of which was connected by an ingenious toggle arrangement to a lever in the inside of the cab, permitting the motorman to raise and keep in contact the brush when passing over the street crossing at which point this interesting and really first demonstration of such an underrunning trolley was used. The motorman by a foot lever raised the third-rail contact wheel and with his left hand controlled the overhead attachment and thus maintained a continuous contact. This arrangement was not added to the original method of third-rail contact until the road had been in operation many months, its necessity was urged on account of animals being injured by coming in contact with the third rail at street crossings. The details of this device were handled by Mr. A. H. Haywood, who took up the Daft Company's interests in Baltimore after Mr. H. A. Foster severed his connection with that company.

The train was made up of the "Morse" attached to one of the ordinary passenger cars. Mr. Gest, who had been identified with every detail of the construction of the motor, stood at the controller and at a signal from Mr. Robbins turned on the power and set in motion this pioneer of third-rail electric trains. The report of the *Morning Herald* tells us: "A brilliant flash of light shot out into the darkness as the contact-wheel fell upon the center rail and a shower of sparks flew right and left and then the motor, dragging the passenger car with its living freight, rolled rapidly out of the yard and sped on its way. A few hundred yards were traversed and then the current was cut off, the brake applied and the train returned to the yard up a steep incline. Back and forth the motor ran again and again, and each time it ran over the rails it improved in its action. Once it ran off the track, owing to a misplaced switch, but it was quickly replaced. Afterwards the passenger car was detached and the motor was run at a rapid rate of speed around curves and over switches with the greatest ease and safety. The trial was a most thorough and satisfactory one, as was testified to by all, and with the exception of a few minor mechanical defects, which can soon be adjusted, the trial perfectly demonstrated the practicability of the motor." It was estimated that the use of electricity would be attended with a saving of over 50 per cent. over that of horses. Later, two other and larger electric locomotives were installed on the road. The average daily run of each was 75 miles.

The attention of the street car companies of New York, Boston, Chicago and Philadelphia and of all the great cities in Europe had been riveted on this epoch-making trial in Baltimore and its triumphant success gave everywhere a tremendous stimulus to the substitution of electricity for horse or cable power. Less than twenty years have sufficed to fulfill the prediction, made by Mr. Robbins and Mr. Foster at the conclusion of the trial, that its success marked the beginning of a revolution in street car propulsion as complete as that wrought in stage-coach traffic by the appearance of Stephenson's locomotive; and to-day, having completely conquered the domain of city and suburban traction, the mighty successors of the little "Morse," driven by Mr. Gest, are threatening to relegate the descendants of the "Rocket" to the limbo of the stage-coach and the horse car.

Speaking recently of the wonderful development of electric subways with a fellow member at the Union League Club, Mr. Gest said: "I was little more than a lad, just about old enough to vote, when I assisted in that almost-forgotten trial of the first electric motor in Baltimore. To my mind it marked the beginning of the era of the successful application of electricity to locomotion and as such the event is worthy of commemoration. I take a keen satisfaction in the fact that I bore a part in it, and as I look back to that small beginning I am astonished at the progress that these comparatively few years have brought about. It should not be forgotten that a very substantial share of the credit for the success that attended the electrifying of the Baltimore road was due to the skill and energy of Mr. H. A. Foster, whose admirable ideas in carrying out the work of construction of the power plant and the track arrangements showed him to be the accomplished electrical engineer that he is. From the beginning, however, none of us who were associated in the work had the least doubt of its complete success, although it is easy to see how, in that early stage of electrical science, there were many unforeseen difficulties to be met and overcome. I do not know whether the old 'Morse' on which I officiated as motorman is still in existence, but if she is I think that a place should be found for her in the National Museum beside the earliest locomotive. Although she took her power from a primitive form of third-rail her performance fully demonstrated the practicability of the electric railway system.

"And apropos of that," continued Mr. Gest, "I am reminded how universally visitors to New York express wonder when they see one of the old horse-cars crawling along one of the side streets downtown. Of course, the reason for keeping these old cars in service is obvious in the economic objections which stand in the way of laying down subway conduits under the conditions that prevail in many parts of the city, but the change is bound to come and sooner or later. With the disappearance of the last horse-car our country cousins will have one less metropolitan wonder to talk about when they go home. I had an amusing illustration of this the other day when I brought my son, a youngster of seven, to New York on a visit. About the first thing that attracted his attention after leaving the ferry was one of the old cars on West Street. He stopped in open-mouthed wonder, for he had only seen horse-cars in pictures, and was only satisfied when I promised that some day I would take him for a ride in one. I thought to myself, 'surely that the world do move' when the son of the man who drove the first electric street motor is curious to enjoy the novel experience of a ride on a horse-car. I shall have to hurry up, before the last car is gone, if I want to keep my word with the little lad."

A Period of Great Development.

By Francis Blake.

In reply to your letter of invitation, I have to say that I am much impressed by the fact that the life of your journal covers the period of the birth and a marvellous development of the science which governs the commercial use of electricity.

If I were asked for specific reasons for this general statement, I should refer my questioner to the volumes of the Electrical World and Engineer which—by their advertisements as well as by their leading articles and their editorial matter—present a most valuable record of this important epoch in the world's progress.

Upon the occasion of your thirtieth anniversary, I congratulate you upon the fidelity and the ability with which your journal has rendered its technical services to the electrical fraternity in particular and to humanity in general.

The Electric Railway Industry in 1883.

By Frank B. Rae.

FIG. 1.—FIRST ELECTRIC RAILWAY TICKET.

The early days of the electric railway business were all twenty-six hours long and loaded with trouble. Motors were puny things in the early eighties. It was necessary to sit up with them nights and give them homœopathic doses of shellac in various parts of their anatomy, tie up the sore places with tape, and devise schemes to hold the armature leads and the commutator bars together for the next day's run.

The things we did not know back in '83, put in book form, would make a Carnegie library look like an elevated railway book stall. This should perhaps be qualified by saying, the things that some of us did not know, etc. There were those who knew all about everything; moreover, they wrote about it in the papers, whereat we of the working force marvelled. Some of these things, re-read to-day, would make most anyone marvel; but one of the real scientific facts that some chap wrote at the Philadelphia Exposition in '84 looms up like the shadow of a great rock in a desert, and has been a daily help and guide. He said: "A dynamo machine may be painted any color without affecting its efficiency." This is as true to-day as when it was written, twenty years ago, which is more than can be said of some of the other stuff.

The first electric railway company in this country, organized to construct and equip electric roads, was, I believe, the Electric Railway Company of the United States, with offices in the Mills Building, New York. This company acquired, or expected to acquire, the railway patents of Thos. A. Edison and Stephen D. Field. It

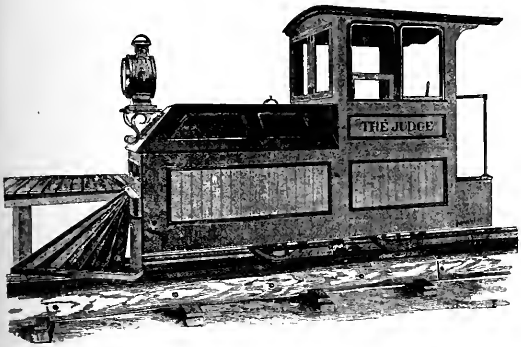


FIG. 2.—THE FIELD ELECTRIC LOCOMOTIVE "THE JUDGE."

was backed by Cyrus W. Field and his associates, with Mr. S. G. Reed, president, C. W. Rogers, vice-president, and Chas. Dimon, secretary and treasurer. Rogers was the active man, and his activity was of the brand that "eboluted" a lot but resulted mostly in hot air. He traveled in a stateroom with a typewriter and a hard-working young chap that was referred to frequently as "my secretary." Letters were mailed at every stop, and confirmed by telegraph. The end came before any real business happened, probably due to the preliminary funds having been used up in postage and telegraph tolls. The company did, however, equip one road, not a very long one, it is true, but it was as broad as some of them, and has the distinction of being the first electric road for business purposes in the United States. One night in March or April of 1883, there was a meeting at the Fifth Avenue Hotel, attended by Edison, Field, Prof. Morton, the engineer of the Northern Pacific road, and myself, the last three being a committee appointed to pass upon the Edison and Field patents, and determine their value to the Electric Railway Company of the United States. After it was over, Field said: "Frank, I wish you would go to Chicago to-morrow, and build an electric road for the Exhibition of Railway Appliances. I have had shipped there two Weston 100 incandescent light dynamos; use one as a generator and the other as a motor. You will find the track down around the gallery of the building, and Mr. J. McGregor Adams will give you any assistance you require." When more details as to construction were insisted upon, Field covered a sheet of paper with drawings and said: "There, put your motor crosswise on a truck, extend the shaft, use a bevel gear to drive a countershaft, put some pulleys on the counter-shaft, and belt to some others on the truck axle. Make a rig to reverse the brushes to reverse the armature, and—there you are."

All this was done, and several other things, before "The Judge," as the machine was called, was ready for service; and this brings us back to the remark above, about things we didn't know in 1883. At least, we didn't know them right off quick. For instance, it required something like twenty-four hours, mostly spent walking along the lake front, to grasp the fact that a shunt-wound dynamo, built as only Weston knew how at that date, would not generate current when started up on a short circuit, *because it couldn't*. It would not do, of course, to throw the shunt-wound motor on to the dynamo after the dynamo started and was up to voltage, so it was provided that the motor should start up with the generator and run continuously, the load being thrown on with a friction clutch on the axle. But the motor refused to start up with the generator, hence the ramble

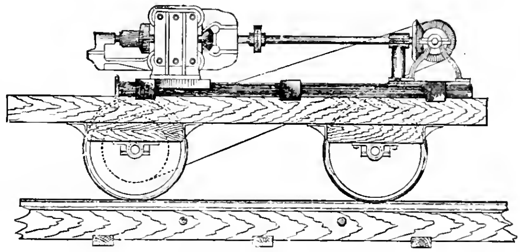


FIG. 3.—DETAILS OF "THE JUDGE."

along the lake front, resulting in making a resistance for the armature circuit of the motor and a switch to gradually cut it out. It is quite possible the board of underwriters would not pass this particular style of starting rheostat to-day. It was constructed of bare soft iron wire wound in grooves, planed into some pine boards, which boards were set on fire four or five times a day, with a regularity that would have been greatly missed, if a modern iron-clad rheostat had been substituted.

This road was a third-rail road bonded with No. 6 copper and had a total circular length of 1,553 feet. The locomotive, Figs. 2 and 3, hauled one car, seating 20 people, and in the ten or twelve days of operation, 26,805 passengers were carried, and $2,680 was earned. All this was comparatively easy; the days of trouble came a few years later, but that's another story.

I believe that the electric railway ticket here shown in Fig. 1 was the first ever printed and issued specifically for electric railway purposes.

Telephony the Greatest Invention of All.

By P. B. Delany.

This paper now and what it was thirty years ago is graphically illustrative of the progress made in electrical science and invention.

To my mind, the greatest invention within, or without this span, is the telephone. The electric light is a priceless boon, the trolley a great utility, wireless telegraphy a wonderful achievement; but the telephone is all these and a blessed benefaction in human affairs as well. Its sublime simplicity and marvelous adaptability, transcend all comparisons in the domain of pure or applied science.

The extension of audible speech transmission from a stone's throw to a thousand miles, and with quieter inflection, is a work unrivaled. The telephone is an allayer of worry, an assuager of sorrow, a life saver, a deterrent of crime, an earnest of security, and an indispensable commercial necessity. The world could better afford to go back to the "penny dip" and the stage coach, than give up the telephone.

As to what the future holds, no man may say; but even though he explores the ambient clouds on a radium motor, with a searchlight for a rudder, the telephone invention will still be secure in its peerless position.

The First Central Station for Incandescent Lighting.

By W. J. Hammer.

SOME years ago while preparing a lecture on Edison's life and his inventions, which I delivered before the Franklin Institute, I asked Mr. Edison what he considered his most important achievement, and he replied without hesitation, "The Jumbo dynamo." Those who are familiar with the early days of electric lighting will remember that prior to the construction of these huge Edison machines there were practically no dynamo machines in existence which could not be lifted and carried around by two or three men, and it was a tremendous step forward from the small machines then generally constructed to the mammoth Edison dynamo, which weighed 23 tons and employed a bar armature weighing 4½ tons.

Those who are familiar with the experimental work at Menlo Park on the Edison bar armature machine and the subsequent construction and testing of the first "Jumbo" machine which was sent to the Paris Electrical Exposition of 1881, will understand and remember the number of times which this machine was taken apart and put together again at the old Goerck Street Machine Works. Those who participated in the sleepless days and nights at that period of great anxiety will understand why Mr. Edison has attached such importance to the construction of this huge dynamo.

I well remember having been entrusted with the loading of this Paris Exposition machine on the gigantic "Ox," the only derrick in New York Harbor which could handle it, and lying all night alongside of the steamer on the North River; and I remember also the difficulty I had in securing the shipment of this machine, which necessitated the risky carrying of the 4½-ton armature upon the deck.

The second and third "Jumbo" machines were sent to England and were installed by Mr. Edward H. Johnson and myself in the 3,000-light central station on Holborn Viaduct, London—this constituting the first central station for incandescent lighting in the world, it having been started on January 12, 1882; whereas the Pearl Street station in New York, the first one established in this country, did not start until September of the same year.

It is probably known to very few where the term "Jumbo" dynamo originated, and I can claim the honor of giving this type of machine this name—and it came about in this way: The two dynamos which were sent to England were despatched on the "Assyrian Monarch," of the Monarch Line, this being the same steamer which had just before that carried the celebrated elephant, Jumbo, which the American showman, Barnum, had purchased from the London Zoological Society, and it occurred to me to dub the first machine "Jumbo" and the second one "Alice," after Jumbo's mate in London; and the name "Jumbo" has ever since characterized this type of machine.

It is interesting to call attention to the fact that this Edison dynamo was the first direct-connected generator. One of those which were sent to London had its armature directly coupled to a Porter-Allen engine and the other to an Armington-Sims engine. I had the honor of first coupling up two of these machines and making one run the other as a motor; and in April, 1882, the two machines which had been alternately used were run together successfully in multiple or parallel, this being the first time that these machines were so coupled. A cablegram was sent to Mr. Edison by Mr. Johnson announcing the success of this test, and subsequently not only two, but three of these machines were run in parallel. There are many who will remember the great difficulties which were subsequently met at the Pearl Street station when efforts were made to run the "Jumbo" machines there in parallel.

The history of the first central station for incandescent lighting established in the world, namely, the 3,000-light Holborn Viaduct station, started January 12, 1882, has never been written. The present occasion offers neither the time nor space to present this matter properly, but I should like to call attention briefly to a few important features connected with this historic plant, which was originally intended as a European demonstration of what Mr. Edison's electric lighting system was, and which was operated long after the time originally proposed. The station had been erected on property belonging to the Crown, and it was impossible to construct the large station subsequently planned. That, together with other electric lighting enterprises, were knocked in the head by the celebrated Electric Lighting Act of 1882, which caused financiers contemplating investments in electrical enterprises to button up their pockets until Parliament should deal with the industry in a more liberal spirit.

It may interest many to know that this station supplied its consumers by a network of feeders and mains of the standard underground two-wire Edison tubing, such as was subsequently used for a long time in New York City, Milan, Italy, and elsewhere. It used a meter system employing the well-known Edison electrolytic meter. Arc lamps were run from these circuits, and I assisted Dr. John Hopkinson in experimenting with Siemens' differential arc lamps, specially constructed for this purpose. I also assisted Dr. Hopkinson in his experiments with his mechanical meter employed experimentally on these circuits; and one of the first sets of "Faure" batteries sent to England was experimentally used at the Holborn Viaduct station.

In connection with this set of "Faure" batteries an interesting incident occurs to me. A small boy passing through the station, whistling a tune and swinging carelessly a hammer carried in his hand, rapped a carboy of sulphuric acid which happened to be on the floor above a "Jumbo" dynamo. The blow broke the glass carboy and allowed the acid to run down upon the field magnets of the dynamo, destroying the windings of one of the 12 magnets, which formed the pole pieces of this machine. This accident happened during a vacation I was taking in Germany, and a prominent scientific man connected with the company cabled Mr. Edison to know whether the machine would work if this coil was cut, and Mr. Edison made the laconic remark, "Why don't he try it and see?" I remember about this period assisting Sir William H. Preece in a lecture before the Society of Arts in which an Edison bipolar machine was dropped off a truck and the winding of one leg of the magnet sot badly cut that I was forced to use the machine with only one leg connected, but it worked with perfect satisfaction, although the machine had to be placed on the Thames embankment a long distance away and controlled from the lecture stage.

Up to the time of the construction of this plant it had been customary to place a single pole switch on one wire and a safety fuse on the other, and the practice of putting fuses on both sides of a circuit was first used here. Some of the first, if not the very first, of the insulated fixtures were used in this plant, and many of the fixtures were equipped with ball insulating joints, enabling the chandeliers or electroliers to be turned around, as was common with the gas chandeliers. This particular device was invented by Mr. John B. Verity, whose firm built many of the fixtures for the English company, and constructed the notable electroliers shown at the Crystal Palace Exposition of 1882.

The streets and bridges of the Holborn Viaduct were illuminated by incandescent lamps turned on and off from the station, and a device designed by my assistant, Mr. Cunnington, was used experimentally for turning on a second lamp should one of the two lamps in the post give out.

Dr. Parker's City Temple was supplied from this station, and was the first church in the world to be lighted by incandescent lamps. I well remember the astonishment of Dr. Parker and his associates when they noted the difference of temperature as compared with the gas. I was informed that the people would not go in the gallery in warm weather owing to the great heat caused by the many gas jets, whereas on the introduction of the incandescent lamp there was no complaint.

The operating room of the General Post Office, a long distance away, was supplied with 400 Edison lamps from the station, and I remember the anxiety of the chief electrician, Mr. (now Sir William H. Preece), when the cables were run through the subway under the Holborn Viaduct in which were placed the cables of the telegraph company, and the authorities were certain that the enormous currents carried in the Edison mains would interfere with the telegraph system mains. They had found this the case when the Jablochkoff system had been installed on the viaduct and the cables run through the galleries underneath. Although Mr. Johnson and I called their attention to the fact that whereas the Jablochkoff people used an alternating current, the Edison system employed a low potential direct-current, with both wires enclosed in an iron pipe, still there were many who were sure that there would be trouble, and on arrangements being made for the official test I remember the astonishment on the part of the telegraph people when I informed them that the current had been on for a good part of a week, and there had been no effect noticed on the telegraph system.

Of course, this was many years ago, and the large size of the mains employed in the Edison system and the previous experience which had been had with the Jablochkoff system naturally caused considerable anxiety.

For throwing the load of lamps from one "Jumbo" machine to another I constructed a huge snap switch, there being 16 metal pawls mounted on a ring of brass, these pawls resting on 16 teeth of the revolving disc. One-half of these teeth were ebonite, and were set into the brass plate which the other teeth formed a part of. Turning the handle of the switch would break the circuit simultaneously at 8 points. There were large rubbing surfaces and powerful springs employed. We also designed the first automatic circuit-breaker ever built, and the drawing of this is still in my possession, although the circuit-breaker itself was never completed.

Early Electrical Days at Cornell.

By Prof. W. A. Anthony.

When I went to Cornell University in 1872, the development of the dynamo electric machine had just begun. Accounts of the Gramme machine had appeared in some of the technical journals. I immediately went to work to design and build one, which served a very valuable purpose in the experiments at Cornell University and I followed with the keenest interest everything that took place in electrical development during those early years.

For convenience in communication with the various departments of the university and the people in the village of Ithaca, a telegraph line was established which finally developed to something over forty offices in 1876, when we began to hear of the telephone. I was immediately interested in that and I think it was early in 1877 I succeeded in obtaining some of those wooden hand telephones, which I connected to this telegraph line, and used them in connection with the telegraph instruments. Very shortly after this the telegraph line was changed to a telephone line, battery call bells and telephones being substituted for the telegraph instruments.

Only a single telephone was used at each office, parties using it alternately as the transmitter and receiver, and many ludicrous incidents occurred from two people attempting to carry on a conversation with each other and both talking at once or both listening at once. This telephone line led to the development of a telephone exchange, which obtained quite a large patronage and employed all-night operators before we had gone so far as to use both transmitter and receiver at the subscribers' offices.

In connection with the early development of electric lighting I remember well returning one night from Washington. The train stopped at Menlo Park, not far from midnight. I saw some incandescent lamps lighted about the grounds. I immediately got off the train to try and see what was going on. Lamps having filaments of the old cardboard carbon were scattered here and there about the grounds and were evidently in use in some of the houses. I found my way to the workshop and to the dynamo room, where one of the earliest of the Edison dynamos was in operation supplying these incandescent lights. On a large table located in the center of the room of one of the work rooms was a Thomson galvanometer with its lamp-stand and scale enclosed by a screen of black cloth so that its indications might be better observed, and this was serving as a voltmeter for indicating the voltage of the machine. Persons about the grounds were calling in by telegraph and making various suggestions about the illumination which the operator at the instrument was endeavoring to carry out, when all at once the lamps began to flicker ominously and finally went out. I went to the dynamo room, to find Mr. Edison himself there in a considerable state of excitement, ordering instruments brought for making a test. It was found when the machine was stopped that one of the coils had burned out. Another armature was in process of winding, but it was hopeless to think of completing that and getting the lights into operation again that night, or rather, morning, for it was getting to be near three o'clock. Mr. Upton, one of Mr. Edison's assistants, very kindly took me with him to his house, which provided for the hours remaining between then and daylight, the disposition of which I had not at all considered when I left the train.

Remembering all this as vividly as I do, the growth of and development of telephone communication and of electric lighting in these later years seems to me a thousand times more marvelous than to those whose memory does not extend back of 1881.

Before leaving Menlo Park I was given a card on which was mounted the punched cardboard horseshoe and inside of it the corresponding carbonized horseshoe showing the shrinkage in carbonizing to be something like a quarter.

The Captains of Industry in the Electrical Field.

By C. J. H. Woodbury.

YOUR reminder of my contributions to the editorial columns of the *Electrician* in 1882 recalls several lines of reminiscence, one of them being that it did not take much to make an editor in those days.

It appears to me that the most notable element in electrical matters, has been that of the men who made all other things possible, that is the administrative leaders in these enterprises. The magnificent figures of the census contained in a recent issue of your journal which stated the present measure of electrical development, caught in its increasing growth like a bird on the wing, may well inspire feelings of reminiscence upon the total development of thirty years. Week by week the advance has been chronicled, and year by year its totals summarized, but the whole term gives an aggregate which furnishes a bewildering comparison.

As the development of Grecian art in twelve years produced the Golden Age of Phidias, so the genius of invention applied to electric lighting, distribution of power and transmission of speech in the years immediately following the establishment of your journal in 1874, were so brilliant as to afford but little opportunity to make any discriminations, but it is worthy of note that all of these inventions were applied to public weal rather than to individual benefit, in the exercise of that true socialism which builds up the interests of all, and does no harm to any.

It is in no sense of disparagement to those electric inventors, whose skill produced the essential initiatives of electrical development, that attention is called to the importance of the type of human skill exercised in that administrative ability which established and operated the enterprises engaged in manufacturing and conducting these electrical undertakings.

The early dynamos savored of the laboratories where they were invented, and it devolved upon others to reorganize the machines to conform to the requirements of factory production, and continuous service.

The lack of suitable supplies for the manufacture of electrical plants created a demand which produced numerous lines of subsidiary manufacture.

The gap in insulating materials between those of submarine cables and of door bell wire was soon filled. The requirements of central station plants for the various electrical purposes have taken the best suited elements of other mill architecture, and blended them into special types of buildings whose permanency is a token of stable, continuous service.

The whole business of the manufacture of prime-movers lost its precedence, and became subsidiary to the electrical demand which required radical changes in steam engine and water wheel to fulfil conditions of improved regulation and economy.

The control of the electrical output to meet the variable demand has developed switchboards and their accessories to an extent which constitutes new systems of mechanical arrangement.

The operation of these plants has in turn required new systems of commercial organization to coalesce the many details required by the public corporation with their privileges from the municipality, in order to give service to the individual consumer intent upon his own wants. This has required a high type of business skill in the operation of all electrical enterprises, particularly in the case of telephone companies where the great number of patrons and the corresponding number of lines of connection has rendered the problem one of infinite detail, in the close relation of the many patrons with the company and with each other. It is in the development of the telephone service to the present standard that American skill has shown to great advantage in comparison with what has been done in other countries in the application of electricity to the service of mankind.

In all of this work beginning with the original devices of electrical inventors, and extending to the application in commercial details of the systems in their respective fields, the pre-eminent service has been that rendered by men whose broad scope was endowed with sufficient imagination to foresee the ultimate possibilities of the demand for applied electricity, and with adequate knowledge of present events to provide for the future by selecting competent men to whom were assigned the tasks of solving engineering problems, and above all, these men were equal to the greatest task of all by their power of inspiring confidence in capitalists who invested the enormous amounts essential for establishing these electrical industries, and in this respect the work of these leaders has constituted the greatest element in this electrical development.

Electrical History and the Importance of Systematic Inspection.

By Ralph W. Pope.

THE gradual advance to the present standard of electrical engineering practice is now so generally recognized that there can be little excuse for the crude construction which is still permitted in various parts of the country. Twenty-five years ago telegraph construction was perhaps the only model, and even the limited experience in that branch was not profited by as it might have been. The original telephone lines were built without regard to permanency, while the electric light lines in our principal cities eventually caused losses of life and property directly traceable to inferior construction that finally led to a public demand that all wires should be placed underground. This naturally led to improved construction, as any other procedure was practically impossible. In spite of the objections to underground work on the part of many of the electrical companies, the best electrical engineers insisted that the problem was largely financial, and their opinions have been justified by experience. Possibly New York City is now the leading example of general underground construction for all classes of service, but even here there are doubts as to the possibility of a conduit electric railway on West Street. The financial return from all classes of service in New York are sufficient to warrant an investment which might be prohibitive in many other cities. Whether underground or overhead construction be adopted, however, proper electric service demands the best, and wherever the population is sufficiently dense to offer a proper field for its establishment, every precaution should be taken to prevent accident which may lead to financial loss through damage suits or diminished revenue.

It is not enough, however, that the original construction in New York should be of the highest class, as the question of proper maintenance is equally important. When everything is new, repairs may not be necessary and if proper care is not exercised there is likely to ensue a period of general break-downs that should be avoided. Frequently an electrical system is properly maintained for years, when a change of administration introduces a policy of so-called economy, and a large proportion of the income previously appropriated for maintenance is diverted to the payment of increased dividends, reflecting corresponding credit upon the new management, while the gradual deterioration of the plant will, in a few years, lead up to extraordinary cost of repairs or possibly reconstruction, which might have been readily avoided.

In most cases periodic inspection will avert many accidents, and gradually lead up to systematic renewal of plant which will insure practically continuous service. Too frequently the inspection is a minor portion of the duties of those who are otherwise engaged, or the inspection and repairs are made under the supervision of one person, or the whole system may be operated until the break-down occurs, and then it may, for lack of time, be fixed temporarily, and subsequently neglected, when the same operation is repeated. Such cases are likely to occur where a manager is loaded down with office work, and while he may nominally look out for weak points in the system, he is practically unable to do so, or prefers to confine himself to the desk and take his chance that everything is all right outside.

The advantage of thorough inspection was impressed upon the writer when engaged in the service of the Gold & Stock Telegraph Company in 1873. At that date this system was probably the highest development of electro-mechanical engineering, for the reason that about 1,000 instruments were required to be in perfect condition in order to give satisfaction to the subscribers. Each inspector was allotted 100 instruments on about five different circuits, and was held responsible for their operation. He was expected to visit each instrument twice a week, and see that it was properly cleaned, adjusted, oiled, inked and supplied with paper. So far as actual visitation was concerned, he could, to a certain extent, regulate his own movements. The circuits being grounded at the end, it was important that the last instrument on each should be examined every morning, after which inspection could proceed according to personal preference. Each inspector was allowed a quota of spare machines kept in readiness by running a short time on a test circuit. Complaints from subscribers were made at the superintendent's office, where they were tabulated by the month, and when the bulletin was posted a bonus of five dollars was paid to the inspector having the least number charged against him. There was an element of chance in this, for an occasional circuit trouble might bring in twenty complaints on one day, while there were occasional instances of a clean score for the month. In addition to the regular force, there was an office inspector, to be sent out on call, while each of the regulars in turn took a day inside. The chief inspector must not be overlooked, as he was the man who was supposed to keep all "keyed up" to a proper performance of their duties, and while at that time his subordinates may not have properly appreciated his electrical and mechanical ability, he was certainly gifted with a microscopic eye, and the faults which the inspectors may have entirely overlooked were duly magnified when entered upon his report of general inspection. The very best of overhead line construction was at that time insisted upon, and when on one occasion the entire system was broken down by a heavy sleet storm, every inspector was detailed to assist in its reconstruction and the orders of the superntendent were to rebuild if possible so that the lines would stand if a similar storm should come along next day.

Having been out of practical electrical work for twenty-five years, the writer is not in a position to state whether similar practice prevails elsewhere, but observation has led to the belief that proper inspection is not universal, and that many serious accidents might be avoided and better and more continuous service provided if serious attention was given to this important branch of service. During the discussion of high-tension distribution at the Institute meeting in December it was stated by one speaker that in a Massachusetts town a high-voltage wire passed through a group of telephone wires only ten inches distant from them. In a New Jersey town the writer every morning last summer passed a frame building where a leading-in "weather-proof" wire was drawn taut over the edge at the end of an iron pipe which ran down into the ground. The attention of a policeman was called to the danger, and he said he would report it and have the wire changed, but nothing was done. No doubt there are many other danger points in the same town which would readily be seen by a competent inspector. While small companies cannot afford to employ expert inspectors continuously, it appears quite feasible for them to combine and obtain their services at regular intervals. Such traveling inspectors would probably be more efficient than local employees, by reason of their wider experience and freedom from the suspicion of meditating injury to the standing of the regular employees, whose work they might be expected to criticise. Such a plan of inspection could be readily systematized by a regular report of faults to be rectified, followed by a subsequent examination, when it could be ascertained whether the work had actually been done as specified.

The Growth of the Sale of Current.

By W. F. White.

The commercial electric lighting and electric railway industries of the world have been created since 1874. Thousands of millions of dollars are now invested in them in the United States alone. The stride is without a parallel. The growth has not been of the mushroom order, but has been a growth with stability. No class of securities withstood the 1893-97 period of financial depression so well as the securities of meritorious electric properties. This record will be maintained. Good electric securities will increasingly win the favor of investors.

The field for the sale of electrical energy is comparatively unexploited. Its sale for general power purposes has only begun. In not a single large city of the United States have the possibilities of the industrial power business been fully developed, much less exhausted. In many of our best cities to-day the gross receipts from the sale of electrical energy for all purposes do not exceed \$1.00 or \$1.50 or \$2.00 per capita per annum. Such volumes of business can be multiplied three, four or five fold.

The existent demand unsatisfied, the great undeveloped market at hand waiting only to be cultivated, insure the future, and guarantee against the effects of even a period of general commercial retrenchment. Come good times, come bad, the electric industries will constantly grow, electric investments will be increasingly profitable and popular, and therefore both commercial and engineering development will continue on the forward march.

The Foundation of the Modern Street Railway.

By Brig. Gen. Eugene Griffin, U.S.V.

You ask for my personal recollection of the electrical evolution of the past thirty years. My personal experience goes back only to 1887, when, as assistant to the engineer commissioner of the District of Columbia, I made a tour through the principal cities of the United States in search of information concerning telephone, telegraph, arc light, incandescent light and electric railway underground wires. I secured a great deal of valuable data on this interesting subject (valuable, in the light of the progress made in burying wires up to that date) and incidentally I became interested in and inspected several electric railways and secured data concerning the same. Upon my return to Washington I made a report to the engineer commissioner (Col. Wm. Ludlow) on the subject of electric railways (December, 1887,) preparatory to the more extended report upon underground wires. My report on electric railways was called for by the United States Senate and published as a public document. I joined the Thomson-Houston Electric Company, of Boston, in March, 1888, and as a result my report on underground wires was never made.

The report on electric railways referred to above shows that in the summer of 1887 there were twenty electric railways in the United States and Canada, viz.: Appleton, Wis., Appleton Electric Street Railway, 4½ miles, 5 motor cars, Van Depoele system; Asbury Park, N. J., Sea Shore Electric Railway, 4 miles, Daft system; Baltimore, Md., Union Passenger Railway Company, Daft system; Binghamton, N. Y., Washington Street & State Asylum Electric Railway, 5½ miles, 6 motor cars, Van Depoele system; Brooklyn, N. Y., 6 miles; Denver, Colo., Denver Tramway Company, 4 miles, 7 motor cars, Short-Nesmith system; Detroit, Mich., Detroit Electric Railway Company, 2 miles, 4 motor cars, Van Depoele system; Detroit, Mich., Highland Park Railway Company, 3 miles, 2 motor cars, Daft system; Gratiot, Mich., Gratiot Electric Railway Company, 1 motor car, Van Depoele system; Kansas City, Mo., Kansas City Electric Railway Company, Henry system; Lima, Ohio, Lima Street railway Motor & Power Company, 6½ miles, 7 motor cars, Van Depoele system; Los Angeles, Cal., Los Angeles Electric Railway Company, 5 miles, 4 motor cars, Daft system; Mansfield, Ohio, Mansfield Electric Railway, 4½ miles, 5 motor cars, Daft system; Montgomery, Ala., Capital City Electric Street Railway Company, 12 miles, 14 motor cars, Van Depoele system; Port Huron, Mich., Port Huron Electric Railway Company, 2¾ miles, 3 motor cars, Van Depoele system; St. Catherines, Ont., St. Catherines, Merriton & Thorold Street Railway Company, 6 miles, 12 cars, Van Depoele system; Scranton, Pa., Scranton Suburban Railway Company, 4 miles, 7 motor cars, Van Depoele system; Wichita, Kan., Wichita, Riverside & Suburban Railroad Company, 4 miles, 6 motor cars; Windsor, Canada, Windsor & Walkerville Electric Railway Company, 1½ miles, 1 motor car, Van Depoele system; Woonsocket, R. I., Woonsocket Street Railway Company, Bentley-Knight system.

There were 22 roads being constructed or under contract, including the Sprague road in Richmond, Va.

This was the very beginning of the modern electric railway development. I became general manager of the railway department of the Thomson-Houston Company, and on the 4th of July, 1888, we started our first car at Crescent Beach, Mass. This car was equipped with two F. 20 (10-hp) motors, which were the first Thomson-Houston motors built for railway equipments. (The Thomson-Houston Company had previously built several motors of different design for the Bentley-Knight Company.) In the fall of 1888 the Eckington & Soldiers' Home road was constructed in Washington. This road was a long step forward in the progress of the electric railway. The overhead line was installed with center poles, a very neat and attractive looking construction.

Then we made our great contract with the West End Street Railway wherein we agreed to keep the apparatus on the cars and the overhead lines in good working order at three cents per car mile. This guarantee ran for five years and was a very serious undertaking for an electrical manufacturing company to assume at that time. Within two years, however, the West End Company found it to their advantage to relieve us from this guarantee and to take over the maintenance themselves.

Sprague's Richmond road, the Eckington & Soldiers' Home road, and the West End road may be regarded as three of the stepping stones on which the electric railway business crossed the stream of possible failure and landed safely on the side of success. Within two years, i. e., in 1890, the railway business of the Thomson-Houston Company had grown from nothing to nearly $4,000,000 per year. We were unable to meet our customers' demands.

During the period of sixteen years in which I have had general charge of the electric railway business of the Thomson-Houston and General Electric Companies, the industry has developed from a total of about 100 cars electrically equipped (in the United States) in 1887, to a total of about 55,000 cars electrically equipped in 1904; from a 10-hp motor per car in 1887 to two (and even four) 200-hp motors per car in 1904; from the small "bob-tailed" car of 1887 to the 48-ton, 60-ft. interurban car and 2,250-hp electric locomotive of 1904. It has been an interesting development. I regard myself as fortunate to have been connected with a development which has added so much to the wealth, happiness and comfort of mankind.

If I were asked to summarize the improvements made in electric apparatus for street cars since 1887, I should do so as follows: Large motors, single reduction motors, enclosed motors (waterproof), increased number of poles (reducing weight), form-wound armature coils, ironclad armatures, carbon brushes, casings to permit gear and pinion to run in oil, series-parallel controller, circuit-breakers, underground working conductors.

Practically all of the elevated and underground railways in the world have been, or are being, equipped electrically. Suburban roads have been constructed and are operating electrically where no roads would have been built but for the advent of electric traction. One of the large trunk railways has already contracted for an electrical equipment to operate not only its suburban service in the vicinity of New York, but also its express service within a radius of forty miles of New York City; other trunk lines are preparing for the execution of similar contracts, and it is only a question of a very few years when the steam locomotive will have disappeared from the vicinity of New York City. Similar results may be expected in other large cities. It is then but a step to extend the electric service to cover all transportation between the large cities of the East, and it is by no means improbable that many of us will live to see the day when the steam locomotive is as much of a rarity as is the horse car to-day.

An Era of Central Station Underground Work.

By John Langton.

A feature in the history of electric lighting, which now runs some risk of being forgotten, is the important part played in the development of central stations in large towns, by the Edison system of underground conductors, known as "electric tubes." The Pearl Street Station in New York, with its low voltage, large current and a considerable area of distribution, necessitated unprecedentedly large conductors which no existing system could adequately supply. Overhead wires would have been intolerably cumbersome, even had they not been barred by the permanent character of construction which was aimed at, and which could only be achieved by underground distribution. The service to be given was strictly analogous to the supply of gas and water, and Mr. Edison's idea of iron pipes containing insulated copper rods, to be manufactured in fixed lengths and joined together in the trench, was characteristic of his direct mode of thought. Their construction and the development of details were confided to the remarkable mechanical skill and judgment of the late Mr. John Kruesi, whose resourcefulness and indomitable perseverance overcame the faults and troubles inseparable from a first essay in a new field, and under whose direction a flexible, reliable and well-standardized system of underground conductors was produced which covered a wide range of sizes. The larger Edison stations constructed in the middle 80's were made possible by electric tubes. No cables then available could stand the severe conditions which the tubes successfully met. Hence, electric tubes did yeoman's service in the early demonstration of the commercial possibilities of central station work; possibilities which justified the construction of conduits and stimulated the production of cables. It is safe to say that the present wonderful development of central station work would have been several years delayed but for the share taken by electric tubes in the pioneer work of electrical distribution from large central stations.

The Development of Telephone Engineering.

By Angus S. Hibbard.

I should consider the thirtieth anniversary of your journal an appropriate time to remark upon the widespread and ever-growing appreciation of the telephone which has scarcely passed its quarter century mark. Born a marvel in electrical art, treated at first as almost an experimental freak, the telephone in its early years traversed a hard road. Unknown and unnamed obstacles obstructed it. New electrical terms and laws were pushed into existence by means of it. Difficulties of all kinds and descriptions were encountered and surmounted by an enthusiastic and devoted band of men of America, who first earned for themselves and gave to the world the title of telephone engineer. With no past experiences to guide them, these men made technical and electrical history as they advanced. Their years of labor have cleared away electrical and mechanical difficulties as they have arisen. The telephone has, by reason of their work, been proved to be the great time saver, and it would be difficult to exaggerate the millions of hours saved daily by the millions of people who now avail of its service. Ever ready at hand, on the desk, in the room, by the fireside or bedside, the telephone, by reason of skillfully designed systems and well-trained service brings, in America, the greater part of a continent within speaking distance. Ten years ago a city having 10,000 telephones in service led the world. To-day there are several single offices in New York or Chicago accommodating the service of more than 10,000 instruments. The tremendous value to the public of such an extended and unified service can scarcely be overestimated. New York with 120,000, Chicago with nearly 80,000, Philadelphia, Boston, Brooklyn, Cleveland, Cincinnati, St. Louis, Omaha, Kansas City, Minneapolis, and all other leading cities of the country, following closely in good proportion to their population, these and more than 20,000 other cities, towns and villages directly connected by long-distance lines, all within earshot, represent an intercommuncating service and system never before equaled nor even dreamed of; while the Pacific Coast with a system of more than 40,000 telephones, centering in San Francisco, is equally developed throughout an area nearly 2,000 miles in extent.

It is not inappropriate that these hundreds of men who have devoted themselves untiringly to the work should at this time review the great and accomplished factor they have been building, nor that others in contemplating it should realize that it represents to-day the accomplishment of that devoted and able technical force now widely recognized throughout the country as telephone engineers.

The First Edison Isolated Lighting Plant on Land.

By Fred'k A. Scheffler.

You ask me to give you some personal reminiscences of interesting periods or occurrences in regard to my connection with the electrical business. I cannot recall anything perhaps which will be of more interest than to state briefly an outline of what I believe was the first private house isolated plant installed by the Edison Company twenty-two years ago.

This plant was put in Mr. W. H. Vanderbilt's residence, corner of Fifth Avenue and Thirty-first Street, during the summer and fall of the year 1881. It was located in the basement of the beautiful new mansion, which he completed about that time.

The appurtenances consisted of two 60-light old "Z" type Edison dynamos, having a combined capacity of 120 16-cp, 110 volts, with a countershaft on the floor connected by belts to two 6½ x 8 high-speed Armington-Sims engines. The steam was supplied to these engines from a locomotive type of boiler designed especially by the writer to fit the circumstances and the space available. It was built by the Baldwin Locomotive Works, and covered with wood and Russia iron lagging with brass bands.

The house was wired for over 1,000 incandescent lamps, 16-cp each, and as it was the intention even as far back as that date to supply eventually that part of the city with current from a central station, the mains were carried in the vicinity of the street for future connections; and as the wiring was done on the old two-wire system, these mains consisted of a bunch of small wires of such a number that the combined size of each main was about three inches in diameter.

As it was impossible to operate more than 120 or 130 lamps at any one time from the isolated plant, the various rooms could not be lighted at the same time, and this would have proved to be a decided annoyance to the owner, if the plant had remained in the building for any length of time. For the purpose of illustrating what could be done with electric lighting for private houses, the results obtained were eminently satisfactory. The arrangement was objectionable from the standpoint of the owners, particularly the ladies, who did not like the idea of living in a house where there was so much noise from the machinery, and especially with a boiler carrying 120 pounds of steam pressure. The whole machinery was removed by the Edison Company before the owner ever occupied the residence.

One very interesting result of the test and exhibition of this lighting plant occurred one evening when the owner and friends had been invited to make an inspection. Just before the visitors arrived, tests of each room were made by turning the lights on and off from the switches located at convenient points on the walls of each room. Everything was found perfectly satisfactory, with the exception of one room on the second story front facing Fifth Avenue. This room was beautifully decorated with "cloth of gold" on the walls. The lighting was effected by single pendants upon the ceiling and two or three side lights or brackets. The latter were combination fixtures, arranged with wires to light the gas also by electricity. In this room when the switch was turned on the most beautiful effect was noticed of the current traveling all around the room on the wall and in one place this "cloth" was cut from a side bracket down to the wainscoting as clean as though it had been cut with a knife. It was, of course, discovered that there was a short-circuit between this particular bracket and some other part of the room; but whether the fault was due to defects in the Edison circuit, or to the plumbers who installed the gas fixtures, or to the parties who put in the gas lighting wires, could not be discovered. The Edison Company paid for a considerable amount of repairs which were necessary to the decorations in the room.

The Field as Seen by One Who Worked With Farmer.

By George A. Hamilton.

I want to congratulate the Electrical World and Engineer on the completion of its third decade in electrical journalism; on its magnificent success—the compensating return for the sacrifice made by its founder—and on its active and faithful chronicling of the marvelous electrical progress that has been made during this period.

When I recall that thirty years covers almost the beginning, development and maturity of the electrical industries of to-day, I find it difficult to realize the fact. Yet such it is. All are, with slight exception, embraced within the lifetime of this publication.

The dynamo had made its appearance only a little while before. Previously, too, the telegraph and electroplating occupied almost alone the entire electrical field.

At that early day it was my good fortune to be associated with Prof. Moses G. Farmer at Boston. He had simultaneously, with Wilde, applied the self-exciting principle to the dynamo and was then actively engaged in the manufacture of various types of machines for electroplating, lighting, torpedo and telegraph work.

At this time, too, Prof. Bell began his preliminary experiment, which later gave us the speaking telephone. I was an enthusiastic participant in some of these, and recall with interest now the fatherly caution then received, not to allow myself to be unduly carried away by some of his theories.

The giant strides that have been made in so many directions since are familiar to all. They have been duly noted in the Electrical World and Engineer and in its contemporaries. Few then realized the force and the magnitude to which these varied interests would attain or realized the vast amount of capital they would employ. Tesla's communication with Mars, in fact, appears hardly less possible now than wireless telegraphy, for instance, did then. Loomis meanwhile has been forgotten.

It is but a step to speculate on the future. Will the next thirty years show progress as remarkable as the past? Who can say? At the beginning of the period just elapsed there were comparatively few workers in the field. The number to-day is multiplied many times over. They are young, energetic now, far better equipped, theoretically at least, than their predecessors. They have, moreover, the incentive of the latter's accomplishments and emoluments before them. It would be strange, indeed, if they failed to score high.

Success to them! Success and long life also to the ELECTRICAL WORLD AND ENGINEER, that it may continue to record and promulgate their achievements as well!

An Era of Electrical Expansion.

BY HENRY A. REED.

I wish first to congratulate you that you were not born earlier. As great men depend for development upon great opportunities, which great events furnish, and the favorable issue of great events depends upon the genius and fidelity of the great men whom they arouse to action, so a great journal to succeed must be called into being by necessity and must minister to that necessity. Prior to your advent, electricity was used commercially only in telegraphy and the principles therein involved, or at that time being discussed, were not sufficiently great, intricate or numerous to inspire, or the dependent industries sufficient to support, a first-class electrical journal. The developments which rapidly followed furnished plenty of material for your consideration, and from the general appearance the commercial results have kept most of your attachés far removed from the want of worldly comfort.

The different system of multiplex telegraphy were being more discussed, the arc light was demanding recognition by capitalists, and in 1876 the success of the telephone was established by its exhibition at the World's Fair in Philadelphia. In 1879 Edison had the incandescent light in commercial shape. A little prior to this date he had perfected the electric pen and had introduced the phonograph. All of these and other inventions relative to light, heat and power required factories for the manufacture of the instruments and attachments necessary for their operation and supply stores for their distribution among the numerous and eager customers.

The effects of the magical powers of electricity were nowhere more noticeable at this time than upon the people. It seemed as though everyone not fossilized was electrified and ready to swallow almost any kind of a pill with an electric coating.

Prior to your advent very few of our schools or colleges had special courses in physics. Civil engineering had been taught at West Point and at the Troy Polytechnic for several years, and Stevens Institute of Technology for mechanical engineering had been opened in 1871; but the rapid developments in the science of electricity demanded not only organs but more schools, and our colleges and universities in great numbers vied with each other in their haste and in the completeness of equipments to meet the demand. Well do I remember when the degree of Civil Engineer was scarcely known in this country.

Our old surveyors could run boundary lines or levels for canals and railroads, but knew little about building bridges or dams. High Bridge and the first Croton dam were built about 1840, and considered the greatest engineering works of this country. High Bridge answered its purpose, but the dam was carried away by the next spring freshet, because the foundation was not properly secured.

Since railroads must have bridges, and rivers must be dammed, the young men who were competent to superintend the operations could wear high collars and flowing sleeves (then the rage) which few of their companions could afford. The result was that the Troy Polytechnic was crowded with young men dreaming of high collars. This may have had something to do with starting the great collar industries in that city. Unfortunately, for some of the young men, railroads did not multiply as fast as civil engineers, and before your début the market was overstocked with the latter.

The rapid development of electrical inventions and electrical industries have had a similar effect upon the young men coming upon the stage during your existence, and an over-abundance of electrical engineers might seem to be feared. But by expansion and imperialism our country is much larger and richer than at the time of the civil engineer boom, and there appears to be plenty of room at the top of the present ladders, with higher peaks already in sight awaiting for ladders and for men.

That the ELECTRICAL WORLD AND ENGINEER may keep in the future as it has kept in the past, abreast of the front line in every advance, is the earnest prayer of one who was in the harness a quarter of a century before your advent.

The Evolution of Dynamo Design.

BY DAVID B. RUSHMORE.

THE science of dynamo design dates from the discovery, by Faraday and Henry, independently, of the law of electromagnetic induction, which states that the electrical pressure generated in a coil of wire, by relative motion between it and a magnetic field, is directly proportional to the rate of change of interlinkages of turns and lines of force. The evolution of this science has been a steady growth in which a process of continual differentiation has taken place. An increasing knowledge of electrotechnics and of the qualities of material employed, has given an ever-growing precision. Applications to numerous fields for the transmission of power and intelligence have given to dynamo machinery and allied apparatus a field of utilization never before equalled, and the stimulus of a world-wide competition has transformed the subject from one of technical interest to that of a commercial consideration of the greatest financial importance.

The original apparatus contained the embryo of the present alternating-current transformer, but the infant dynamo appeared so soon afterwards that both may be said to date from the year 1831.

LIMITS TO DESIGN.

As electrical machinery is designed with regard to the limits imposed by the conditions of operation, it is at the factors affecting such limitations that we should look to understand the lines of development on which progress has been made. An increase in temperature under load, due to energy losses in copper and iron, is found in all electromagnetic apparatus, and the point at which the insulation is injured determines the maximum allowable heating. Besides this common attribute that of regulation of voltage in generators and of speed in motors is next in importance. All commutator machines, both direct and alternating current, have, as a property of first importance, the subject of satisfactory commutation. Standards have undergone great change. What was satisfactory fifteen years ago in regard to the heating, regulation and commutation of dynamo machines would not be accepted to-day. Also in different countries, and with different manufacturers and users in the same country, the requirements in these respects varied widely. Fortunately, engineering societies are fixing the standards for classes of apparatus and conditions of service, thus bringing about uniformity in regard to designing limits.

DIRECT-CURRENT GENERATORS.

The limiting conditions in design of direct-current generators are, in order of their importance, commutation, heating, regulation and efficiency.

Commutation.—Faraday's first machine, shown in Fig. 1, was a unipolar. The simple collecting rings of the early machines were easily changed to two-part commutators. The many interesting experimental machines which formed steps in the early development had little of real design about them. The mechanical construction of the commutator, now one of the greatest arts in dynamo building, was the source of much trouble as machines increased in size. Different materials, iron, brass, gun metal and various alloys of copper were used for bars, and a still larger variety of insulating substances between segments before copper bars and micanite insulation became standard. Sparking was regarded as a necessary evil and as long as the machine operated at all it was considered more or less satisfactory. The early magneto machines, as well as those of Siemens, Pacinotti, Gramme, Brush and Thomson, possessed great armature inductance, but where the outputs were small this caused no serious sparking; and, when it was necessary in the larger generators, special means, such as air blasts at the brushes, were used to prevent harm. When the manufacture of dynamos reached a commercial stage, about the only point in design which was considered, was to keep the pole arc down to a certain percentage of the pitch. These machines, such as the Edison bipolar type, were surface-wound, smooth-core armatures with large magnetic air-gaps and the brushes were shifted with load when necessary.

Designers then began to study armature reaction and a large number of different pole constructions were tried. A rule used in designing was to keep the induction in the air-gap under the weakened pole corner above 1,500 for drum armatures and above 2,500 for ring armatures. The maximum voltage between bars was fixed, but as this is in reality no criterion of commutating ability, it naturally varied greatly, being taken later at about 25 volts for an average value. A careful study was made of armature reaction, and maxnetic air-gaps were then proportioned to give desired relations between armature reaction and field excitation at full load. Also the amperes per inch of armature circumference were used to judge commutating ability. Railway work, with its suddenly varying loads and calling for fixed position of commutation introduced the carbon brush. High resistance commutator leads were tried and a great number of special armature windings, such as the Sayers, and commutating lugs and pole face windings, as in the Thompson-Ryan machine. A careful theoretical study of the very complicated phenomena of commutation was made by several men, among whom must be mentioned Prof. E. Arnold, and the various factors which affect this action were expressed mathematically. The inductance of the armature coil while passing through the period of commutation, was discovered to be of vital importance and many experimental results and rules deduced therefrom have been published. The computation of what is termed the "reactance voltage" of the armature coil is now one of the important determinations in the present design of direct-current machinery. By making a few allowable assumptions

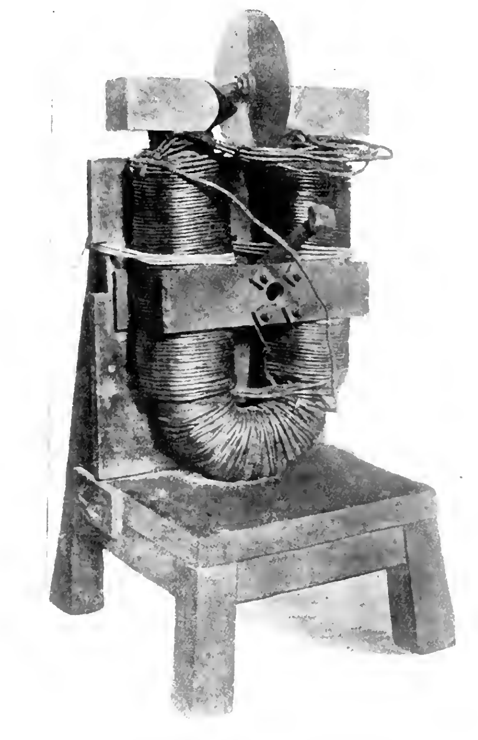


FIG. 1.—FARADAY'S FIRST MACHINE.

and where we have but one turn per coil, the reactance voltage is conveniently expressed by the formula:

$$E_L = 2.5 \times 10^{-8} \times N_B \times S \times I_c \times l_c''$$

E_L = reactance voltage, N_B = no of bars in commutator, I_c = amperes per conductor, l_c'' = length over armature iron in inches, and S the revolutions per minute. A large number of generators and converters have been designed using this rule, and it has been found very satisfactory. It must be remembered, however, that it considers but one of the factors, and the limiting value will vary with such quantities as percentage of pole arc, distortion of field from armature reaction, kind of armature winding, number of conductors per slot, number of segments covered by brush, form of slot, ratio of length of idle to active conductor, kind of brush and resistance of armature coil, commutator leads, brush contact, etc.

The subject of commutation is now one of great theoretical and practical interest, especially since the appearance of the alternating-current series, repulsion and compensated motors with commutators. A very careful study is at present being made and the theory has advanced far beyond the point here indicated. It is now possible to pre-determine the curve of current change in the coil with fair precision, and when this can be done the subject has passed from empirical rules to the domain of exact science.

Heating.—All electrical machines are subject to heating and in many cases the output is limited thereby. It is the result of inevitable copper and iron losses—either of which may be nearly constant or vary as some function of the load—and the temperature reached must not exceed the point where insulation receives permanent injury. Generators, motors and transformers are now designed in this respect with attention to the particular conditions of operations.

Early machines were designed for heating by fixing the current densities, and temperatures reached were abnormal. The field coils were in some cases covered with heavy rope and protection from mechanical injury took precedence over heat radiation. The large number of magnet designs used required field coils of various forms and constants for temperature rise varied accordingly. Rules for the determination of magnet windings for given heating and magnetizing power have been and are still numerous, although applicable, with precision, only to machines similar to those from which the data were obtained.

Multipolar construction did much to improve field coil ventilation. The poles have been lengthened to allow exposed ends on both shunt and series coils, bobbins have been removed, and ventilation secured inside the coil by using round coils with rectangular or elliptical poles, heavy shunt coils have been ventilated by dividing them into two parts, making four exposed ends, or by leaving a cylindrical space one-half inch wide lengthwise through the middle of the coil. The varnished round wire has, wherever possible, given place to square and in some cases where the round is used the interstices have been filled with a compound to aid in conducting heat from the center of the coil. By painting the coils black radiation is at its best, and by placing ventilating ducts through the armature, and especially at the ends, also by considerably raising or sinking the fibre wedge in the armature slot to make the cylindrical surface rough, and by running the core at a high peripheral velocity, a maximum quantity of air is circulated most efficiently around the field coil and the dissipation of heat by this means is obtained with the highest degree of effectiveness.

Excepting the pre-commercial forms and arc light machines, the early type of armature was a long, smooth core, covered with wires and the cross connections lapped irregularly at the ends. The heating of different coils varied greatly and the iron core was entirely covered by the winding. Multipolar types allowed internal core ventilation, brought about symmetrical and well-exposed end connections, and increased the armature diameter while diminishing the length. Toothed armatures exposed the core surface, brought some ventilation through the exposed ends, which was increased when the supporting flanges were omitted, and brought the winding and core more closely in contact, thus equalizing the temperatures between the two parts. Increase in capacity necessitated ventilating ducts in the core and these have been increased in number, and in efficiency, by dispensing with the cast plate supporting the separating fingers and attaching the latter directly to the extra heavy adjacent laminations. By proper mechanical construction the direction of the currents of air set in motion by the armature has been guided so as to give a maximum cooling effect for the energy lost in windage. Great reduction in heating and increase in output have thus been obtained by extensions of the armature end plates and by webs placed on the arms inside the core and on the outside of the end plates under the open cylindrical surface of the cross connections.

BRUSHES AND BRUSH HOLDERS.

Excellence in electrical design is of no avail unless accompanied by goodness in mechanical construction of commutator and brush holders. The necessity for using insulation in its construction, the considerable mechanical stress to which it is subjected and the great variations in temperature which it must undergo, all tend to make the large commutator the part of dynamo construction requiring the greatest care. The electrical design of commutators has had to do with voltage between bars, with numbers of bars between brushes and pitch on commutator, with current density at brush contact, with best brush pressure for the peripheral velocity of commutator, with the heating from friction, contact resistance loss and stray eddies, with the insulation of the segments from the spider, the thickness of the segments and insulation between them. Refined electrical commutator design is of recent origin. A great many machines have been designed by assuming the volts between bars, width of brush and contact density. It is true with low-speed commutators, which existed before the days of converters, this may have been satisfactory. It is, however, at present necessary to make a detailed calculation regarding the heating of the commutator as well as the conditions of commutation.

The use of brush resistance as a factor for successful commutation has changed the metal brush to one of carbon. Here for the last decade a refinement has been in process to suit the resistance, size and lubricating qualities of the material to the special conditions under which the brush is to be used. Carbons and graphites, with various mixtures of lubricating compounds and cementing materials, with and without copper gauze as the carbon, and having undergone various heat treatments, are now the material used for nearly all brushes.

The early brush holders were simple, giving pressure to brush and affording contact for taking off the current. The history of this device shows a wonderful fertility of invention from which a few simple forms have survived. The subject is one requiring illustration for treatment.

DIRECT-CURRENT ARMATURE WINDINGS.

The subject of armature windings may be said to date from the inventions of Pacinotti and Gramme. The ring-wound armature was followed by drum and disc types. A large number of ingenious and interesting windings have been devised. With large outputs but few of these have been successful and in this country but two or three varieties are seen. The possibilities of connections with different armature windings has been thoroughly worked out, principally by E. Arnold, and equations for many possible arrangements have been given. When the conditions for commutation are considered only the simplest types of windings are practicable. Parallel and series or lap and wave windings are the only ones which give satisfactory results. European makers still employ combinations of these, but in this country such exceptions are seldom found. Chord and pitch arrangements of coils are used, dependent upon manu-

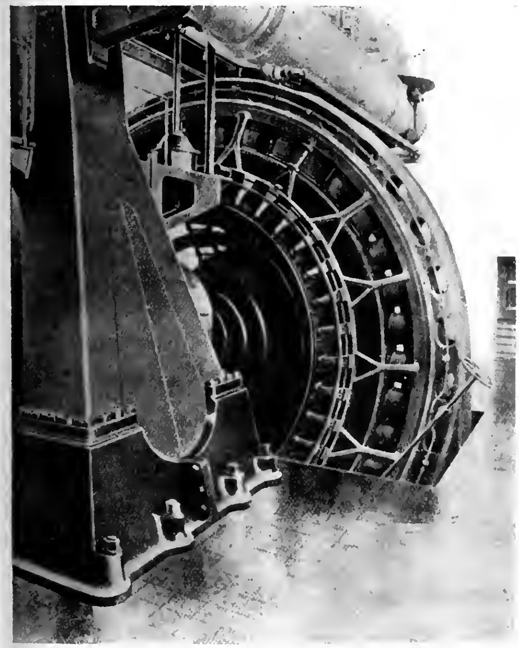


FIG. 2.—3,700-KW GENERATOR.

facturers, type of machine and subdivision of winding. When outputs began to exceed a few hundred kilowatts, the series winding became impossible and parallel windings have needed equalizing rings. The use of these is general and is very satisfactory. Modern designing is characterized by subdivision of reaction and heat generation, so we have small conductors, with but few in a slot, many poles, smallest possible number of turns per coil, maximum numbers of bars between brushes, large diameters, short lengths, small sections, etc.

DIRECT-CURRENT GENERATORS.

The form of field magnet has undergone great change. The two-pole wrought-iron structure has been changed to almost every possible shape by different makers. The greater economy in use of material in multipolar types for large sizes has resulted in the standard

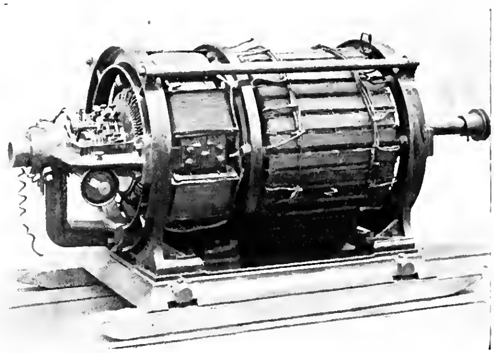


FIG. 3.—REVOLVING-FIELD GENERATOR WITH DIRECT-CONNECTED EXCITER, BUILT IN FRANCE ABOUT 1880.

form of to-day. Curiously enough, some English manufacturers still cling to the old bipolar construction for large units.

Wrought iron was at first almost exclusively used for magnets. This was followed by combination circuits of which cast iron formed a part. The art of casting steel is of recent development and has had a wide application. The best steel castings are now magnetically equal to wrought iron. The critical saturation point of steel, its greater conductivity for eddy currents set up by a varying flux, the disparity between necessary sections for magnetic and mechanical reasons with large diameters, some uncertainty with regard to its manufacture and a lack of magnetic retentiveness and stability have caused some manufacturers to substitute cast iron for its use for field yokes, while for pole cores it is still employed. Rectangular laminated poles cast into iron yokes are also used.

External revolving armatures have almost disappeared. Complications in design of special pole shapes, compensating windings, peculiar magnet forms and unusual armature and field windings continually appear, but as yet none have been able to supersede the simple form which is standard to-day.

ALTERNATORS.

Formerly engineers were divided into two classes in regard to the form of current supply which they advocated, and many were the controversies as to the relative merits of direct and alternating currents. The wide application of the latter awaited a successful motor.

In this country the first commercial alternators had smooth-core armatures with flat pancake coils, external yoke and radial internal poles. The periodicities used were 125 and 133 cycles. These machines ranged in output from approximately 50 to 200 kw. The yoke and poles were of one piece of cast iron and owing to the single-phase reaction became very hot. Owing to limitations of pole forms for these high frequencies, and also to the fact that the armature cores were surface-wound and mechanical conditions necessitated certain clearances, these early machines were possessed of excellent regulating properties.

The pulsating single-phase armature reaction made it desirable to use laminated poles, which were cast into the iron yoke. Wear of bearings which allowed the winding to strike the poles, or the accidental falling of some small body on the armature core, would so completely strip off the surface winding that the next change was to use an armature having as many large teeth as the field had poles and to place the wire in large coils on these teeth, pressing them under the extended edges and holding them in place by wedges driven between two adjacent coils. The first so-called polyphase machines in this country consisted of two such single-phase machines with armatures displaced with respect to each other. While a great advance mechanically, the concentrated armature winding and the great pulsation in reluctance of magnetic circuit gave bad regulation and a very irregular wave form. An alternating-current generator of this type for series arc lighting was developed, by giving it an abnormal armature reaction. The "plus two type" of polyphase generator, in which the armature had two teeth more than the field had poles, was developed and with these was tried a compounding of the machine by use of a series transformer, a two-part commutator and an additional field winding. The increasing demand for polyphase machines and the necessity for good wave form and regulation brought about a distributed armature winding, the frequency in the meantime dropping to 60 cycles.

At about this time a great jump was made and the Niagara type of generator with its internal stationary armature and the umbrella like external revolving field with inwardly projecting poles brought with it the use of 25 cycles.

The last step in the development of this type of alternator has been to make the armature external and stationary and to revolve the internal field. This construction allows the armature to be wound for high voltages and to possess an unbroken electric circuit. The wire field winding has been changed to a copper strip bent edgewise, and with the improvements in mechanical and electrical design we have the present excellent revolving field generator.

In Europe the course of evolution has been somewhat different,

FIG. 4.—MODERN ENGINE TYPE OF REVOLVING-FIELD ALTERNATOR, 2,000 KW.

embracing as it did such types as those of Mordey, Ferranti and Kapp. The result has, however, been the same.

Many different devices for compounding of alternators have been devised, but these have in most cases been extraneous to the generator.

The inductor alternator was early in the field and was for a time decidedly superior to machines which existed contemporaneously with it. The absence of moving wire and sliding contacts, the external stationary armature, the single field coil with its small waste of energy, the almost perfect wave form, excellent regulation, high efficiency, good ventilation and capacity for standing abuse of all kinds, gave it decided advantages. To those who follow closely the development of any path of progress, the influence of fashions as opposed to reason cannot but be apparent. So the fad for revolving-field generators which existed in this country and abroad is now giving place to a reasonableness which leaves the inductor alternators admittedly superior in some fields, equally as good in many and inferior only in few. This refers to the nature of the machine. Comparisons of specific designs can be fairly made only when all factors are considered.

Early generators were of the belted type and 200 kw was considered a large unit. Then came a demand for engine-driven sets, which was reasonable within certain limits, but which for combinations of small output and high frequency was an expensive taste to gratify. Water wheel sets have been made for speeds determined in general by hydraulic conditions and these have and always will be, to a considerable degree, special machines; 300 kw is near the limit for belted machines. Engine-driven alternators have been made up to 5,000 kw and over 40 ft. in external diameter, which is probably the limit as regards size. The new turbo-alternators which promise soon altogether to displace the engine units, naturally run at much higher speeds and are smaller in dimensions; 10,000 kw has been the largest water wheel alternator built.

From the early periodicities of 125 and 133 cycles, the change came to 60 and 66 to allow the use of motors and to save in line inductive drop. The Niagara installation and the use of converters introduced 25 cycles and the projected use of series alternating-current motors has caused one plant to be designed for about 17 cycles. Many generators have been built for odd frequencies as 62.5, 50, 40, 33 and 30 p.p.s. Abroad 50 and 100 cycles are the common usage.

The most important characteristic of the alternating-current generator is its property of inherent regulation. With but few exceptions this largely determines the design. Formerly a large number of ratios were used to express this value, but it is now taken as the ratio of the increase in terminal voltage from full load to no load, with constant speed and excitation, to the full load voltage. Regulation is to alternating-current design what commutation is to direct, and many of the elements in both are common. The principal factors which affect regulation are a variation in the useful magnetic flux due to the demagnetizing influence of the armature; a distortion of the magnetic field, due to the cross turns, which changes the form factor of the induced wave of e.m.f., the reactance of the armature winding and the real and apparent resistance of the same. These quantities, with the exception of the armature resistance, vary with the power factor of the load and also, at any given power factor, vary through a cycle. Methods for predetermining the regulation have been developed simultaneously with improved methods for obtaining the same in the design of the machine. It is impossible to test large generators under actual load conditions before they are installed, and some method of calculation from test results is necessary in order to determine if the guarantees in this respect have been met. Also it is extremely important in estimating the conditions of excitation for different load and power factors.

The first method was to run the machine on short circuit and from a determination of the synchronous impedance calculate the fictitious value of the generated e.m.f. which gave the regulation, and, with the saturation curve, determined the exciting power. The next was to consider the magnetomotive forces obtained in this way, and to take the final e.m.f. from the saturation curve. A later refinement has been to separate the effects of self-induction from those of armature reaction, and to use a combination of the above methods. Many other methods have been proposed and discussed.

When used with reference to the particular type of machine, the above methods give more or less accurate results for non-inductive loads; the combined method, if good judgment is used in estimating the reactance, gives fair results for power factor loads as well, but after a large amount of discussion the subject is still in an unsatisfactory state.

The changes in design to secure good regulation have varied with different manufacturers. Some have distributed the winding while partly enclosing the slot, and use low reactions and a nearly straight saturation curve; low reactions bringing small exciting power but large iron sections and producing a heavy machine. Others use open slots with heavier windings on armature and field, a somewhat saturated magnetic circuit, and obtain thereby a lighter machine.

ALTERNATOR ARMATURE WINDINGS.

Early single-phase generators had all coils in series for 2,200 volts and the two halves of the armature in parallel for 1,100 volts. Some early polyphase machines possessed closed windings with taps brought out for the number of phases desired. Many two-phase generators were wound, as is present practice, with two single-phase windings each occupying half of the armature surface.

Three-phase windings are connected either star or delta. With the latter connection care must be taken to see that no pronounced third or ninth harmonics exist, which might cause a circulating current to flow in the short-circuited delta. This has never been found to any marked degree with inductor alternators, and where, in the revolving field type, some current may exist, the design of the machine renders it practically harmless.

As in direct-current generators, alternators may have series or parallel armature connections. The coils may be connected in groups and these groups may be connected in either series or parallel. Naturally a large number of peculiar windings exist, but only the simpler ones have found wide application. The slot contains one or two coils and we have either a barrel or a chain winding.

Increasing outputs, necessitating larger conductors and the use of higher tooth densities, have brought about the use of rectangular stranded cable for armature conductors. This is sometimes used in conjunction with solid bars in the bottom of the slot. Square copper wire was developed for space economy and has had much use for armature windings. For many cases a special rectangular conductor of dimensions determined by the specific design, offers the best solution.

The early machines were wound for 1,100 and 2,200 volts. This was later changed in some installations to about 400 volts. Improvements in insulating materials and the desire to save the cost of step-up transformers have resulted in machines wound for all voltages up to 13,000, which is the highest standard in this country to-day; 6,600 volts are common practice for large installations and 13,000 volts are rapidly becoming so.

The design of alternators for parallel operation has been a recent advance. To provide means for quickly damping any oscillation is the element of success in devices which have been employed on the generator itself. The problem of such operation, while successfully solved, involves much besides the electrical relations. The latest European designs include induction and compensated machines of various types which are still in an experimental stage.

The great change which has taken place in dynamo construction is shown in the accompanying illustrations. Fig. 1 is Faraday's first experimental machine, and Fig. 2 the largest direct-current generator built—the 3,700-kw machine at Boston. Fig. 3 shows a revolving-field type polyphase generator with direct-connected exciter, built in France about 1880, and Fig. 4, a modern engine-driven alternator of 2,000 kw.

Reminiscences of Work on Electrical Patents.

By Edward P. Thompson.

"Whatever the title may be, the subject matter always includes temperance," I once heard remarked about John B. Gough's noted humorous lectures. Similarly, whatever generic title is proposed to me, the specific title must be inventors or inventions. This time it will be both, by way of variety, omitting names, for fear their owners might possibly object.

First, I would like to tell about the narrow escape of a wealthy electrical inventor, who, when not rich, had informed me that he wanted to live in a $50,000 residence. He has since owned two such villas. While rooming with him in the same suite many years ago, I heard moaning and groaning, one night, and I found him only able to say that he was dying, and that, during the day, while experimenting with vacuum pumps, he had swallowed a few drops of mercury, by sucking on the end of a tube, terminating in that metal. "The tube was vertical and forty inches long!" he exclaimed, "and yet I thought mercury would rise only thirty inches, even by full atmospheric pressure." A little mustard cured him. The next day he engaged his patent solicitor to apply for a patent on the conception of a pump operating upon an alleged new principle, which was discovered by his being poisoned nearly to death.

Inventors are often in such a hurry to test an idea that they do not take the necessary time to collect and construct the proper apparatus. Incandescent electric lamp vacuum pumps were all the rage with inventors of a quarter of a century ago. I had occasion to visit one of our five most prominent electrical inventors. On my way to his laboratory I pictured to myself the luxury of the facilities that must certainly surround him. The amount of capital he could call upon was practically unlimited; his record as a great inventor had been long established, and he had been awarded many patents. I found him alone in a barren room ten feet square. The lamp bulb which was being exhausted (?) was suspended by a string from the ceiling. No carpenter had been ordered to construct a shelf to hold an iron reservoir containing about five pounds of mercury. No, the inventor held it up high with one hand while with the other he raised and lowered a tomato can full of that heavy metal. The glass tubes, mostly iron gas pipes—if I may perpetrate an Irish bull—had been patched together at a hundred different points by himself or some other amateur. "Crude, crude, crude," I said to myself. "Just trying to see if the principle is O. K.", he remarked, apologetically, as if he could read my thoughts by my expression.

The generosity of another one of the "Electrical Five" was almost incomprehensible. On one occasion I inquired casually what result would follow from certain technical speculations. "Try it," he replied, instantly. "It is all very well for you to say to experiment, but I have no adequate facilities," I responded. "Use my laboratory," he urged. "A week or more would be required," I answered. "Take as long as you please," he said. For ten alternate days, although a suit of clothes which became saturated with odoriferous red oxide of nitrogen in the chemical room had to be thrown away; although the smell of gas from the Bunsen burners in the glass glowers' department was rather asphyxiating; although not only my hands but my face became black in the tool room, and although the mercury vapor in the pump room was appreciably salivating, yet I was blissful.

Inventors and their backers sometimes appear ludicrous. I remember the sight we once created at an electric brake test, ten years ago, while we were riding through the country for a few hundred miles. The villagers and farmers stared, not only with wide open eyes, but with wide-open mouths, at a train made up of dilapidated and abandoned freight cars, dotted here and there, on top, by men wearing silk hats and frock coats. Contrasted with the freight cars was a new Pullman car in the middle of the train. More dress hats were on the locomotive—or more accurately stated, were on *men* who were on the locomotive. While still staring, the spectators witnessed an emergency stop, and glossy high hats flying through the air by their own momentum. In those days, only when all on board were knocked down, was the brake pronounced highly efficient.

The popular or non-technical mind is more observant in experimenting than we sometimes give it credit for. One day, while making some tests, my father appeared on the scene. I was adjusting the aerial wires and connecting up the wires between the relay, battery, coherer, etc., etc. The wires were long and snarled, and, therefore, were much in evidence. I thought he might be interested to know that all this paraphernalia related to wireless telegraphy, so I mentioned the fact. "Wireless telegraphy!" he exclaimed. "I never saw so many wires in my life."

I congratulate you upon the long and prosperous career of the Electrical World and Engineer. I measure my technical term by its life, for it was in 1874 that I entered Stevens. May many more years of usefulness await you.

The Unknown Nature of Electricity.

By Major John Millis, U.S. Eng. Corps.

To me the most impressive thought connected with the extraordinary advances that have been made in electrical science and in its industrial applications during the past thirty years is that the present state of the science and its related arts has been attained with so little knowledge of the real nature of electrical actions. This suggests the enormous strides in the number of practical applications, in the simplicity and economy of apparatus, and in general efficiency that are yet to be expected in case the mysteries of electricity are ever solved.

As to the progress in this direction during the last thirty years it must be said that it has not been especially encouraging. On the other hand, the newer manifestations of very recent times, or rather the interpretations and theories that have been engendered by certain recently discovered phenomena, seem to me to have befogged the subject rather than to have contributed to its elucidation. It is my belief and expectation that the time is not far distant when the extensive and somewhat confused collection of data regarding electrical as well as all other physical phenomena will be crystalized by a generalization of surprising simplicity. Neither abstract mathematical research nor complex and illogical assumptions regarding the nature of matter will, in my opinion, point the way to the ultimate solution, but the basis for such solution is to be sought in principles that will appeal to the human intellect as simple, practical and consistent. I regard the acceptance of such a general theory for all phenomena of matter as likely to mark the beginning of the next most important period of practical electrical development, and I have not yet seen the announcement of anything that looks to me as likely to indicate directly the development of such a theory.

The Growth and Influence of Electrical Industries.

By C. A. Coffin.

On the occasion of the thirtieth anniversary of your paper, the establishment of which was the genesis of electrical journalism in the United States, it is interesting to review this period, during which the growth of your journal has kept pace with the wonderful development of a great industry. The great ability and candor with which you have ever recorded the achievements and stimulated the activity of all workers in the field of electricity has been a potent force.

In 1874, practically the only commercial piece of electrical apparatus in use was the simple Morse telegraph, followed immediately by the duplex and Edison quadruple instruments. While the arc lamp, the telephone and the incandescent lamp had all made their appearance a few years earlier, it was not until 1886 that the electric railway motor came to be regarded as possessing commercial possibilities. Thus, springing from an experimental laboratory, there have, in twenty-five years, been developed industries which in the last year alone have produced over $150,000,000 in manufactured articles. That this development is still going on with unabated enthusiasm on the part of the engineer, inventor and manufacturer is an ample guarantee of continued growth and of more varied uses of the electric art.

New designs of apparatus and devices, embodying physical phenomena unthought of even four or five years ago, continue to surprise those intimately associated with the industry, no less than they surprise the public. During this evolution there has grown up a class of young engineers, chemists and physicists who form a body of trained minds unique in the world's history. There certainly is no other field of work where the element of scientific knowledge is so influential and essential as in the multifold applications of electricity.

The producers of accessory apparatus and material have been forced to come to the electrical standard. To the electrical engineer is largely due the present excellence of the gas and steam engine and of hydraulic machinery. The maker of iron and steel has better learned his product and has brought it to the present high quality largely through the requirements of the electrician. The present wonderful development of the steam turbine, in whatever form, has been stimulated by electrical requirements, and but for these demands it would be far less advanced than it now is.

It has been your good fortune to record the discoveries and the growth of the industry, and to encourage it vitally these many years. That such a function, so well performed, has been of the highest value, none can question, and I express the sentiment of all who have watched your career, in wishing that your next thirty years may be a witness to and a part of continued progress in the development of the electric art.

Twenty-four Years in the Edison Lamp Factory.

By John W. Howell.

When Mr. Edison concluded that a successful lamp should have an enclosing globe made entirely of glass with all joints fused, the corollary which at once presented itself to his mind was that the lamp must be so durable and so cheap that when it failed it could be thrown away. When the Edison Lamp Company was organized Mr. Edison fixed the price of lamps at 35 cents, knowing that the lamp would cost more than that until suitable manufacturing methods were developed. This development has been going on for twenty-four years, and still there is work for the engineering department of the lamp works.

In this newly-created industry all operations were done by hand by more or less skilled labor. Now machine methods are quite general. The making of carbon filaments and the making and assembling of the glass parts were entirely new operations. No machines existed which could be adapted to the work. The machines had to be originated and developed for this work, and they have been. This statement is nothing like so impressive as is seeing the machines by one who was familiar with the work as previously done by hand.

The exhaustion of lamps by mercury pumps required from four to six hours in 1881. Improvements in pumps and methods reduced this to ½ hour in 1895. Since then by simple piston pump and "chemical exhaust" a much better result is produced in one minute. The cost of exhausting a lamp at the end of 1882 was considerably greater than the total cost of a lamp at the present time.

All the glass working operations have been changed from hand work by "glass blowers" to machine work by unskilled labor. The labor cost of the principal glass operations is now a little more than 10 per cent. of the cost in 1882.

Until 1894 all our filaments were made from bamboo, each piece passing through eight separate hand operations. Now squirted cellulose is used. In this department we now employ 83 operators. If we should go back to our bamboo fibre we would require over 2,150 operators for the same production.

Photometric methods and apparatus have been wonderfully improved and developed. The cost of photometric measurements is now 9 per cent. of the cost in 1882 with a great gain in accuracy.

The lamp of 1880 contained at least 30 times as much platinum as the lamp of the present day. The amount and cost of glass and other materials used have also been greatly reduced.

The greatest production reached in the Menlo Park Lamp Factory in 1882, was 1,000 lamps in a day of 24 hours. The present production of lamps by the General Electric Company is 100,000 lamps a day of ten hours. To produce these requires about 3,800 employees, of whom 80 per cent. are girls.

The lamp of to-day is very much superior in quality to the lamp made in Menlo Park, a great many improvements having been made by careful attention to small details of manufacture, while some very considerable steps in advance have been the results of careful investigations of phenomena observed in the processes of manufacture, and the adoption of new processes or methods.

The lamps made at Menlo Park for the steamship *Columbia* consumed about 100 watts for 16 candles. To-day the standard 16-cp. lamp consumes 50 watts. The useful life of a 50-watt lamp to-day is undoubtedly longer than was the useful life of the 100-watt lamps of 1880, and while we have no data for a correct comparison showing the improvement which has taken place, we can get a good idea of it from the fact that the estimated useful life of a 100-watt, 16-cp. lamp made to-day is over 10,000 hours, which is about as many times the probable useful life of the 1880 lamp as the number of elapsed years.

In the future I believe this multiplier will greatly exceed the number of elapsed years, for I have entire confidence in the fitness of the carbon filament to maintain its place among artificial illuminants.

The Slowness of Storage Battery Evolution.

By Robert McA. Lloyd.

In reviewing the scientific literature of the last twenty years one is impressed with the vast results recorded to the credit of investigators, engineers, manufacturers and energetic business men, but perhaps we may lose sight of the fact that in this period an immense amount of work has been done of which no account exists. Many great researches have been prosecuted for definite purposes which were unproductive of results of commercial value or scientific interest and, therefore, not reported. And many able men have wasted their time and resources in fields that have proven barren or in the study of problems that remain unsolved.

There are other fields in which great efforts have failed to achieve the success hoped for, but where enough has been accomplished to form the basis of commercial operations of some importance. The storage of energy and electrical energy in particular began to attract a great deal of attention about twenty years ago, and a continuous search has since been made for materials in which and methods by which this energy may be accumulated and reserved for future use. Life, reputation and treasure have paid dearly for the development of the storage battery of to-day, about which has grown up a thriving industry in Europe and America; but it can hardly be said that the goal for which electrochemists were striving twenty years ago has yet been reached. Research in storage battery science is slow for the reason that months and years are necessary for many of the experiments. The test of time is also paramount in every application of storage batteries to commercial purposes, and while there is every reason to expect great development in this branch of electrical science and industry during the next twenty years, the rate of progress may still seem slow to the readers of this journal.

I cannot send my congratulations to the Electrical World and Engineer without expressing my warm regard for its personnel, and the hope that the electrical fraternity will continue to have for at least twenty years more the encouragement and comradeship of its present editors.

Fifteen Years of Electric Heating.

By JAS. I. AYER.

MY participation in this work covers a period of a little more than twenty years, beginning at a period when incandescent lamps were little more than toys, and the arc lamp had reached a stage where we could cheerfully assert that the last lamp on the circuit would burn as brightly as the first, no matter how long the circuit; and that it required but two-thirds horse-power per lamp for their operation.

To the confiding investor it was later necessary to explain why a 50-hp engine was fully loaded driving a 40-light dynamo operating 30 lamps, and he was told that the horse-power consumed by the lamp was electrical and not the indicated horse-power of the engine. It was then clear to the lay public that the mysteries of electricity were not to be compared with anything which had come within their ken before.

To-day when we have children entering college who do not remember any other than the incandescent light in their home, the pater stands by watching the electric meter correctly record on the dial exactly the number of lamps that are being operated under his own observation by the innocent electric meter, which has developed such an extraordinary bill. He then realizes that the mystery of electricity is as great as ever.

The remarkable expansion which has taken place, showing practical so many new applications and methods that by wise leaders from time to time were condemned as impossible or impracticable, seems to leave no just ground for any one to predict any limitations of the expansion in the future. It is curious in looking back to find how few of any proposed electrical branches have failed to make good. This to me is the most remarkable element of the history of this wonderful industry. In almost every instance the toys and condemned theories have become important elements of useful application. There is hardly a proposition in the way of a new development that was considered at all seriously that I can recall, except the development of electricity direct from coal, that has not justified itself.

Electric heating attracted attention about fifteen years ago, and first efforts were met with that hearty loyalty characteristic of the public to everything electrical, and its successful development was frequently pronounced on hearsay only as an accomplished fact by the average electrical "expert" in his usual optimistic way when appealed to. He could not afford to admit his ignorance; and it was safer to endorse the claim. All of this resulted in securing favorable consideration for the early elementary products created in a new field, at a time when the demands in the older developments for both men and money, far exceeded the supply. The result of feeble efforts with crudely made products, coupled with the then high cost for current, was a general impression, very firmly established, that electric heating apparatuses for general domestic and factory applications were delicate, expensive toys, which, even if they could be improved and made sufficiently good, were impracticable because of the cost for operation.

This swing of the pendulum was wide, and when the development of the industry was taken up more seriously the debris of this advance guard formed obstacles quite as serious in securing the ear of the public as had to be overcome in preparing a more suitable and logical product to offer them. Electric heating is one of the last of the early developments to "make good," but in the past few years it has made good, and to-day, while it has firmly established itself and gained its place in the line of permanent electrical industries, its broad and extensive development is just about beginning.

While the number of electric heating units in daily service runs into many hundred thousand within the next few years the contrast with results developed to-day will be insignificant. It has been a slow process putting into service thirty or forty thousand flat irons to smooth the way for the work that is to come, but it is something of a triumph to put twenty thousand stoves at work baking as many thousand crackers every five minutes, developing thereby a product that could be produced in no other manner, and yet doing it at a cost that puts it on a par with other methods for turning out such goods.

The complete and elaborate equipment of the large Government Printing Office in Washington for all special heat requirements, and similar work in a great variety of establishments in other lines, are the foundation stones for the beginning of as broad a development in this line as the application of the electric motor if not greater.

Reminiscences of the Universal Exposition of Electricity in Paris, 1881.

BY PROF. HENRY S. CARHART.

The Paris exposition of electricity in 1881 was notable for many things. The first international Electrical Congress was held in connection with it, and this congress stands out in the history of electricity both on account of the eminence of its members and the results of their deliberations. It will be recalled that the theoretical definitions of the ohm and the volt were confirmed by this congress, and that it added the ampere, the coulomb and the farad. These units went into immediate use, and the International Committee charged with the determination of the length of the thread of mercury one square millimetre in cross section and at a temperature of zero degrees Centigrade, which should represent in material form the resistance of the ohm, immediately began its work.

The personnel of the congress, which was composed of official delegates assembled under the auspices of the French Government, was no less notable than the work done. It included many names which stand forth with great prominence in the annals of electricity. There were Clausius, Helmholtz, Hittorf, Kirchhoff, Siemens and Wiedemann, of Germany; Ayrton, Latimer Clark, Crookes, Dewar, Hopkinson, Preece, Rayleigh, Kelvin and Tait, of Great Britain; Becquerel, Cornu, Fizeau, Bouty, Joubert, Lippman, Mascart, Planté and Violle, of France; Rowland, of America, and Ferraris, of Italy. Alas! How many of these have since died.

The Paris Exposition of 1881 was notable also for its exhibits. It was the period of the inauguration of great electrical industries. One recalls first, perhaps, the exhibits in incandescent electric lighting. The Edison "system" was there, of course, "Jumbo" and all. Who had the temerity to predict at that time that in little more than twenty years we should see grow out of this as one of the chief contributing streams the present General Electric Company. When one compares the Edison "Jumbo" generator of the Paris exhibition with the direct-connected generators of the present, of 5,000-kw capacity and upwards, he is impressed with the rapidity of the evolution that has taken place, not only in size, but still more in scientific and technical development.

When the youth of to-day hears of Sir Hiram Maxim and his fame derived from the design and manufacture of rapid firing guns, he is hardly prepared to read that the inventor of the Maxim system of incandescent lighting at the exhibition of 1881 was indeed the original of the present Sir Hiram. He was then a plain aggressive American; he is now a knighted English subject. The year 1881 may be properly described for him as the period when "knighthood was in flower."

In 1881 the storage battery was in its infancy. Faure had just produced a great sensation by sending a storage cell to Sir William Thomson, who had made a rather startling report about it. In the Palais de l'Industrie were the exhibits of both Faure and Planté. Among my recollections of the distinguished men at the exposition none are more delightful than those relating to that charming French gentleman, M. Planté. His memory should ever be kept green as a pioneer scientific worker of exceptional value.

Perhaps the exhibit which one recalls now as "bahnbrechend" above others was the electric railway installed and exhibited by Siemens & Halske. It was indeed only a few hundred feet long, and the connection of the car with the trolley wire was of a very primitive and uncertain kind. The under-running trolley wheel was an invention of a later date; still the exhibit contained the germ of the modern electric railway in the early stages of development.

Such an exhibition has a large value in the dissemination of new ideas. The seeds of invention are there thrown to the winds and are carried to the four corners of the earth. The Paris electrical exhibition was the beginning of the new era, both in the science of electrical measurements and in the technical applications of electricity. We look back to it as the day of small things electrical, but it was in reality the day of large and brilliant ideas.

Past, Present and Future of Electric Traction.

By Frank J. Sprague.

On an anniversary one may become reminiscent. 1874, the year of the birth of the Electrical World and Engineer, has for me a special interest, for although I had set foot on this planet about the date of the laying of the first Atlantic cable, it was then that as a cadet at the United States Naval Academy I began the professional career which ended in the electrical field, when I resigned from the service in 1883 to become one of Mr. Edison's assistants. A prolific period this, and one in which the Electrical World and Engineer has been an effective recorder, tutor and encourager. Of what has been done in many electrical fields others can tell much better than I, so I will speak in brief fashion of but one subject—some features of the development of electric traction.

Although when the Electrical World and Engineer first went to press, a quarter of a century had passed since Farmer and Page had carried on their experiments with small model electric railways, there was not in existence a single car operated by electricity. Five years later Edison had in his development of the incandescent light created the low-resistance dynamo and established the multiple arc system of distribution, but even after eight years more elapsed there were less than a dozen electric railways the world over, scarcely any two alike, and none typical of the modern development, to mark the work in this line of such pioneers as Siemens, Henry, Edison, Van Depoele, Reckensaun, Daft, Field, Bentley, Knight and others. Perhaps the time was not ripe, and it needed a special combination of opportunity and willingness to assume the great commercial risks, as well as a departure in practice profiting by the mistakes of earlier work, to start that industrial progress which has been so astounding. Such an opportunity occurred at St. Joseph, Mo., and more especially at Richmond, Va., in 1887, when, under the auspices of the Sprague Electric Railway & Motor Company, which had been largely fathered by Edward H. Johnson, and adopting a principle of motor construction and suspension tested by me on the New York elevated railroad the year before, the active commercial development of the electric railway began.

The vicissitudes of the Richmond road have passed into history, its apparatus into honored and well-earned rest, but the principles underlying its construction and operation have survived, and to-day mostly dominate all electric traction, for there was used the multiple system of distribution at constant potential of 400 to 500 volts, the single overhead trolley with parallel main conductor and feeders, the ground return with bonded and reinforced rails, the universal movement underrunning trolley carried in the center of the car, double motor equipments under the car, centered on the axles, geared to them and flexibly supported at the free end, fixed brushes for both directions of movement, variation of current and torque by variation of field resistance and turns, dual control of motors, and series and parallel operation. While novel, all these features were not original with Richmond. Edison and others had used constant potential, Van Depoele form of underrunning trolley. I had proposed a rigid overhead conductor with flexible overhead contact for the Metropolitan Railway in London, in 1882; and Reckensaun had put into operation series parallel control; but many features were distinctly new there or in the preliminary experiments of the Sprague Company, and at Richmond there was the combination of various ideas old and new on a scale commensurate to achieve results.

While that work was in progress the Van Depoele Company was offered me by Mr. W. J. Clark, whose commercial sagacity and effective work in the development of electric traction has been so many times exemplified, and on my failure to take it up (I could not) it fell to the Thomson-Houston Company and Mr. Coffin. Aided in a great measure by Van Depoele's happy adoption of the carbon brush, and with unusual business energy, the Thomson-Houston Company rapidly developed. The resulting rivalry and warfare between it and the Sprague Company, although not unattended by some disastrous results, on the whole was of ultimate great benefit to the art because of the rapid development of apparatus and the extension of electric traction. In 1890 came the absorption of the Sprague Company by the Edison General Electric, with which it was allied by financial and manufacturing interests, and later the union of it with the Thomson-Houston in the General Electric Company.

At Richmond, it should be noted, began the contest between the electric railway and the telephone interests because of the common use of earth and rail returns, with resulting injurious effects on the weaker and more delicate apparatus. This was waged in not less than sixteen States of the Union, with the practical result of the adoption of complete metallic circuits for the telephone system—a result the necessity of which was already beginning to be apparent, and which was later emphasized by the growth of long-distance telephone service, quite independent of the influence of electric railways, who were not the sole distributors of peace and—potential.

A decade passed and the trolley hummed its song of victory and emancipation while weaving its threads in every civilized country. Horse, mule, cable and prejudice disappeared, towns became cities, farms became suburbs, homes grew up in the place of tenements, time and money were saved, the health and morale of employees were improved, great works were created, and an army of men were employed. Companies were consolidated into great systems, as under the initiative of Henry W. Whitney on the West End of Boston, and hundreds of millions of capital were invested.

But with it all the trolley remained essentially an individual system, the movement of single cars along highways, picking up and leaving passengers wherever desired, its use largely determined by convenience, capacity and economy under such conditions, save in a few instances of limited train movement where the power was consolidated in a single car at the head of a train, a kind of equipment in fact on which work was progressed as early as 1885. The steam railway field on its own exclusive right of way was practically uninvaded, although as early as 1892-3 the construction of a locomotive for experimental work for Henry Villard had been undertaken by Drs. Louis Duncan, Cary T. Hutchinson and myself; and the General Electric Company had actually undertaken the contract for operating the trains through the Baltimore tunnel. But conditions where electricity could be applied on such a scale were limited.

In 1897, however, just ten years after the Richmond beginning, an opportunity again arose for a development which may also be fairly termed epochal. For a dozen years the Manhattan Elevated Railway Company had been the objective point for electric enthusiasts, and for nearly two years I had endeavored unsuccessfully to get an opportunity to make demonstration there at my own expense of a new system which was the outcome of the electric control of elevators. The proposed equipment of the South Side Road, of Chicago, under the technical advice of Sargent and Lundy, the latter of whom had been with me in the early work, afforded the opportunity I sought, with the result that the multiple-unit system was contracted for, and before the end of the year tested at Schenectady and Chicago.

This system did not consist simply of a method for single control of motors on different cars of a train, for that had been proposed many years before by others as well as myself, but for grouping into a train two or more motor cars, each equipped with motors and controllers for those motors, with provision for simultaneous control from master switches of all the main controllers through the medium of an independent electric train line common to all the cars, and connected on the one hand to the master switches, and on the other to the operative parts of the controllers of several equipped cars. The connections from car to car were made by jumpers, and the main current for each car was taken by collectors on that car. The train connections were such that cars could be made up into any desired aggregation, without regard to number, order or relative relations. As originally planned (and the original equipment is still in operation) the main controller was of the cylinder form, with pilot motor drive. Stepped or automatic advance under current limitation on each controller was obtained by relays operated from the train line. Since then the multiple unit idea has grown and spread until it is now almost universally adopted for all heavy work. Many variations in detail have been made from time to time by different inventors, such as operating the cylinder by air pistons or magnets instead of by a pilot motor, or breaking up the controller into different parts, each operated by a magnet or air piston, with or without automatic control, or with the automatic feature limited to the main switch. But the essential principle—the electric control of the controllers from master switches through an independent line—has never been and is not likely to be, departed from.

From combining and operating car units equipped with motors aggregating a capacity of 100 hp for passenger service only, the practice has now developed until it is applied to locomotive operation.

The 2,200-hp units which are to form a part of the New York Central Railroad equipment will be so operated, giving at times a possible aggregate of nearly 7,000 hp under single control! It is here in New York that two of the greatest improvements are now being carried out which will have a marked, although perhaps specialized influence on electric traction. I refer, of course, to the great work of the Pennsylvania Railroad Company, and the even more extensive electric undertaking of the New York Central—the latter of which is actively pushing, in connection with its terminal changes, the electrical equipment of its regular main and suburban service for nearly 40 miles out from its city terminal, where the heaviest trains will be operated at the maximum speed.

The plans adopted for this equipment, decided on by a commission of which Vice-President Wilgus is chairman, include the use of continuous-current motors within the zone to be equipped, a decision of perhaps more than ordinary moment at a time when world-wide experiments are being undertaken, and extraordinary claims made, in behalf of alternating-current motors; and one which warrants some comment both upon the special subject of such motors and the electric operation of trunk lines in general.

The present is not the time for me to go into any detailed statement of the reasons which were conclusive for the commission's decision, but suffice it to say that I am entirely satisfied with it, and believe it was the only one which could have been safely reached at the present time. This is said without any spirit of antagonism to the alternating-current motor development, and without abating any jot of confidence in, or hope for, its future. Certain statements, however, I think, can now be safely hazarded: One, that the polyphase motor will not secure any lasting foothold in railway operation; another, that the continuous-current motor will not for a long time outlive its usefulness; and finally, that trunk line electric operation as such is not of the immediate future.

Machine for machine, the commutatorless motor, coupled with the ability to economically transmit electricity at high pressure for a great distance and transform with stationary apparatus to any desired pressure, has been matched against the limitations of the commutated motor and restricted distribution for the 15 years since Ferraris and Tesla first advocated its use. Polyphase transmission has become a most influential factor in long-distance transmission, and the polyphase motor finds a wide and increasing field of usefulness; but the continuous-current motor still performs its service placidly and demonstrates its utility, while throughout the United States there is not a single polyphase railway, and in Europe there are but a few introduced, chiefly by a single company of great technical ability.

Within the past year, however, undoubtedly spurred on by Mr. Bion J. Arnold's predictions and pioneer work, the leading companies in this country have made material progress in the construction of single-phase alternating-current motors, and similar developments are taking place abroad. Probably in no phase of the electrical development has there been greater concentration of high technical skill and mathematical ability than in this new departure by such men as Steinmetz, Lamme, Finzi and others. The methods and results vary materially, but one significant fact is patent in all—the much-despised commutator has reappeared, and under conditions some not as favorable as exist in the continuous-current motor.

In all alternating-current motors there must be a reduction of armature potential if high-potential transmission on the trolley exists, either by short-circuiting a closed armature with independent circuits in a field supplied direct by high potential, as in Prof. Elihu Thomson's repulsion motor, or by transformation of the whole or part of the current energy, as in the Lamme and other motors. In some cases even a greater number of brushes is used than in continuous-current practice. At present the latter type of motor apparently has some advantage in the matter of weight, individual efficiency and freedom from sparking, and I think will maintain it. Undoubtedly, however, the future holds out much promise for the single-phase motor, and it will be a satisfactory machine. It is well, however, to ask wherein lies the demand for it, and why does it threaten the supremacy of its rival? There are two special reasons remaining, that one on which much stress was laid, the absence of commutator, no longer existing. These are the possibilities of use of a fairly high potential on the trolley, or secondary system of distribution, with resultant increase of distance between the substations and better averaging of load on them, both very important features, and the abolition of the rotary converter, a desirable result. But as to the first there is a chance for error of judgment, for the possibilities of the direct-current motor are by no means exhausted, and for any given maximum potential and track rails specific resistance continuous current admits of the less size of conductor.

In the matter of initial transmission to sub-stations, the advantages of high potential are common to any system of motors. At these points the pressure must be transformed down, the energy being then delivered through rotaries or motor-dynamo sets for continuous current or direct for alternating current to the seconday supply system.

Up to the present it has been the general practice to limit direct-current work to about 600 volts partly for construction reasons and partly because of the existing practice on city systems, or at terminals, where the alternating current is used at 3,000 volts. It would appear at first sight that with the same size of conductors and loss increase of pressure would mean an even greater increase of distance between sub-stations. Since, however, the load on the secondary circuit would increase about as the distance between the sub-stations, and the capacity of the secondary circuit would probably be considerably less than that of the ordinary third rail because of the necessity of carrying smaller conductors over the cars, even if such conductors are reinforced, as would be most advisable, by a main conductor extending along the tracks and supplying the trolley wires parallel to it, the distance between the sub-stations would be materially reduced, and in fact would generally be considerably less than that represented by the simple ratio of the increase of potential.

While direct-current motors may be always somewhat at a disadvantage in the matter of individual potential, when there is a plurality of motors, as in a large locomotive, it is quite possible on a direct-current system to work up to 1,700 or even to 2,000 volts on a single trolley line, maintaining a maximum as in regular use on the Berlin Elevated of from 850 to 1,000 on individual motors; and if a three-wire system be used it is quite possible to make use of a maximum transmission potential of nearly 4,000 volts. I am not prepared to say yet that this is advisable, but it is possible and I submit that in the problems involved in any trunk line development there are many questions of greater importance than that of the relative allowable trolley potentials for direct and alternating-current equipments.

The very essence of successful electric railway operation has been to supply from a single source of power a large number of moderate powered and well-distributed units. Trunk line service is of quite a contrary character, and many of its present features must be changed, or its density of traffic greatly increased before investment necessary for electric operation can be generally considered. It may be accepted as a cardinal principle that no large railway system will generally adopt electricity as a motor power unless it be dictated by the assurance of less cost of operation or a greater return on existing and new investment, and such adoption will not take place until the average density of traffic will warrant the operation on a section measured by the practical limits of transmission from a single station, at which time the joining together of sections will become possible. Infrequent and spasmodic service in large units over long distance offers little chance for electric operation. The early application to the large locomotive units will be in such zones of electrical operation, like the New York Central, where the pressing use of electric suburban service and other special requirements, exist, under which cases all equipments should be electrically operated. Such cases are, however, specific, and are not necessarily favorably conclusive on the larger distance proposition. On this subject I see no reason to change my views as expressed at length many times during the past fifteen years.

Flat Wheels.

The New York State Railroad Commission has recently reported on its work with regard to improving transportation facilities in Manhattan and Brooklyn Boroughs. The operation of cars with flat wheels causing annoyance to residents by the noise has been taken up with the various companies and a more thorough inspection and removal of flat wheels has been ordered by the Board. During the quarter ending November 30, 1,367 pairs of new wheels were placed under the electric cars of the Interurban Company. During the same period 1,659 wheels were placed under the cars of the Brooklyn Rapid Transit Company.

The Dissappearance of Overhead Wires.

By W. Maver, Jr.

While it is true that electrical subways for the use of high and low-tension cables were in use in Chicago, Philadelphia and elsewhere on a comparatively small scale before their employment was begun in New York City, nevertheless it was in the last-named place that the problem as to whether it was feasible to operate high-tension circuits commercially, and on a large scale in cities was to be solved. That this was considered a problem by many at the time in question, 1886 to 1890, will be evident from the fact that some of the men then most prominent in scientific circles were willing to place themselves on record as being of the opinion that it would not be possible to operate such circuits underground. If, said one of those men in a portion of his argument, the conductors are lead-covered to enable the insulation to withstand the destructive influences of moisture and gases present in these conduits, the trouble is only mitigated, for the lead covering is itself subject to corrosion by the same agencies of moisture and gas. As soon as by these means, or by such abrasion as is liable when the lead-covered cable is being drawn into the conduit, or by a defect in the manufacture, the lead pipe is punctured, moisture will soon exert its injurious effect upon the insulation. Besides, with current of high electromotive force there is always present an action of polarization of the insulating material which tends to change its structure and cause the formation of faults in it, which, with other things, would make the difficulties of operation insuperable.

Some of the high-tension companies were at the time willing to place their circuits underground, others professed to be willing to do so, but insisted that the civic authorities should, by actual tests, first show that it was practicable to operate high-tension circuits underground, claiming that the attempts in this direction in other cities had resulted in failure.

The rules that were promulgated for the operation of the high-tension cables in the city were also objected to vigorously by the dissentient companies, especially the rule requiring that the cables should be shown to possess an initial insulation resistance of 15 megohms per mile, per 100 volts e.m.f., it being asserted that this could not be obtained in practice and, if it could be, it would be impracticable to make the tests to demonstrate the fact. 'Said the same authority, the measurement of 100 megohms with the apparatus ordinarily used for the measurement of resistances is a very difficult operation and requires not only a very high degree of skill and the most sensitive and finely adjusted instruments, but it is essential for even tolerable accuracy that the instruments should be free from all disturbing influences and used under conditions which are rarely formed outside of the best equipped physical laboratories.

So far as the making of the necessary tests is concerned, the present writer may modestly say, inasmuch as he either made or supervised the thousands of tests of the cables that were laid in New York subways for a number of years thereafter, that it presented no great difficulty. It may be noted, however, that at the time in question and as showing the dearth of practical electricians then existing, that Mr. G. A. Hamilton, Mr. D. W. Jones and the writer were perhaps the only available experts in New York City for this class of work. The fact that such was the case may be credited when it is stated that the writer was engaged jointly by the cable manufacturer, the purchaser of the cable, and the subway company, to test for them the first high-tension cable that was laid in these subways.

There was at the time under consideration no exact data relative to many of the conditions to be met with in actual practice. Thus the thickness of insulating wall necessary for high-tension cables was not definitely known, and hence some of the first cables manufactured were deficient in this respect, the mechanical strength being insufficient to meet the strains of hauling in, bending, etc., to which the cables were subjected in practice. The writer was fortunate enough to specify in one instance a thickness of insulating wall of .25 in. for a cable designed for 7,000 to 10,000 volts, a thickness which subsequent experience has shown to be ample. The proper size of manholes, handholes, etc., was also an unknown quantity and as a rule they were in numerous cases made too small, a defect which has been remedied in later years. A few months' experience, however, sufficed to throw much light upon all of these questions, and as fast as possible improvements were suggested looking to the betterment of the service. Among these was the use of beveled edges at the entrance of the ducts in manholes to prevent the cutting of cables; the placing of switches on posts or on walls outside of the subways to which switches the cables should be led for purposes of testing, changing circuits, etc., which plan was adopted in the case of the fire department cables and some of the electric light companies, and might be extended further to advantage.

Reverting to the rules relative to the testing of cables, it is but fair to add that these rules were probably drawn purposely rigid as a precaution against the dangers of explosions in the subways. It was a more or less open secret at the time that the opposing interests would subject the cables to the severest tests to demonstrate the accuracy of their contention as to the impracticability of high-tension underground systems, and obviously counter precautions were taken by those financially and otherwise interested in the success of the subways; and to-day no one questions the wisdom of that course.

Early Automobiling Reminiscences.

By Oberlin Smith.

My chief experience in electrical matters (since spending much time when a boy in manufacturing a variety of what was then called electrical apparatus, for my own amusement) has been in the line of motor-driving of machines, especially power presses. As some of the readers of the Electrical World and Engineer may have noticed, I have for several years been an earnest preacher, in the various engineering societies and elsewhere, upon the subject of individual driving. This system, as opposed to the mere coupling of motors to long lines of shafting, or to group-driving, so-called, has passed the successive eras of crankiness and of doubtfulness, and has, mostly within the last two or three years, established itself as the paramount system of the future. Its advantages are too numerous to be repeated in this article, but I venture to predict that very few of the first-class newly-built machine shops of five or ten years hence will contain much, if any, shafting and belting.

Passing over the tremendous and obvious developments which are bound to occur in the near future in electric lighting, power transmission, high-speed railroading, etc., and also the glorious development which many of us see with prophetic eye in the not too far off future regarding the transmutation of heat into electricity, a nearby and very practical line of development lies in the improvement of the storage battery. This will vitally affect the running of automobiles and small pleasure boats, most of which are now run by their owners and chauffeurs under conditions of martyrdom, tempered by a spirit of self-sacrificing cheerfulness, which it is difficult for their friends to appreciate. When a mere layman in this motoring amusement, or art, or whatever it may be called, contemplates the tangled mass of tanks, and cylinders, and pipes, and rods, and screws, and what not, together with the tool outfit for adjustment and repairs, he can but sigh for the time when the electric carriage and boat will prevail, at any rate for purposes of business and pleasure.

To bring about such halcyon days of pleasure travel but two important new conditions are necessary. The first is to have a cheap, light and durable storage battery. The second will consist in the establishment of a system of electric charging stations at proper intervals, upon all our streets, roads and waterways which are suitable for the kind of travel we are considering.

It goes without saying that, upon the whole, we must have throughout our country a tremendous and radical improvement in the quality of country roads. This, however, is sure to come as the use of automobiles increases. It has been already developed somewhat by reason of the invention of the bicycle. Such charging stations should be regulated in some way by state or national law, in connection with the control of highways and waterways, to prevent extortionate prices; and thus will be enhanced the volume of travel and the development of the quantity and quality of the vehicles used therefor.

New Jersey's greatest inventor has taken up the first problem mentioned, with already a considerable measure of success. This it is hoped by all of us will soon ripen to complete fruition. We Jerseymen further hope that a State which has so large a field of travel, and which has already made such progress in good roads construction, will be one of the first to establish the charging stations in question.

While speaking of New Jersey (remembering the editor's invitation for reminiscences) I am reminded that I myself may have aided the progress of automobiling by showing how *not* to do it, I being perhaps one of the earliest chauffeurs in the State, or at any rate in the southern section thereof.

Upon a certain occasion over forty years ago I entered into an autoing collaboration with another boy, who is now a distinguished professor of mathematics, both being fired with enthusiasm to emulate the recorded performances of the occasional steam carriages appearing in England from Sir Isaac Newton's time into and through the eighteenth century.

Instead of building such a vehicle entire, the boys procured a farm engine of about 5 hp built in the general style of a steam fire engine, that is, with a vertical boiler at the rear, fired from behind, and a horizontal engine lying upon the framework in front. They soon realized the difficulty of steering by swinging the front axle with sufficient power and delicacy should either wheel strike an obstruction. This they overcame somewhat ingeniously by fastening ropes near each end of the axle, which came upward and rearward to the main shaft of the engine, being wrapped loosely two or three times around the same, on the principle of a "snubbing post." These ropes continued upward to the hands of the steersman, and with them he could control the axle perfectly by tightening one or the other more or less, the power to hold it against obstacles at either wheel being, of course, supplied by the engine as a rope tightened upon and grasped the shaft thereof.

Upon the first trial one of the rear wheels was connected with the engine by a wide belt running from a small pulley on the end of its shaft to a very large one bolted to the spokes of the wheel, which thus served as the only "driver."

In their haste to get the machine under way they waited not for good weather, but started upon a rainy day with the ground covered with slush. The belt soon got wet and the "auto" was held up for repairs.

For the next trial a chain and sprockets (not easily procurable in those days) were substituted for belt and pulleys. The machine itself ran well in spite of having only one driver, but, time still being precious in the eyes of the adventurers, the next start was made over a very bad road covered with snow two or three inches deep. This road was narrow and crooked, soon reaching a narrow wooden bridge spanning an icy river, then running up a hill at a moderate grade. To avoid delay, no connection was made at this first trial from the throttle valve (an ordinary 1¼-in. steam cock) at the rear of the boiler to the driver's seat in front, where he might have attended to it had not both hands been busy with the steering ropes, and both feet with bracing himself to keep him in his seat.

The professor was kindly allowed the honor of the first trial and when duly mounted yelled to the small boy who acted as fireman (standing upon the ground) to turn on steam, which then stood at high pressure. Being both obedient and strenuous, this youngster revolved the cock handle suddenly through an arc of some 90°, then letting it slip off and fall hidden in the snow as the machine bounded forward and left him standing in amazement at the ambition thereof.

Your servant, who was acting as general traffic manager, rushed into the shop ("garage" should it not have been termed?) wildly searching for a monkey-wrench and triumphantly emerging in chase of the lost auto car, which the powerless chauffeur had by that time succeeded in steering at full speed around the turns of the road and between the railings of the bridge—rather than down a steep bank into the river below. As he reached the hill beyond, with the car ascending and the steam pressure descending, the monkey-wrench and the boy he left behind him succeeded in reaching the steam-cock, and everything ended happily.

The machine not afterwards proving comfortable enough for a touring car was classed in the grade of runabouts, in view of the performances it had performed. Later on it became a stayabout.

Street Crossing Signal.

Mr. C. L. Cole, U. S. Consul-General, Dresden, says: "I notice the trial of a new safety device at street-car crossings in this city, which may be described as follows: A box 2 ft. long and 1 ft. wide is suspended from the wires at the center of the crossing, and at a certain distance the approaching car automatically turns on the current and from the opposite sides of the box is shown in red letters the word 'Halt,' to warn the car coming at right angle as well as teamsters and pedestrians. When the car reaches the center of the crossing, the light is extinguished. Watchmen are placed at all crossings in this city where cars meet, but I am told this device is being tested with a view of avoiding the expense."

A Historical Sketch of International Electrical Congressess.

BY DR. A. E. KENNELLY.

THE history of electrical congresses dates from the year 1861, and the development of the power of such congresses, together with their relation to scientific and industrial activities, is a story of great interest. The electric literature of 1860 shows that telegraphy was then the only industrial application of electricity outside of electroplating. As a branch of physics, however, the theory of electricity was well developed, and nearly all of the fundamental laws were well known, as, for example, Ohm's law, the laws of electromagnetic induction and the laws of electrostatic induction. The practical application of those laws was, however, in a most backward condition. There were galvanometers, batteries and resistance coils, but their calibration was very crude.

The British Association for the Advancement of Science, appointed a committee in 1861, on Lord Kelvin's motion, to report upon the best unit of electric resistance. This committee of a few eminent physicists formed the first electrical congress.

In the following year the committee reported to the Association in favor of Weber's absolute metric system of electromagnetic units. An attempt was made to base the system on the British foot and grain, but fortunately the centimeter and gramme prevailed. Since 1862 all electrical units have been metric units.

The British Association continued its work for several years and the results were finally published in 1875. The committee not only established the C.G.S. system, but also created its half-brother, the practical system, of the quadrant and eleventhet-gramme variety. It determined the value of resistance coils in ohms and of current strengths in amperes. Its ohm, called the B.A. ohm, was 1⅓ per cent. short of the correct resistance, as more recently determined and adopted. It issued copies of the B.A. ohm and B.A. microfarad. It did most valuable service and laid the basis of all subsequent international work.

In the meantime the electric telephone and the electric light came into existence. These new industries greatly extended the needs of electric units, and electric measuring apparatus of an industrial type.

France, since her first Paris Exposition of 1855, has given evidence, like the sun, of an eleven-year cycle of expositions. They have succeeded each other in 1867, 1878, 1889 and 1900. Whether there is any deep sociological connection between these recurrences, and the eleven-year periods of sunspot activities, we leave as a curiosity to the curious. But in 1881 Paris gave a special international electric exposition, as a *hors d'œuvre*. At this exposition an international electrical congress was first convoked. The congress adopted seven articles of faith. The C.G.S. system and its half-brother, the ohm-volt-ampere-coulomb and farad system were adopted. An international commission was charged with a redetermination of the ohm, for practical purposes.

The international commission was convoked in pursuance of this resolution in 1882, and again in 1884. At the latter conference the "legal" ohm was adopted and defined as the resistance of a column of mercury 106 cm. long and 1 sq. mm. in cross-section, at the temperature of melting ice. This legal ohm was about 1 per cent. larger than the B.A. ohm, and about one-quarter of 1 per cent. shorter than the present generally accepted value. The volt was defined in terms of the legal ohm and of the ampere.

The second international congress was held at the next Paris International Exposition of 1889. There were three sections, the first devoted to units, the second to industrial applications and the third to electric signaling, comprising telegraphy, telephony and signals. The first section adopted the joule, watt and bougie-decimale. The second section the quadrant and various definitions in alternating-current technology, namely, definitions of period, frequency, mean and effective current strengths, effective e.m.f. and apparent resistance. The third section considered no units.

The third International Electrical Congress was held in connection with the Chicago World's Fair of 1893. At this congress, for the first time, papers were read and discussed on various subjects in theoretical and applied electricity, apart from the work of the chamber of delegates appointed by the various governments to consider and vote upon units and other matters of international importance.

At this congress there were 144 enrolled members, about 125 of whom were Americans. Some 500 persons attended the opening ceremonies. The proceedings of the congress were published by the American Institute of Electrical Engineers. The chamber of delegates adopted the international ohm of 106.3 cm. of mercury, as an amendment upon the legal ohm of 106 cm. in 1884, which was an amendment upon the B.A. ohm of 104.8 cm., in 1875. The various other international units were adopted to match the international ohm. The international volt was defined in terms of the ohm and ampere fundamentally, but also collaterally as a fraction of the e.m.f. of a standard Clark cell, the specifications for the preparation of which were left to a committee. The committee has not reported. The international ampere was defined in terms of the rate of deposition in a standard silver voltameter. A table of international notation was accepted and printed as an appendix.

Two unofficial international electrical congresses were held at Frankfort and Geneva, in 1891 and 1896, respectively. No official government delegates were appointed to either.

There were three sections in the Chicago congress, Section A for theory, Section B for intermediate subjects and Section C for practice. Thirty papers were presented and discussed. The proceedings of the congress form an octavo volume of 488 pages. No provisions were made in advance for the preservation of this literature and it would probably have been lost if the American Institute of Electrical Engineers had not assumed the task of rescuing it and financial risk of its publication.

The fourth International Electrical Congress was held in Paris in 1900. Like all its predecessors, it was held in connection with an international exhibition. The French Minister of Commerce authorized the movement, which was originated by the Société Internationale des Électriciens. The organization of the congress was first established eighteen months in advance of the sessions and circulars were addressed to very many persons interested in electricity, inviting their adhesion. The total number of congress members enrolled was about 933, of whom about half were French and only a very few were Americans. There were five sections, with several sub-sections, in addition to a chamber of government delegates. About 120 papers or communications were presented and discussed. The only work accomplished by the congress in regard to international units was the christening of the C.G.S. units of magnetic flux and flux density under the titles of "maxwell" and "gauss," respectively. The proceedings of the congress were published in two octavo volumes of 526 and 318 pages, respectively.

The forthcoming International Electrical Congress of September, 1904, at St. Louis, was originated by the St. Louis Exposition, at the suggestion of a number of members of the American Institute of Electrical Engineers. A committee of organization was formed about fourteen months in advance of the sessions. About 5,200 invitations to join the congress have already been issued to persons interested in electricity. Over 1,000 acceptances of membership have already been received and the number is steadily increasing. Invitations have also been extended by the State Department at Washington to the various foreign governments asking them to appoint official delegates, as in the case of the two last congresses, in Chicago and in Paris. Invitations have also been sent to a considerable number of well-known electrical workers all over the world, asking for special authoritative papers to be read before the congress. About 120 papers have already been promised, in response to these invitations. No papers are to be read except by invitation, and the maximum number to be read has been set at 150, so that instead of having to press for papers the difficulty will apparently be to prevent the generosity of authors from exceeding the number of papers set by publication limits.

A feature of the St. Louis Congress, which has never before appeared, will be the official participation of societies and institutions interested either in the science of electricity or in its applications. The American Institute of Electrical Engineers has already adopted a plan of co-operation by holding a convention at St. Louis contemporaneously with the congress, and holding joint meetings with various congress sections, of which there are eight in all. By this means the papers in the joint sessions read on behalf of the Institute are to be printed in the congress proceedings, as being presented by the Institute, while the transactions during such joint sessions will be placed at the disposition of the Institute for incorporation in its own proceedings. It is expected that similar co-operation may be looked for from various other American and foreign societies, the purpose of the committee of congress organization being to enlist the aid and sympathy of electrical workers all over the world, not merely as individuals, but also as societies, the societies lending their influence to promote the success of the congress, and freely receiving a part of the congress transactions, as officially their own, to incorporate, if desired.

There seems every reason to hope for the success of the fifth International Electrical Congress in connection with the St. Louis International Exposition. The number and character of the papers promised, the number of the congress members and the efforts which all connected with the movement are freely contributing towards the enterprise, augur well for the result. The success of such a movement redounds to the credit, not only of the country in which the Exposition and Congress are held, but also to the benefit of electrical science and electrical industry all the world over.

The first electrical congress was made up of a handful of leading scientists of one country. Gradually the movement spread and broadened until an International Electrical Congress came to include scientists from all civilized countries. Now an International Electrical Congress means a carefully prepared organization in advance, a large membership, including not merely electrical scientists, but also very many who may only be interested in some industrial application of electricity. It means, moreover, the collection of theoretical and practical ideas from many sources and different countries, all uniting in a common cause, the increase of knowledge in the science, and the increase in the extent and usefulness of the science's universal applications.

The Ward Leonard Single-Phase Locomotive.

By G. T. Hanchett.

THE development of heavy electric railroading has brought to commercial usefulness a number of devices which have heretofore been of academic interest only. The series alternating-current motor and the repulsion motor belong distinctly to this class,

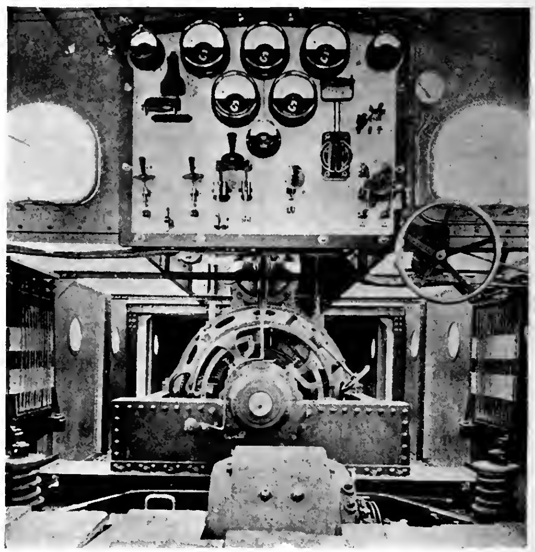


FIG. 1.—CONTROLLER CAB.

and it now seems that the Ward Leonard system of single-phase locomotion will develop into an apparatus of serious importance and consideration in large electric railway work.

To the superficial observer the Ward Leonard system seems to be a mass of unnecessary complication. It was brought before the public by Mr. Leonard in 1891, and briefly described, employs on the locomotive a synchronous or induction motor taking current from a single-phase system, and driving a direct-current dynamo which in turn drives direct-current traction motors suitably geared to the axle of the car. A superficial glance at the device does not impress the engineer favorably. He sees in such an apparatus a rotary system of energy transformation which is a bugbear that he has studiously striven to avoid; and indeed when electric railroading was confined to the propulsion of 8 to 10 ton cars over the streets of our cities, that the time was not ripe for such a radical change for the application of electricity to traction.

It must now be remembered that the requirements of a traction system are now very much different from those that were all-sufficient some ten years ago. At that time the only consideration seemed to be a simple rugged reliable system which would make the wheels revolve. Now much more is needed, and it will be briefly rehearsed in the following paragraphs.

The modern system of electric traction requires: First—Reliability. Second—Economy. Third—A very specific and satisfactory curve of acceleration. Fourth—A system of control which is thoroughly reliable and free from detrimental effects of heavy arcs. Fifth—Simple adaptation to the multiple unit system of traction. Sixth—Ready adaptation to the use of electric power of any variety.

In the old days when it was customary to compare a simple pair of controllers and motors carrying moderately light currents, with the same equipment plus the additional apparatus required by this system, the situation was such that engineers were not inclined to be enthusiastic over the new plan, but now when we have to compare the Ward Leonard motor and dynamo with the complicated multiple unit arrangement, switching large currents, or with a system of transformers and voltage regulators, which are the modern alternatives, to obtain the results that can be obtained with the Ward Leonard system, the latter certainly merits some consideration.

This system as now employed at the Oerlikon Works in Switzerland, where it is undergoing a rigid test, consists of an induction motor adapted to receive and transform single-phase currents into mechanical power. This is transmitted to a dynamo of appropriate capacity by direct connection, and thence the current is distributed to the motors by means of the Ward Leonard control. To refresh the memory of those who are not familiar with this well-known system, it may be stated that in controlling a motor for variable speeds by the Ward Leonard system, the motor is given constant field and the voltage is varied by varying the field on the generating dynamo from zero to a maximum, and also in a reverse direction. Therefore the motors are permanently connected to the dynamo terminals, and there is no opening of the main motor circuit. Those who have had to do with the opening and closing of heavy traction circuits will appreciate that in this way an enormous difficulty is practically eliminated. The burning and melting together of controller and contactor contacts has in these days of great power become indeed a formidable difficulty, and this system, in which the only circuits which are manipulated are those of the field magnet carrying only a few amperes at moderate voltage, it is easily seen is free from this difficulty.

In the second place, the Ward Leonard system supplies its power to the motors without the interposition of rheostats, and it may be safely stated that the efficiency of such a system is undoubtedly superior to the system of rheostatic control even when reinforced by a series-parallel system. Therefore in point of economy of the car equipment itself, there are advantages in favor of the system, and furthermore it is capable of returning power to the line not at a critical speed but at any and all speeds, thereby providing an electric brake of most economical type. In all other traction systems, with the exception of a few which have not been particularly practicable, all the power employed in getting the current of the car under headway is subsequently wasted in heat at the brake shoes. In the Ward Leonard system, however, the accumulated energy of the car is transformed into electricity and fed back into the line, and moreover the system of braking is ideal. It is well known by traction engineers that the proper method of braking is to apply just sufficient braking power to prevent the wheels from skidding on the track. A system whereby power is returned to the line does this automatically, for the moment that the wheels cease to turn, braking effort ceases also, so that by the simple device of weakening the dynamo field on the Ward Leonard system to such a point that the back electromotive force exceeds that of the dynamo, a very effective brake is produced and the energy of acceleration is returned to the line.

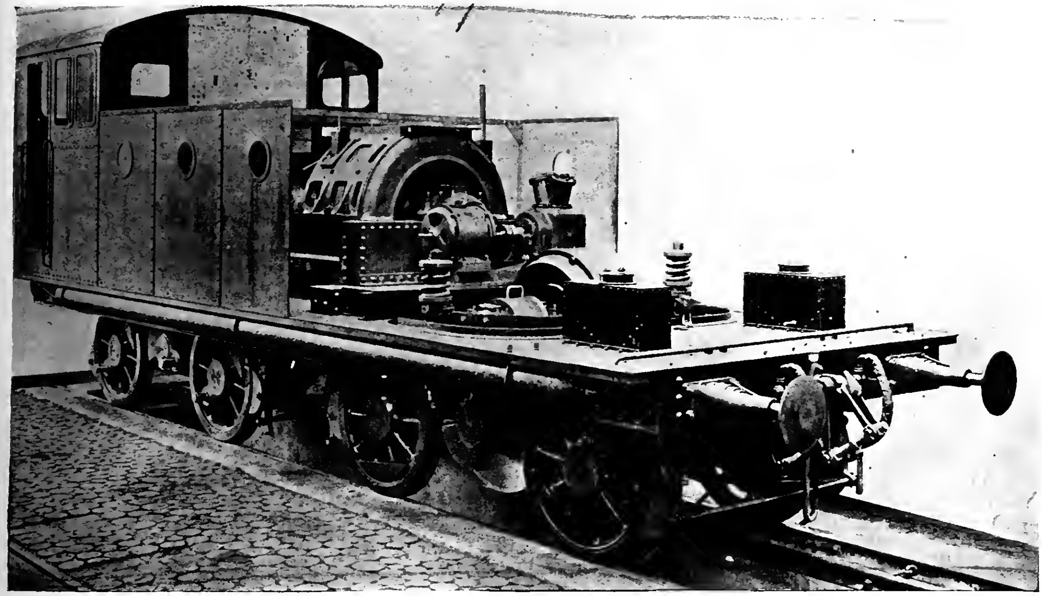


FIG. 2.—GENERAL VIEW OF LOCOMOTIVE.

It may further be noted to the advantage of this system that the acceleration curve is practically under absolute control. An ideal acceleration curve is that which applies power to the motors in just sufficient measure to prevent the wheels from skidding. With motors in series, this skidding of wheels is a very objectionable feature, for one motor having begun to skid, its wheels absorb practically all the power for that purpose, leaving the other almost if not quite at rest, the only alternative being to shut off the power until the wheels get a fresh grip. With the Leonard system, all the motors are in multiple, and this defect is abolished. In applying the power, it is only necessary to strengthen the fields of the dynamo almost up to the point of skidding. If any of the wheels should skid, it is only necessary to drop back a notch or two to reach the result desired.

A further feature of this system of control is the fact that the power taken from the line is directly proportional to the power used at the car and is not proportional to the amperes that happen to be flowing at the time in the motor. The motors may be carrying their full current and exerting their maximum torque, and at the same time only a small amount of power is required from the line for this purpose. With the ordinary system it is impossible to give the motor full torque unless the full power of the motor is taken from the line, which is thereby divided into two portions, a small portion going to the motor and the balance being absorbed in C^2R losses in the rheostats. This greatly simplifies power house design and management by wiping out the element of large starting current and heavy sudden loads.

Not the least of the advantages of the system are the ease with which it can be converted to the multiple unit plan. No bus train wires are necessary; in fact, the number of train wires can be reduced to a minimum of three light wires which supply the fields of the various dynamos on the equipments, and carry a few amperes only. A single rheostat and exciter provide means for raising these wires to any potential desired. The fields of all the dynamos come up uniformly, and with them the voltage of the traction motors. Consequently their speeds increase uniformly.

We are now able to prepare two interesting columns showing the advantages and disadvantages of the Ward Leonard system versus the ordinary heavy system of multiple unit direct-current traction. In this table all of the particulars which are common to both systems are omitted and the auxiliary apparatus of each is listed:

WARD LEONARD SYSTEM.	ORDINARY MULTIPLE UNIT SYSTEM.
Dynamo, motor and exciter.	Not less than 13 and usually more than 20 automatic contacts.
A simple system of low voltage wiring.	A complicated system of series parallel wiring and auxiliary contractor wires.
Acceleration under absolute control.	An acceleration curve seriously limited by the inherent qualities of the apparatus.
Minimum current from the power house when maximum starting torque is required.	Maximum current from power house when maximum starting torque is required.
Rheostatic control involving a rheostat waste of only a few watts at very light current.	Rheostat control wasting very large quantities of power at heavy currents and high voltage.
Return of power to the line and automatic braking.	No return of power to the line under any circumstances and no automatic braking.
The employment of any kind of power desired by the proper design of the receiving motor.	Complete re-design of the entire equipment necessary to use any one kind of power.
Weight in excess of that of the traction motor 100 per cent.	Weight in excess of the traction motor 25 per cent.

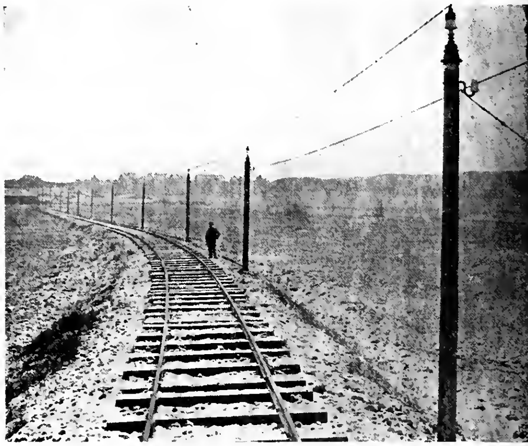


FIG. 4.—VIEW ALONG THE LINE.

A careful system of figuring, Mr. Leonard claims, will show that the added losses of the ordinary series-parallel rheostatic system of control will produce sufficient kilowatt-hours to more than carry the extra weight involved in his system, leaving a surplus for useful purposes.

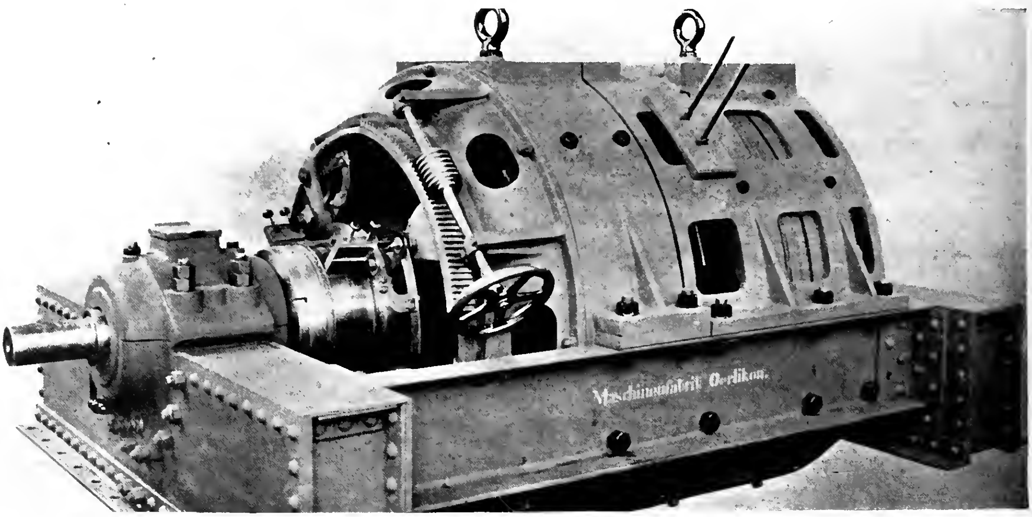


FIG. 3.—THE MOTOR-GENERATOR.

These figures of comparison seem to justify the careful consideration of the traction engineer, and in fact that the system is now being tried in the Oerlikon Works in Switzerland seem to prove that this is being done.

In a paper read on the subject of electric traction on railways, before the Institute of Civil Engineers on February 18, 1902, Mr. W. M. Mordey, whose judgment on such matters is notably sound, made numerous statements which seem very pertinent in this connection. To quote them in toto is beyond the scope of this article, but a few selections may not be out of place. He says: "There need be no irregularities of control of speed, such as are caused by the notches in an ordinary series parallel controller. A perfectly smooth transition can be obtained through the whole range, from large torque at starting and at low speeds, through all the variations of speed, to large power returned at stopping or braking. One further important point in this system is that it makes a much lower maximum demand than either the direct-current or composite system. It has already been pointed out that in the latter system (and the same is true of the three-phase system), the maximum demand occurs at the moment of starting, when the least power is being developed in the train. The output of the generating station and the losses in transmission, in transformation, and in wasteful resistance are then all greatest. Two-thirds of the power produced is lost in resistance. The one-phase system with its variable ratio gear saves all this, or a large part of it."

He further states that large starting torque of the single phase motors is not necessary in this system. Even if they should be so improved as to have a starting torque equal to that of direct current motors, it is likely that a variable ratio process would still be worth using, especially on lines with frequent stoppages. He closes by saying that sufficient has been said to show that the system possesses great flexibility, and offers at least a practicable solution of the problem of a comprehensive general system of electric traction for railways.

Mr. P. E. Huber, before the Zurich Association of Engineers and Architects, has set forth the advantages of the Ward Leonard system, and he gives some very interesting figures with reference to weights. He puts the weight of the locomotive at 44 tons, and states that a three-phase locomotive of equal power would weigh only about 30 tons. He holds that this advantage of weight is more than offset by the difficulties arising in connection with the trolley wires of a three-phase system. Mr. Huber's paper was read February 18, 1902.

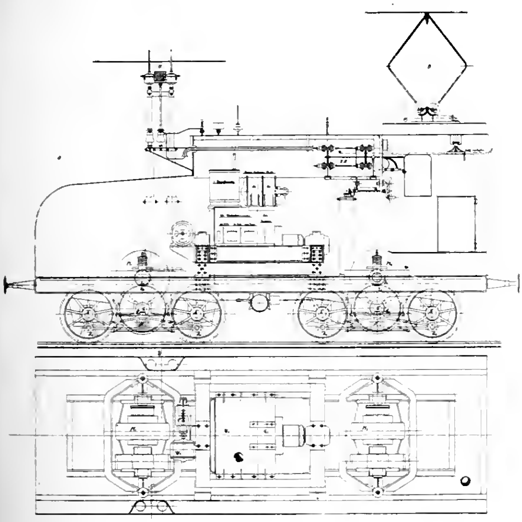


FIG. 5.—ELEVATION AND PLAN OF LOCOMOTIVE.

and at that time he did not have at his command data with reference to the additional weight and complication required by the multiple unit system, which would have naturally added further to his remarks in favor of the flexible controller offered. During the latter part of the year 1902 the Royal Commission of Swedish Engineers reported to the Crown upon the practicability of substituting electricity for steam power, and after carefully considering the various single-phase systems then extant, reported in detail upon the Ward Leonard system. This report was reported in the Swedish periodical, *Teknich Tidskrift,* of January 10, 17 and 24, 1903, and after making every proper allowance for the cost, operation and installation of the Ward Leonard system, a net yearly saving was estimated at $2,000,000. Details on the subject were given at the time in the pages of the Electrical World and Engineer.

In connection with the Oerlikon work the illustrations accompanying this article may be of some interest. In Fig. 2 is shown the locomotive arranged on the Ward Leonard system. It comprises in one frame a motor-generator. The traction motors are arranged so that they come one-half above the car floor, and are geared to an axle below which is connected to the wheel by means of connecting rods The controller cab shown in Fig. 1 displays various instruments and circuit breakers essential to the operation of the system and the rheostatic control is shown at the left. Fig. 3 exhibits in more detail the motor-generator, which, it will be seen, is a very compact and convenient machine.

Fig. 4 shows a section of the roadway, which is interesting because of its peculiar method of top contact, for the trolley wheel, the trolley resting on the top instead of on the bottom of the wire, as is common in American practice. Lastly, Fig. 5 displays to good advantage a diagram of the Ward Leonard locomotive, in which is shown the motor-generator exciter and its transformer, the main motor-generator, the traction motor and connecting rods, in which it is interesting to note the flexible sliding link connecting the motive shaft of the connecting rod.

It is to be hoped that the work of such a well-known American inventor may not be compelled to look exclusively abroad for its exploitation. Such experiments should be undertaken in America, and the present state of the art is such that careful work is certainly justified.

Institute Meeting on Air and Circuits Under High Voltages.

The 184th meeting of the American Institute of Electrical Engineers was held on February 26 at the Chemists' Club, New York City. The meeting was called to order by Vice-President Lieb and the secretary announced that at the meeting of the board of directors, held in the afternoon, 67 associates had been elected.

A very elaborate paper on "The Conductivity of the Atmosphere at High Voltages" was presented by Prof. Harris J. Ryan, of Cornell University. He first analyzed the results obtained several years ago by C. F. Scott in the laboratory in Pittsburg and afterwards by R. D. Mershon on the Telluride line in Colorado. Prof. Ryan deduced from theoretical considerations a formula which he had found to represent correctly Mershon's results, but not those of Scott, nor those of other tests in which he had himself repeated Mershon's tests in the laboratory. He then traced the disagreement to the fact that in his first formula he had neglected the influence of the temperature and pressure. He, therefore, studied this problem and arrived at the following final equation:

$$Emax = \frac{17.94\,b}{459 + t} \times 2{,}055\ log_{10} \left(\frac{s}{r} \right) D'\ (r + d) \times 10^{10}.$$

In this equation *Emax* is the maximum value of the voltage wave, applied to the line, b is the barometric pressure in inches of mercury, t is the temperature in degrees Fahrenheit, s is the distance of the line conductors from center to center in inches, r the radius of the line conductor in inches, d the distance from the conductor surface at which the strain due to the electrostatic field causes initial atmosphere rupture, and D' the strength of the electrostatic field of force (dielectric flux density) that will electrically rupture the atmosphere at the distance d from the surface of the conductor with radius r, D' being measured in coulombs per square inch.

For diameters of conductors larger than 0.250 inch, the values of d and D' are constant and the above equation assumes the simpler form.

$$Emax = \frac{17.94\,b}{459 + t} \times 350{,}000\ log_{10} \left(\frac{s}{r} \right) (r + .07)$$

The author had made efforts to determine the effects of the presence of moisture upon the point at which the atmosphere about high-voltage lines becomes conductive, i. e., upon the point at which the sudden rise in the loss curve occurs. However, no definite effect of this sort could be found, and this is practically in accord with Mershon's conclusions after his observations made upon the Telluride line under variable weather conditions.

From the above equations the following table was calculated by the author. It shows the corresponding diameters of line conductors that must be employed to avoid loss between wires for a series of line voltages wherein the barometric pressure is 29.5 in. of mercury, the temperature 70° F., and the distance between the conductors 48 in.

Maximum volts at which atmospheric conduction loss occurs.	Corresponding effective volts (sine wave).	Operating pressure 90 per cent. of corresponding effective volts.	Diameters of conductors in inches.
78,500	55,000	50,000	0.058
118,000	83,300	75,000	0.106
157,000	111,100	100,000	0.192
235,500	166,600	150,000	0.430
314,000	222,200	200,000	0.710
392,000	277,700	250,000	0.990

Prof. Ryan pointed out that the real voltage limit to-day in transmission is due to the insulator, where the line has to be exposed to the weather. In future the insulator difficulty will be solved in one way or another and higher voltages will be used. Possibly in large undertakings the line may be protected from the elements by means of a continuous covering. When such high voltages are employed atmospheric conduction, or "the brush," or, as Steinmetz calls it, the "corona" must be avoided. Prof. Ryan found that the brush discharge or corona occurs always when a definite strain exists in the atmosphere next to the high-voltage conductors, and that to avoid such corona with its destructiveness and waste of power, it is necessary on transmission lines and auxiliaries to proportion things so as to keep the dielectric strain of the atmosphere below a definite point, above which the corona will inevitably appear.

In the above table a factor of safety of 1.11, or a margin of 10 per cent. was allowed by Prof. Ryan in estimating the safe voltage at which to operate so as to avoid losses due to brush discharge; but this was a laboratory conclusion only.

Concerning the maximum of the voltage wave, Prof. Ryan pointed out that almost invariably the line charging current will cause an important line voltage wave—distortion—so that the maximum of the wave (upon which the corona formation primarily depends) will exceed the effective value of the voltage by a factor much greater than the square root of two. He also pointed out that the insulators must also be properly proportioned, otherwise the presence of the insulators made of material that has a considerably greater permeability to dielectric flux than the atmosphere, will cause corona to a greater or less degree to form over the conductors in their neighborhood. This will likely be accompanied by corona over the pins inside the insulators, resulting in their ultimate injury if made of wood, from this cause alone, even if the surface leakage current is so limited as not to injure the pin.

Prof. Ryan closed his paper with the suggestion that when viewed in the dark the corona, formed upon wires of given diameters and distances apart, provides a method for gauging high voltages that is free from the short-circuit and surging disturbances occasioned by the use of the spark discharge method. Either two parallel conductors or a conductor mounted at the center of a cylinder may be employed for this purpose.

The discussion was opened by Mr. C. F. Scott, who characterized Prof. Ryan's paper as a remarkable one, reaching out into the future and the unknown. It dealt with something beyond the present commercial practice, but something toward which the actual engineering work of the present time is fast approaching. Mr. Scott then spoke of his own experiments made in the laboratory in Pittsburg, and of those made by Mershon on the Telluride line, and presented a communication by Mr. S. M. Kintner, who pointed out that on account of the influence of temperature, if a range from 25° below zero in winter and 125° above in summer is taken, there would be a range of 30 per cent. in the voltage at which the corona would appear. With respect to the effect of the use of small or large wires upon the discharge, Mr. Kintner pointed out that this would indicate that blunt gaps are more reliable for measuring voltage than needle points.

Mr. Scott also read a communication from Mr. P. M. Lincoln, who first raised the question whether any loss in our present transmission lines is due to the corona effect. From Prof. Ryan's paper it follows that this is not the case. For the very worst conditions which would occur in actual practice, viz.: a No. 6 wire with a spacing of say 48 in., the corona loss at sea level does not begin until the voltage has reached the neighborhood of 100,000 effective. For the maximum altitude at which transmission is apt to be carried on, say 10,000 ft. above the sea level, the voltage at which the loss begins may be as low as 65,000 for the worst cases, but still considerably beyond the limits of the actual practice of to-day. Normal progress is bound to carry transmission voltages beyond those used to-day, hence it is important to consider which remedies are available to counteract the losses. It is well known that a good rubber insulation on the wire will almost entirely prevent the corona loss, at least within the lower limits of voltage at which the effect occurs. Mr. Lincoln pointed out that it would be interesting to determine the effect of various kinds of insulation on the loss.

Dr. S. Sheldon then spoke on the character of the various forms of discharges through air, as distinguished by the names glow discharge, brush discharge, spark and arc. The glow and brush discharges are probably due to a sort of gaseous ionization, and Dr. Sheldon is of the opinion that this corona discharge is a combination of both these discharges.

Prof. H. B. Smith spoke of an electrometer which he had devised for high potential measurement, and Mr. P. H. Thomas asked various questions which were answered by Prof. Ryan. It was pointed out that it would be interesting to compare the effect of substituting aluminum for copper wires upon the loss. Mr. Thomas stated that he had made direct measurements of the loss from the line into the air on a 50,000-volt plant, with a length of something less than 100 miles. The loss began to be measurable at about 20,000 or 25,000 volts and ran then up very steeply. At 60,000 volts the loss amounted to a total of 10 kw, which is insignificant for power transmission purposes, but yet a measurable loss.

A paper on "European Practice in the Construction and Operation of High-Pressure Transmission Lines and Insulators," by Mr. Guido Semenza, was then presented. In the absence of the author it was read by Mr. J. W. Lieb. The author pointed out that a transmission line needs just as much careful design as any electrical apparatus and first refers to the calculation of the best wire section; this problem is best solved by a graphical method. The next question is the route of the line. He then discussed at some length the comparative advantages of wooden and iron poles. The advantages of iron poles are, durability, the possibility of using large spans and lower cost of maintenance. Their disadvantages are a somewhat greater capital investment and the necessity of using better insulators. He thinks that the adoption of iron poles for important transmission lines will become more and more general.

The author gave an outline of the best way of proceeding in the design of a line, and discussed at length the design of insulators. Wooden cross arms are sometimes employed with iron poles; but, in general, supports constructed entirely of iron are preferable. A special cement is employed to fasten the insulators to these brackets, or, in the case of small lines, tarred rope is employed. This differs entirely from American practice, and no attempt is ever made in Italy to use threaded insulators, as it is difficult to obtain good insulators with thread of the exact gauge. The best cement for this purpose consists of 10 parts of litharge and 1 part of glycerine, well mixed. The brackets and insulators thus cemented together form an indivisible unit.

When the span exceeds a certain length, care must be taken that the wires do not come in contact through their oscillation due to the wind. It is obvious that in order to avoid such a contingency it is necessary that two or more wires should never be placed on the same level, and the adoption of cross arms as practised in America should not be followed, in the opinion of the author. In any case, it is easy to calculate the deflection of the wires from their vertical position, due to the force of the strongest wind prevailing in the country and midway of the span, thus finding the distance between the insulators to prevent the wires coming in contact.

The problem of high-pressure insulation is very carefully studied by European electricians. Glass insulators are not used in Europe probably because good porcelain can readily be obtained there. Glass is considered to have a better dielectric strength, but not as good surface insulation; moreover, glass is weaker against meteorological agencies, the superiority of porcelain being due to the materials composing the glazing. European engineers do not consider American porcelain as good as European porcelain. It is possible that they may be mistaken, but a few tests made by the author on American insulators showed a higher dielectric resistance for the European porcelain, which in appearance, finish and homogeneity of material is much better.

In designing an insulator the following points are to be considered: Dielectric resistance, resistance against surface arcing, mechanical strength, facility of cleaning, ease of construction.

The first two points have reference to electric qualities and an ideal insulator ought to be so proportioned that, under a certain voltage, it should break in both ways, by puncture and by surface arcing. The resistance against puncture can be increased by making the insulators of several pieces, introduced one piece inside the other. In general, the different pieces are cemented together with a kind of glazing in the process of manufacture and put on the market as single pieces.

The author does not follow this practice, but prefers having them furnished by the factory in separate pieces, for the following reason: When the thickness of the pocelain reaches a certain limit the ordinary testing will not puncture a sound insulator. In testing an insulator made up of two or more pieces, one layer of porcelain may be cracked, but is protected by the other layers. When the tests are performed on the single component parts, this cannot happen, and one is sure to have the insulators made up of sound parts. Moreover, each composing part can be better inspected and the character of glazing observed. Following this suggestion many factories produce insulators in two parts, which, after test, are put together with glycerine and litharge cement. Experience has demonstrated that it is useless to increase the number of component parts; up to 40,000 volts two parts are quite sufficient and above that voltage not more than three are necessary.

The ability of an insulator to resist surface arcing is due to its dimensions and shape, the latter to be considered under a double aspect, the protective action against moisture and rain; and the property of giving origin to electrostatic phenomena. An insulator with a very large petticoat on the top and only a second petticoat round the pin will not afford a very good protection against rain and moisture, as during a storm the inner petticoat will get quite wet. It is, therefore, good practice to have one or two intermediate petticoats, which will also insure the dryness of some part of the surface in all kinds of weather. Care must, however, be taken not to put on too many of them, as their edges would come too near, thus forming a good path for the arc, besides increasing the difficulty of cleaning the insulator. The use of intermediate petticoats should be limited to those strictly necessary to protect the inner part from rain and to insure that a part of the surface shall be quite dry.

The discussion was opened by Mr. Lieb, who said that the paper indicated the character of analysis which European engineers give to mechanical problems when they are presented. While perhaps European engineers may not be as active in undertaking pioneer work in new fields, particularly where much investment and commercial development are necessary, yet when these applications are once made by them the constructions are subjected to very careful analytical treatment. Mr. W. N. Smith remarked that the method of construction of the high-tension lines described in the paper is quite different from our usual practice and might perhaps lead to complications in this country, for instance, from the small boy nuisance.

President Arnold remarked that just such a line, as described in the paper, has almost been completed in Mexico. It is about 100 miles long, built with steel towers, regular wind mill towers, using seven poles to the mile and supposed to be the most modern line now built. When the New York Central Railroad recently considered the transmission question, the conclusion was reached that it is safer and more reliable in operation to have the transmission wires overhead on steel poles than to put them in conduits.

Mr. L. L. Perry remarked that some constructions shown in the paper might be due to local European conditions, for instance, narrow streets. Mr. W. E. Dix said that he thought that American insulator manufacturers are now adopting the suggestions of the writer of the paper, viz.: to reduce the number of petticoats, increasing the surface and also increasing the space between the petticoats, thus reducing arcing and leaking. Mr. C. F. Scott agreed with the author that there is a difference between the engineering inside the station and that outside the station. In many cases the external line construction lacks the standardization, the uniformity, and the higher grade of considerations which have generally been given to other departments of manufacture.

Big Searchlight for the World's Fair.

The General Electric Company is building the largest searchlight made. It is to take 300 amp. and the lens is 7 ft. in diameter. This will be used by the Clark Publishing Company, of St. Louis, on top of its tower which is being built adjoining the World's Fair grounds. It is not unlikely that experiments with telephony over this searchlight beam will be made during the progress of the Fair.

Early Days of the Brush Arc Light.

By S. M. Hamill.

The wonderful story of the past twenty-five years of the development of the electric business is ever new to all of us. The able men of the electrical journals who from week to week have chronicled this story, educators in the business, constantly stirring up the new and raking over the old, have exerted a powerful influence for which the world owes them a debt of gratitude.

The Brush Electric Company was the first in the field in the era you celebrate this week. Stockly, its president, and his assistants, Tracy, Swift and Potter, were men of energy and ability. From 1879 to 1884 they accomplished a great work. The Brush system of arc lighting was soon perfected and it was pushed for all there was in it. The first series street arc lights were erected in the Public Square in Cleveland, Ohio, in 1879. Shortly thereafter local electric light companies were started in all the large cities and towns in the country. Millions of dollars were raised for the purpose. Leading men of the country were induced to invest their money and to take part in the management of the enterprises. Europe and Asia did not escape. Even to-day, in England, the Brush influences persist. Potter in the early eighties organized local companies in Japan and China. Brush with his genius for designing and constructing a new system that worked well. Stockly with his few energetic able assistants, accomplished results seldom equalled in the history of any new industry.

They were pioneers of the highest order: First, in the electric lighting field; second, in getting rich quickly in the electric business; third, in selling their company to a modern combination.

We may not yet be far enough away from Brush's early work in the development of electrical apparatus and his electric lighting system in order to appreciate fully what he accomplished. Time will place him on a lofty pedestal. So far as his actual accomplishments were concerned, during the early days prior to 1884 he was easily the leader. Between the years 1878 and 1884 he rose rapidly to prominence, and his name and reputation were world-wide. Distinguished honors abroad were conferred upon him. The apparatus which he designed and the building of which he superintended was widely used, and brought him and his immediate associates large fortunes.

Brush was a university-bred man, having graduated from the University of Michigan in 1869 with the degree of Mechanical Engineer. This was rare and was before the days of electrical engineering schools and accounts in part for the mechanical perfection of his apparatus.

While the factory of the Brush Company in the early days of its history was small in comparison with the great factories of to-day, yet for its time it was enormous, and turned out millions of dollars worth of apparatus which was shipped to all parts of the globe. Many of the engineers, or what were so commonly called "inventors" in the early days of electric lighting were not particularly good business men. The fact that few, if any of them, have amassed any wealth indicates this. Brush had very keen business instincts and not only was fortunate in his business arrangements with his company, but was a wise and conservative adviser. He loved work, which was always done thoroughly and remarkably well. The Brush dynamo so largely used to-day is to all intents and purposes the same as that designed and built by Brush in 1878. The arc lamp, with his magnetic cut-out for series circuits, the storage battery and the arc light carbon, each the foundation of a great industry, have not drifted very far from his original ideas and inventions.

In 1879 Brush was poor; in 1886 he was very rich, with a beautiful home and large grounds in Cleveland, O., where he lives to-day, devoting his time to scientific work in his laboratory and in caring for his large interests. Take it all in all, no one man has contributed more than Brush to make this electrical age what it is; and to the writer, intimate association with such a leader has not been the least pleasure of a laborious electrical career.

Wireless Telegraphy for Russia.

A dispatch from Paris says: "In order to prevent interruption of the telegraphic service during field operations in the Far East, a French company of wireless telegraphy is arranging to provide the Russian Government with a wireless system which will enable it to communicate between stations thirty miles apart."

Great Northern and City Railway, London, England.

The latest London electric railway opened to traffic is a line which joins the Great Northern Railroad station at Finsbury Park, just at the four-mile radius, with the heart of the city in an almost straight line. It is 3½ miles long and furnishes the shortest and most direct underground route from this station to London's business section. The new line runs through a very densely populated district of workers, who, up to the present time, depended for entrance to the city on omnibuses and tramways, both of which take considerably more than double the time to reach the city than is required by the tube trains. This economy in time is expected to attract a great deal of traffic. It is estimated that at least 5,000,000 passengers per mile, or a total of 17,000,000 passengers per annum, may be looked for from local business alone. These figures are considered very conservative, as the Central London Railway, for instance, is carrying about 7,000,000 passengers per mile per annum. About 30,000,000 passengers per annum are brought to Finsbury Park, via the suburban trains of the Great Northern Railway. It is figured that at least one-third of these passengers will use the new direct line in preference to the roundabout older ones, thus adding 10,000,000 passengers per annum, making an annual total of 27,000,000 passengers.

The underground portion of the line consists of two 16-ft. diameter tunnels, opening out to nearly 23 ft. diameter at the stations. As

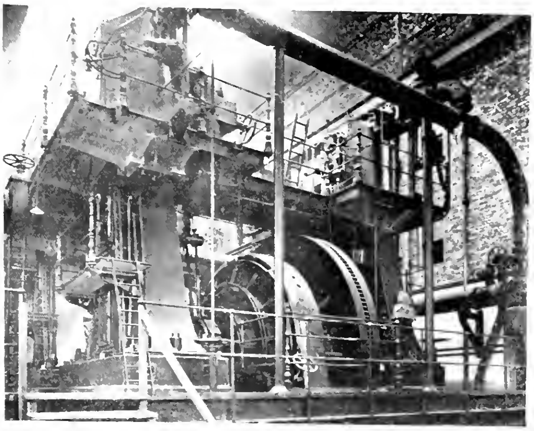


FIG. 1.—ONE OF THE UNITS.

the diameter of the Central London Railway tubes is 11 ft. 8 ins., and the City & South London Railway only 10 ft. 6 in., the new line is able to carry larger rolling stock and enjoy much better ventilation than the others. The track and tunnels are also arranged to permit the standard cars of the Great Northern Railway to run through the Great Northern & City Railway's tubes should it be found desirable to make the necessary connections.

A novelty in connection with the construction of the tunnels is the introduction, for a very great proportion of their length, of a vitrified blue brick invert. It has been demonstrated by trial runs that this material combined with a cast-iron roof will minimize noise and vibration. It is less resonant than complete iron rings, and the fact that the tubes are constructed of such different materials makes the transmission of sound waves more difficult with a consequent noise reduction.

The standard trains are made up of seven cars, three motor and four trailers, having a total approximate seating capacity of 430. The first motor car is at the front of the train, the second in the center, and the third at the end. The approximate weight of the loaded train is 200 tons.

The cars were built by the Electric Railway & Tramway Carriage Works and the Brush Electrical Engineering Company. They are supplied with Westinghouse quick-acting brakes. Each motor car carries a British Thomson-Houston motor-driven air compressor, reservoir, etc. There are also conductors' emergency cocks at the end of each car for applying the brakes in case of need.

Each motor car is carried on two McGuire trucks, having 36-in. diameter driving wheels. The trailer cars are mounted on Brush trucks. On each truck of the motor cars is mounted one 550-volt, series wound, direct-current motor. Current is collected by four collector shoes per truck.

The capacity of each motor is 125 hp, rated on the basis of 75° C. rise in temperature above the surrounding air after one hour's run on full rated load. The gear is of steel, machine cut, and enclosed in a waterproof case. The motors are controlled by the General Electric multiple-unit system. An interesting fact in connection with this installation is that the Great Northern & City Railroad was the first British electric railway to adopt the multiple-unit control system.

A 3-minute service will be introduced, single trips being completed in 13½ minutes, which permits four intermediate of 20 seconds each. The trains will be shuttled at the termini thus avoiding shunting around the stations. It is hoped to be able to maintain a 3-minute service throughout the day simply by shortening the trains, so that they may be run profitably on each short headway.

The power for operating the system is supplied from a single generating station located at Poole Street, New North Road, about a mile north of Moorgate Street station. The length (3½ miles) of the line and position of the generating system are such as to enable the system to be operated without feeding in at several points, the current being transmitted directly to the collector rails. The generating machinery also furnishes the current for lighting and the operation of the passenger elevators.

The site adjoins the Regent's Canal, from which water is being taken for condensing and other purposes, and returned to the canal at a point 300 ft. on the down-lock side of the in-take. Its connection with the Regent's Canal also permits fuel to be delivered cheaply alongside, from whence it is conveyed to the storage bins and fires by a Hunt gravity bucket conveyor, which handles 30 tons of coal an hour.

Steam is supplied by ten boilers, each having an effective grate area of 40 square feet and capable of evaporating 11,200 pounds of water per hour at 212° F. when using coal giving 13,500 B.T.U. The boilers are fitted with automatic stokers, driven by two motors.

The four main engines are of the vertical cross-compound type, built by John Musgrave & Sons, Bolton. The engines give 1,250 hp at 100 r.p.m. and 150 pounds pressure. They have fly-wheels weighing about 45 tons each, and are capable of sustaining 100 per cent. overload momentarily. They are direct-connected to four railway-type generators, rated at 800 kw each, but capable of taking for two hours, without objectionable heating, a load up to 1,200 kw. These generators are also able to carry momentary overloads of 100 per cent. without injurious sparking. They are British Thomson-Houston compound-wound to give 525 volts at no load and 575 volts at full load.

Two engines of the single-acting, tandem-compound type, built by Davey, Paxman & Co., drive two B. T. H. six-pole 120-kw generators at 375 r.p.m. They are compound-wound for the same voltage as the main generators, and have an overload capacity of 50 per cent. for two hours. They will supply power for lighting of power house, etc., and for operating the electrically-driven auxiliary plant when it is not convenient to take power from the main generators for this purpose.

There are four Wheeler surface condensers, each having a cooling surface of 2,400 sq. ft., and arranged with steam-driven combined air and circulating pumps. They are capable of maintaining a 26-in. vacuum when dealing with 2,200 pounds of steam per hour. There is also an auxiliary condenser of the same type, capable of handling the auxiliary plant and boiler feed pumps' exhaust. These condensers discharge into a hot well, from which the water is delivered by two three-throw vertical lift pumps of the Blake-Knowles type, driven by enclosed motors. All the condensers have combined air and circulating pumps, driven by steam. In addition to the supply from the canal mentioned previously, water can be obtained from the city mains. A storage tank has been provided connected directly to the latter.

The water taken from the canal is dirty, and varies in hardness from time to time during the year by reason of floods and droughts. For softening and purifying both this and the town water, which is also variable, a Desrumaux plant has been installed in the rear of the boiler house, capable of treating 8,500 gallons per hour. This gives water having its hardness reduced to 5° and alkalinity to about 6°, free from solids. An automatic arrangement is adjusted between the softener and storage tank, whereby the softening process is suspended and recommenced as occasion may require, thus giving a continuous supply of purified and softened water, with a minimum of

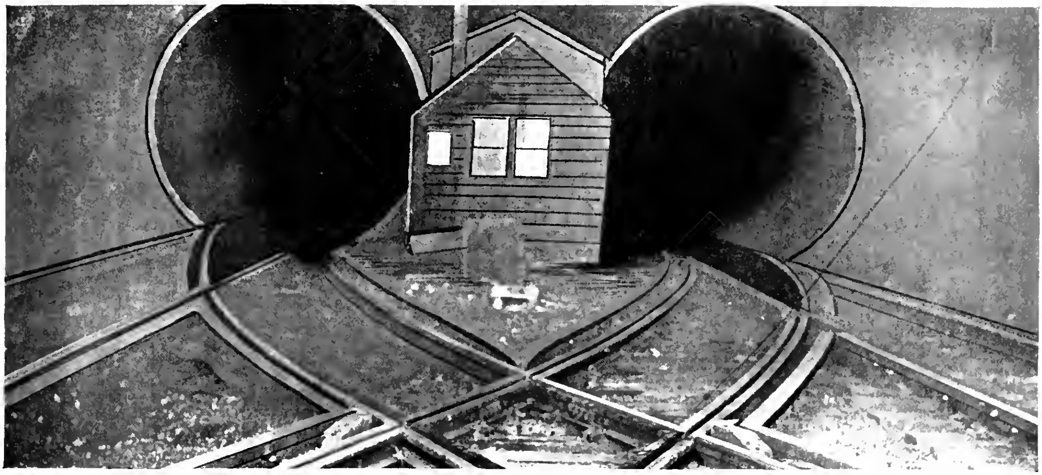


Fig. 2.—Entrance to the Tunnels.

supervision. A Masson-Scott plan is installed for removal of oil and grease from the water of condensation and for the purification of the water for boiler feed purposes. This plant is capable of dealing with 10,000 gallons per hour.

The oil and grease which has passed through the steam engines is in the form of a divided emulsion, so fine in its character that it

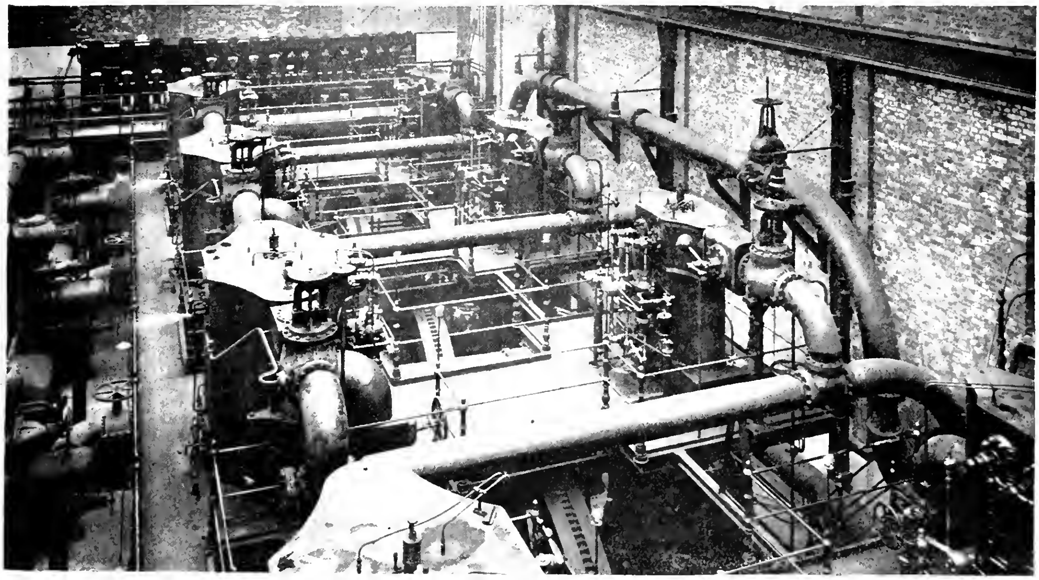


Fig. 3.—General View of Power Station.

is impossible to remove it by mechanical filtration alone, chemical treatment as well as filtration being essential. The apparatus is thus a combined plant for first chemically treating, and finally filtering every gallon of water which leaves the surface condensers, producing a perfectly clear effluent, free from grease of chemical admixtures and of a fixed degree of hardness suitable for boiler feed purposes.

A switchboard, consisting of four main-generator, four-feeder, two auxiliary generator panels, three-auxiliary power and three-auxiliary light panels, is installed in a gallery at one end of the engine room, commanding a view of all the main generators. The circuit breakers are of the magnetic blow out type, and the measuring instruments of the astatic illuminated dial and feeder type.

Cables run from the switchboard along the outside of the boiler house wall and then down a special cable shaft into the tunnels. The bus-bars on the board are so divided that the auxiliary-generator lighting and auxiliary-motor panels can be isolated from the main generator and heavy feeder panels by the operation of one switch, insuring the uninterrupted operation of the lighting system if any accident occurs to the main power circuits. Separate paper-insulated feeding cables are provided for traction, for lighting and for elevators, and rubber insulated cables for lamp circuits and connections.

The other station plant comprises steam-driven feed pumps, motor-driven economizer, two motor-driven lift pumps, storage and receiving tanks, water softening plant, one 30-ton three-motor overhead crane, etc.

Two insulated conducting rails are used per track, one being for the return circuit. Both rails are placed outside of the running rails. The conducting rails are of channel section, weight 80 pounds per yard, and are rolled to about 42-ft lengths. They are of a special quality of low-carbon steel, having a conductivity of 14 per cent. of that of pure copper of equal area. These rails are supported on earthenware insulators, 10 in. outside of the gage, carried on spindles supported by cast-iron brackets fixed to the sleepers. The system of collector rails is divided up into four sections, fed independently from the generating station. The running track is laid to standard gage, consisting of 85-pound flanged rails laid on longitudinal stringers in the tunnels and on cross-ties in the open. As it carries no current it is not bonded.

All lighting circuits are carried in iron tubes, and the tunnels are

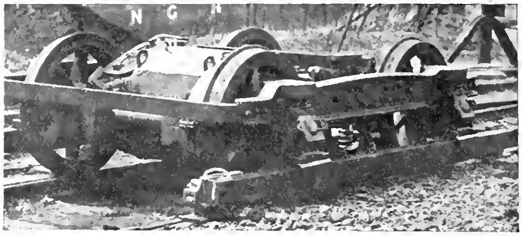


FIG. 4.—VIEW OF ONE OF THE TRUCKS.

provided with lamps every 100 ft. The passenger stations are lighted on the rail and street level by enclosed arc lamps, and station switches are fixed which control the incandescent lamps in the tunnel halfway to the next station in each direction. The lamps are placed five in series, and the circuits are run so that there is never more than the voltage of one lamp between two adjacent wires in the same pipe. Special throw-over switches are provided to take the lighting current from the conductor rails when the special lighting cables are not charged.

Power Transmission in Washington State.

Mr. Herbert Hunt, of Everett, Wash., furnishes some interesting details as to the May Creek power plant of the Everett Railway & Electric Company, on Lake Isabel, 32 miles east of that city. The plant is designed to furnish 15,000 hp to Everett for the street railway, public lighting and private power, as well as for the Everett-Snohomish interurban line of 12 miles, and later to supply other interurban trolley lines which this company will build.

The intake for the 32-in. steel pipe will be 30 ft. below the surface of Lake Isabel. The pipe will be carried 12,000 ft., with a fall in that distance of 2,500 ft. This distance will be shortened by 4,000 ft. if the company determines to tunnel a granite hill lying between the lake and site for the power house. Owing to the pressure special steel pipe has been ordered. Toward the nozzle the pipe decreases in diameter to 20 in.

The diameter of the nozzle itself will be but 5/8 of an inch. A wheel of the Pelton type will be used. One 5/8-in. stream will develop 10,000 hp. Later, when additional power is needed, another stream and wheel will be installed, developing 6,700 hp additional. The pressure on the steel pipe is 1,100 pounds to the sq. in. The speed of the water leaving the nozzle is 25,000 ft., or more than four miles a minute. The cost of the plant will be about $600,000, and it will take the place of a fine steam plant built two years ago.

The outlet of Lake Isabel will be dammed, thus storing enough water for a six months' run. This is not necessary, but is a precautionary measure. May Creek is not large, but is a tumbling mountain stream flowing into the lake, and is never dry, so far as the oldest inhabitant knows. The company is now building roads to the lake, which is a little more than a mile from the Great Northern tracks.

Power Lines Near Ocean.

It is stated that the transmission wire of the United Electric Gas & Power Company, through Santa Monica, Cal., is to be removed from Speedway and carried back to Eighth Street, extended on to Redondo, San Pedro and Long Beach. The close proximity to the ocean, it is thought, has been the cause of the frequent sparking of the poles by the 22,000 volts carried through the wire. The company is reconstructing its transmission lines and using only iron poles in the new work.

New Telephone Patents.

IMPROVED SWITCHBOARD CONNECTING CORDS.

Wherever flexible electrical conductors have been required it has been well nigh universal practice to built them up out of numerous strands of small diameter. In telephone work tinsel strands have been largely used, and prior to the introduction of the common battery system such conductors were considered amply good for any service. With this modern system, wherever a continuous current is conducted, considerable annoyance may be experienced from the breaking of a few of the tinsel strands, the loose contacts at the break serving as microphones. To obviate this difficulty in switchboard connecting cords, which are subjected to great wear, a cord having single-strand conductors has been designed by Mr. H. B. Holmes, of Evanston, Ill. This is a three-conductor cord, the conductors being spiraled up in a manner such that while the whole is sufficiently flexible all bending takes place upon a radius of sufficient length to distribute strains.

In Fig. 1 is shown a section of cord partially fanned out to render the construction clear. It will be noted that a hemped string forms

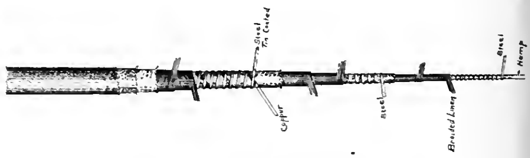


FIG. 1.—HOLMES CONNECTING CORD.

the core. About this core a thin ribbon of spring steel strip .008 in. thick and .025 in. wide, tinned to prevent corrosion, is tightly wound making approximately twenty-two turns to the inch. Two layers of silk floss and a braid of linen follow. Then comes the second ribbon conductor, spiraled in the reverse direction from the first and making eighteen turns per inch. Floss and braiding follow, as for the first conductor. These two conductors have resistances respectively of nine and eleven ohms for a seven-foot cord and are to be used for the talking circuit.

Now follows the signal conductor, for which the resistance must be kept low in order not to disturb the current ratios of existing systems. This conductor consists of a copper ribbon wound on in one direction and a steel ribbon wound in the reverse direction, the copper lying beneath at four turns to the inch, and the steel at fourteen turns to the inch. This combined conductor has a resistance of two and a half ohms per seven feet. The cord is finished with braiding and reinforcing in the usual way. This cord is apparently of a construction to stand great wear and tear, and should have a life considerably greater than the tinsel cord. The Western Electric Company have obtained this patent by assignment.

CENTRAL ENERGY CIRCUITS.

A two-wire central energy system has been patented by W. M. Davis, of Chicago. A differential line relay is used, one winding of which is so arranged that it becomes shunted by the insertion of a plug in the associated line jack. The armature of the relay then, of course, comes up, thus opening the line signal circuit. The connecting cord circuit runs directly from plug to plug for one side of the line, while for the other a condenser is inserted to permit of the use of two supervisory signals. The supervisory relays which control the lamps through back contacts serve as retardation coils through which current is fed to the subscribers' lines. This arrangement of relay, of course, corresponds to a closed circuit for the lamps, when the cords are not in use; and, therefore, the lamp circuit must be opened independently of the relays by the removal of the plugs from the spring jacks. This is accomplished by making a portion of the circuit common for the lamp and for talking, this common portion including the plug and jack. Mr. Davis has assigned his patent to the Stromberg-Carlson Company.

NEW DESIGN OF JACK.

A two-wire system jack recently patented by Alfred Stromberg has also been assigned to the Stromberg-Carlson Company. This is designed for a system slightly different from that just described. This may be called a "bank" jack, being built in groups or banks of one hundred. Fig. 2 shows the construction fairly well. The front plate of hard rubber is shown at 1. The back plate, 5, in which the springs are mounted is built up of rubber strips. The jack thimble, it will be noticed, is not spun into position according to standard custom, but is held by its conducting extension being riveted to one of the line springs. At the ends of the bank metal

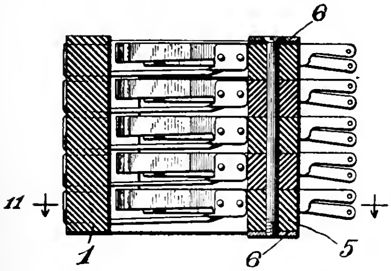


FIG. 2.—STROMBERG SWITCHBOARD.

spacing pieces are run across from front to back, to maintain the parts in their proper relative positions.

TRANSMITTERS.

Something quite peculiar in transmitters appears in a patent which has been issued to Pierre Germain, of France. This transmitter is provided with a heating coil which surrounds the carbon electrodes, the inventor stating that these work best when at about 80° C. Another feature is a supply of sodium or similar substance within the casing of the transmitter. This is designed to absorb moisture and oxygen to prevent corrosion of the parts. The third feature of note is the mixing of metallic oxides with the carbon of the microphone. In some cases it is mixed before baking; in others, after baking.

Two other transmitter patents relate to an instrument for the use of the deaf. The transmitter described is a double affair, being composed of what is practically two transmitters with their mouthpieces removed and their inlets opposed. Leading into these inlets are two curved sound passages, so shaped that two currents of air meet, the idea being to make the sound wave disturbances spread out over the diaphragms in virtue of the meeting of the two passages. The casing of each element is perforated with numerous small holes in a manner such that these serve to connect the outside air directly with the air spaces in front of the diaphragms. The inventor, H. G. Pope, of Brooklyn, N. Y., states that this perforation promotes clearness.

RECEIVER SUPPORT.

The receiver support has again appeared, this time in a form rather more commendable than some of those of earlier design. This support has an attachment engaging the hook switch in a manner such that the hook is not depressed except when the ear of the user is forcing it to one side. G. B. Buchanan, of Haverstraw, N. Y., is the patentee of this holder.

RINGING DEVICES.

An apparatus for ringing from subscribers' stations without the use of a magneto has been patented by O. O. Lee, of Chicago. Mr. Lee employs an auxiliary hook switch contact which is closed only when the hook is near the mid-position of its stroke. When this contact is held closed, a vibrator, associated with the induction coil, begins to move, rapidly breaking and making the primary circuit of the induction coil. The secondary sends out impulses of alternating current to the line. A rather powerful battery must be used for the ringing, a cell or two of this being used for the talking circuit.

Another ringing device is one patented by W. D. Watkins, of San José, Cal., designed for selective signaling. This is a step-by-step mechanism of very simple construction. The pawl operating armature is worked under the influence of the coils of the ringer while the selective device does not render any circuit changes necessary, being dependent upon releasing one bell hammer after another as the parts rotate, by the withdrawal of a stop which normally restrains its motions.

Two other step-by-step selective devices are subjects of patents in the issue under consideration. These are respectively the work of R. Hamilton, of Milton, Mass., and Messrs. H. Redmon, R. L. Hall and R. H. Conway, of Cynthiana, Ky. The apparatus and methods of operation of the two systems are markedly different, yet both involve merely the usual features of such systems, with the possible exception that special attention has been given to synchronizing all the instruments of a line after its use.

CURRENT NEWS AND NOTES.

LONDON STREET LIGHTING.—The most recent returns show that the streets of the 118½ square miles of London are lighted by 4,974 electric arc lights, 1,185 electric incandescent lights, 56,690 incandescent gas lamps and 18,248 flat flame gas burners. This leaves a lot of work ahead for electricity.

TELEPHONY IN CHINA.—For some time the introduction of the telephone in Canton, China, has been talked of, and is now said to be a *fait accompli*, the arrangement being in the hands of the Imperial authorities. All the large yamens will have the advantage of this new departure, and many large dealers and banks will also be provided for. It may not be generally known that some years ago the telephone was introduced in Shameen, but very high charges were made, and the enterprise proved a failure.

BRITISH TRAMWAYS.—During 1903 the number of passengers carried by the tramway system in the United Kingdom reached the number of 1,681,948,655, an increase of 287,495,672 over 1902, while the mileage had increased from 1,482 to 1,772 miles. The number of companies operating was 296. In 1894, 30,528 horses were at work in connection with the tramways in England; in 1902 the number was 24,120, but last year the total fell to 20,005, and the number is destined still to diminish, as the tramways are rapidly becoming electrified.

MORE SUBWAYS FOR NEW YORK.—The Metropolitan (Interurban) Street Railway system of New York has laid plans before the Rapid Transit Commission for a complete underground system to be operated under a 5-cent transfer system in connection with the 500 miles of Metropolitan surface line. Mr. Parsons is quoted as saying that the system will take about $40,000,000 to build, as compared with $35,000,000 for the Belmont subway now nearly ready for use. At the best, the Metropolitan system can hardly be ready before the growth of population has more than overtaken the new facilities.

PIPE THAWING IN NEWARK, N. J.—During the recent severe cold spell, the Street and Water Board of Newark, N. J., adopted the electrical method of thawing out water pipes. The transformer and rheostat were put upon a wagon and moved from place to place. When one service pipe was to be thawed out a wire was attached to a faucet in the kitchen or laundry and the other was fastened to a fire plug in the street. In five minutes the ice in the pipe thawed out to the main, and steaming water ran from the faucet. When two houses which were in trouble were close together, one wire was attached to the faucet in the first house and the other to that in the next. The frost went so deep into the ground that there was trouble all over the city, and the authorities cleared twenty or thirty pipes a day by this novel method. It was done gratis where the pipes have been laid from the mains to the houses by the city, which is the case with all that have been laid in the last ten years. Otherwise the cost was $5 or $10. By the old means of digging up the street it would cost from $25 to $50.

BOHEMIAN PITCHBLENDE.—Mr. N. J. Ledoux, United States Consul at Prague, Austria, writes as follows: "The government mines at St. Joachimsthal, which have become famous since the discovery of radium, are in Bohemia. In the course of the manufacture of uranium colors, the radioactive element of the pitchblende (radium, etc.) remains in the residue of the alkaline solution of patassium salt, which, since the discovery of the fact that it contains radioactive substances, is being evaporated and sold to chemical works and institutions of learning for the manufacture of radium preparations. The quantity of residue of alkaline solution of potassium salts amounts, according to the extent of the manufacture of uranium colors, to 11,000 to 17,600 pounds per annum. Orders for this residue should be addressed as follows: 'K. K. Bergwerksproduktion-Verschleiss-Direction, Vienna, Austria,' or to 'K. K. Berg-und Hüttenverkaltung, St. Joachimsthal, Bohemia, Austria.' There is, however, no pitchblende for sale now. Application should be addressed to the above-named officials for proper attention when any available supply is on hand."

NERNST LAMPS FOR ST. LOUIS EXPOSITION.—The Art Building interior at the St. Louis Exposition will be lighted by Nernst lamps. The white light of this lamp should adapt excellently to the illumination of paintings so as to give approximately a daylight effect.

WIRELESS TELEGRAPH INSTRUCTION.—The Navy Department is making preparations to transfer the wireless telegraphy school for enlisted men from Newport to the Navy Yard at New York, where better facilities are afforded for this work. It is intended to assemble there all men under electrical instruction, both in wireless telegraphy and other branches.

NEW CABLE TO JAPAN.—The *Bourse Gazette,* of St. Petersburg, commenting on the report that the United States has undertaken to lay a submarine cable from the Philippine Islands to Japan, to prevent the latter's isolation in case the Russians cut the Shanghai cable, makes a bitter attack upon the United States Government "for this new evidence of its breach of neutrality," claiming that the contention of the United States that the laying of the cable will be undertaken for the improvement of trade relations "does not clear America's skirts," and inquiring "what the Americans would say if Germany had run a cable from Kiaochou to Port Arthur or Vladivostok?" Washington dispatches on February 24 said that the Commercial Cable Company had addressed inquiries to the government as to whether permission could be secured to land on the island of Guam a cable connecting with Japan. This cable would connect at Guam with the present Pacific Commercial cable to the United States. It was said that the request was based on the apprehension that the existing Japanese cables, both of which run to Shanghai, might be cut during the present hostilities, and Japan thus be isolated from the world. In considering the request the government was said to have reached the conclusion that an assent would not involve a breach of neutrality, taking the ground that a cable is a commercial instrument like a mailship.

RUSSIAN TELEGRAPH CENSORSHIP.—The Russian Government has abolished the censorship upon all news and other telegrams going abroad. The lifting of the embargo, which has existed for generations upon the free transmission of news from the Russian Empire, came as a direct result of the consideration of the subject by the Czar himself, and in some respects this abolition is regarded there as the most important act since the emancipation of the serfs. Foreign telegrams, until recently, were subject to censorship at the Ministry of Foreign Affairs, but, since the death last autumn of M. Gretch, who was at one time connected with the Russian Embassy at Washington, the censorship has been temporarily under the Ministry of the Interior, where the permanent censorship bureau of plays, books and newspapers in Russia is located. News telegrams addressed to foreign sources originating in the most distant parts of the empire, Vladivostok, for example, were formerly telegraphed to St. Petersburg to be passed on. M. de Plehve, Minister of the Interior, and Count Lamsdorff, the Foreign Minister, both joined in the recommendation that the censorship be abolished. The internal censorship is to be retained, but foreign dispatches are to be entirely free. Inasmuch as a state of war exists, telegrams from the theatre of hostilities will be subject to the same kind of military censorship enforced in all countries under similar circumstances.

N. E. L. A.—Mr. Ernest H. Davis, secretary of the National Electric Light Association, reports that for the Question Box at the Boston convention, next May, nearly 300 questions for Mr. Hartman to get answered, have come in. The new active members of the Association are: Montgomery Light and Water Power Company, Montgomery, Ala.; Hot Springs Water Company, Hot Springs, Ark.; Monterey County Gas and Electric Company, Monterey, Cal.; Moscow Electric Light and Power Company, Moscow, Idaho; Freeport Railway Light and Power Company, Freeport, Ill.; Richmond Light, Heat and Power Company, Richmond, Ind.; Keokuk Electric Railway and Power Company, Keokuk, Iowa; Waterloo and Cedar Falls Gas and Electric Company, Waterloo, Iowa; The Electric Railway, Light and Ice Company, Junction City, Kan.; Clinton Gas Light Company, Clinton, Mass.; Great Barrington Electric Light Company, Great Barrington, Mass.; Edison Sault Electric Company, Sault Ste. Marie, Mich.; Edison Electric Light and Power Company, Amsterdam, N. Y.; The Allegheny County Light Company, Pittsburgh, Pa.; Newport and Fall River Street Railway Company, Newport, R. I.; Bristol Gas and Electric Company, Bristol, Tenn.; Burlington Light and Power Company, Burlington, Vt.; The Washington Water Power Company, Spokane, Wash. The new associate members are: Ford, Bacon & Davis, New York City; American Conduit Company, New York City; B. D. Nath, Schenectady, N. Y.; William Thomas Taylor, Schenectady, N. Y.

LETTERS TO THE EDITORS.

Steam Turbine Economy.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the article by Mr. A. N. Mattice in your issue of February 20, on the 1,250-hp steam turbine for the Interborough Company, the economies shown are certainly very good, but it is unfortunate that Mr. Mattice does not give the consumption of the auxiliaries, particularly the air and circulating pumps and superheaters.

Articles of this kind are apt to be misleading and as an illustration, the operation of a compound reciprocating engine by means of the air pump may be cited, where no steam is actually consumed by the engine itself, the work being done entirely by the "vacuum," i. e., atmospheric pressure.

We have been informed so many times by the manufacturers of turbines, of the necessity of high—in fact almost theoretical—vacuum, that it is somewhat of a question if the high economies claimed are not more than offset by the means adopted to obtain them; viz., the use of large air and circulating pumps, and super-heaters, etc.

CHICAGO. CYRUS ROBINSON.

Theory of the Repulsion Motor.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the data published in the ELECTRICAL WORLD AND ENGINEER on page 266 and following, on the subject of repulsion motors of the General Electric Company. The information, as well as the discussion by Mr. Steinmetz confirms fully the elementary theory of the repulsion motor which I gave last year (see *Elek. Zeitschrift,* June 11, 1903), and which was later developed by several authors.

In the article referred to I pointed out the fundamental characteristic and that which decides the future of the repulsion motor; that is to say, in this motor there is produced a true revolving magnetic field which in itself suffices to insure a perfect commutation of the motor at normal speed. I am, therefore, convinced that the large motors of the General Electric Company, if they are satisfactorily dimensioned, will operate at normal speed with a commutation equivalent to that of the best continuous-current dynamos. Under the above conditions it is not necessary to establish a comparison between the repulsion motor and the ordinary series motor. In fact, an ordinary series motor of 100 hp, 25 cycles (I refer to a motor with a continuous output of 100 hp) has an impossible commutation. High-resistance connections between the armature leads and commutator undoubtedly improve the commutation, but not to a sufficient degree.

The repulsion motor is manifestly superior to the series motor at normal speed of operation, but conditions of commutation during the period of starting are the same for both motors. In this respect it is quite certain that the large motors of the General Electric Company commutate badly during the period of starting unless some special and novel arrangements have been adopted to avoid this effect.

The repulsion motor is the only serious competitor of my series compensated motor with power factor unity. Large motors built according to my design evidently present during the period of starting commutation difficulties which are the same as those of large repulsion motors. I have, however, discovered several new improvements which entirely overcome the defects for both kinds of motors, and I intend to describe these improvements later.

Concerning discussions of efficiency, power factor and weight of the ordinary series motor and the repulsion motor, I would say that they cannot bring forth any new results other than those which have already been obtained with single-phase induction motors.

PARIS, FRANCE. MARIUS LATOUR.

Single-Phase Alternating Current Motors.

To the Editors of Electrical World and Engineer:

SIRS:—My attention has been called to the luminous sketch contained in your issue of February 13 describing the widely heralded Westinghouse (Lamme) alternating-current railway motor. (Blow ye trumpeters, blow!) And I have read the entire article with much pleasure and some profit. ('Tis always pleasant to meet old friends.) The following startlingly novel discoveries are disclosed:

1st. With alternating currents laminate the magnetic circuits.

2d. To reduce secondary circuits in the armature circuits insert resistance. Formula, $I = \dfrac{E}{R}$. This failing, do something else.

3d. To reduce the inductance of the motor.—*A.* Decrease the applied frequency. *B.* Unwind the field coils. *C.* Demagnetize the blessed thing.

4th. To get good commutation—commutate.

5th. To make the motor work with alternating currents, make the alternating currents work the motor.

6th. To make it work better, patent it. (Don't patent it plainly, just patent it so the experts can have a chance to tell the truth.)

7th. If it looks a little old and seedy, get a new name plate.

From the above data I draw the following conclusions: There are two fundamental methods of producing inventions—first, make them; second, take them. Yours very truly,

WILLIAM STANLEY.

P. S.—If the above is not entirely clear—

Ask Weston about the multiple armature winding used about 1880.

Ask Kelly about the armature resistances used about 1891.

Look at patent No. 479,675, July 26, 1892, for the rest of it.

BROOKSIDE, February 20, 1904. W. S.

[Following is a reprint of the specifications, drawings and claims of Patent No. 479,675, issued July 26, 1892, to William Stanley, Jr., and John F. Kelly, on an application filed November 4, 1891, the title being "Alternating-Current Motor."—EDS.]

This invention relates, mainly, to electro-magnetic motors designed or adapted to be operated by alternating currents.

The special form of motor contemplated as within the limits of the applicability of the invention may be very widely varied; but for purposes of illustration the invention will be described as applied to any ordinary type of motor having a commutator and armature-winding similar to those existing in continuous-current generators and motors and a field magnet (which should be laminated or magnetically subdivided) energized by coils in series with or in derivation to the armature-circuit. If an alternating current be caused to flow through the armature coils of such a motor, it will, as is well understood, be subject to a given retardation, due to the self-induction of the armature. In fact, it has been found that this retardation may be and generally is sufficient to very seriously impair the efficiency of the machine. It may be corrected or neutralized in its effects and the trouble due thereto avoided by the employment in the circuit of a condenser of suitable capacity; but when the whole of the energy to be transmitted must pass through the condenser the latter becomes a large and costly adjunct and the apparatus as a whole becomes less available for general service. It will be understood that if on the armature a second winding were applied symmetrical with the first, but in which the current passes in a direction opposite to that of the current of the first, that no self-induction, and in consequence no lag, would result. With both windings attached to the armature-core, however, no effective torque would be developed, as it will readily be seen that each winding or coil would be impelled in an opposite direction. If, however, only one of such windings be made fast to the revolving armature-core while the other is fixed in space, the maximum torque is secured, while the self-induction is reduced to a minimum, since the two windings, as before, will neutralize one another, so far as self-induction is concerned, while the stress due to the field will be transmitted from but one of them to the core. It is not necessary that the two windings should be exactly alike, if only the magnetizing effects shall be approximately equal and opposite.

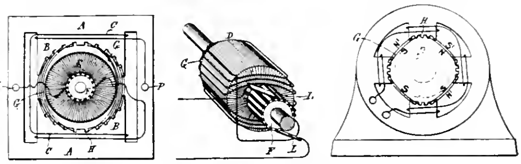
In direct-current motors and generators a somewhat similar disposition of coils to that above described has been employed to neutralize the magnetism imparted by the armature-coils and for the purpose of preventing change of lead; but as we propose to deal only with alternating-current machines we place our coils exactly parallel to the field magnetization and organize them so that they serve as anti-induction rather than anti-magnetization coils and close them upon themselves, so that they will be acted upon inductively by the moving armature-coils and, by the current generated therein, tend, so to speak, to check the rise of magnetism in the armature rather than its ultimate development.

The invention therefore consists in the combination, in a machine of the kind described, with the rotating armature and coil or coils thereon, of a stationary coil or coils closed upon itself or themselves, adapted to produce an effect approximately equal but opposite to that of the coil carried by the armature, whereby the self-induction and consequent retardation in the armature will be neutralized or overcome.

The plan or means by which the invention is carried out is illustrated in the accompaning drawings.

Fig. 1 is an end view of a motor embodying the invention. Fig. 2 is a perspective view of an armature, exhibiting, diagrammatically, the special winding which the invention involves. Fig. 3 is an end view of a multipolar field-magnet with the improvements applied to the same.

In Fig. 1, *A A*, represent the field-core of any ordinary motor; *B B*, the polar projections between which the armature is mounted,



FIGS. 1, 2 AND 3.—SINGLE-PHASE ALTERNATING-CURRENT MOTOR.

and *C C*, the energizing field-coils surrounding such polar projections. *D* is the armature-core, *E* the coils wound thereon, and *F* is the usual commutator. *G* designates the stationary coil. This coil is wound in convolutions parallel to those on the armature and are conveniently contained in recesses or grooves *H*, cut or formed in the faces of the pole-pieces.

The relations of the two armature-coils are better illustrated in Fig. 2. The armature *D* in this case is wound in the usual way, with a conductor laid parallel with its axis in coils connected with the segments of the commutator *F*. The line of commutation is shown by the position of the brushes *L L*, and the stationary coil *G* is shown as surrounding the armature, its convolutions being in planes at right angles to the line of commutation.

In Fig. 1 the armature and field-coils are in series and the stationary coil is closed upon itself. The stationary coil is shown more clearly in Figs. 2 and 3 as having its ends connected together, the coil being thus in closed circuit.

In Fig. 3 the field-core is provided with a number of pole-pieces, being, in fact, a type of multipolar machines. The stationary coils in this case are wound in grooves in adjacent pole-pieces, so as to produce an opposite magnetizing effect upon or in the armature to that of the armature-coils. For example, if the tendency of an armature-coil is to produce a north pole in its core at any given point, as *N*, the corresponding stationary coil will have an equal tendency to setting up at the same point an opposite pole. So, in general, where the armature-coils act to establish poles *N S*, the stationary coils neutralize such action by establishing poles *S' N'*, as indicated in the diagram. The stationary coils, *G*, it will be observed, do not sensibly affect the magnetic conditions of the field, owing to their position relatively thereto; but their magnetizing influence is manifested in the armature-core, where it opposes that of the armature-coils.

In practice the conductors of the supplemental or stationary coil or coils will be bent aside at one or both ends of the armature to permit the latter to be introduced in or withdrawn from the field-magnets, as is indicated in Fig. 1.

This invention is more particularly applicable to and useful with motors; but it may be used to advantage, when the machine is run as a generator, for preventing lagging of the current.

The claims are as follows:

1. The combination with the armature of an alternating-current motor and the energizing-coils wound thereon, of a stationary coil closed upon itself and having its conductors or convolutions substantially parallel to those of the armature-coil, whereby the self-induction of the armature will be neutralized, as set forth.

2. The combination, with the armature of an alternating-current motor having a commutator to which the coils wound on the armature are connected, of a stationary coil closed upon itself and having its conductors or convolutions substantially parallel to those of the armature-coil, whereby the self-induction of the armature will be neutralized, as set forth.

American Electrochemical Society Elections.

To the Editors of Electrical World and Engineer:

Sirs:—In common with most of the directors of the American Electrochemical Society, I signed a petition for a constitutional amendment, making the president, vice-presidents and managers ineligible for re-election. I must, therefore, decline to be a candidate for re-election to the office of vice-president, for which, I am officially informed, I have been nominated.

At the same time, in view of the very handsome vote which my friends have cast for me in nomination for the presidency of the Society, and of the fact that the board of directors are not endorsing any one for that office, I announce myself as a candidate for the presidency.

Ann Arbor, Mich. Henry S. Carhart.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Alternators in Parallel.—Bohle.—An abstract of a paper read before the Leeds Section of the (British) Institute of Electrical Engineers, discussing the operation of alternators in parallel. He briefly discusses the methods for quickly damping oscillations which occur; they are either mechanical damping methods of the well-known device of Hutin and Le Blanc or similar methods. If, on account of sufficient fly-wheel masses, the fluctuations of energy supplied to the network are smaller than the fluctuations of energy of the crank effort diagram, damping is useless. But if there are small fly-wheel masses, so that the fluctuation into the network are larger than the fluctuations of energy of the crank effort diagram, damping will give good results. In other words, use damping with multi-crank sets, but not with single-crank sets.—Lond. *Elec. Rev.,* February 5.

References.

Theory of Alternating-Current Generator.—Puluj.—The conclusion of his mathematical article on the application of the circle diagram to the theory of alternating-current generators. He develops the equation of the power curve.—*Zeit. f. Elek.* (Vienna), February 7.

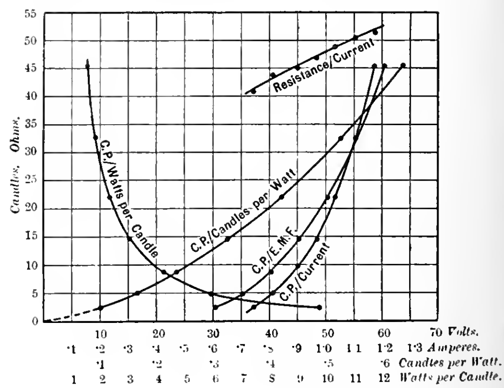
Theory of the Repulsion Motor.—Creedy.—The first part of an article in which the author starts with a discussion of Steinmetz's symbolic method, in order to deduce later the circle diagram of the repulsion motor, and to give a general method of deducing the graphic theory of an alternating-current apparatus.—Lond. *Elec. Rev.,* February 5.

Single-Phase Commutator Motors.—Lehmann.—A note on some special points in Blondel's theory of single-phase commutator motors, and especially on the repulsion motor diagram.—*L'Eclairage Elec.,* February 13.

Eddy Currents.—Field.—An article on eddy currents in dynamo machines. The author criticises several points of Thornton's recent paper and endeavors to show that the figures of his estimates cannot be right.—Lond. *Elec.,* February 5.

Lights and Lighting.

Osmium Lamp.—Baily.—An article in which the author gives some results obtained with 55-volt, 32-cp lamps, made by the Vienna company which owns the Osmium lamp patents. There are three loops of wire, each anchored at the end, the total length of wire being 40 cm., with a diameter of 0.1 mm. The wire is very hard, and as brittle as glass, with a pale greyish-white surface. The variation between the five lamps tested in candle-power and efficiency was very slight. The average results are given in the adjoining diagram. In general the curves resemble those of the carbon filament lamp, but the agreement is not e :t. The resistance increases with the temperature, while that of carbon between a red heat and a yellow heat slightly diminishes. Therefore, the watts absorbed, as the e.m.f. is raised, increase more rapidly for the osmium than for the carbon lamp. Nevertheless, the increase of candle-power is more rapid in the carbon than in the osmium lamp. Thus it varies as the sixth power approximately in the former, while the curve shown here is of the form cp = 0.0000035 multiplied by the fourth power of the e.m.f. The relation of efficiency (candles per watt) to candle-power for the osmium lamp is given by the equation efficiency = 0.065 multiplied by the 0.62d power of the candle-power, as against 0.028 multiplied by the 0.7th power of the candle-power for a carbon lamp. Thus, the improvement of efficiency is more rapid in the carbon lamp than in the osmium lamp. The important point about the lamp is its efficiency, which at the normal pressure of 55 volts is 1.9 watts per candle. Some favorable results, obtained by Wedding, as to life and maintenance of efficiency, are recorded; they were already noticed in the Digest. The cost of the high efficiency of the osmium lamp is stated to lie mainly in the higher temperature which the metal will stand, but it seems to be a slightly more efficient light radiator than the carbon, especially at lower temperature, although the ratio is probably reversed at higher temperatures. The color may be defined as similar to that of a carbon lamp running at 2.1 watts per candle. It is thought that the lamps should form excellent sec-



OSMIUM LAMP CURVES.

ondary standards of light, because of the whiteness of the light, the small deterioration of the candle-power, and, lastly, because of the smaller variation of candle-power with change of e.m.f., rendering error of adjustment of e.m.f. less serious than in the case of the carbon standard lamp. On this account they should be adjusted to a definite e.m.f., not to a definite current.—Lond. *Elec.,* February 12.

Reference.

Theatre Lighting.—A fully illustrated description of the new lighting installation of the Drury Lane Theatre, in London. The equipment has been recently brought up to date to minimize danger of fire. The installation is described in detail, especially the switchboard and the regulators for stage lighting.—Lond. *Elec.,* February 12.

Power.

Electricity in Mines.—A reprint in abstract of a report of the (British) Departmental Committee, appointed to consider the use of electricity in mines; also an editorial on the subject. The committee, while refusing to dictate as to which system of generation, transmission and distribution should be employed, clearly exhibits a leaning towards three-phase working. In one instance it is stated that a coal cutter, daily cutting 250 tons of coal, was driven by a three-phase induction motor, and has worked well for some years; coal cutting is the most arduous work in coal mining. Dangers with the use of electricity in mines do exist, but they are much smaller than is generally imagined and accidents usually arise from faulty installations and careless or unskilled handling. The committee emphasizes the fact that no matter what the system may be or how high the voltage employed the whole installation should be considered a source of "potential danger." Except where electric locomotives are employed, or under other very special conditions, the committee do not consider an earthed return advisable. A warning is uttered against the overloading of cables by the addition of numerous subsidiary motors. —Lond. *Elec.,* February 5, 12.

Hoisting in Mines.—HERZFELD.—An illustrated article in which the author says that the sudden variation of load, which is one of the disadvantages of winding work, is felt much less with electric power distribution than with steam driving. In every case where electric driving has been adopted the cost of winding has been considerably reduced, and the larger the generating station from which the supply is obtained, the greater is the saving effected. He discusses the "Koepe wheel" and says that, for the same plant, a Koepe pulley coupled to an electric motor can be of about one-fourth the weight of a drum coupled to a steam engine. He believes that the Koepe pulley system with direct-coupled electric motor will be the system of the future. Some installations of German plants are described.—Lond. *Eng'ing,* February 12.

Electric Power in Ship Yards and Engine Works.—ANDERSON.—A paper read before the Newcastle Section of the (British) Institute of Electrical Engineers. He thinks that a combination of the three-phase system for power and the direct-current, three-wire system for lighting and special power purposes has the greatest advantages. For ordinary use he advocates the employment of the squirrel-cage induction motor. Since the wiring is not complicated nor expensive, squirrel-cage motors should always be used on such machines as punches, shears and beam benders, where the starting gear has sometimes to be placed at a considerable distance from the motor. On the other hand, for such machines as winches and cranes the slip-ring motor is the only one which will prove satisfactory. Details are given on power consumption of three-phase motors driving various machines in Newcastle.—Lond. *Elec. Eng.,* February 12.

Power Equipment of the Cleveland & Southwestern Traction System.—An article on this plant which is the first steam turbine installation for electric railway work in this country. A large portion of the system is provided for by the high-tension alternating-current system and eventually the entire road will be operated along these lines, but at present direct-current transmission is used for a portion of the system. In the main power house the direct-current units, aggregating 1,000 kw, occupy twice the space that the present turbine equipment requires, although the latter is double the capacity, or 2,000 kw. The turbines are of the Westinghouse-Parsons multiple expansion, parallel-flow type. Each system consists of three independent sections, namely, high-pressure cylinder, low-pressure cylinder and generator, the construction being explained in detail. In addition to the ordinary sub-stations located along the line the company has a portable sub-station which has been found very convenient in relieving the excessive load at particular points where there may be some unusual temporary demand for current.—*St. R'y Jour.,* January 30.

Electric Power in a Pianoforte Factory.—A description of the electrical equipment of a large pianoforte factory in London. A special advantage in electric driving in such factories lies in the fact that the manufacture can be carried on in a uniform direction, no transporting to and fro of partly finished parts from one tool to the other being necessary. Direct current at 230 volts is used, there being altogether 19 motors, nearly all totally enclosed (to prevent any danger of fire) and ranging in power from ½ to 26 hp. Some have been adopted for directly driving the various machine tools such as saws, polishing lathes, planing machines, etc. Others serve to drive short lengths of shafting.—Lond. *Elec.,* February 5. A longer illustrated description is given in Lond. *Elec. Eng.,* February.

REFERENCES.

Curtis Turbine.—SAMUELSON.—An abstract of a paper read before the Rugby Engineering Society. Several illustrations, giving comparative views of various turbo-generator sets and comparative elevations of engine-driven and steam turbine sets, and some diagrams showing the effect of different degrees of vacuum and expansion upon the steam consumption are reproduced.—Lond. *Elec.,* February 5.

Steam Meter.—BAYNTUN.—An illustrated description of a meter designed to measure and record the weight or quantity of steam passing through a pipe. By its means the rate at which a boiler is raising or an engine using steam may be read directly off a scale, and, by the addition of a recording drum, continuous record may be kept from which the total weight passed in any given time may be ascertained. The meter is essentially a volume meter.—Lond. *Elec. Rev.,* February 5.

Boiler Room Practice.—EDWARDS.—An article containing valuable suggestions regarding the care of boilers and their accessories.—*Am. Elec.,* February.

TRACTION.

Accumulator, Third-Rail and Three-Phase Traction in Italy.—LANINO.—A long account of the results obtained on four Italian railroads with electric traction. The first road is from Milan to Monza (13 km.), with storage batteries on the cars. The motor car, used on this road, had a weight of 58 tons, of which 20 tons were the weight of the battery (Hensemberger-Planté type) and could develop 100 hp with an average speed of 35 to 40 km. per hour and an acceleration of 2 to 6 cm. per second at the start, one charge of the battery being sufficient for a run of 50 train km. The system was found to meet in general the requirements of normal service, but not those of rush service on holidays, since there was only a limited number of motor cars available. The financial results were good, the cost of operation being 16.25 cents per car km. The energy consumption was 65 watt-hours per ton km. The maintenance of the plates caused an expense of 7 cents per ton km. The cars running on the road from Bologna to San Felice had a weight of 15 tons and could forward 75 passengers; with a battery of 12 tons weight with one charge they could run 100 km. and draw a 15-ton trailer on the first half of the line. The average speed was 45 km. per hour on a road with grades up to 0.3 per cent. The positive battery plates lasted more than 12,000 train km., the negative ones more than 20,000 ton km. The cost of maintenance of the battery was 6.08 cents and the total cost of operation 11.15 cents per train km. Thus the economical and technical results were must better than had been expected. In spite of this the operation with storage batteries was completely discontinued, partly by the influence of some railroad officials and partly because the service was not "elastic" enough to fulfil the requirements of very heavy service at certain hours. On the Milan-Varese-Porto Ceresio road (75 km. of which 60 km. are double-track) the third-rail system with 600-volt direct current is in use, the transmission of power being 12,000-volt three-phase current. The success of this line has been complete, there being no serious accident on account of people coming into contact with the third rail. "This fact is the more remarkable since the third rail, although properly protected from contact, runs through all stations, including a considerable number of tracks in the interior of the hall of the central station in Milan." Attention is called to the fact that in Italian stations the tracks are on the same level as the platform and that passengers have often to pass over the tracks. In very cold winter and in spite of heavy snow falls there was no difficulty with the third rail. The loss of current per km. of road was 0.06 to 0.07 ampere in dry air, and 0.11 to 0.12 ampere in moist air. The fourth road is the Valtellina line, on which 20,000-volt, three-phase currents are used for transmission to transformer sub-stations, which reduce the voltage to 3,000. The motor cars are provided with 3,000-volt, three-phase induction motors and tandem connection is used to get a second speed. This system has also been very successful. The author remarks that there is no competition between the third-rail, direct-current system and the three-phase system. The service on the third-rail road is characterized by many light trains with good acceleration; that on the three-phase road by heavy trains in longer intervals. The first is similar to a street railway; in the latter low first cost of installation and high efficiency are essential conditions. The author believes, however, that the future of electric traction belongs to the series motor.—*Elek. Zeit.,* February 11.

Third-Rail Shoe.—A description of the new third-rail shoe on the Boston Elevated, which differs radically from any other shoe in use on third-rail work. It consists of a soft steel bar, weighing about 5 kg. This bar, which is the portion used for making the contact with the third rail, rests in a hanger at each end and is held down by its own weight and also by a light steel spring, which is constructed to give a downward pressure of about 23 kg., making a total pressure between the shoe and rail of 28 kg. without regard to the motion of the shoe along the rail. When the car moves, however, it tends to bunch the shoe up and compel it to make harder contact with the third rail at one end, depending on the direction in which the car is moving. The life of the shoe is about 21,600 km. A feature of the shoe is that it does not jump at joints.—*St. R'y Jour.*, February 6.

REFERENCES.

Collector for Single-Phase Cars.—An illustrated description of this collector which is manufactured by the Oerlikon Company and consists of curved rod having its convex face in contact with the power wire. The collector can move through an arc of 180°, so that the power wire can be in almost any position. The advantages of the apparatus were noticed recently in the Digest (abstract of Herzog's paper). Two diagrams are given showing the universality of the application.—*St. R'y Jour.*, January 30.

Contact Rail System.—Del Mar.—An illustrated article dealing with the practical problems with which a draftsman has to contend when preparing to lay out a system of contact rails for railways about to be converted from steam to electricity.—*Am. Elec.*, February.

Electrification of a British Railway.—An illustrated article on the electrical equipment of the Tynemouth lines of the Northeastern Railway, a third rail and the Thomson-Houston multiple-unit system being used. The power house will contain two 2,000-kw and two 3,500-kw Parsons turbo-alternators.—Lond. *Elec.*, January 22.

Conneaut & Erie Interurban System.—A description of this line, which is 56 km. in length, and forms the connecting link between Buffalo and Toledo and Detroit. Snow falls quite heavily in this region and the company has the second largest rotary plow in the United States, provided with four axles with four General Electric 100-hp motors on the trucks and a 200-hp motor to drive the fans. The power station contains two 400-kw generators and a booster for 375 volts and 300 amp. Polyphase transmission is not used.—*St. R'y Jour.*, February 6.

Rating of Stations.—Bond.—A paper on the rating of tramway and light railway undertakings. The paper deals mainly with English legal conditions.—Lond. *Elec.*, January 29.

Installations, Systems and Appliances.

British Central Station.—A description of the municipal station of Chesterfield. The direct-current, three-wire system is used. There are two 100-kw and two 200-kw generating sets and a battery of 280 cells with a rated capacity of 60 amp. for 10 hours and 300 amp. for one hour. In the years 1902-3 a total of 208,316 units was sold, the works costs being 1.64 cents per unit sold, and the total cost 2.74 cents. The current is mostly used for lighting, but the demand for motors is increasing, an equivalent of 170 hp being at present connected to the mains.—Lond. *Elec. Times*, February 4.

Wires, Wiring and Conduits.

REFERENCES.

Calculating the Capacity of Overhead Lines and Cables.—Lichtenstein.—The first part of a mathematical article in which the author develops approximate formulas for the capacity of parallel overhead wires for direct-current, single-phase current and three-phase currents, and for concentric two-phase and three-phase cables. The method, used by the author, is a generalization of Kelvin's principle of electric images. On account of its mathematical character, it is impossible to abstract the article briefly.—*Elek. Zeit.*, February 11.

Cable Works.—A fully-illustrated description of the cable works of Pirelli & Co., in Milan, which is stated to be the first firm in Continental Europe to manufacture submarine cables. The works are described under the following headings: Manufacture of washed rubber, spread sheet, cut sheet, calendered sheet, preparation of compound rubber for wires, manufacture of India rubber wires and cables, manufacture of dry-core telephone cables and manufacture of electric light cables.—Lond. *Elec. Rev.*, February 5.

Conduit Work.—Weeks.—An illustrated descriptive article on conduit work. The information is very practical in its nature and many valuable hints are given on conduit installation.—*Am. Elec.*, February.

Electro-Physics and Magnetism.

Evolution of Helium from Radium Bromide.—Dewar and Curie.—An account of observations, quite analogous to those of Ramsay, who observed a change of radium into helium. Some radium bromide weighing 0.4 gram was left for three months in a glass tube, communicating with a small vacuum tube and a mercury manometer. There was a continual slow evolution of gas, but the spectroscope showed nothing but hydrogen and mercury vapor. The same specimen was then taken by Dewar to the Royal Institution, where it was sealed up in a quartz tube and fused, the gases evolved being drawn off and examined with the spectroscope. Nothing appeared to be present except nitrogen. After thoroughly clearing off all the gas the tube was sealed up under the oxyhydrogen flame and sent back to France. About 20 days afterward Deslandres examined the tube with an induction coil, connecting it up by means of two pieces of tin-foil attached to the ends. He found a spectrum, not of nitrogen, but of helium, and that in its entirety, no other lines appearing on the plate even after an exposure of three hours with quartz lenses. The permanent luminosity of the tube only showed a continuous spectrum.—*Comptes Rendus*, January 25; abstracted in Lond. *Elec.*, February 12.

Selenium Cells.—Pfund.—While according to Bidwell the sensitiveness of a selenium cell is due to the presence of selenides in selenium, the present author concludes from a series of experiments that the sensitiveness is due rather to some direct action of light upon the selenium itself. It may be that light in falling upon selenium changes its crystalline character, and that the new modification of selenium is stable only in light, so that it reverts to its original condition when light is cut off.—*Phil. Mag.*, January.

REFERENCES.

Electromagnetic Theory.—Kolacek.—A mathematical note on the ponderomotive forces to which a homogeneous dielectric is subjected in a variable electromagnetic field. The author suggests experiments which would decide the correctness of either Maxwell's or Lorentz's theory.—*Phys. Zeit.*, January 15.

Impedance.—An illustrated didactic article on reactance, impedance, angle of lag and phase difference. All of these phenomena are minutely explained.—*Am. Elec.*, February.

Electro-Chemistry and Batteries.

Electroplating upon Aluminum.—Burgess and Hambüchen.—The principal difficulty in the deposition of a metal coating upon aluminum is as regards its adherence, and this is due to the very thin film of oxide which is always present on an aluminum surface. The authors first clean the aluminum by immersion for a few minutes in a dilute hydrofluoric acid bath where it remains long enough to produce a suitable roughening of the surface. Upon removing the aluminum from this bath it is rinsed in running water and then dipped for a few seconds in a mixture of sulphuric acid and nitric acid, both concentrated. It is then transferred to the zinc plating solution, which is a slightly acidified mixture of zinc and aluminum sulphate, with about 1 per cent. of hydrofluoric acid. Electrolysis is made for about 10 or 15 minutes with a current density of from 10 to 20 amp. per sq. ft. A coating of copper or silver from cyanide solutions may then be applied.—*Electrochem. Ind.*, March.

Electrochemical Equivalent of Silver.—Van Dijk and Kunst.—An account of the results of a redetermination of the electrochemical equivalent of silver. Former researches of various investigators have yielded results varying from 0.011156 (Mascart) to 0.011195 (Pellat and Leduc). The present authors used a tangent galvanometer for determining the strength of the current. Owing to the high degree of accuracy with which the constant of the instrument and the horizontal intensity of the earth's magnetic field and its space and time variations may be determined, this method is well adapted for a laboratory which has been built without iron, and in a place where no vibrations or stray currents in the earth are to be feared. The authors adopted Kohlrausch's bipolar method. The cathodes consisted of platinum, being either cup-shaped or in the form of a cylinder ending in a hemisphere. A silver rod served as an anode. Two voltameters were placed in series in order to insure that no irregularities occurred in the deposition of the silver. The final mean value obtained from 24 measurements was 0.0111818, which the authors believe to be accurate to within one part in 10,000. (The above figures are taken from the Lond. *Elec.* If the electrochemical equivalent is given in divided by 10. The value adopted by the Chicago Electrical Congress is 0.001118 gram per coulomb.)—*Proc. Akad Wet.*, Amsterdam, January 21; abstracted Lond. *Elec.*, February 5.

REFERENCES.

Action of Light on the Formation of Accumulators.—TOMMASI.—An article in which he describes some experiments which show that the negatives of an accumulator form more rapidly in the light than in the dark, and that the positives form more quickly in the dark than in the light, other things being equal. The capacity, however, is found to be practically unchanged.—Lond. *Elec. Rev.*, February 12; *L'Eclairage Elec.*, February 13.

Resistance Furnace.—HERAEUS.—An article in which the author, in form of a reply to Guntz, gives some details of his resistance furnaces for laboratory work, in which around the heating tube very thin platinum foil is wound.—*Jour. Chim. Phys.*, January.

Electrolytic Analysis.—PAWECK.—An illustrated description of some improvements in electrolytic analysis, dealing especially with the use of revolving electrodes.—*Elektrochem. Zeit.*, February.

Progress in Electrochemistry.—KERSHAW.—A summary of the progress in electrochemistry and electrometallurgy in 1903, giving briefly the developments in the different industries.—Lond. *Elec. Rev.*, February 5, 12.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Names of Units.—TEICHMÜLLER.—A long communication in which the writer discusses the advisability of new names of units, proposed at the suggestion of Dr. Kennelly by the American Institute of Electrical Engineers to the next International Electrical Congress. In discussing new names, the question is not whether they are really needed in practice or in commerce, since they may be applied later extensively, even if they appear superfluous at present. He says that many considered the name mho horrible when first proposed, but did not oppose it, since they thought the name would not be used: at present the name mho has become so familiar that opposition would now be fruitless. Concerning the new proposals of the American Institute he thinks that the names do not sound well, and that the lack of harmony, which has been brought into the system by the names of gauss and maxwell, will become worse in future. For, later on, all names of the absolute units may have the prefix ab, but not gauss and maxwell, nor gilbert and oersted. In agreement with Hospitalier, he, therefore, suggests to adopt the following names for absolute units: e.m.f., centimicrovolt; resistance, millimicrohm; current, decaampere; electric quantity, decacoulomb; capacity, kilomegafarad; coefficient of self-induction, millimicrohenry; power, decimicrowatt; energy, decimicrojoule. While these names are rather long, he thinks they are not worse than many names of organic chemistry. He thinks the American Institute is fully justified in wishing names to be adopted for the linear integral of magnetic force and for reluctance. He thinks it is unfair that five English names should be used for units against two each of German and French and one each of American, Italian and Danish scientists. He urges to adopt the name of weber instead of gilbert.—*Elek. Zeit.*, February 4.

Ammeters with Adjustable Sensitiveness.—FEUSSNER.—A long illustrated description of an ammeter which consists of a millivoltmeter with shunt. The millivoltmeter has, besides the ordinary two binding posts, a third one by means of which a small part of the series resistance may be disconnected. The shunt is designed so as to have seven steps. By means of a switch with revolving handle, the instrument may be adjusted so as to give readings according to these seven steps. The lowest sensitiveness corresponds to 1 scale division equal to 1 amp., the highest sensitiveness to 1 scale division equal to 0.01 amp. The switch is operated without any sparking, so that when one takes a reading one may pass from one sensitiveness to another one without interrupting the current or changing any wires. The construction is described in detail.—*Elek. Zeit.*, February 11.

REFERENCE.

Insulation Testing Set.—A brief illustrated description of a very compact insulation testing set made by a British company. It is intended for carrying out insulation tests on the direct-deflection method and consists of a sensitive moving-magnet galvanometer, a resistance of 10,000 ohms and a set of 1/10, 1/100 and 1/1000 galvanometer shunts.—Lond. *Elec.*, January 22.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Cable Department Accessories.—COAR.—An illustrated article describing a number of articles used in a telephone cable department. A drip pan is shown, which eliminates many of the difficulties attending the boiling-out process. In most boards for making cable forms an arrangement of pegs or nails is used to terminate the different wires. A board which has some advantages over this method is illustrated. Instead of using pegs, holes are bored through the board, which enable the form to be laced more readily and also permit the insulation to be pealed from the wires without altering the shape of the form. A box for holding tags, preparatory to marking the different wires of a cable, which presents some advantages over the old methods of stringing the tags together or hanging them on hooks fixed in a marked board, is also described. A cableman's telephone circuit is shown, and a method for testing out conductors in a cable, which is applicable to both live and dead lines, is described—*Am. Elec.*, February.

Trunk Exchange.—A fully illustrated description of the new trunk exchange of the post-office telephone service, which provides for telephonic communication between London and provincial and continental towns. There are positions for 42 trunk operators. Each switch section is divided into three panels, controlled by two operators. Five trunk circuits terminate on each of the outer panels, which also carry the multiples of the junction circuits serving the minor local exchanges. The junction circuits of the principal local exchanges are multiplied on the middle panel of each section, where they are accessible to either operator. Transfer circuits for interconnecting trunk circuits are provided on each of the trunk panels, as well as foreign, reserve and the usual official circuits. Apparatus is also provided for terminating a number of local subscribers' circuits which are used only for extensions to the trunk system.—Lond. *Elec. Rev.*, February 5, 12.

Railway Signals.—An article on the Hall electrode-gas signalling system, which will soon be introduced on a section of 11 miles of the North Eastern Railway Company, of England. While in European practice the semaphore signal was heretofore worked by an electric motor, carbonic acid gas has now been adopted as motive power. The gas is admitted into cylinders containing pistons attached to the upright rods. The valves controlling the admission of the gas into the cylinders are opened and closed by the armature of an electromagnet, which is energized in the usual way by a local circuit controlled by the relay of the track circuit.—Lond. *Elec. Rev.*, January 22.

Railway Telephones.—An illustrated description of telephones for railway use. Two types are shown, one being an iron box telephone to be attached to the poles along the line and the other being a portable car telephone encased in a wooden box with a leather strap for carrying. This instrument is fitted with a long cord, at the end of which is attached a plug for insertion in jack boxes. These jack boxes may be installed on poles along the line and communication had with the central office by plugging in at these points. The cord is long enough to allow the motorman to leave the instrument in the car.—*St. R'y Jour.*, February 6.

Tramway Signal System.—A description of an electromagnetic signal system using two solenoids for operating the semaphores. When the car enters a block it makes contact with a plate on the trolley wire. This contact closes a circuit operating the main solenoid. The energized solenoid pulls up the semaphore, which is then held in place by a catch. When the car reaches the end of the block, contact is again made through a second plate and current flows to energize the second solenoid. The latter pulls back the catch, thus causing the semaphore to fall back to safety position.—*St. R'y Jour.*, February 6.

MISCELLANEOUS.

REFERENCES.

Manufacturing Plant.—A fully-illustrated description of shop No. 3 of the Bullock Electric Manufacturing Company.—*Mach'y*, February.

Obituary.—An account, with portrait, of the life and work of W. G. McMillan, the late secretary of the (British) Institution of Electrical Engineers.—Lond. *Elec. Rev.*, February 5.

New Books.

Messungen an Elektrischen Maschinen. By Rudolf Krause. Berlin: Julius Springer. 158 pages, 166 ill. Price, 5 marks.

This is a capital little book on engineering measurements and tests of dynamo machines from an electrotechnical standpoint. Polyphase dynamos receive especially full treatment.

The first chapter is devoted to measuring instruments generally. Their elementary mathematical theory is well outlined from the engineer's viewpoint. The theory of the modern hot-wire voltmeter and ammeter is given here for the first time so far as has come to our notice.

The second chapter considers the electric power measurements of alternating-current generators. The third chapter deals with temperature changes of resistance and their measurement. The fourth chapter deals with measurements of frequency and the fifth with the measurement of insulation and conductor resistances. Magnetic measurements are followed in the sixth chapter and in the seventh tests for efficiency and regulation are considered, also tests for temperature elevation and torque. The eighth chapter relates to the measurement of losses in machines by tests on open circuit. The ninth chapter deals with the measurement of the wave form of voltage and current in alternators. A brief final chapter considers standard tests of machines and their formal tabulation.

The book is an excellent compendium of polyphase tests according to German practice. It does not contain many of the methods that are adopted in other countries. It will be found of much value to students of electric machine testing.

Wireless Telegraphy. By Charles Henry Sewall. New York: D. Van Nostrand Company. 229 pages, 85 illustrations. Price, $2 net.

Mr. Sewall puts forward his admirable book very modestly. It is intended for the general public as well as for the technical student. There is growing up a specialized literature on wireless telegraphy, so that the expert has to, and in fact prefers to, restrict his range of study; but there are many points and much data in this volume that render it an exceedingly useful book to have handy in an electrical library. Not the least interesting part of this nature is the chapter devoted to Mr. Tesla's work. It is the first connected story of the kind on any work of Tesla's, since the book by Martin, issued away back in 1894, before Mr. Tesla had begun to carry out even experimentally the theories and ideas with which he had even then been so daringly profuse as to wireless transmission, not only of intelligence but of actual energy. It may be a close guess that the author had Mr. Tesla's help on this fascinating chapter, which somehow seems to leave the reader "in the air," but is full of deep suggestiveness and is generously illustrated.

Mr. Sewall is certainly liberal and eclectic in his methods, for while he thus takes us up into the ambient wireless air with Tesla, he also plunges us into the depths of the sea with Pupin's coils, as applied to ocean cables. At first the propriety of the juxtaposition is hardly realized, but after all in a comparison of rival methods the matter has its place in such a book, and many will welcome it. They will also welcome many other quite unexpected little plums, not forgetting the portraits of several leaders in the wireless field. Mr. Sewall has been fair, industrious and broad-minded, and we hope his reward will be reaped. The publishers may be congratulated on the handsome shape in which the book is put forth.

Maver's Wireless Telegraphy. By Wm. Maver, Jr. New York: Maver Publishing Company. 216 pages, 123 illustrations. Price, $2.00.

The fact that this book is written by one of the foremost telegraphers of America, whose encyclopædic work on American telegraphy is already a standard, will suffice to insure for it a warm welcome. But Mr. Maver has not merely traded on his reputation and thrown together a haphazard catch-penny volume, to meet the sensational demand of the hour. With his usual thoroughness and clean-cut style, he has taken up the subject in a highly practical manner, soberly and seriously, giving space, it is true, to theory, but going straight for practice. It is here that Mr. Maver excels. He can himself theorize as well as do justice to the philosophies of others, but he is at his best when discussing and dissecting circuits and apparatus. In fact, much encouragement is to be derived from the issuance of such a book. We realize of a sudden that, beset as it may be by a dense mass of ill-digested theory and of loose statements that explain nothing, a new art is upon us and is being legitimately practiced.

Chiefly to be commended in addition to the lucid descriptions are the excellent diagrams and drawings. We have an idea that Mr. Maver likes to work a thing out thus on paper for his own guidance and comprehension; and he succeeds just as well with wireless conditions as he has done in the past with metallic circuits and the apparatus on which he spent his own life as a telegrapher. Another point is that all the various plans, schemes, inventions and apparatus now struggling for supremacy are set forth in a strong, dry, white light, with full impartiality. The index is most complete and praiseworthy, and we like also the business-like closing chapter of practical suggestions on wireless signalling. We would recommend every telegrapher to read this book, but it will find a large public also outside the telegraphic ranks.

Elemente der Elektrotechnik. By Moriz Kohn. Leipsic and Vienna: Franz Deuticke. 108 pages, 121 illustrations. Price, 2.50 marks unbound.

This little book contains a series of ten lectures given before a mining association at Pilsen. The conditions under which the course was held prohibited mathematical treatment and required all the subjects to be selected and presented with reference to practical electrical work. Ordinarily, these requirements would have rendered the work of an author so commonplace and colorless that there would have been no reasonable motive for publication except for circulation among that class of workmen for whom they were designed and delivered.

The present book, however, has a real interest for the reader. Its author is a professor in one of the excellent national industrial schools, which are now such a prominent factor in German education. He has come to his task of simplification with a firm grasp on exact technical knowledge; and, moreover, he has accommodated his subject to a class for whom he must select only the vital elements of technology, and bring them within the comprehension of those unskilled in mathematics. This will indicate the scope of the book and suggest its usefulness.

The lectures as a whole are admirable in the selection of subjects and topics, and the treatment is clear and concise. The matter of the book would have gained had it been less descriptive, and been emphasized by more frequent numerical examples. The illustrations are wholly diagrammatic, and they are exceptionally clear and well conceived. One illustration, in particular, is novel and more clever than the usual cumbersome mechanical analogue. The displacement of phase between two functions is illustrated by a device of two pistons in tandem with a spring connection between them. The frictional resistance of the head piston of the diagrammatic tandem engine perfectly represents the lag of the current in an alternating circuit. A surprising statement is made regarding the efficiency of large direct-current dynamos, where the value is given between 70 and 90 per cent.

The subjects discussed are the direct and alternating-current dynamo, the transformer, rotary converter and the accumulator. To those readers who are familiar with that excellent class of German works of which Keck's "Graphische Statik" may be instanced as a representative, this book by Kohn needs no further commendation than to include it in the number.

Radium in Cancer Treatment.

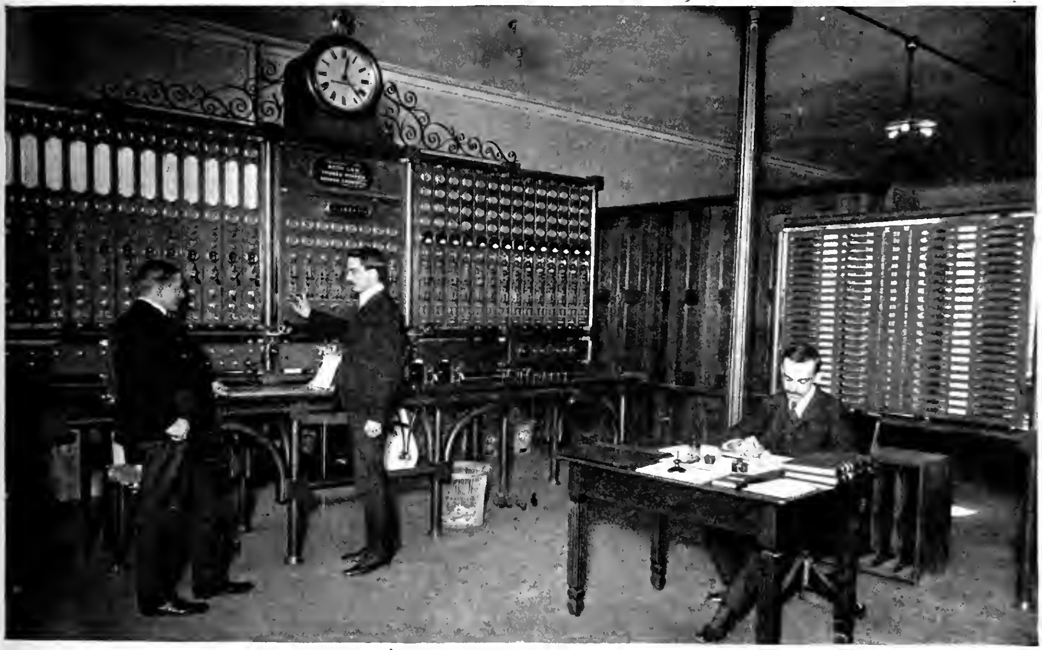
By advices from London it appears that both Dr. G. H. Plimmer, who has returned from a study of radium cures under the care of Prof. Etner, in Vienna, and Dr. Snow, of the Brompton Cancer Hospital, are very sceptical as to its results, the latter characterizing cancer as remaining "the darkest Africa on the map of medicine."

Dr. Snow, who has had vast experience in the treatment of cancer, in what probably is the last address he will deliver at Brompton Cancer Hospital, the other day pointed out that cancer is not one, but is constituted of many diseases. He said that the radium treatment had proved exceedingly disappointing and, in fact, it might now be dismissed from the sphere of potential cancer cures. At Brompton Hospital, he added, they had studied cancer as it had been studied nowhere else in the world. They had sought to investigate it from every conceivable point of view. They had labored by every means in their power to substitute for the mass of chaotic confusion and the traditional fallacy which had hitherto prevailed a genuine cancer science as a sure foundation for all future research; but in this attempt they had utterly and miserably failed.

Unique Fire Alarm Switchboard on Staten Island, N. Y.

An improvement in telegraph switchboard construction has lately made its appearance in the shape of a new board built for the fire alarm system of the New York fire department, Borough of Richmond, New Brighton, Staten Island. The board is constructed of non-combustible material and embodies all the latest and most desirable points to insure prompt results and absolutely sure and reliable working.

The new board is so constructed that the only part liable to combustion is the insulation on the wire, of which there is very little in evidence, omitting the magnet wire on the relays and the rubber knobs on the keys. The entire board is built of a frame of heavy steel tube. The method of construction is that each section of tubing is threaded right and left hand and is screwed into the fittings in such a manner that it may be at any time dismantled and moved to another location should it be desired. All panels and counters are of slate 1¼ in. in thickness. The switchboard is arranged for the accommodation of 14 box circuits and 8 gong circuits. All the apparatus applicable to each circuit is mounted upon a separate panel. These panels are removable without disturbing the other parts of the board. This in itself is a step in the right direction for one reason that in case of trouble arising in the operation of a fire alarm system it is of the utmost importance to be able to repair it in the shortest possible time.



Fire Alarm Switchboard at New Brighton, Staten Island.

The system adopted in the New Brighton board for announcing the circuits is simple and is as follows: Connected in each circuit panel is an annunciator consisting of a bull's eye of ground glass on which the number of the circuit is painted. To the rear of this is a 4-cp incandescent lamp, which lights up in case of the circuit opening, thereby visibly throwing up the number of the circuit.

Another novel feature is the arrangement of the relays. All relays are made on the same general principle and are non-combustible. They are mounted on the back of the panels, the working points of the armatures protruding through to the front. All circuits are provided with jacks similar to those employed in the telephone systems, so that by the introduction of a plug it is possible for the telephone operator to connect any of the circuits, thereby enabling him to hold conversation with men on the line who may go to any box on the circuit and call up the central office. It is possible to hold conversation over these telephones during signalling transmission from a box.

One of the principal features in connection with the board are the test panels for each circuit to be seen on the right of the switchboard. Each circuit has one test panel upon which is mounted an ammeter, transfer battery switch, pole changer and bridge. The ammeter denotes at all times the strength and direction of the current on the wire. The pole changer enables the operator, by the simple moving of a key to throw on a battery in case the main battery becomes inoperative. The bridge is arranged so that the operator by the movement of plugs similar to those in use in a Wheatstone bridge can change the polarity of the current and make any tests promptly. In addition to these test panels a novelty has been introduced on one of the lower panels, which is certainly a time-saving device so far as testing for cross lines is concerned. Heretofore it has been the practice to move a plug or a switch individually on each circuit, for the purpose of testing for crosses, thereby consuming a considerable amount of time; and in large stations where the business is somewhat heavy, the pursuing of such method has made it possible to lose an alarm. This is overcome in the New Brighton board by each circuit being connected to a dead spring point. These points are arranged in a circle and are covered by a plate which is capable of being pushed into contact with all the points except one, a knotch or section sufficiently large to miss making contact being left in the plate, thereby enabling the operator, by the simple operation of pushing the plate to make the necessary test in a few seconds instead of one or two minutes.

Another unique departure embodied in the new system is the multiple pen register for the reception of all signals transmitted. This register is so constructed that all springs, adjustments, pens and ink rolls are independent and easily reached by the insertion of the hand in front of the register. Each pen has an independent ink roll. With a solid ink roll the whole affair has to be taken apart should one pen get out of order.

Yet another new feature of the Staten Island system is that all the wiring and connections are in full view of the operators. Provision has also been made so that during the transmission from a fire alarm box it is at the option of the operator, by the movement of a switch, to throw in repeating apparatus that will transmit automatically gram per coluomb all the above figures for the equivalent are to be direct from the box to the gong or fire house circuits. This is not as a rule depended upon, but is used only in exceptional cases, for the reason that should an error occur it will be transmitted, and the principle of all manual central stations is that mistakes of this kind cannot take place.

The switchboard was designed by Mr. Henry E. Vineing, the electrical engineer of the New York fire department. It was built by Foote, Pierson & Co., 82-84 Fulton Street, New York City.

English Form of Continuous Current Prepayment Meter.

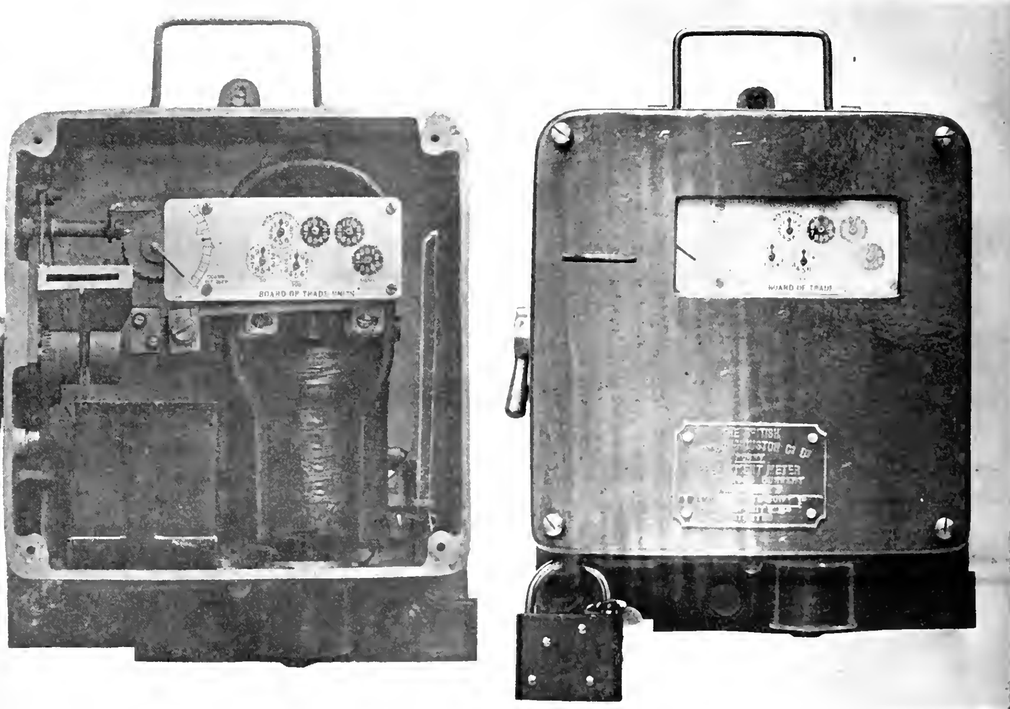
The success of the prepayment gas meter has been generally accepted as indicating that a large sphere of usefulness exists for prepayment electrical meters. The prepayment meter possesses several advantages, among which may be mentioned the avoidance of the perpetual trouble of writing for accounts to be settled, and the reduction of bad debts to a minimum. To the user it offers a great inducement in so far that small payments extending over a protracted period can be made. The British Thomson-Houston Co. has achieved success in the development of a prepayment meter which it is now prepared to offer, for use on continuous current circuits.

This meter consists essentially of two parts—the electrical meter proper, and the mechanical prepayment mechanism, a general idea of which can be obtained from Figs. 1 and 2.

Both the meter and prepayment mechanism are contained within a strong cast aluminum dust-proof case, which is of neat appearance, and occupies a space of only 8⅜ x 10½ x 5 inches deep. It is so constructed that by the removal of the cover, which is held in place by four sealing screws, easy access to all parts of the meter and mechanism is obtained. A window is fitted to the cover, through which both the meter dial and coin indicator are visible. The meter dial registers the total number of units consumed and can be used as a check on the coins deposited, while the coin indicator shows the number of coins still to the credit of the consumer. The terminal box is situated at the bottom of the meter, and has a separate cover, held in place by a small cap covering the commutator, brush gear, and jewel screw, the arrangement being such that they can be sealed independently from the other parts of the meter. A till capable of containing 120 coins—pennies in England—is provided to hold the money deposited in the meter, which may be removed by opening the door at the bottom of the meter. This door can be secured either by a seal or padlock as desired.

The switch is of the single-pole, quick-break, knife-blade type. It is designed to open circuits carrying current up to the amount of the maximum overload allowable for the largest meter to which the device is used. The closing and retaining mechanism of the switch is positive in its action and both strong and simple in construction.

To operate the meter, a coin of the correct denomination is put into the slot provided, and the handle at the left hand side of the meter turned to its full up position, and then returned to its down position. This movement closes the switch and moves the coin indicator hand one division. Successive coins to the number of ten may be put into the meter at one time. At each insertion the indicator hand moves forward one division, and as the consumer uses the current, this hand will gradually travel back to zero, on reaching which the switch opens automatically. Additional coins can be inserted at any time previous to the consumption of the last coin, and so long as the indicator shows there is a coin or fraction of a coin to the credit of the customer the switch will not be opened. Hence by always inserting a coin before the indicator reaches zero, the light will never be switched off.



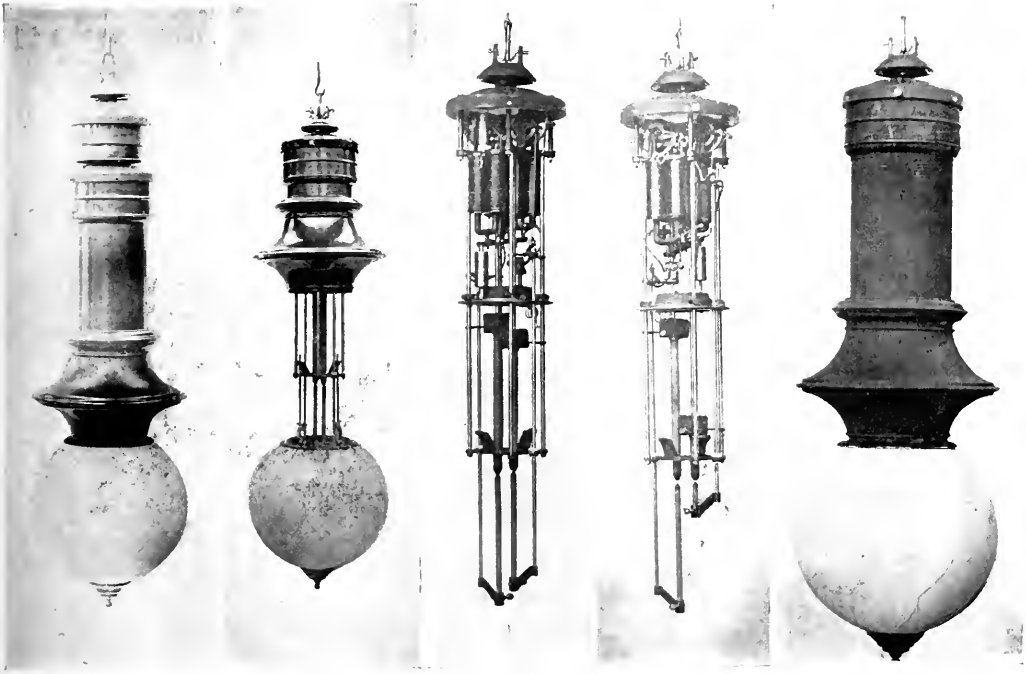
FIGS. 1 AND 2.—CONTINUOUS-CURRENT PREPAYMENT METER.

A prepayment meter must be constructed in such a way as to render cheating impossible, as should it be possible to tamper with the instrument in any way it is evident that it would be worse than useless. In view of this fact, the B.T.H. prepayment meter is made proof against any attempt to obtain current by unfair means.

These prepayment meters are manufactured in 2, 3 and 5 ampere sizes for any required voltage, and may be operated with one penny, sixpenny or one shilling coins as desired. The rate of payment chosen can be easily changed at any later date without having to recalibrate the meter. Special care has been taken to use only the best insulating material possible. This enables the meters to be subjected to an insulation test of 1,000 volts alternating.

Open Arc Lamps in England.

Open arc lamps still appear to enjoy a vogue abroad, and new ones are still introduced there. The British Thomson-Houston Co., Ltd., has designed, and is now manufacturing at its Rugby Works, a 10-amp., open arc, continuous-current focusing lamp. The brake wheel and feeding mechanism are of novel design. The wheel is made on the toggle principle and is very positive in its action, while friction losses are kept at a very low figure. The casing, made of solid copper, with a black oxidized finish, is constructed in two parts which slide over one another. It is supported at the top on bayonet catches, and by removing one thumb screw the upper portion can be lowered, exposing the entire mechanism for inspection or minor repairs. For trimming, the lower portion is raised, and the lamp can be trimmed by lowering the globe only 9 inches.



FIGS. 1, 2, 3, 4 AND 5.—ENGLISH OPEN ARC LAMPS.

When operating two or more lamps in series, it is necessary to have some means of adjustment in order to keep them burning with equal arc voltage. In the B.T.H. lamp this adjustment is made by shunting the series magnets with a high-resistance adjustable coil. The adjustment can be made without turning off the lamp, and much closer regulation can be secured than with a mechanical adjustment.

All parts of the lamp are made by machinery and are entirely interchangeable. No fitting is done when the lamp is assembled, and parts are designed to work together, without being so accurately fitted that their operation would be affected by the dust and dirt which always work into the parts of an arc lamp.

The lamp is so insulated that, when the casing is on, no external part is in connection with the circuit. All the interior insulation is of mica or lava, and the insulation of each lamp is tested at 1,500 volts alternating current applied for 30 seconds. The lamp has a self-contained automatic cutout, and is supplied with or without substitutional resistance as required. External line resistances are used depending upon the line voltage and the number of lamps in series. These line resistances can be supplied for mounting either on a wall or inside of the pole base, and can be made weatherproof when required. The lamp, plain, without substitutional resistance, and with globe in place, measures 51 inches in length, and weighs with globe and casing 53¼ pounds.

An Automatic Mailing Machine.

To take stacks of newspapers, magazines, catalogues or periodicals as they come from the printing press, and to fold, wrap, seal and address them individually is the office of the Agnew auto-mailing machine illustrated herewith. All this is accomplished at the rate

FIG. 1.—MAILING MACHINE.

of from three to five thousand an hour, obviously several times faster than it could be done by hand. In fact, it is claimed that one machine will replace twelve persons, and accomplish the work with greater neatness and less liability to errors, and with less skilled attendance, one man being all that is required.

The operator standing on the side of the machine shown in Fig. 1 works in front of the elevator or conveyor, refilling the shelves as fast as they are emptied, with bunches of the papers or magazines just as they are taken from the press. The construction of the elevator is clearly shown in the cut. It consists of two sets of moving shelves carried, perpendicularly to their direction of travel, by endless chains and arranged to run at the same speed, but in opposite rotation, so that contiguous shelves register with one another. Its action is intermittent, and under electrical control, which maintains the top of the pile at a fixed height. At each cycle of the machine little pneumatic suckers come down on the uppermost paper and, with a combined lifting and pulling movement, start it far enough into the machine to be taken along by a horizontal belt conveyor. Simultaneously at the opposite side of the machine wrapping paper drawn from a continuous roll is introduced under the periodical and cut off the required length.

When the paper and its wrapper have reached a definite position

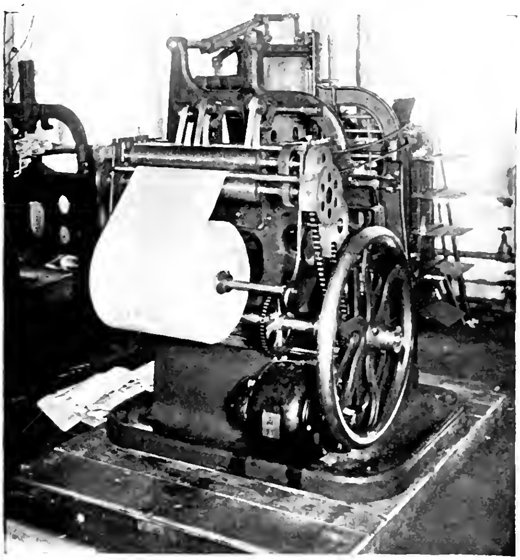


FIG. 2.—MAILING MACHINE.

a vertical blade descends, creasing them through the middle and carrying them down between a set of steel rolls. The vertical blade then returns to its upper position and a horizontal blade folds them again and carries them to a basket or receiver. The wrapper is not entirely under the paper when folded with it, consequently only part of it goes into the inside with the operation of folding. It is sufficient, however, to prevent the wrapper from sliding off the paper later on, and the extra amount projecting on the outside forms the flap. This is gummed by a roller covered with a solution of dextrine, and is pressed down by another roller as the package passes out of the machine. On the shelf at the side of the machine just before being discharged it pauses long enough to receive an impression through a stencil, giving it its individual address.

The perforated stencils for the addressing are arranged to replace one another successively at each cycle of operations. These may be previously assorted by towns or States, thus eliminating the necessity of distributing the mail afterward. For instance, all of a certain group may be run through at a time and discharged into one mail bag, another being in readiness to be moved up to receive those belonging to the next group and so on.

One motor mounted against the side of the machine at the rear, as shown in Fig. 2, provides the power with one reduction through a spur gear and pinion. It is noticeably out of the way and fortunately located where it is protected by the fly-wheel. The motor is of the Crocker-Wheeler make, of a semi-enclosed type, and of 1-hp size, which shows that the cost of running is not very great.

The machine is positively driven at all points by chains or gear connections, so that there is no chance for slipping and causing a loss of co-operation between the different parts. Furthermore, there is an electrical device to open the motor circuit automatically and stop the machine if any interruption in the regular operation occurs, such for example as when a paper fails to feed, or a wrapper is not in place, or when the stack of stencils is exhausted.

The entire machine occupies a floor space of about 4 x 5 ft., has an overall height of 76 in. and weighs about 2,000 pounds when equipped with a Crocker-Wheeler motor, as shown.

Latest Types of "C & C" Dynamos and Motors.

After over two years spent in preliminary work, the C & C Electric Co., of New York, with works at Garwood, N. J., is placing on the market its new line of "type 'S'" direct-current dynamos and motors. The C & C Co., as most of our readers doubtless know, is a pioneer manufacturer of direct-current motors, its experience

FIG. 1.—OPEN TYPE FLOOR PATTERN.

covering a period of over 16 years, during which time it has been exclusively engaged in the manufacture of dynamos and motors for industrial purposes. Its aim in designing the type "S" machine has been to produce a motor or a dynamo of artistic and attractive design, pleasing appearance, minimum weight, compact and symmetrical, and adaptable to almost any class of service. It also aimed at a machine which would be of the highest efficiency, and would withstand unusually heavy overloads without sparking, and with a much lower temperature rise than has heretofore been the case. The apparatus is built in all the standard sizes from 2 to 30 hp inclusive, for

FIG. 2.—ENCLOSED TYPE FLOOR PATTERN.

slow and moderate speed, and expects before long to have ready an entire line from ¾ to 75 hp inclusive.

The machines are made in the open, semi-enclosed and entirely enclosed types. The open-type, floor-pattern machine is illustrated in Fig. 1; the enclosed-type, floor-pattern machine in Fig. 2. Both these illustrations give a good idea of the symmetrical and pleasing appearance of the machine. The machines are furnished in the floor, ceiling or wall (see Fig. 3) horizontal patterns and in the vertical pattern. The motors are well adapted for mounting upon machine tools or machines of almost any description, for direct connection or chain drive. The machines are all of the four-pole type. The magnet frames are of soft homogeneous cast-steel, as are the brackets or feet, and the pole-pieces, which are cast as part of the magnet frame. The pole-tips or shoes are of the same material, and secured

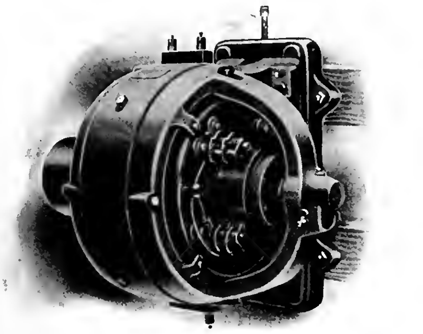


FIG. 3.—VERTICAL PATTERN.

to the pole-pieces by means of external bolts. The bearing-brackets are of cast-iron and carry self-oiling and self-aligning bearings of generous dimensions. A frame-ring is cast as part of each of the brackets, and this ring carries lugs between which the cast-iron brush-ring is supported. The brush-holders are of the well-known "C & C" "reaction" type and are secured to brass pins carried by the insulated brush-rings. This form of support of the brush rigging assures absolute stability and non-vibration of the brushes. The field coils are wound on metal bobbins of novel construction and are

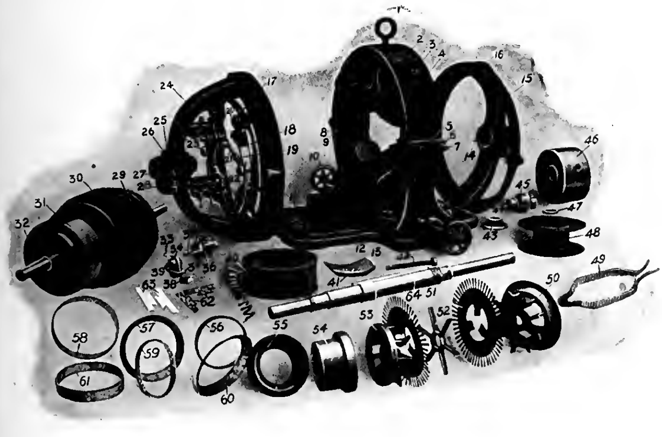


FIG. 4.—COMPONENT PARTS OF MACHINE.

readily removable. The armature is of the hollow drum type. The insulated laminæ forming the core have three openings punched therein around the shaft hole for ventilating purposes, and a spacing spider is placed in the centre of the core for the purpose of forming air ducts connecting with the three channels adjacent to the shaft. Form-wound coils are laid in the armature slots and are retained therein by means of hard wood wedges driven between notches in the teeth of the armature core; consequently no band wires are used for retaining the coils in position. The commutator is of unusually large diameter and face, and is composed of hard drawn copper bars insulated with mica, assembled in a heavy cast-iron shell, mounted on the armature spider.

The C & C Company states that after a continuous run of 24 hours at full load, no part of the machine will show a temperature rise of over 30° C. by thermometer. It also makes other unusual guarantees. This unusually low temperature increase is accounted for by the novel construction of the armature. The armature laminæ spacers, back-plate and end-plate, as well as the commutator itself, are so designed that their several parts radiating from the shaft act as the vanes of a fan, and when the armature is in motion a powerful draught is created. The cool air is taken in through the commutator shell, and part of it is forced through the ventilating ducts of the armature up against the pole-pieces and fields; the remainder through the back of the armature; thus cooling the whole machine. The construction of the armature, as well as all the component parts of the "type 'S'" machine, are well shown in Fig. 4.

"Core" Transformers.

A new line of transformers has recently been manufactured and put upon the market by Messrs. Hornberger and Irwin, who have been identified with the development of alternating-current apparatus from the outset, and who have organized the Crawfordsville Electric Company, of Crawfordsville, Ind., for the purpose of producing apparatus of a standard character in this field of work. Based upon their familiarity with the subject and their experience, they have selected the core type of transformer for manufacture in preference to the shell type, and while admitting that in core type transformers, as ordinarily known, sundry disadvantages appear, they claim that they have overcome the points of objection as to length of core and excessive temperature. In all but the smaller sizes they employ multi-coil construction.

The Crawfordsville Electric Company, as just intimated, builds transformers in the smaller and intermediate sizes, such as are generally used by central stations, but it also builds those of the larger size and heaviest duty, and hence has found it advisable to provide a separate case design for each of the different classes. Their design for sizes up to 15 kw consists of a simple cast-iron case arranged for the use of oil and equipped with steel hangers in the usual manner. For convenience in hanging the smaller sizes they use the well-known suspension hook devised by one of the members of the company.

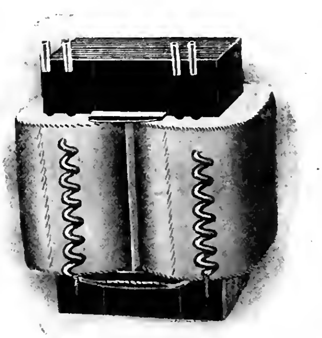


FIG. 1.—"CORE" TRANSFORMER.

The cable terminals are brought out from the case through heavy porcelain bushings securely cemented in place with a compound which prevents effectually the entrance of rain or moisture. All cable connections are made permanently and no connecting block is used inside the case.

For sizes from 20 kw up to 100 kw, inclusive, the case is made with a cast-iron base and cover and with a body of substantial sheet steel. While the sheet-steel case is superior to a cast case and is more expensive to build, the weight is greatly reduced. As a comparison, it may be mentioned that the 50-kw Crawfordsville case complete weighs only 350 pounds, whereas the cast-iron case of a well-known type of the same size weighs over 800 pounds.

For sizes larger than 100 kw the case design is made for foundation support only, on account of the heavy weight, and is so arranged that it can be adjusted to either oil, air-blast or water circulation. The construction is massive, in keeping with the heavy duty for which it has been designed, such as street railway work or long-distance high-voltage performance. The transformers of this magnitude are designed for any frequency from 25 upwards, for any voltage, and for single or polyphase circuits. In sizes of this type

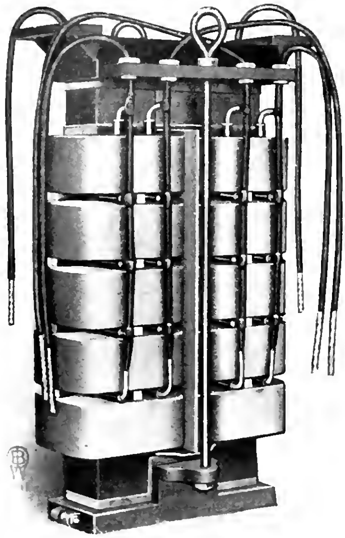
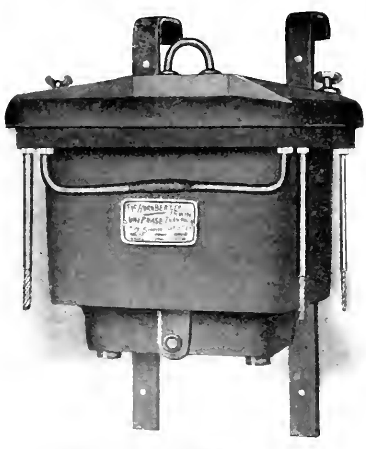


FIG. 2.—MULTI-COIL TRANSFORMER.

the multi-coil construction is used, the complete transformer being made up of many coils, each having the required number of ratio turns within itself, and all coils being then joined in multiple to the terminals; so that a possible disablement of one coil does not mean that the entire transformer must be replaced or the terminal voltage lowered.

In these "H. I." transformers, as they are known, the cross-section of copper allowed is liberal, and the copper used is electrolytic.



[illegible] TRANSFORMER COMPLETE.

Owing to the multi-coil construction used, cross connection of coils is unnecessary in order to maintain the equal voltage on each side of the neutral wire for three-wire distribution. Ample allowance of copper has also been provided for the increased amount of current required in the operation of inductive apparatus of low power factor. Special attention has been given also to questions of insulation, and mica insulation is used throughout in the construction of the coils, reducing to a minimum the liability or tendency to break down. An improved porcelain fuse box is furnished with broad electrical contacts and liberal copper parts, as well as a long fuse which will break the circuit in every case without injury, ample vent being provided for the escape of gases. The use of oil is recommended, especially in the larger sizes, but the company's guarantee requires that the oil used in the transformers shall be furnished by the company itself. All transformers are tested before shipment under a break-down voltage of 10,000 volts between primary and secondary windings and between the windings and the core. With the multi-coil core type construction and the low densities secured, together with the special steel employed, "ageing" is regarded as impossible, when the apparatus is operated in accordance with its design and purpose; but the company stands ready to replace any transformer showing an appreciable increase of core losses.

Englarging the Field for Unwired Clusters.

The "wireless" clusters made by the Benjamin Electric Manufacturing Company of Chicago are becoming such a staple electrical article that it will be of general interest to state that the company has recently brought out a shade holder which makes it possible to

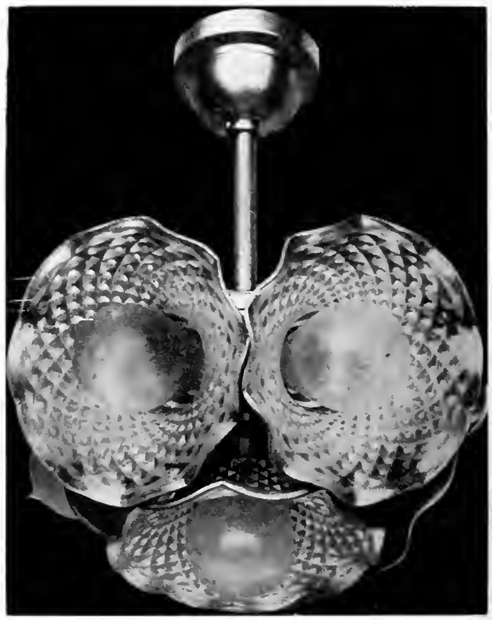


FIG. 1.—CLUSTER WITH INDIVIDUAL SHADES.

place an individual shade on each lamp in a cluster, as shown in Fig. 1. This shade holder fits under the lamp receptacle bushing of any Benjamin wireless cluster. A fixture with a cluster of shaded

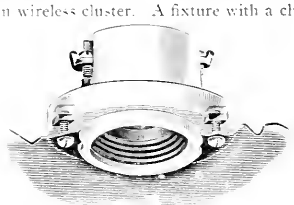


FIG. 2.—RECEPTACLE FOR LARGE GROUPS.

lamps of this kind is pleasing in its simplicity and will materially add to the possible uses of the wireless clusters.

In Fig. 2 is shown a new lamp receptacle, by which the company is enabled to put together easily large clusters of any desired number of lights.

The Reeves Vertical Cross-compound Engine.

Any improvements that add to economy, efficiency and convenient handling of a steam engine, particularly when of a nature that lessens personal attention and assures constant operation, are always of interest, and below are briefly described some of these features as embodied in the Reeves engines.

The design of these engines permits of the development of great power within very small floor space and provides for easy access and adjustment of all parts. In the engine shown in Fig. 1 the cylinder dimensions are 10½ in. and 24 in. x 14 in. stroke; the shaft is 6½ in. in diameter and is provided with three bearings, the outside ones being 11 in. and center one 10 in. long, all the parts so proportioned as to assure a perfectly balanced machine.

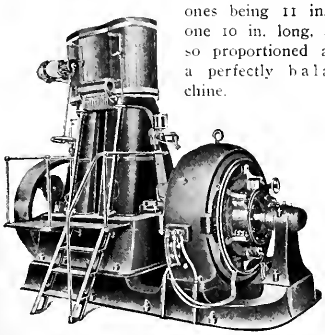


FIG. 1.—CROSS-COMPOUND ENGINE.

In the cross-section, Fig. 2, the high-pressure piston is about to start on its downward stroke, and the low pressure on its upward stroke. The admission valve is moving upward, admitting steam on the top of the high-pressure piston and across through the connecting port, *B*, and around the head of the main valve. At the same time the main or center valve is moving downward, admitting steam under the low-pressure piston. This is the exhaust steam from the previous stroke of the high-pressure piston, which passes through the port, *B*, around the neck of the main valve and through port *C* into the bottom of the low-pressure cylinder.

When the pistons have moved about three-eighths of their stroke the admission port has been opened and the admission valve returned to point of cut-off. The main or center valve is now moving upward and finally closes port *C*. At this point compression commences in the high-pressure cylinder and continues until the main valve opens the port, *C*, again; meanwhile the main valve closed the upper port and compression took place in the low-pressure cylinder.

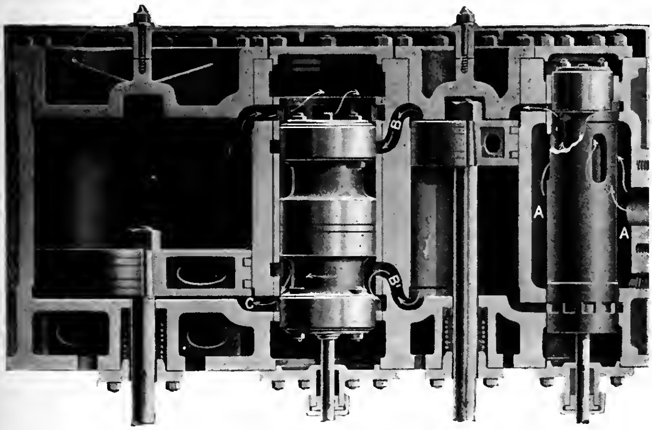


FIG. 2.—CROSS-SECTIONAL VIEW OF ENGINE CYLINDERS.

The steam distribution gives practically an equal division of work in the high and low-pressure cylinders and there being no receiver employed, losses from free expansion and condensation are obviated. The engines are so designed that either cylinder can be used, independently of the other, should necessity require.

The chamber, *A*, around the sleeve in which the admission valve works, acts as a separator and is drained, as can be seen, at the extreme lower end. The sleeve receives the direct impact of the steam instead of the valve; the latter is absolutely balanced, as all its exposed surfaces are under constant uniform pressure. Each of the three openings in the sleeve are larger than the steam pipe, and the steam is, therefore, not wire-drawn in passing to the cavity inside the sleeve.

The cubical capacity of chamber *A*, together with space inside of sleeve, is greater than the amount of steam the high-pressure cylinder can take, up to three-fourths cut-off; as a result, the cards show remarkable steam lines, the actual difference between the initial cylinder pressure and pipe line pressure being extremely small. The space formed by the separator acts as a bank or storage from which the engine draws its supply of steam.

The separator being close to the high-pressure cylinder, acts also to a degree as a superheater; thus instead, as in other separators, being a source of loss, it is here a direct gain, it is evident that any heat it may lose must be taken up by the cylinder. There is no repassing of steam over the same surfaces, which is, in itself, a guarantee of economy. The low cylinder heads are cast integral with the cylinders, which reduces the number of joints to keep tight.

The piston valves employed assure practically constant economy, as they can be easily adjusted (each end independently of the other), and made steam tight without removing them from their seats, and while steam is on the engine.

Referring to the governor, the holes for the shaft and governor pin are bored at the same setting, thereby assuring perfect alignment; then a hard cast-iron bushing, which has been carefully reamed and ground, is pressed into the cavity that is to carry the pin. Into this bushing is introduced a carefully finished gun metal sleeve, constructed with connected lubricating grooves on the inside and outside, around and lengthwise, and by means of which the lubricant, which is supplied by force feed grease cups, is carried to all bearing surfaces.

The governor is attached to the wheel by inserting the pin through the gun metal sleeve. The shoulder on the bar will face the finished surface on the back of the wheel, and the end of the pin will come flush with the face of the sleeve on the front and be held in place by the cap, shown in cut. Referring to the pawl on the cap, and the teeth that are cut into the rim of the sleeve, it will be seen that when the cap is in place it must move with the pin since it is securely held by a dowel and stud bolt.

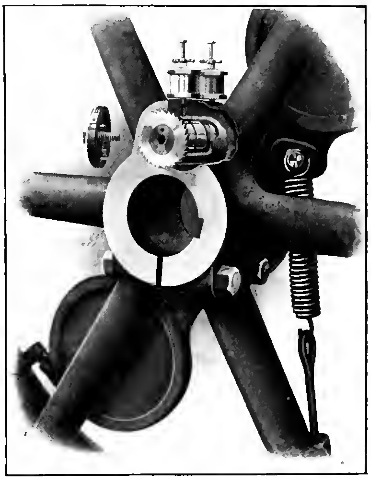
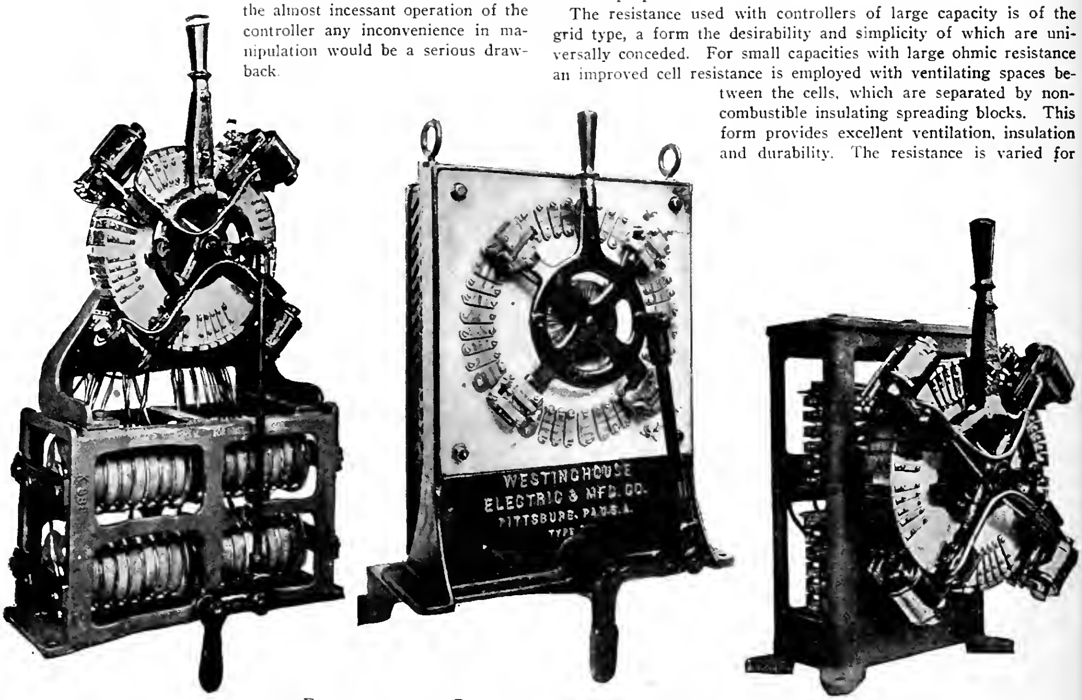


FIG. 3.—THE GOVERNOR.

When the governor arm moves away from the stop on the rim of the wheel—as it is sure to do when the engine is started or whenever there is any material change in load—the pawl on the cap will pick up a tooth and turn the sleeve a short distance (always in the same direction); when the arm moves back another tooth will be engaged and the operation repeated, thereby presenting continuously to the pin a freshly lubricated and practically new bearing surface. This insures constant lubrication and practically perfect continuous regulation. Any wear that may occur takes place on the revolving sleeve, and this being interchangeable can be replaced, when necessary, in a very few minutes.

Regulating and Reversing Controllers.

Controllers for motors used upon cranes and in other places where frequent stops and reversals are necessary must have unusual sturdiness, in order to withstand the strain and wear of constant motion. They must also be simple and positive in action in order to give perfect control of the motor, both in speed and direction of rotation, and with the fewest possible movements of the handle, for with the almost incessant operation of the controller any inconvenience in manipulation would be a serious drawback.



FIGS. 1, 2 AND 3.—REGULATING AND REVERSING CONTROLLERS.

To meet the peculiar requirements of such service, controllers possessing the desired features have been designed. One style of such a device, the commutator type, as made by Westinghouse Electric and Manufacturing Company for use with direct-current series, shunt and compound motors, is shown in the accompanying illustrations. In form and construction it is unlike any other controller and its design enables the manufacturers to give special prominence to the qualities most desirable in an appliance of this kind.

For convenience in installation, it is made in two forms. In one type the controlling mechanism is mounted on the side of the frame containing the resistance, and in another it is mounted above the resistance as shown. The space available for installing controllers for motors used with cranes and other machinery is usually greatly restricted, and this provision for adapting the device to the place in which it is to be used is of corresponding value.

The controlling mechanism is mounted upon a circular slab or base of insulating material, which provides high insulation between adjacent contacts and between the contacts and ground. Throughout the entire controller, ample provision for insulation is made.

Both the contact and finger tips can be easily removed and renewed without disturbing the connections. The contacts are arranged in parallel rows along the periphery of the disc, the relative position of the contacts and the finger tips being the same as that of the brushes and commutator in a generator or motor—a form which has been found more desirable than any other for this particular service. The same contacts are used for application of the current in either direction, thus lessening the number required, while an effective magnetic blow-out makes it impossible to maintain an arc and prevents burning of the contacts.

Each controller has four brush holders mounted upon a rocker arm to which the handle is attached directly, working without gears or pinions. A single movement to right or left applies or reverses the current, and the distance the handle is moved determines the motor speed by varying the amount of resistance in series with the motor armature. There are sixteen steps in each direction and a very close regulation of the speed is thus obtained.

When the controller is placed in the rear of a crane cage, it is operated by a crank and lever directly attached to the spider which carries the brushes. The second type above mentioned, with the controller mounted above the resistance, is very generally employed for this purpose.

The resistance used with controllers of large capacity is of the grid type, a form the desirability and simplicity of which are universally conceded. For small capacities with large ohmic resistance an improved cell resistance is employed with ventilating spaces between the cells, which are separated by non-combustible insulating spreading blocks. This form provides excellent ventilation, insulation and durability. The resistance is varied for the different capacities and uses of the motor which the controller governs, a different resistance being used for crane controllers where a closer regulation is required than is provided for roll tables and soaking pits, where sudden and repeated starting and reversing is the prime requisite.

The chief characteristics of this type of controller are its simplicity, strength, durability, flexibility of application, and ease of manipulation. Any mechanic can care for it, and keep it in order, the cleaning, oiling and renewal of contacts when necessary, being all that is required. All parts are exposed to view, and connections are easily made.

Controllers of the commutator type are made regularly in capacities of from 3 to 75 hp, but are furnished especially of any capacity desired. For less than 10 hp, the Westinghouse Company makes a face plate type of controller which contains many of the main features of the device described. It is small and compact; has contacts and finger tips which are easily renewed without disturbing the connections; has a powerful magnetic blow-out, and in principle and manipulation is the same as the commutator type. The resistance used is especially designed for the purpose and is particularly effective and durable, withstanding an extraordinary amount of heat without impairing its efficiency.

The three types illustrated afford a choice of a regulating and reversing controller suitable for any service within the range of capacity named.

Flush Receptacle and Plug.

A flush receptacle and plug is ordinarily used as a means of connection between an electric circuit and some portable device requiring current. It is obvious that the simpler the means of making this connection between the plug, which is attached to the device by a flexible conductor, and receptacle, which is stationary and fastened in the wall—the better the result. In the usual receptacle and plug, one hand is required to open the face plate and the other to insert the

FIG. 1.—FACE PLATE.

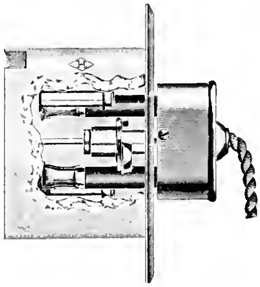


FIG. 3.—PLUG AND RECEPTACLE COMPLETE.

plug. In the "Diamond H" receptacle and plug, the shutter for the opening in the face plate is automatically operated by the plug itself —one hand, only, being required.

These receptacles are made in gangs of any number, or are put in gangs with the "Diamond H" push button or rotary flush switches, and will fit the usual wall appliances designed for these

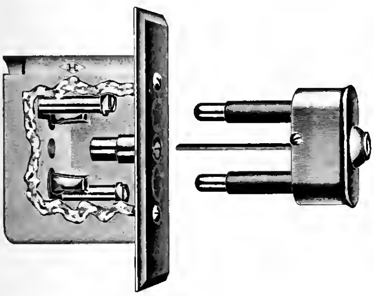


FIG. 2.—RECEPTACLE AND PLUG.

switches. Fig. 1 is a cut of the face plate, plug removed; Fig. 2 shows the plug in a position for entering the face plate; Fig. 3 shows the plug and receptacle complete.

The device is manufactured by The Hart Manufacturing Company, Hartford, Conn., manufacturers of switches bearing the same designation.

Variable Speed Too Drive Motors.

In order to meet the demand for variable speed in motors for tool driving, the Commercial Electric Company of Indianapolis, Ind., have brought out a line of Commercial variable speed motors specially designed to meet the problems connected with the subject. In these machines herewith illustrated (Fig. 1), the variation of speed is accomplished by means of a double commutator armature, having two different windings; but each winding is of the same size conductor or of the same ampere capacity. A range in speed is secured of four to one, in twelve uniformly graded steps without overlapping. A speed controller is furnished for making the necessary combination of these armature windings and for varying the field strength to secure the intermediate steps between the armature combinations. These controllers are simple and compact and the changes from minimum to maximum speed are easily and quickly effected. The controllers are made reversible. Included in the controller is the rotary starting and reversing switch, by means of which the motor is started, stopped and reversed, while the speed control is set at any desired point. The speed controller and starting switch are combined into one piece of apparatus and enclosed in a neat compact case which can be placed at any desired point on a driven tool, or which can be mounted on a stand con-

FIG. 1.—VARIABLE-SPEED MOTOR.

FIG. 2.—CONTROLLER.

veniently located by the side of the tool. This controller may contain a main switch or not, as may be desired. Fig. 2 shows a universal interlocking controller and stand. Fig. 3 illustrates the motor equipment in connection with a standard machine lathe. The litera-

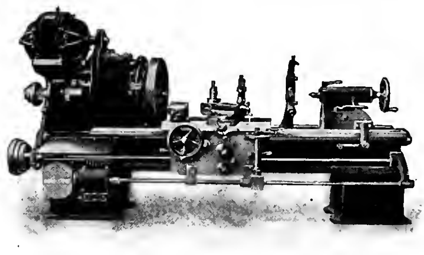


FIG. 3.—MOTOR-DRIVEN LATHE.

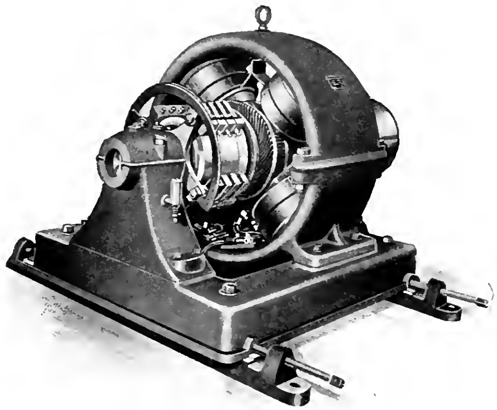
ture of the company gives further data, including some interesting curves of performance. The motors range from 2 up to 20 hp, weighing 500 pounds in the smaller of these two sizes, and 2,475 pounds in the larger.

"Ideal" Multipolar Generators.

The cut herewith shows the new line of generators being manufactured by The Ideal Electric and Manufacturing Company, Mansfield, Ohio, and is known as its "Type D," ranging in capacity from 25 to 150 kw. They are four pole up to and including 40 kw, slow speed; the larger machines being of six pole design. The magnet frame is of soft cast iron divided horizontally in all sizes and with forged steel magnet poles of circular cross section cast welded into the frame so as to insure an absolutely perfect magnetic joint. These poles are provided with cast-iron shoes which protect and support the field windings and embody the special features of this construction in reducing the density of the magnetic flux where it enters the armature, and permitting the use of a comparatively large air gap.

The armature is of the iron-clad type having a laminated core of the best quality of sheet steel of very thin gauge. Ventilating ducts are provided at right angles with the shaft and transversely through the core, insuring perfect ventilation. In the smaller sizes the core discs are mounted directly on the shaft and securely keyed thereto; while the larger sizes are provided with armature spiders so devised that the armatures can be arranged for mounting directly on the extended crank shaft of the engine for direct-connected service. Ribbed flanges are mounted on the outer edges of the core discs which ventilate the outer surface of the armature core and the windings at the bend of the coil. The windings consist of form-wound coils made of flat copper strip thoroughly insulated with horn fibre linen tape, dipped in the best quality of insulating varnish and thoroughly baked. Surface bands are used to retain the coils in the slots.

The commutator segments are well proportioned, being of sufficient length and depth to allow ample margin for wear. The flanges are of cast iron, insulated from the segments with solid V rings. The mica segments are of the best grade of pure, soft mica and the mechanical construction of the commutator is very rigid. Copper-coated composition carbon-graphite brushes are also used, clamped directly on the face of the holders. The holders are of heavy brass construction amply large to carry all current required without heating. The holders are of such a type that the brushes operate without vibration and the machines run cool and sparkless. The brush holder stems to which the holders are fastened are insulated from the quadrant and firmly secured in place to prevent



MULTIPOLAR GENERATOR.

them from working loose. The brush surface never exceeds 30 amperes per square inch of carbon contact.

The generators are designed to operate at their full rated capacities without a rise in temperature to exceed 30° above the surrounding air in either the armature or field winding, and 35° C. rise in the commutator. They are built to operate at an overload of 25 per cent. for two hours, and to withstand an overload of 50 per cent. for two to three minutes without injurious heating or sparking. The machines are thoroughly tested before leaving the works and guaranteed against defective workmanship or material.

Series Enclosed Arc Lamps.

A series enclosed arc lamp for use on 9.6 ampere circuits, which has now been in successful use for over six years, is now being made in quantities for the general market by Mr. W. F. Warner, of Muncie, Ind., its inventor and designer. During the past nine months, the lamp has been introduced in a number of cities, and has found favor as a lamp made for electric light men by one of themselves. Mr. Warner has had a number of years of experience in the manufacture of electrical instruments, and for over twelve years has had active control of electric light plants. Throughout this period he has been impressed with the need for such a lamp as he has worked out and introduced. The lamp is a very radical departure from the ordinary arc lamp construction. It is of the shunt feed type, and is purely electrical in its operation. The shunt coil does not control the feed of the carbon in the usual mechanical way, but does it electrically. Mr. Warner has therefore been able to simplify the interior of the arc lamp very much, doing away with springs, levers, cut-outs, pinions, and other familiar features.

While the lamp was designed especially for 9.6 amperes, and gives satisfactory service, operating on 50 volts at the arc, it will work equally as well, or perhaps better, on circuits of lower amperage. It is furnished for multiple work as well as series. The lamps are enclosed within a sheet copper hood, and the finish is natural copper for the hood, and aluminum finish for the top and bottom castings.

It might be well here to mention three of the features which have made the "Warner" enclosed arc lamp a success on circuits of such high amperage. In the first place he uses a globe which is considerably larger than the ones used on ordinary enclosed arc lamps, and instead of using an iron gas cap, he has made the gas cap entirely of an insulating material in one piece, which is an insulator to both heat and electricity. This cap with its globe is at a reasonable distance from the bottom of the lamp body, permitting the air to circulate around and about the globe, and the

SERIES ENCLOSED ARC LAMP.

gas cap so as to dissipate the heat without allowing it to enter the lamp body, and thereby raise the temperature of the mechanism.

The cut shows an outer globe which has some radical features. Most of the objections made to enclosed arc lamps lie in the extra time required to trim, and the many broken outer globes on account of having to remove these each time the lamp is trimmed. The Warner globe has a large opening at the bottom to allow the inner globe to be removed and the lamp trimmed without having to take the outer globe off. This saves considerable time in trimming a lamp, and many broken globes, aids very much in keeping the inner globe cool, and has thereby increased the life of the inner globe itself.

Electric Signs and Letters.

The increasing requirements in regard to safety, durability and good appearance of electric signs and letters have caused the in-

FIG. 1.—ELECTRIC SIGN.

troduction of steel in their construction. The Haller Machine Company, of Chicago, has given much thought to improving the construction of electric signs and letters, and has put on the market such

FIG. 2.—ELECTRIC SIGN.

goods. These signs are constructed of galvanized sheet steel, and although they are quite rigid and strong they are surprisingly light. The signs are decorated with embossed metal ornaments and scroll work, finished in gold leaf and colors, and are, therefore, very attractive also as day signs. The sign letters have a glossy white enameled face, reflecting the light brilliantly, while the sides are usually bright red, and the background smalted blue or black. All parts, the letters, ornaments and background, are in one piece, and none can come loose. The metal has further the advantage that it does not shrink, warp or crack, and is incombustible, waterproof and weather-proof. The lamp sockets used have removable shells. The letters are made either in the old raised or box shape, in a novel depressed or grooved style. The latter need fewer lamps and less current, as the light from the lamp is concentrated in the grooves of the letters that show up in distinct outline and can be read at any angle without blurring.

Besides different kinds of flashers, automatic switches, etc., the above company has also put on the market Goltz's automatic dimmers, by which the lights are quickly brought from darkness to full brightness, in which they stay a while, and then turn quickly to darkness, staying dark for a while, etc. The duration of darkness

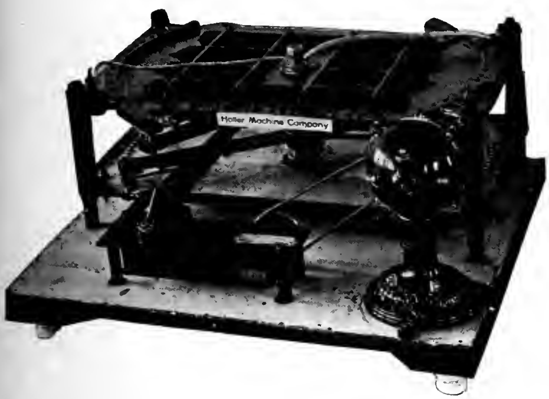


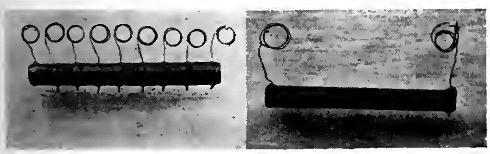
FIG. 3.—AUTOMATIC SIGN DIMMER.

and brightness can be regulated and thereby any desired saving of current made, say from one-half to two-thirds. Double dimmers operate as described above, on two parts of a sign in rotation.

Besides full background signs, the Haller Machine Company manufactures wire screen signs, roof signs and single electric letters from seven inches up to twenty-five feet in height. The small cuts herewith, Figs. 1, 2 and 3 show a raised letter sign, a grooved letter sign and a large automatic double sign dimmer.

New Resistance Unit.

Mr. H. Ward Leonard, president of the Ward Leonard Electric Company, has designed and perfected a resistance unit to meet the most advanced ideas regarding permanent high resistance. It is a porcelain tube, the thickness of a lead pencil, and only 2 in. long, with 5,000 ohms of resistance, but with only one layer of wire. The enamel covers all the resistance wire and the connection between



HIGH RESISTANCE UNITS.

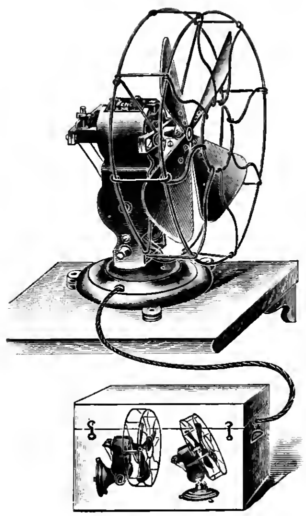
the small resistance wire and the larger terminal lead wire. The wire and joint are, therefore, hermetically sealed from the atmosphere and its corrosive action. Eleven thousand ohms can be put upon a tube 4 in. long by 7/16 in. diameter.

The cut shows a high-resistance unit tapped, giving eight equal steps of resistance. These units are especially applicable for use in constructing small rheostats, telephone resistance, etc.

Battery Fan Motor.

Many of the early battery fan motors were grotesquely inefficient, but in this line as in others, good engineering design has been brought to bear. The fan motor shown herewith, built by the Knapp Electric Novelty Company, of New York, may be cited as an illustration of improvement in this field.

This efficient, attractive and low-priced fan, taking current from portable batteries and easily moved as occasion requires, is designed for use where the street current is not available. The field is formed from steel punchings and the armature is drum-type with six teeth.



BATTERY FAN MOTOR.

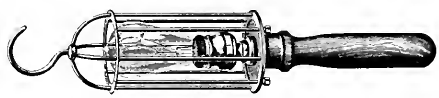
The brushes are readily adjusted while the motor is running, and oil cups with automatic feed keep the motor at the point of proper lubrication.

The fan is mounted on an iron base fitted with starting switch and rubber feet. It throws a good breeze directly forward or can be tilted to an angle either up or down or made into a wall bracket fan by adjusting the wing nuts at the lower sides of the field.

Good dry cells, connected four in each series of five multiples (twenty cells total) will draw so small a fraction of an ampere from each cell as to hold the voltage and enable the battery to stand up to the work. Used only four hours per day, about 300 hours can be obtained. If worked continuously, not allowing the battery to recuperate, the length of life is, of course, greatly reduced. Where constant work is necessary, as in a sick room, etc., it is more economical to have extra sets of battery. Two storage cells, or two or three acid cells, according to the amount of current back of them, will also give good results.

Portable Lamp Guard.

A new portable lamp guard is the latest addition to the "Crescent" line manufactured by the Crescent Company, of Chicago. After



LAMP GUARD.

many experiments the concern is able to furnish a portable lamp guard designed for all requirements. Its construction is such that, while it is strong enough to withstand the hard usage of an engine or boiler room, it is sufficiently ornamental for offices. As will be seen it is provided at one end with a hook for suspension and at the other end with a handle, so that it can be carried around easily and safely.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Values in the stock market at the close of the week were irregular at concessions following a recovery from a general decline earlier in the week. Bearish influences arising from the disturbed financial situation abroad and railroad cutting at home accounted for the decline. The public took little interest in the market, which was narrow in consequence. The heaviness of the trunk line shares, particularly Pennsylvania, was noted, and New York Central later became conspicuous. Brooklyn Rapid Transit and Amalgamated Copper also became active and advanced with ease. The United States Steel shares were steady at first, but afterwards became quite weak and were depressed by renewed unfavorable reports about the earnings of the corporation. Prices on the curb for outside securities generally sagged in sympathy with the main market. The largest transactions were in rights at a lower range of prices. There were a few scattering sales of New York & New Jersey Telephone rights at 3⅝. Interurban Rapid Transit closed at 102, being a net gain of ⅛. Tractions are all lower. Brooklyn Rapid Transit closed at 39⅜, which represents a loss of 1 point. Manhattan Elevated closed at 141½, rallying from 140¾, and Metropolitan Street Railway closed at 114½, which is ½ above the lowest price and a net loss of 1½ points. In the electric list a loss of 5 points net is recorded in General Electric, which closed at 158 after having reached 163. Westinghouse closed at 158, which is a loss of 1 point compared with the closing price of the previous week. Western Union gained ½ point, closing at 87½, and Commercial Cable was off 5 points, the closing quotation being 187. Following are the closing prices of March 1:

NEW YORK.

	Feb. 23	Mar. 1		Feb. 23	Mar. 1
American Tel. & Cable......	82	84	General Electric.	158¾	159
American Tel. & Tel........	118	121	Hudson River Tel...........	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.........	114⅝	114¾
Brooklyn Rapid Transit ...	38⅞	40⅛	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	..	188	N. Y. & N. J. Tel...........	..	..
Electric Boat.	..	20	Marconi Tel............ ...	..	..
Electric Boat pfd...........	..	49	Western Union Tel...... ...	86⅝	87⅝
Electric Lead Reduction.. .	..	¾	Westinghouse com....	154	156⅛
Electric Vehicle	..	7½	Westinghouse pfd..........	170	175
Electric Vehicle pfd.........	..	10			

BOSTON.

	Feb. 23	Mar. 1		Feb. 23	Mar. 1
American Tel. & Tel	120	120¾	Western Tel. & Tel. pfd....	77	78
Cumberland Telephone....	114½	114½	Mexican Telephone.........	1½	1½
Edison Elec. Illum..........	234	230	New England Telephone. .	118	118
General Electric............	158	157	Mass. Elec. Ry.............	18⅛	18
Western Tel. & Tel	9	8⅛	Mass. Elec. Ry. pfd.... . .	74⅛	73¾

PHILADELPHIA.

	Feb. 23	Mar. 1		Feb. 23	Mar. 1
American Railways.........	44	43	Phila. Traction..	..	..
Elec. Storage Battery.. ...	53	52	Phila. Electric	5¾	5¾
Elec. Storage Battery pfd.	53	52	Phila. Rapid Trans.........	14	14⅜
Elec. Co. of America.	7¾	7¾			

CHICAGO.

	Feb. 23	Mar. 1		Feb. 23	Mar.
Central Union Tel	..	..	National Carbon pfd........	97	98
Chicago Edison.........	..	..	Metropolitan Elev. com.....	17	1
Chicago City Ry....		160	Union Traction	4¼	4½
Chicago Tel. Co	..	..	Union Traction pfd.........	29⅛	30
National Carbon	25	25¾			

*Asked

NATIONAL CARBON.—The annual report of the National Carbon Company for the year ending January 31, 1904, already quoted in these columns, showed net earnings of $736,441 compared with $594,372 the previous year. The increase was $142,069, or about 24 per cent. Net earnings for the year just reported amounted to 7 per cent. on the $4,500,000 preferred stock, and to 7.6 per cent. on the $5,500,000 common. Nothing was paid, however, on the common, the company charging off the greater part of the surplus after preferred dividends. This has been done every year since organization, in 1899. The company has made a good record of earnings. The following table compares income accounts for the five-year period 1899-1904:

	Net earn.	Pfd. div.	Balance.	P. C. on common.	Charged off.
1904....................	$736,441	$315,000	$421,441	7.6	$280,429
1899....................	451,687	315,000	136,687	2.4	100,000
Increase................	284,754	....	136,687	5.2	180,429

This good showing is also evident in the balance sheets in the form of increased working capital. The following table compares working capital at the beginning and at the end of the five-year period:

	1904.	1899.
Current assets	$1,368,129	$890,424
Current liabilities	93,570	154,479
Net working capital..............................	$1,274,559	$735,945

The working capital shows an increase of over $500,000. Meanwhile there have been additions and improvements made to the property. The demand for carbons, quite outside the lighting field, becomes yearly more varied and the output gains in bulk and value.

COMMERCIAL CABLE COMBINATION.—It is reported that a new company will be formed which will offer its preferred stock share for share for Commercial Cable stock and issue a bonus in common stock. It was said that the new company might be formed for the purpose of combining the Commercial Cable Company and the Commercial Pacific Cable Company, which is the company incorporated in 1901 to lay and operate the cable from California to the Philippines and China. The authorized capital stock of this company is $12,000,000, and it is controlled by the Commercial Cable interests. The Commercial Cable Company increased its stock about a year ago and it was said then that a part of the $1,666,000 increase would go toward completing the Pacific cable. The cable company's stock is $15,000,000, and its bonded debt $20,000,000. This week Mr. Clarence Mackay has given out details of the scheme and has just organized an investment trust under the name of "The Mackay Companies," the design of which is to perpetuate the name of his father, the late John W. Mackay; to provide for the development of the companies which John W. Mackay founded and to safeguard, upon an even basis with Clarence H. Mackay's own, the interests of those who have invested capital in the enterprises with which his father was identified. "The Mackay Companies" has authorized for exchange for the stock noted above $30,000,000 par value of its own 4 per cent. cumulative preferred shares and a like amount of common shares, so that each stockholder in the cable company will receive for his holdings 200 per cent. in the preferred and 200 per cent. in the common shares of the new concern.

NIAGARA, LOCKPORT AND ONTARIO POWER.—Opposition is being made to the plans of the above enterprise. Julius Henry Cohen, chairman of the Legislative Committee of the Citizens' Union has given out a statement condemning the Assembly bill amending the charter of the Niagara, Lockport and Ontario Power Company. He says: "It is a measure which deserves the attention and condemnation of the press, not only in New York City, but throughout the State." The Citizens' Union recognized the danger in this bill and asked for a hearing before the Assembly Committee on General Laws. The delegation which went to Albany and opposed the bill came away with the general assurance that it would be materially amended. But the bill is, in its amended form, a dangerous measure. Here is a company which was given a franchise ten years ago. It has not yet spent one cent on actual construction. It is now proposed to extend its time, to give it the right to deface Niagara, without any compensation to the State, and to give it extraordinary franchise rights in every city and town of the State. The pretended probition in the amendment does not prohibit it for, by combining with a local company in any city or town, it will have a perfect franchise, even in New York City, to rip up the streets, lay conduits, erect poles, and exercise any other powers enumerated above."

NORDEN-BITTNER ELECTRIC COMPANY.—A petition in bankruptcy has been filed against the Norden-Bittner Electric Company, manufacturer of electric supplies, of New York City, by the following creditors: Munder Electric Company, of Springfield, Mass., $816; Joseph George, $68, and O. E. Nantel, $16. It is alleged that the company is insolvent, and in January and February transferred cash to certain creditors to prefer them. John Bittner was president and treasurer, and M. Norden secretary and manager. It was incorporated on August 16, 1901, with a capital stock of $100,000. Judge Holt of the United States District Court appointed Job E. Hedges receiver of the assets on the application of Stern, Singer & Barr, attorneys for the petitioning creditors, who stated that the assets are about $8,000, of which $5,000 are collectable accounts and the balance merchandise. The cause of the bankruptcy petition was the withdrawal of Mr. Bittner, as he declined to advance any more money to the corporation.

ST. LOUIS LIGHTING.—The stockholders of the Laclede Gas Light Company of St. Louis, which is controlled by the North American Company, will hold a special meeting on April 18 to vote upon a proposition to increase the common stock from $8,500,000 to $17,500,000, making the total capital, including preferred stock, $20,000,000. A vote will be taken at the same time on increasing the bonded indebtedness from $10,000,000 to $20,000,000. In a circular to the stockholders, President C. W. Wetmore of the North American Company says that $5,000,000 cash will be needed before February 1, 1905, to meet expenditures for improvements and extensions incidental, largely, to the contracts of the company for the St. Louis Exposition period. The fresh capital will also provide for the development of the business of the company for a series of years. It was said that a local banking house was prepared to take the entire $10,000,000 issue of Laclede bonds and that there would be no syndicate to handle them.

NEW YORK AND NEW JERSEY BELL TELEPHONE.—The New York and New Jersey Telephone Company has issued its full report for the year ended December 31, 1903. Below are some of the figures:

	1903.	1902.	1901.	1900.
Gross	$4,741,344	$3,962,597	$3,376,433	$2,827,481
Expenses	3,269,996	2,823,458	2,294,633	2,018,603
Net	$1,471,348	$1,139,139	$1,081,800	$808,878
Charges and taxes	181,214	166,350	174,104	174,731
Surplus	$1,290,134	$972,789	$907,696	$634,147
Dividends	852,216	707,627	616,286	490,650
Surplus	$437,918	$265,162	$291,410	$143,497

Earnings and expenses in detail follow:

Gross earnings:				
Exchange service	$2,262,289	$1,903,707	$1,633,319	$1,372,916
Pay stations	596,031	490,294	428,996	356,560
Tolls	1,656,943	1,365,854	1,162,279	965,341
Leased lines and instruments	23,730	....	....	....
Real estate	132,803	113,415	107,415	83,939
Other sources	69,547	89,327	44,424	48,725
Total	$4,741,344	$3,962,547	$3,376,433	$2,827,481
Expenses:				
General	$761,541	$646,240	$536,665	$504,613
Operating	761,331	594,730	522,071	460,840
Reconstruction and maintenance	1,446,050	1,330,172	997,828	847,649
Instrument rental	219,950	181,616	176,855	147,417
Real estate	81,124	70,699	61,214	58,085
Total	$3,269,996	$2,823,457	$2,294,633	$2,018,603

BALTIMORE UNITED RAILWAYS.—The United Railway & Electric Company of Baltimore reports as follows for the year ended December 31, 1903:

	1903.	1902.	Changes.
Gross	$5,480,629	$5,041,275	Inc. $439,354
Expenses	2,554,241	2,252,133	Inc. 302,108
Net	$2,926,388	$2,789,142	Inc. $137,246
Other income	90,374	53,405	Inc. 36,969
Total income	$3,016,762	$2,842,547	Inc. $174,215
Changes	2,708,030	2,637,115	Inc. 70,915
Sulplus	$308,732	$205,432	Inc. $103,300

CANADIAN BELL TELEPHONE.—The Bell Telephone Company of Canada makes a satisfactory annual report as follows for the year ended December 31, 1903:

	1903.	1902.	Changes.
Gross	$2,522,275	$2,085,134	Inc. $437,141
Expenses	1,940,123	1,580,852	Inc. 359,271
Net	$582,152	$504,282	Inc. $77,870
Dividends	467,510	....	....
Surplus	$114,642	....	....

The capital stock of the company is $6,000,000, of which the American Telephone and Telegraph Company owns $2,314,700.

UNION SWITCH & SIGNAL COMPANY.—The following is a summary of the annual report of the Union Switch & Signal Company for the year ending December 31, 1903, as compared with previous years:

	1903.	1902.	1901.	1900.
Gross receipts	$2,132,835	$1,774,005	$1,605,649	$1,690,319
Interest and other disbursements	1,803,513	1,420,322	1,308,143	1,300,406
Net	$329,322	$353,683	$297,506	$389,913
Preferred dividends	130,867	79,726	79,726	79,726
Surplus	$198,455	$273,957	$217,780	$310,187

DIVIDENDS.—West Jersey and Seashore Railroad directors have declared the regular semi-annual dividend of 2½ per cent., payable March 15. The South Side Elevated, Chicago, has declared the regular quarterly dividend of 1 per cent., payable March 31.

Commercial Intelligence.

THE WEEK IN TRADE.—Winter's icy grip on trade seems to be relaxing, according to reports from the various sections, and although severe weather conditions still exist in some, spring trade is asserting itself. Distributive trade in the South has been good and generally in excess of a year ago, and the milder weather has brought out more country buyers. In the East spring trade is growing, but retail business is still restricted by the continued cold weather. Manufacturing plants are gradually restoring idle machinery, and there is more disposition to anticipate future requirements. In the building trades there is every indication of activity with the advent of spring. The cold weather still hampers outdoor operations, but several very large transactions in lumber are reported from the West and Northwest. Baltimore concerns are resuming in temporary quarters, stocks of goods being accumulated with great rapidity, but no permits have been issued for rebuilding the burned district, as plans are in preparation for realignment of the streets. Foreign commerce at New York for the last week shows a loss of $2,489,799 in exports and a decrease of $2,549,672 in imports as compared with the same week last year. The strength of the wheat market, and of the coarser grains, which is looked for to increase, and of provisions generally, are the leading features of the price situation. War talk is still an influence tending to strengthen food products, but to depress raw cotton. Collections are still unsatisfactory at most Northern markets. Money is easy and deposits show increases at leading centers. Railway earnings are not as encouraging as in the past, owing partly to the congestion growing out of blockaded shipments, but partly to cutting of grain freight rates, which, despite the small movement at present, affects the situation appreciably. Iron and steel are still irregular, but the tendency, as a whole, has been in the direction of improvement, owing to the enlarged demand reported for finished products, notably bars, wire and wire goods, steel pipe, and light and heavy hardware. The liabilities of the commercial failures thus far reported for February aggregated $10,796,166, of which $2,732,453 were in manufacturing, $4,290,235 in trading, and $3,773,453 in other commercial lines. *Bradstreet's* summary of business failures for the week ending February 25 shows that there were 200, against 23 the week previous, and 185 the corresponding week last year. Copper remains unchanged, dullness still being the prevalent condition in the market. Quotations are, for Lake, 12½ to 12¾.; electrolytic and casting stock, 12⅜ to 12⅝c. The exports so far in February show a marked falling off, the shipments amounting to but 8,800 tons.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a number of contracts for the installation of batteries of "Chloride" accumulators. Among them may be noted two batteries of the North Shore Railroad Company, one to be located at San Anselmo, Cal., having a capacity of 846 kw, the other located at Sausalito, Cal., having a capacity of 975 kw. Both these batteries to be used for line regulation. The Bay City Traction and Electric Company, Bay City, Mich., have contracted for a battery having a capacity of 288 kw, to regulate the fluctuations of the generator lead. The Northwestern Fuel Company, Superior, Wis., have contracted for a battery having a capacity of 677 kw, which is to be used entirely for the regulation of a motor load. The Bartlett Illuminating Company will install for the use of the Saginaw Traction Company a battery having a capacity of 200 kw, to be used in regulating the fluctuations on the latter company's railway circuit.

NEW POWER STATION FOR NEW ORLEANS.—The construction of a new power station is contemplated by the New Orleans (La.) Railway Company, for which concern Sanderson & Porter, 52 William Street, New York, are the consulting engineers. The proposed new plant will have an initial capacity of 7,000 hp, while eventually it will be capable of developing 20,000 hp. Alternating-current equipment will be installed.

MEXICAN WATER POWER PROJECT.—Mexican advices state that L. B. Cabellero, of Mexico City, has secured the necessary concession from the Secretaria de Fomento by which he is permitted to utilize 3,000 liters of water per second from the Realito River of Tubares, in the District of Andres del Rio, State of Chihuahua. The current so generated will be used for lighting and general power purposes in that vicinity.

CORTLAND (N. Y.) PLANT TO BE REMODELED.—The power station of the Cortland County Traction Company, Cortland, N. Y., is to be remodeled. The existing equipment consists of Watertown engines and belt-driven General Electric railway generators. Two new 200-kw generators will be installed. Jeremiah J. Kennedy, Exchange Court, New York, is consulting engineer.

EQUIPMENT FOR GOUBERT PLANT.—The Goubert Manufacturing Company, 85 Liberty Street, New York, will award contracts shortly for considerable electrical equipment to be installed at its new plant, Bayonne, N. J., where, in addition to the feed-water heaters, steam separators and other specialties of the company, large castings, such as engine cylinders and marine engine work, will be turned out. There will be four foundry buildings, one being 70 ft. x 310 ft. and three, each measuring 60 ft. x 310 ft. The larger building will be equipped with a 40-ton, also a 25-ton electric traveling crane, and each of the other buildings will have a 25-ton equipment. The machine shop will be 90 ft. x 400 ft. The equipment will be operated electrically, the larger tools being driven by individual motors, while the smaller ones will be worked by means of line shafting operated by motors. The power plant will be of 300-hp capacity. The engine will be direct-connected to the generator and of compound non-condensing type. The boilers are to be water tube equipped with superheaters. There will also be a blacksmith shop and plate shop, and various other buildings for storage, pattern-making and similar purposes. Industrial railways will be installed in the plant so as to connect the buildings and supplement the crane and railroad service, as a spur of the Central Railroad of New Jersey will be run to the works, which are located on the water front.

ELECTRIFICATION OF SOUTH AUSTRALIAN STEAM LINES.—Regarding the proposed electrification of the suburban railways in South Australia, advices state that for working the Port Adelaide and Glenelg lines, three alternative schemes are outlined in a report recently prepared on the subject by the Railways Commissioner and leading officers of the department. Two of the schemes are on the high-tension system with one power station, and one on the low-tension system with two power stations. The third scheme has been recommended for acceptance in view of its being the least expensive both as regards installation and as to maintenance. T. Roberts, the chief mechanical engineer of the South Australian Railways, estimated the capital cost at about $1,500,000 and the annual cost at about $170,000, provision being made for 48 cars and as many trailers. The Railways Commissioner, Alan G. Pendleton, thinks the work should be carried out on this scheme. As difficulties are anticipated in operating cars successfully in and out of the Adelaide station, an estimate has been made of bringing the cars into North Terrace by a deviation from the Port line. Such a deviation is calculated to incur an expenditure of $150,000—$125,000 for the track and $25,000 for electrification.

AMERICAN SIGNALING FOR YERKES.—The Underground Electric Railways Company, Limited, of London (usually referred to as the Yerkes' Syndicate), which is constructing an extensive underground and surface electric traction system in and around the British metropolis, has decided to utilize an American system of signaling on the 15 miles of double track of the Metropolitan District Railway. The contract has been awarded to the Westinghouse Brake Company, Limited, of Kings Cross, London, N., which concern has the British rights to manufacture the specialties of the Union Switch and Signal Company, of Swissvale, Pa. The signals will be operated automatically on the Westinghouse electro-pneumatic system and are to be about 300 in number. The service in the tunnels will be arranged for trains running at intervals of 1¼ minutes. A new form of combined signal motor and arm will be employed. This system has been in service for several months past on the Ealing-Harrow experimental section of the Metropolitan District Railway. This is the first instance of a British electric railway to be automatically signaled by means of track circuits.

THE ST. LOUIS SMELTING AND REFINING COMPANY of St. Louis, Mo., is erecting a new smelter at Collinsville, Ill. After considering the matter, on the advice of its consulting engineer, Mr. Henry Floy, of New York City, it has decided to use electric power throughout and has placed orders with the General Electric Company for three-phase motors, varying in size from 75 hp down, and a 240-volt alternator, to be direct connected to a Rice & Sargent tandem, compound engine, operating at 150 r.p.m. The Babcock & Wilcox Co. has been awarded the contract for boilers; the Deane Steam Pump Company has received the order for pumps, and the Buffalo Forge Company, the order for blowers. It is expected the plant will be in operation by July 1, 1904.

BELL TELEPHONE OUTPUT.—The American Telephone and Telegraph Company instrument statement for the month ended January 30, is as follows:

	1904.	1903.	1902.
Gross output	90,644	129,837	87,412
Returned	36,854	43,286	34,796
Net output	53,790	86,551	52,616
Total outstanding	3,833,307	3,236,871	2,578,626

While there is a large total gain over last year, there is an apparent decline in net for the month of nearly 33,000 instruments, the net being barely in excess of the same month in 1902.

THE RIO TAMASOPO SUGAR COMPANY, of which Col. Russell B. Harrison, of Indianapolis, is president, will shortly be in the market for considerable electrical equipment, etc., to be installed on its plantation known as the Agua Buena Hacienda, located about 130 miles west of Tampico, Mexico. A horse tramway is now used for the purpose of hauling the sugarcane from the fields to the mill and conveying the sugar thence to the Mexican Central Railroad at Tamasopo, a distance of about five miles. This line will be converted into an electric traction system. A lighting plant will also be installed for lighting the sugar factory and other buildings on the plantation. The sugar mills are to be operated by water power.

DODGE & DAY, modernizing and contracting engineers, Nicetown, Philadelphia, Pa., are installing in the power house of the Link-Belt Engineering Company, Philadelphia, Pa., a 340-hp Buckeye vertical cross-compound engine, direct-connected to two General Electric 100-kw direct-current, compound-wound generators. The boiler plant at the same establishment is also receiving attention, and while it may not be found necessary to increase the capacity, it is probable under-feed stokers will be introduced. The Taylor system of management is well underway at the Link-Belt Works, and the results attained have been most gratifying.

TRUMBULL SPECIALTIES FOR MEXICO.—Adolphe A. Chaillet, formerly technical director of the Shelby, O., Lamp Company, is now located in Mexico City, where he is primarily interested in a project to manufacture incandescent lamps for that market. He also represents the Mexican interests of a number of United States manufacturers of electrical equipment supplies, etc., and has placed a substantial contract for fusible cleat rosettes, plug cut-outs, switches and other specialties, with the Trumbull Electric Manufacturing Company, New York, offices 136 Liberty Street.

THE FRENCH THOMSON-HOUSTON COMPANY has received a new order from the Paris Metropolitan Railway for 100 complete train control equipments similar to those in use on the Central London Railway, Great Northern and City Railway, the Northeastern Railway and the Metropolitan and District Railway. This order is all for new equipment in addition to that heretofore in use or on order, and is said to be the only additional equipment ordered by the Paris Metropolitan.

ELECTRIC SUPPLY CO., of 298 Second Street, Memphis, Tenn., is having a new store and warehouse built for it in that city, which it expects will be ready for occupancy about May 1. This warehouse will enable it to increase materially the supply stock carried. It proposes also to do a general jobbing business throughout the South. Mr. C. H. Harvey is president, and Mr. W. M. Deming is secretary and treasurer.

MAGNET WIRE ORDERS.—The Magnet Wire Company, 80 William street, New York, report receipt of a quantity of inquiries for feeder cable and trolley wires from the South and Middle West, as well as in this section. A substantial contract for feeder cable has just been secured from the Rochester (N. Y.) Railway Company, and the Pittsburg (Pa.) Coal Company has also sent in a good-sized order for trolley wire, etc.

THE POWER AND MINING MACHINERY COMPANY, of Cudahy, Wis., is enlarging a plant, and in connection therewith desires a number of electric motors, in capacity of 5 to 50 hp, constant speed, wound for 220 volts. The main office of this company is 52 William Street, New York, where the bids and correspondence in connection with this matter will be received.

EQUIPMENT FOR NEW STURTEVANT HOTEL.—The new Sturtevant Hotel under construction at Twenty-ninth street and Broadway, New York, which is being built by the George A. Fuller Company, is to be installed with two 225-hp Harrisburg engines, each directed connected to 150-kw C. & C. generators, and two 120-hp direct-connected to 75-kw C. & C. generators.

HOBART ELECTRIC MFG. CO., of Troy, Ohio, is contemplating the erection of a brick addition to its factory, 220 by 50 feet. It will use its own power plant, but will need additional machinery and tools. It had not let any contracts at the time of writing, but is expecting to have some of them closed immediately.

LIGHTING.—Orders are expected within the next few days for lighting equipment to be installed in the New York plant of the Federal Sugar Refining Company. There will be about 3,000 incandescent lamps. Edward R. Knowles, 136 Liberty Street, is acting as the consulting engineer in the matter.

TRACTION FOR ADELAIDE, AUSTRALIA.—Private advices from Adelaide state that it is confidently expected that the existing horse tramways in that South Australian city will shortly be converted into electric traction. The present lines are about 30 miles long.

UTILIZING HAT RAPIDS, WIS.—A company to be known as the Rhinelander Power Company has been organized with the following officers: A. W. Shelton, president; E. A. Forbes, vice-president; Charles Chafee, treasurer, and C. A. Wixson, secretary. The power company is capitalized at $85,000, $40,000 of which has been subscribed by the above named, some of whom are connected with the Rhinelander Electric Light Company, and who will begin at once the development of the excellent water power a few miles below Rhinelander, Wis., known as Hat Rapids. Their first move will be to have a new and accurate survey made of the power, and follow it up with the construction of a dam, giving a 20-ft. head, and which it is estimated will be capable of developing up to 1,500 hp. The concern will be a lighting and power company, and there is not the slightest doubt that there will be a demand for all the power developed. The Rhinelander Manufacturing Company, the Wisconsin Veneer Company, the Rhinelander Paper Company, the Rhinelander Iron Company, the city pumping station, etc., will be in the market for electric power as soon as the development is completed and the current turned on. An estimate of the time required for the completion of the work is given as six months.

OTIS ELEVATORS FOR YERKES' LONDON SYSTEM.—The Otis Elevator Company, Limited, of London, has been alloted the contract for the "lifts" for the whole of the Yerkes' system of tube railways in the British metropolis. The elevators will be operated by power transmitted from the central station at Chelsea. There will be 170 elevators in all, capable of carrying an average of 65 passengers at a time, or nearly 100,000 people all told. The speed will be 200 feet per minute. The underground stations will be fitted in most cases with four and in some cases six elevators each. The average rise will be 60 feet. The machinery will be of the Otis type and special safety appliances and non-flammable material are to be employed throughout the mechanism and its accesories. The shafts will vary from 40 feet to 180 feet in depth; the majority of the shafts will be 23 feet in diameter and some will be 30 feet in diameter. It is expected that the bulk of the equipment will be manufactured on the other side. The contract, which is the most valuable ever let for elevators on either side of the Atlantic, will represent an expenditure of upwards of $1,750,000.

DUTY ON ARC CARBONS.—Judge Lacombe in the United States Circuit Court of Appeals in New York City last week decided the case of the United States versus R. F. Downing & Co., in favor of the importers, thereby materially reducing the duty to be exacted on carbons for electric arc lights. These carbons, in the condition in which they are used, are 12 inches long, and they are specifically provided for in the tariff law at 90 cents a hundred. Some years ago the importers tried bringing them in in longer lengths, from 12½ to 20 inches, and the claim was made that they were entitled to classification as articles manufactured of carbon at 35 per cent. This claim was overruled by General Appraiser Fischer on November 7, 1901, and Judge Henderson M. Somerville wrote a dissenting opinion sustaining the importers' claim. This dissenting opinion is now confirmed by the Circuit Court of Appeals. The importers were represented by Comstock & Brown.

INTERNATIONAL TELEPHONE CONTRACTS.—Among the contracts recently secured in the Northwest by Mr. Henry Shafer, president of the International Telephone Manufacturing Company of Chicago, was one for a 1,000-line capacity central energy lamp signal double supervisory switchboard, distributing board, lightning arresters, complete power plant, together with a 50-number self-restoring drop country party line and tollboard for re-equipping the exchange of the Portage Telephone Company, Portage, Wis., and telephones for increasing the exchange. The Portage company will use its present generator-call telephones on the system, by cutting out the generator and cutting in an International condenser, thus changing them to centralized calling energy local talking battery instruments.

NEW STURTEVANT WORKS.—The boiler plant of the B. F. Sturtevant Company's new works at Hyde Park, Mass., is now in full operation. This plant comprises three 250-hp Stirling boilers equipped with Jones under-feed stokers, air for which is furnished by a 6 ft. x 28 in. Sturtevant steam fan operating at 2½ oz. pressure, a 9 x 4½ ft. Sturtevant induced draft steam fan, and an economizer (to be installed later) of their own make. The maximum steam pressure carried will be 150 pounds. Fire was started under these boilers on December 23. This company has in process of construction a 400-hp vertical compound engine with direct-connected 250-kw generating set, which will be the first of several units to be installed in the engine room.

THE NERNST LAMP COMPANY has appointed Mr. G. E. Bennett to act as district sales manager of its Buffalo district office, recently established at 17 West Mohawk Street. These quarters will include an office, show room, exhibition room and stock room, with a complete stock of lamps and supplies to meet the requirements of the trade in this territory. The company has recently closed contracts for the installation of 165 Nernst lamps in the Washington National Bank Building, and 75 lamps for the Pittsburg Supply Company, at Pittsburg, Pa. It has also succeeded in securing the adoption of Nernst lamps by the municipal electric light plant of Silverton, Colo., in competition with enclosed arc lamps.

MEXICAN HYDRAULIC PROJECT.—A hydraulic plant is to be constructed on the river Alaja in the San Miguel Allende district, State of Guanajuato, Mexico. Jose de J. Garcia has been granted the necessary concession from the Mexican authorities which permits of the utilization of 1,500 liters per second. The usual franchises and obligations are embodied in the concession. A deposit of $5,000 in bonds of the Mexican 3 per cent. consolidated silver debt has been made by the concessionaire. Construction work is expected to be begun immediately and orders will be placed here very shortly for the necessary equipment. The plant will develop current for general power use.

BRIDGEPORT, CONN., MANUFACTURING PLANT.—The Eaton, Cole & Burnham Company, manufacturers of steam fixtures, etc., is to install considerable electrical equipment in its plant now being extended at Bridgeport, Conn. A Westinghouse turbine of 400-kw capacity will be put in. There will also be installed 31 Westinghouse motors varying in capacity from 5 hp to 30 hp and aggregating 350 hp. A 30-kw General Electric direct-connected exciter set has also been ordered. G. K. Hooper, Bowling Green Building, New York, is the consulting expert.

MEXICO CITY LINES EXTENDED.—The Mexico Electric Tramways Company (usually known as the Wernher-Beit system), which operates an extensive electric traction system in Mexico City and suburbs, proposes to construct a further line. The company has filed an application with the Department of Public Communications in the Mexican capital for the necessary authorization to build a line from Nino Perdido, on the south, to Los Angeles on the north side, thus forming a complete circuit.

EQUIPMENT FOR HOTEL NETHERLANDS.—Mackenzie, Quarrien & Ferguson, 114 Liberty Street, New York, have taken an order for a 150-hp Harrisburg side-crank engine for direct connection to a 100-kw Western Electric generator. The equipment will be used for lighting the Hotel Netherlands. The New York Dock Company has ordered a 75-hp Harrisburg standard simple engine for direct connection to a 50-kw General Electric generator for lighting purposes.

THE CATAWBA POWER COMPANY has secured the contract for lighting the streets of Charlotte, N. C., and advises that it is now in the market for pole line supplies for eighteen miles of transmission, high potential circuit. It is also in the market for the necessary supplies for wiring the city of Charlotte for 155 arc lamps and for private lighting and small motor work. Mr. W. S. Lee, Jr., is vice-president and general manager.

CHANGES IN CUBAN TARIFF.—Under the new Cuban tariff, which has just gone into effect, there is a 25 per cent. increase in the duty on copper wire, copper wire gauze, cables and miscellaneous articles. There is a 30 per cent. increase on incandescent lamps of all kinds, electrical insulators and electric conduits. There is a 25 per cent. increase on dynamo electric machinery, "inductors and detached parts."

AMERICAN ELECTRIC TELEPHONE ORDERS.—Among switchboard shipments recently made by the American Electric Telephone Company of Chicago are the following: Monroe, Neb., one 100-line express; Belize, British Honduras, C. A., one 200-line express; Olivet, Kan., one 100-line express; Dunlop, Ia., one 200-line express; Topeka, Kan., one 40-line express.

BALL ENGINE ORDER.—The Cleveland Arcade Company, Cleveland, O., has contracted with the Ball Engine Company, Erie, Pa., for one of its 400-hp heavy duty side crank engines, arranged for direct-connection to a Westinghouse generator. This is a new design which has been much admired by those who have seen it.

TO LIGHT CAMPECHE CITY.—The city of Campeche, capital of the State of Campeche, Mexico, is to be illuminated by electricity. The city has a population of about 22,000. The lighting equipment will be purchased in the United States. Don Luis Garcia, a prominent lawyer, is one of the principal parties interested in the project.

ELECTRIC TRACTION FOR NEW ZEALAND.—The Australasian electrical, engineering and contracting firm of Noyes Bros. has been awarded the contract for the construction and equipment of an electric traction system in Invercargill, a prosperous seaport town located in the extreme south of New Zealand.

JAPANESE LIGHTING PLANT EXTENDED.—The Yokohama (Japan) Union Electric Light Co. is to double the capacity of its plant, making 1,200 hp in all. Two 300-hp Heine boilers have been ordered. The initial boiler equipment is also of Heine build.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. General meeting, Washington, D. C., April 7, 8 and 9, 1904.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, 1904.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., 1904.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, F. P. Ide, Springfield, Ill. Next meeting, December, 1903.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, LaSalle, Ill.

INDIANA PUBLIC UTILITIES ASSOCIATION. Secretary, A. M. Barron, Indianapolis, Ind.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES. Secretary, Frank G. Jones.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Pichardt, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, New York.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. S. Porter, Eldora, Ia.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Ia. Annual meeting, Des Moines, March 8, 1904.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ind.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May 24, 25 and 26, 1904.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, Canton, Ohio.

SOUTHWESTERN ELECTRICAL ASSOCIATION. Secretary, J. L. Ellis, Oklahoma City, Okla. Next meeting, Dallas, April or May, 1904.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSOCIATION. Secretary, Frank E. Scovill, Austin, Texas.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

UNITED ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

WESTERN SOCIETY OF ENGINEERS. Next meeting of Electrical Section, Chicago, March 18, 1904.

General News.

THE TELEPHONE.

MONTGOMERY, ALA.—The Middletown & Wellsville telephone line has been organized here, with Jeff Haygood as president.

JOLIET, ILL.—The building of the Chicago Telephone Company here has been destroyed by fire.

JOHNSON CITY, ILL.—The Good Service Telephone Company has been incorporated with a capital stock of $2500. The directors are J. E. Poindexter and others.

CHICAGO, ILL.—It has been officially stated that the Chicago Telephone Company will erect an eight-story building on Washington St., next to the Title & Trust Bldg., in which place its present exchange is located and which it has outgrown. It will be several months before the company issues any new stock, as the exchequer is well supplied with immediate funds.

LIBERTY CENTER, IND.—The Liberty Center Telephone Company has filed articles of incorporation. The capital stock is $2500. James P. Mounsey, L. A. Minnear and O. D. Garrett are the directors.

LANDESSVILLE, IND.—The Landessville Rural Telephone Company has increased its capital stock to $9975, for the purpose of making extensions and improvements. Henry Wine is president, and Rudy Freeman, secretary.

GREENFIELD, IND.—The Vernon Township Farmers' Telephone Company, of Hancock County, has filed articles of incorporation with the Secretary of State. The capital stock is $1000. George M. Rumler, John Hiday, C. J. Jackson and others are directors.

CONNERSVILLE, IND.—A stockholders' meeting of the Connersville Telephone Company was held in this city recently. The directors elected George M. Sinks president, W. T. Edwards vice-president, and L. A. Frazee secretary and treasurer. The secretary reported over 700 telephones in operation.

MARION, IND.—C. C. Huff, a country school teacher of this county, has used the telephone successfully in teaching absent pupils. For two weeks the family of James Hewitt has been quarantined because of small-pox in the family. Two of Mr. Hewitt's sons are anxious to graduate this year, and for them to miss school rendered this result doubtful. The teacher suggested the telephone. For two weeks Mr. Huff assigned the lessons to the lads and heard them recite each evening over the telephone. They are now back in school and well up with their class, due to the use of the telephone.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company is rapidly installing new instruments in the burnt district. Fortunately for the company, it had a switchboard stored away in Washington. This is now installed and in working order. The Maryland Telephone & Telegraph Company was little harmed by the fire save in the loss of instruments and distributing poles in the burnt district. It is busy supplying telephones to all subscribers who have opened temporary offices.

HERMOSILLO, MEX.—A long distance telephone line is to be built between this city and Guaymas. A. Mascarenas, cashier of the Banco Sonora, Chihuahua, Mexico, can give information.

TORREON, MEX.—The Government has granted a concession to M. A. Sepulveda, of the Torreon Telephone Company, to extend its lines to the towns of Gomez Palacio, Lerdo and adjacent haciendas. The concession also authorizes the company to extend its lines to the cities of Durango, Monterey, Saltillo, Mapimi and other places. All of the principal towns and cities of northern Mexico are to be included in the proposed system.

ALPENA, MICH.—Mr. C. H. Reynolds has been elected president of the Alpena Mutual Telephone Company, and Mr. W. H. Johnson secretary and treasurer.

MONROE CITY, MO.—J. M. Griggsby, of Goss, president of the Monroe Mutual Telephone Company, met about 75 farmers in this city February 20 and formed a mutual company that will work in connection with the county lines.

CLAYTON, MO.—At a meeting of the directors and stockholders of the St. Louis County Telephone Company, in this city, it was decided to begin work on the new line within the next 30 days. The offer of telephones for $1 a month for residences and $1.50 a month for business establishments will be discontinued after March 14.

ST. LOUIS, MO.—At a meeting of the directors of the Bell Telephone Company of Missouri, February 23, Cyrus P. Walbridge was elected president to succeed F. P. Fish, of Boston. It is stated that Mr. Fish, who is president of the American Telephone & Telegraph Company, could not give his time to both organizations. The officers elected, besides Mr. Walbridge, were Edwards Whitaker, vice-president; Fritz Nisbet, secretary and treasurer, and George F. Durant, general manager. The following directors were elected at a previous meeting of the stockholders: Cyrus P. Walbridge, D. S. Smith, William Duncan, John A. Holmes, James Campbell, P. C. Maffit, F. P. Fish, Casper Yost, A. Bert, George F. Durant and Edwards Whitaker.

AVOCA, NEB.—A number of farmers here have formed a new company to be known as the Avoca Telephone Cobpany, No. 4.

LINCOLN, NEB.—The Phelps County Telephone Company has been incorporated with a capital stock of $40,000. The directors are C. W. Stiger and others.

PIKE, N. Y.—The Pike Telephone Company has been incorporated with a capital stock of $1000 by G. S. Van Gorden, Henry C. Lathrop and Fred W. Gild, Pike, N. Y.

ALBANY, N. Y.—The Big Eddy Telephone Company has been incorporated with a capital stock of $8000. The directors are: Frank Kinnie, G. W. Engleman and others.

JASPER, N. Y.—The Jasper & Canisteo Telephone Company has been incorporated with a capital stock of $300. The incorporators are: Willis A. Schency, Dr. Walter Benedict, Jasper; Ray Jamison, Canisteo.

ASHLAND, OHIO.—The Central Union Telephone Company will install an exchange at this place.

HICKSVILLE, OHIO.—The Hicksville Telephone Company has increased its capital from $25,000 to $40,000.

WARREN, OHIO.—The Phalanx & Leavittsburg Telephone Company is considering the extension of its system.

DAYTON, OHIO.—The Home Telephone Company, of Dayton, has increased its capital from $600,000 to $1,000,000.

WALDO, OHIO.—The Waldo Home Telephone Company has been incorporated with a capital stock of $25,000. The directors are A. Osborn and others.

GALLIPOLIS, OHIO.—A new telephone company has been organized in Green Township to connect with the Gallipolis Telephone Company. Among the stockholders are B. and E. Wadell and J. W. Ecker.

COLUMBIANA, OHIO.—The Fairfield Township Mutual Telephone Company is being organized to build an independent telephone system in Fairfield township. Farmers in the vicinity are interested in the enterprise. Among the promoters are: O. C. Vanskiver, Harvey Woods, John Wisler and J. W. Weaver.

CINCINNATI, OHIO.—The Cincinnati & Suburban (Bell) Telephone Company continues to show a substantial increase in its business, and the number of applicants for surface is still on the increase. The annual report, which will soon be forthcoming, will make an excellent showing. The company has been paying dividends of 6 per cent. per annum, but recently the stock has advanced from 140 to above 160.

TONKAWA, OKLA.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $2500 to $10,000.

GUTHRIE, OKLA.—The Pioneer Telephone & Telegraph Company, with headquarters here, has been chartered to operate telephone lines and district telegraph or messenger systems. The capital stock is said to be $3,000,000. The company is a merger of several independent telephone companies in Oklahoma and Indian Territory.

PENDLETON, ORE.—The Wild Horse Telephone Company has been incorporated with a capital stock of $1000. The directors are W. M. Blakely and others.

WASHINGTON, PA.—The Buffalo & Hopewell Township Telephone Company has been formed, with J. H. Stewart as president.

INDIANA, PA.—About twenty farmers in the vicinity of Shelocta have formed a local telephone company. Wm. Rankin is president of the new company.

COLUMBIA, S. C.—A bill has been introduced in the legislature of South Carolina fixing a schedule of telephone rates for city and country on a basis of $1.50 for residences and $2 for places of business in exchanges of less than 250 subscribers, and $2.50 for residences and $3.50 for business houses in exchanges of 1200 subscribers or over, and a proportionate scale for intermediate size exchanges.

HUDSON, S. D.—The Hudson Telephone Company is contemplating building a large number of exchanges throughout the country districts during the present year. At a recent meeting of the stockholders the following named officers were elected: President, E. D. Cassil; vice-president, O. C. Olson; secretary, E. R. Buck; treasurer, F. B. Cable.

PORT LAVACA, TEX.—The Port Lavaca Telephone Company will make important improvements.

HOUSTON, TEX.—The Citizens' Telephone Company has extended its long distance telephone line to Sour Lake, Tex., from Houston.

BROWNSVILLE, TEX.—The Western Union Telegraph Company will extend its telegraph line from Corpus Christi to this place, a distance of about 175 miles.

AUSTIN, TEX.—The Southwestern Telegraph & Telephone Company announces that improvements to cost about $20,000 will be made to the local system of the company.

SOUR LAKE, TEX.—The Higgins Oil & Fuel Company has constructed a telephone line from this place to Batson, Tex., a distance of about 18 miles. It will be used for the private business of the company.

MENARDVILLE, TEX.—The Menard Telephone Company, of Menardville, has just completed a telephone line to Hext, a distance of 15 miles, and will soon commence the construction of a line to McKavill, Tex.

SAN ANTONIO, TEX.—Col. J. E. Farnsworth, of Dallas, Tex., announces that the Southwestern Telegraph & Telephone Company, of which he is manager, will expend about $80,000 in making improvements and extensions to its local system at San Antonio. Engineers are now preparing the plans for the proposed work.

LULING, TEX.—The City Council of Luling has granted a franchise to the Independent Telephone Company to establish and operate a telephone exchange here. It is announced by the officers of this company that it will immediately begin the construction of a long distance telephone line to connect San Antonio and Houston, a distance of 225 miles. Among the men interested in the company are: H. W. Flato, of San Antonio, Tex.; T. H. Spear, of New York, and George Cornelius, of Minneapolis, Minn.

MONTPELIER, VT.—The New England Telephone Company will build a new line from Burlington to Rutland.

ST. ALBANS, VT.—The independent telephone companies of northern and central Vermont held a meeting recently at St. Johnsbury and decided to build a trunk line from St. Johnsbury to Montpelier. It is the purpose of the independent companies to build trunk lines and ultimately reach all parts of the state.

GANDEVILLE, W. VA.—The Spencer, Gandeville & Weston Telephone Company has been incorporated with a capital stock of $75,000. The directors are: E. Johnson, L. A. Rader and others.

BARRON, WIS.—The Barron County Telephone Company has increased its capital stock from $2500 to $22,500.

ELECTRIC LIGHT AND POWER.

KEMPS CREEK, ALA.—A franchise for an electric plant has been granted to Frank F. Taylor.

EAST LAKE, ALA.—It is proposed to construct an electric light plant, at a cost of $10,000. Robt. A. Morris is chairman of the committee.

ANNISTON, ALA.—The Coosa Water Power Development Company, of Anniston, has been chartered, with a capital of $250,000, to develop the water power of Coosa River for the benefit of Anniston, Pell City and other places.

BIRMINGHAM, ALA.—The City Council and the citizens of the west end are considering the construction of water works and an electric light plant.

DARDANELLE, ARK.—Bonds to the amount of about $7000 will be issued for the construction of an electric light plant.

FORDYCE, ARK.—The Fordyce Light & Water Company has been chartered with a capital of $20,000. It will furnish lights for the town and factories. B. H. Wood, president; John R. Hampton, secretary.

ALHAMBRA, CAL.—The Pacific Light & Power Company, Los Angeles, has secured the electric light franchise.

FERNDALE, CAL.—W. W. Barnes, secretary of the Ferndale Electric Light Company, writes that about $8000 will be expended in improvements.

CORONA, CAL.—The Temescal Water Company, of this place, is making extensive improvements. It is building laterals and digging wells. One of the largest improvements is an electrical transmission line in course of construction between Ethanac and Temescal, 20 miles. At Ethanac the company has a number of good wells, heretofore pumped with gasoline and steam engines, requiring large quantities of oil and distillate, which had to be hauled 20 miles from Corona at heavy expense. Now the pumps will be driven by electric motors. The workmen building the electric line will have a comfortable house on wheels in which to live. Poles have been ordered from Washington State, and it is expected the line will be in operation in six weeks. The improvements will cost $15,000.

DELAWARE CITY, DEL.—W. T. Smith, Mayor, writes that it is proposed to construct a lighting plant.

JONESBORO, GA.—The citizens have voted to issue bonds for an electric light plant.

DOUGLAS, GA.—Bids will be received March 7 by C. E. Baker, City Treasurer, for $20,000 electric light and water bonds.

BUENA VISTA, GA.—Geo. R. Lowe, Recorder, states that the town is contemplating letting a franchise for an electric light plant.

COVINGTON, GA.—The development of two important water powers near Covington, on Alcova River, is said to be practically assured. N. S. Turner, W. C. Clark and C. H. White are the incorporators of a company which expects soon to begin the work of development of the two falls. Thirty thousand dollars have already been subscribed to the stock of the company, and this sum will be considerably increased. The water power available is said to be 14,000 horse-power. It is proposed to supply energy for lighting the city of Covington and for operating the Covington & Oxford Street Railway and other plants.

LENA, ILL.—The business men are considering the construction of an electric light plant.

KIRKWOOD, ILL.—A franchise for an electric light plant has been granted to the Kirkwood Electric Company.

VIRDEN, ILL.—The Virden Electric Light Company, of Virden, has been incorporated, with a capital of $15,000. Incorporators: J. N. Hairgrove, U. G. Tucker and C. W. Carr.

CICERO, IND.—The Town Board is taking steps toward constructing an electric light plant.

NEW HAVEN, IND.—The Town Trustees have decided to construct an electric light plant.

INDIANAPOLIS, IND.—The Indiana Supreme Court has decided that the franchise granted by the town of Booneville to the Booneville Electric Light & Power Company for laying pipes, putting up poles and wires to supply light, heat and power, is void, because the ordinance was never published as provided by statute. It is now probable the company will be enjoined from further service until a new franchise is procured.

LEWISTON, IDA.—The Lewiston Water & Power Company has determined to develop the water power near the mouth of Grand Ronde River. The improvement will cost about $1,000,000. The company also proposes increasing the capacity of its present plant from 1200 to 2000 horse-power.

WALNUT, IA.—Bids are being received for furnishing material and constructing a complete electric light and power plant here. A. R. Longnecker is Town Clerk.

OGDEN, IA.—Bids will be received on March 15 for an electric light plant of 1800 lights, a gas plant of 1800 lights, and a combined gas and electric plant. Address City Recorder.

FT. DES MOINES, IA.—Bids will be received by Maj. R. B. Turner, Q. M., U. S. A., Observatory Office Building, Des Moines, on March 16 for an electric lighting system at Ft. Des Moines.

YATES CENTER, KAN.—It is reported that the Council wishes to grant franchises to a private company to establish electric lighting at this place.

WEST GARDINER, ME.—Jas. Carver and A. L. Childs, of Auburn, are among those interested in a proposed electric power enterprise, on Cobbossee stream at Cram's Mills in West Gardiner, and about two miles below the outlet of Lake Cobbosseecontee. The new owners will increase its capacity from 350 to 500 horse-power by raising the dam. They propose to sell power in Augusta, Hallowell and Gardiner.

MERRIMAC, MASS.—It was voted on January 30 to construct an electric light plant.

NEGAUNEE, MICH.—Rockwell Bros. are to construct a new gas and electric plant at Negaunee.

SOUTH STILLWATER, MINN.—The question of issuing bonds to the amount of $10,000 or $15,000 for an electric lighting plant will be voted on the second Tuesday in March.

CULIACAN, MEX.—Bids are wanted March 31 for constructing an electric light plant. Address Senor Gen. Don Francisco Canedo, Culiacan, Sinaloa.

SAN CRISTOBAL, MEX.—Henry T. Lecert, representing a New York syndicate, is investigating the situation here with the view of establishing an electric light and power plant.

VILARDENA, MEX.—An electric power plant to cost about $50,000 is to be installed here by the American-Mexico Mining & Development Company to furnish power for the machinery at its mines. Dr. W. S. Phillips, of Chicago, Ill., is president of the company.

IRAPUATO, MEX.—An electric power plant will be installed here by Richard A. Barkley for the purpose of furnishing power to operate his four large flour mills, paint works and other industrial concerns.

SAN MIGUEL ALLENDE, MEX.—Jose de J. Garcia has been granted a concession by the Mexican Government to establish an electric power plant on the Laja River near here. He is authorized to use 1500 liters of water per second for the purpose.

TAMASOPA, MEX.—The Rio Tamasopa Sugar Company will install an electric light and power plant on its large plantation, situated near here. The plant will also furnish power for operating an electric freight railway on the plantation. Among those interested in the company are: Dr. John D. Cattic, of Anderson, Ind.; C. A. Smart, of Wild Rose, Wis., and Col. Russell B. Harrison, of Indianapolis, Ind.

COLUMBIA, MO.—A bond issue of $10,000 was voted February 23 for the purchase by the city of Columbia of the water works and electric light plant owned by the Columbia Water & Light Company, which holds the franchise for the supply of water and light to the town. The plant will be purchased for $67,000, and will be improved.

LEXINGTON, NEB.—Bids are wanted for a franchise for an electric light plant.

FREMONT, NEB.—It is reported that the municipal light station will be enlarged by an addition 30x60 ft., in which machinery will be installed, at a cost of $8000.

OXFORD, N. C.—A proposition has been made to the town to put in electric lights and water works, the town to rent the same.

CHARLOTTE, N. C.—The Light Committee has recommended that the city make a contract with the Catawba Power Company, of Ft. Mill, S. C., to supply lights at $54 per year for the first 150 lights and $48 for all over that number.

HARRISON, N. J.—The Town Council has granted a franchise to the United Electric Company to lay underground conduits in Harrison.

ANADARKO, OKLA.—The citizens have voted to issue bonds for the construction of an electric light plant.

KINGSTON, ONT.—The water power at Kingston mills on Rideau Canal has been secured by J. M. Campbell, and he will install an electric plant. A well to permit a fall of 52 ft. will be constructed.

PENDLETON, ORE.—By the filing of a notice of water appropriation at Pendleton, February 8, the Northwestern Gas & Electric Company, of Walla Walla, Wash., took the first step toward carrying out its plan of constructing a power plant on Walla Walla River near Pendleton. The company will furnish electric power for heating and manufacturing purposes in Walla Walla, Pendleton, Athena and other towns.

MT. UNION, PA.—It was voted February 16 to issue $12,000 bonds for an electric plant.

WILKESBARRE, PA.—The Select Council has granted a franchise to the Ashley Electric Light Company. It refused to grant a franchise to the West Side Electric Light Company.

NEW CASTLE, PA.—Robt. Hunt & Company, of Pittsburg, have submitted plans and estimates for a municipal electric light plant. They estimate the cost of buildings, equipment, etc., at $65,415, and cost of operation, $18 per day.

SHIPPENSBURG, PA.—It is stated that arrangements are being perfected for the merging of the Shippensburg Gas Company and the Electric Light & Power Company into the Shippensburg Heat, Light & Power Company. The electric power will be furnished by water about two miles distant from the borough.

STEWARTSTOWN, PA.—The directors of the recently chartered Deer Creek Water & Power Company organized in Stewartstown on February 13, with Jas. H. Gable, of York, president. The company proposes to construct a dam and power plant on Deer Creek, one mile from Stewartstown, and when completed will furnish water, power and light to Stewartstown and vicinity.

LEXINGTON, S. C.—The State Senate has passed the bill authorizing the Lexington Power Company to build dams across Saluda River.

GROTON, S. D.—Herman E. Miles, of St. Paul, Minn., has secured a franchise for an electric light, gas and central heating plant.

COLUMBIA, TENN.—The Louisville & Nashville Railroad Company intends to build a water power and electric light plant at Bigby Creek. The expenditure involved will be between $12,000 and $15,000.

COLUMBIA, TENN.—Bids are wanted for building and equipping an electric light plant to furnish the city with lights. It is desired to let contracts for 60 arc lights, and at end of the term a further satisfactory contract to be entered into, or the plant is to be sold to the city at an appraised valuation. It is contemplated that this plant shall also furnish incandescent lights to private parties. W. A. Dale is chairman of the Light Committee.

PORT LAVACA, TEX.—C. J. Spettae, of Panhandle, Tex., is arranging to install an electric light and power plant at this place.

UVALDE, TEX.—An eectric light plant is to be installed here by W. H. Rose. He also contemplates building a street railway here.

HARDWICK, VT.—This village contemplates increasing the power for its electric light plant.

ELLENSBURG, WASH.—Bids are wanted March 7 for an electric light plant. It is to be operated by turbine wheels of 640 horsepower, and 240-kw dynamos will be installed. Estimated cost, $22,000.

SPOKANE, WASH.—A power company which proposes to utilize the waters of the Spokane River about 20 miles from here in the Big Bend territory, for furnishing electric lights, will shortly be organized here. A 20,000-hp plant will be established, from which electrical energy will be furnished to the large flour mills at Big Bend and for the lighting of numerous small cities in that vicinity. Surveys have already been made, and the route of the pole lines to Spokane was decided upon some months ago. David Wilson is the chief promotor of the enterprise, and has made all necessary arrangements in the east whereby work can be commenced in the very near future. At the point where it is proposed to establish the power plant, a fall of 33 feet can be utilized. Eastern investors will furnish most of the capital for the enterprise.

MONTICELLO, WIS.—A municipal electric light plant is proposed here.

EAST MILWAUKEE, WIS.—The Milwaukee Light, Heat & Traction Company, of Milwaukee, has petitioned for a franchise to light the village.

BELOIT, WIS.—Bids were called for March 3 for the construction of an electric light plant, to cost between $30,000 and $40,000. D. H. Foster is City Clerk. Robert Caldwell, City Engineer.

RHINELANDER, WIS.—The Rhinelander Power Company, of Rhinelander, has been incorporated, with a capital of $85,000, by E. A. Forbes, C. A. Wixson, R. C. Dayton and others, to improve and develop water power in the Wisconsin and other rivers.

NEENAH, WIS.—The Wisconsin Traction, Heat, Light & Power Company, operating the electric interurban line between Neenah and Kaukauna, has petitioned the City Council for a franchise to light the city. The company offers to furnish street lights at $65 per year on an all-night schedule.

THE ELECTRIC RAILWAY.

CHICAGO, ILL.—There is to be a meeting of the stockholders of the South Side Elevated Railroad Company on April 7, to vote on the question of increasing the capital stock to carry out the plans for extensions, as outlined by President Carter at the recent annual meeting.

VINCENNES, IND.—The Vincennes, West Baden & Louisville Traction Company has asked for a $50,000 subsidy, and an election has been ordered for March 12.

LEXINGTON, KY.—O. M. Baker, of Hamilton, O., and George Nowall, of Cincinnati, have taken the contract for building the line of the Paris & Georgetown Traction Company, between Franklin and Versailles.

BANGOR, ME.—Surveys are now being made for the proposed electric railway from Bangor to Dexter, Me., and it is expected that construction work will be begun on the line this summer. The line will be 30 miles in length. The overhead trolley will be used. Power to operate the line will probably be developed from water sources. The officers of the company are: H. F. Bailey, of Bangor, president; E. B. Weeks, of Old Town, treasurer; F. J. Martin, of Bangor, attorney and clerk; F. T. Dow, of Bangor, engineer.

AUGUSTA, ME.—The Northern Main Seaport Railroad Company has been incorporated to build an electric railway from a point in connection with the Bangor & Aroostook Railroad at La Grange, to a point in connection with the Maine Central Railroad near the northwest line of the city of Belfast, with two spurs or branches to tidewater, one in Stockton Springs and one in Searsport. The length of the road is to be 60 miles, and the company is capitalized at $360,000. The directors are: Edward Stetson, B. B. Thatcher, F. H. Appleton, F. W. Cram and H. P. Oliver, of Bangor.

ST. LOUIS, MO.—The Alton, Granite City & St. Louis Electric Railroad has been organized at Alton, with a capital of $100,000. The organizers are: J. F. Porter, W. E. Porter, H. S. Baker, H. E. Weeks and Levi Davis.

KANSAS CITY, MO.—A franchise has been granted to the St. Joseph, Parkville & Kansas City Railway Company for an electric railway through this county from Harlem to the Platte County line.

KANSAS CITY, MO.—The Kansas City & Olathe Electric Railway Company has awarded the contract for the construction of its power plant to the Union Construction Company, of Kansas City. The plant will be located at Lackman, Kan.

NEW YORK, N. Y.—The name of the Interurban Street Railway Company has been changed to New York City Railway Company.

ADA, OHIO.—Thomas C. Childs, of Akron, has obtained a franchise in Ada for the line which will be built from Lima to Kenton.

DAYTON, OHIO.—The Interstate Traction Company has applied for a franchise in Montgomery County for a proposed line from Dayton to Indianapolis.

CLEVELAND, OHIO.—The Eastern Construction Company has closed a contract for building the line of the Warren, Courtland & Jefferson Traction Company.

CANTON, OHIO.—The Canton-Akron Railway Company is in the market for a 600-hp boiler, six 12-bench open cars, six 18-ft. box cars with 67 motors and all other parts necessary to complete cars.

NEW INDUSTRIAL COMPANIES.

THE H. O. S. ENGINEERING COMPANY has been incorporated in New York with a capital of $15,000. The directors are: J. A. Aitkin, W. H. Brearley and W. A. Thompson, of New York.

THE JORDAN AUTOMATIC SIGNAL COMPANY of New York has been incorporated with a capital stock of $1,000,000. The directors are: W. H. Jordan, C. C. Jordan and J. F. Jordan, New York.

RADIUM INCANDESCENT LIGHT COMPANY of New York, with a capital stock of $15,000, is of recent corporation. The directors are: J. Perk, Brooklyn; S. Wolfson and I. Wigdor, New York.

THE UNITED ELECTRICAL MANUFACTURING COMPANY has been incorporated in New York with a capital stock of $1000. The directors are: E. F. Buchanan, A. O. Brown and L. G. Young, New York.

THE PHYSICIANS' ELECTRICAL MANUFACTURING COMPANY of New York has been incorporated with a capital stock of $10,000. The directors are: F. E. Hodgskin, G. A. Wingate and A. B. Reed, New York.

THE GENERAL LIGHTING & HEATING COMPANY of New York has been incorporated with a capital stock of $20,000. The directors are: Stanley Francis, W. A. Smith and G. D. Moffatt, New York.

THE WATSON-FLAGG ENGINEERING COMPANY of Paterson, N. J., has been incorporated with a capital stock of $125,000. The incorporators are: George H. Watson, John L. Flagg and Frank J. Huttin.

THE MUNICIPAL ELECTRIC & CONSTRUCTION COMPANY has filed articles of incorporation with a capital stock of $50,000. The incorporators are: Charles G. Diemunch, William Gottlieb and Joseph Block.

THE CHARLES Q. TYSON COMPANY, of Dayton, O., electrical contractor, has been incorporated with a capital of $10,000, by P. W. Tyson, C. O. Waxler, H. H. Wolloston, G. W. Chaffin and R. W. Baggott.

THE WESTERN RAILWAY SIGNAL COMPANY has been incorporated at Camden, N. J.; capital, $60,000. Incorporators: John G. Bennett, Walter C. Beckworth, Philip Peter, Joseph H. Phillips and Josh B. Chapman.

THE NEW YORK F. E. COMPANY has been incorporated to deal in electrical supplies. The capital stock is $1000, and the directors are: W. H. McClain and C. L. McFetrish, New York; Edward Butcher, Jr., Brooklyn.

THE FALLER AUTOMATIC TELEPHONE EXCHANGE COMPANY of New York has been incorporated with a capital of $10,000. The directors are: J. W. Chisholm, E. A. Faller, New York; Clarkson Clothier, Philadelphia.

THE WITHERBEE IGNITER COMPANY has been incorporated in Jersey City with a capital stock of $50,000. The incorporators are: Thomas S. Witherbee, Albert E. Milliken, Mervyn A. Rice, Thomas Mullally.

FAURE-PRICE ELECTRIC COMPANY has been incorporated in New York with a capital stock of $25,000. The directors are: J. P. Faure, New York; E. A. Watson, Brooklyn, and E. H. Price, Rutherford, N. J.

THE MONTEREY LIGHT & POWER COMPANY has been incorporated in Jersey City, N. J., with a capital of $50,000. The incorporators are: K. K. McLaren, Jersey City; Robert L. Hoguet and Robert H. Williams, New York City.

THE LIEBER-FOYE AUTOMOBILE COMPANY, of St. Louis, Mo., has filed articles of incorporation with a capital stock of $4000, full paid. The incorporators are: William B. Foye, Otto Lieber, Miss Ida E. Foye and Paul V. James.

THE POLYPHASE IGNITION SYSTEM COMPANY, of New York City, has been incorporated to deal in electrical machinery. The capital stock is $50,000, and the directors are: R. L. Heitemeyer, Hoboken, N. J.; G. G. Schreiber and W. B. Symmes, New York.

THE AUTOMOBILE TRANSIT COMPANY, of St. Louis, has filed articles of incorporation with a capital stock of $12,500, full paid. The incorporators are: O. P. Langan, A. G. Lewis, G. F. W. E. Eggert, L. B. Langan, C. H. Cuncker, A. D. Anderson and Myron Peers.

LEGAL.

THE CHICAGO MOTOR VEHICLE COMPANY has, according to press dispatches from Chicago, been placed in charge of a receiver by Judge Tuthill, of the Circuit Court. The action was taken on the application of two stockholders who, it is stated, claimed that they would be defrauded if a proposed plan to divert the assets of the company were carried out. Mr. Edwin S. Day was appointed to take charge of the company's affairs.

INDEPENDENT TELEPHONY IN NEW YORK.—The Appellate Division of the New York Supreme Court handed down a decision affirming an order by Justice Clarke at Special Term denying a motion for a peremptory writ of mandamus asked for by the Independent Telephone Company, of New York, to compel Robert Grier Monroe, then Commissioner of Water Supply, Gas and Electricity, to issue a certan permit. The company had asked for a permit to lay and maintain telephone wires in the low-tension subway and have additional subways of the kind constructed in various localities. Commissioner Monroe refused to grant the permit on the ground that he had been advised that the company had no franchise or right to construct and maintain such structures and fixtures as were asked for. The order denying the motion was affirmed by the Appellate Division, but without opinion. Justice Laughlin dissents. In a brief opinion he says: "The transportation corporation law, under which relator was incorporated, gives it a franchise, and it is, without obtaining any further franchise from the Municipal Assembly, in a position to apply to the respondent for a permit pursuant to the provisions of Section 528 of the Greater New York charter, which must be entertained and granted upon such reasonable terms, conditions and restrictions as may be imposed by the respondent, pursuant to any provisions of law applicable thereto."

FESSENDEN LIQUID BARRETTER PATENT. The National Electric Signalling Company has brought suit in the United States Circuit Court, Southern District of New York, against the DeForest Wireless Telegraph Company, the American DeForest Company, Abraham White, president of said companies, and Lee DeForest, scientific director, for infringement of Reissue Letters Patent No. 12,115, of May 26, 1903, to Reginald A. Fessenden. This patent is for the well-known liquid barretter or receiver for wireless telegraphy, and describes the liquid barretter as having resulted from the discovery that when a loop of the Fessenden solid barretter or hot wire receiver is broken while dipping in nitric acid it works even better than before. In this case the resistance change is a decrease instead of an increase, and it is localized in the minute layer of the liquid next to the wire, instead of in the wire. The patent mentions a platinum wire forty one-millionths of an inch in diameter dipping into dilute nitric acid or other conducting liquid. For six months this receiver has been used by the National Electric Signalling Company, transmitting 20 regular messages a day each way over 80 miles of land between their stations at Jersey City and Collingswood, a suburb of Philadelphia. This has been accomplished with transmitting apparatus using a quarter of a horse-power of electrical energy, and in recent tests this has been cut down to a tenth and even a fifteenth of a horse-power. Professor Fessenden claims to have patented this invention more than nine months ago, and it was fully described in the technical press in September, 1903. (See ELECTRICAL WORLD AND ENGINEER, New York, September 19, 1903, page 272.)

OBITUARY.

MR. S. B. FAIRCHILDS.—Mr. Sidney B. Fairchilds, one of the oldest telegraphers in the United States, and father-in-law of Frederick MacMonnies, the sculptor, died at St. Louis on February 27, aged 72. Mr. Fairchilds had been employed by the Western Union Telegraph Company in that city for 39 years, and for many years had been night wire chief. In point of age and service he was the oldest member of the telegraphers' association known as "The Old-Timers."

MR. W. G. McMILLAN.—We regret deeply to note the death from pleurisy of Mr. Walter George McMillan, the secretary of the Institution of Electrical Engineers of England, an office he had held with great acceptance since 1897. He was educated at King's College, London, where he also taught metallurgy, in which he lectured later at Mason College, Birmingham. He served also as a Government chemist and metallurgist, and at the time of his death was an examiner in metallurgy for the City & Guilds of London Institute. He was only 43 years of age. He has left a widow and two young sons, and the Council of the Institution has now started a memorial fund, which will be invested for the benefit of his widow and for the education of these fatherless boys. American visitors will recall Mr. McMillan's quiet and unremitting efforts in 1900, to promote their welfare and comfort during the foreign trip of the Institute.

EDUCATIONAL.

LYNN GENERAL ELECTRIC ENGINEERING SOCIETY, of Lyon, Mass., is carrying out a splendid programme of papers and visits this winter, with meetings about once a month regularly, and other specialties interspersed. Dr. F. A. C. Perrine has just lectured on "Electricity from the Waterfall," and Prof. H. E. Clifford is down for a special course on alternating-current theory. The Society, which is thus doing excellent work, is composed principally of the engineers of the General Electric Lynn Works, together with students from the testing department.

COLUMBIA RADIUM EXHIBIT.—Because of the importance and interest attaching to the recent discovery of radium, Columbia University is planning a special exhibit at the St. Louis Exposiion. Mr. F. A. Goetz, superintendent of the university buildings and grounds, will have charge of the enterprise, which will also include an exhibition of the Mineralogical Department. This will show various phases of producing radium. Dr. Tucker, of the Chemical Department, will have charge of the chemical side, and Professor Hallock will superintend the physical, including the methods and the illustrations of radio activity. The Pathological Department of the College of Physicians and Surgeons will give illustrations showing its usefulness in medicines.

PERSONAL.

MR. W. B. PARSONS, M.E., engineer of the New York Subway, has been appointed by President Roosevelt a member of the Panama Canal Commission.

MR. R. H. COKER, formerly of Washington, D. C., has been appointed agent of the Colorado Telephone Company at Longmont, Col., succeeding Mr. C. F. Bartell.

MR. H. F. GREENWOOD, chief engineer and special manager of the Havana Electric Company, is now in New York. He may be found at the local offices of the company, 52 Broadway.

MR. M. E. CURWEN, European representative of the J. G. Brill Company, of Philadelphia, whose headquarters are in London, has sailed for the other side, after a short visit to this country.

DR. MARGARET A. CLEAVES has issued in pamphlet form her article on the physiological action of light and the physical factors in phototheraphy printed recently in the *Journal of Advanced Therapeutics*.

MR. J. C. BOYNTON has been appointed manager of the Toll Department of the Colorado Telephone Company, with headquarters in Denver. He was previously traffic manager of the Pittsburg Telephone & Printing Company.

MR. HARRY ALEXANDER, of New York City, has opened an office in Boston at 120 Tremont Street, to conduct an electrical contracting business. He is now engineering the electrical work on the new Siegel Building in Boston.

MR. F. J. ALVIN, of the American Electrical Novelty & Manufacturing Company, 308-322 Hudson Street, New York City, has been elected president of the recently formed Foreign Trade Association of America, 66 Broad Street, New York City.

MR. GEORGE BULLOCK, president of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, who has recently been somewhat seriously indisposed, returned this week from Bermuda, where he has been recuperating for a few weeks.

MR. HENRY SHAFER, president of the International Telephone Manufacturing Company, of Chicago, has been making an extended trip through the Northwest in connection with the growing work of the company in that large and important section

MR. J. R. LOVEJOY, the head of the electric lighting department, etc., of the General Electric Company at Schenectady, has found it necessary to drop business for a brief rest and has been visiting Hot Springs, Va. His vacation, however, will not be a very long one.

MR. W. A. BRACKENRIDGE, C.E., of the Niagara Falls Power Company, has been appointed by Governor Odell, of New York State, a member of the special advisory commission of five expert engineers who will supervise the construction of the $100,000,000 barge canal.

MR. O. M. C. HEYL will have charge of a new electrical department to be inaugurated by Paul Bergner & Company, Mexico City, in order to cater to the increasing demand for electrical appliances and supplies which has lately sprung up throughout the southern republic.

MESSRS. H. HOBART PORTER, JR., and FRANCIS BLOSSOM, of Sanderson & Porter, New York, have returned from a trip to New Orleans, where they recently went in connection with the proposed power house extension of the New Orleans Railways Company.

MR. THOMAS A. EDISON went South last week and has taken up residence on his plantation near Fort Myers, Fla. He has telegraphed his friends that the orange and lemon trees are in full bloom, which is taken as an intimation that he proposes to drop work for a brief spell.

BELLMAN & SANFORD, New York City, have been appointed engineers by the American Exchange National Bank to prepare plans and specifications for a lighting plant, to be installed in their 16-story bank and office building, corner of Broadway and Cedar Street, New York City.

MR. JAMES I. BUCHANAN, who returned recently from Panama, where he went on a special mission for the United States Government, has sailed for Europe to assume his new position as deputy chairman and managing director of the British Westinghouse Electric & Manufacturing Company, Limited.

MESSRS. T. AHEARN and W. Y. SOPER are the subjects of portraiture and of biographical sketches in connection with an article in the Ottawa *Evening Journal* on the Ottawa, Can., street railway system, which they have built up, in addition to doing a lot of other creditable electrical work all over the Dominion.

MR. FRANK KLEPETO, consulting engineer, New York, has sailed for Peru in reference to the construction of the huge smelting works, etc., of the Cerro de Pasco Mining Company, in which enterprise J. B. Haggin is the moving spirit. Considerable electrical equipment will be purchased within the next few weeks.

MR. CLEMENS HERSCHEL, formerly hydraulic engineer of the Holyoke, Mass., Water Power Company, also consulting hydraulic engineer from time to time during the past score of years of several Niagara water power companies, will have charge of the new water turbine and other hydraulic machinery department of the Allis-Chalmers Company.

MR. ABNER DOBLE, of Abner Doble Company, San Francisco, the pioneer railroad engineer, etc., on the Pacific Coast, has had the misfortune to lose his wife, who accompanied him to the State in 1851. Mrs. Margaret Doble was 73 years old, and leaves four adult children. She and her husband had as Argonauts seen all the wonderful growth of California.

MR. H. D. SCRIBNER, who has been prominently connected with the Westinghouse Electric & Manufacturing Company's Pacific Coast agencies for a number of years, has left San Francisco and opened an office of the Canadian Westinghouse Company in Vancouver, B. C. Mr. Scribner has done much of the early and recent electric railroad building on the Pacific Coast.

MR. E. RATHENAU, as already noted in these columns, has been decorated with others by the Emperor of Germany in connection with the Zossen high-speed electric railway work. This honor has given great pleasure to his host of friends and admirers in America. We understand that the decoration conferred is that of the Order of the Red Eagle, with the clasp.

MR. ERNEST F. LEARNED, formerly with Stone & Webster, of Boston, has arrived in Denver on an extensive vacation tour of the United States. Mr. Learned plans to visit California and Washington before returning east, and he accompanied Mr. C. F. Wallace, of the Stone & Webster management, as far as Chicago, Mr. Wallace going through to Seattle.

MR. S. G. McMEEN, of Chicago, Ill., is in the City of Mexico making preliminary arrangements for the extensions and improvements of the telephone system of the Mexican Telephone Company. This company recently obtained a renewal of its concession from the Mexican Government for a period of 30 years, and under the terms that it was granted certain stipulated improvements are required to be made.

MR. JAMES A. CUMMINGS, who secured the contract for the supplying and laying of the conduits for the new municipal telephone and telegraph lines now under construction in St. Petersburg, Russia, has sailed for Europe after several weeks' visit on this side. The conduit is being manufactured at the Raritan River, N. J., plants of the American Vitrified Conduit Company, Broadway-Maiden Lane Building, New York.

MR. J. L. PUTNAM, who for some years has been general manager of the Clark Automatic Telephone Switchboard Company, of Providence, R. I., and whose personal efforts have resulted in the installation of this system all over the country, has resigned his position to accept one with the Central Union Telephone Company, at Indianapolis, Ind. Mr. Putnam goes to his new work with the best wishes of all his friends, of whom he has a goodly number all over the country.

MR. W. J. HAMMER is out in Colorado and is understood to be making radioactive tests on pitchblende there. Dispatches from Denver speak of his handling pitchblende from Gilpin County, Colorado, where hundreds of tons are in sight at this moment, of high testing quality. Mr. Hammer delivered a lecture on February 26 in Denver, before the Colorado Scientific Society. His subject was "Radium." The lecture was given at the Central Presbyterian Church.

MR. ARTHUR WARREN contributes to the New York *Times* of February 28 a most charming and entertaining article on the "publicity" methods by which a great modern industry can be built up. While no names are given, it is of course an open secret that the Westinghouse interests are those dealt with in this instructive sketch. A number of excellent points are made, and none the less for being presented in admirable literary form. Mr. Warren's story deals with achievement on both sides of the Atlantic. Until quite recently, Mr. Warren had charge of the Westinghouse Publicity Bureau, but resigned to take up other important work.

MR. OSCAR T. CROSBY, the well-known electrical engineer, who penetrated recently to the interior of Thibet, has just returned home to this country. While in England he lectured by invitation before the Royal Geographical Society on his interesting journey. Since his return here, a number of his friends in the American Institute of Electrical Engineers and the New York Electrical Society have united in a formal request to him to give them an evening in New York, when they can listen to the tale of his adventures in that mysterious central region of Asia. It is understood that Mr. Crosby will gratify this wish at an early date.

MR. I. A. BENNETT, general sales manager for the Electric Appliance Company, Chicago, has resigned his post to take effect March 1, and will open the Chicago offices of the Phelps Company, of Detroit, Mich., manufacturers of the Hylo turn-down lamps and other specialties. Mr. Bennett was with this company for about 11 years, having previously been connected with the Ansonia Electric Company. Mr. Bennett has also accepted the presidency of the Central Station Publishing Company, which is being formed for the promotion of central station advertising. His new offices will be located in the Monadnock Building, Rooms 529 and 530.

MR. W. H. COVERDALE.—W. H. Coverdale & Company have recently been incorporated to do a general engineering and contracting business, with offices at 66 Broadway, New York. Their organization includes engineers of experience in all matters relating to the design and construction of steam and electric railroads, lighting and power plants, coal and ore handling machinery, etc. Mr. Coverdale was for many years in the engineering department of the Pennsylvania Lines West of Pittsburg, and was track elevation engineer of that company in Chicago during 1898-99. He was also prominently identified with the construction of the Westinghouse shops at East Pittsburg, and for the last three years has been civil engineer for a New York firm of engineers and contractors. Mr. Charles F. Keene is the secretary of the company.

MR. HENRY C. PAYNE.—Postmaster-General Henry C. Payne denies the imputation of the Wisconsin Independent Telephone Association that he has discriminated against the independent companies in favor of the Bell Company. In a letter to E. A. Wadhams, who is a trustee of the Standard Telephone Company, of Madison, Mr. Payne states that a large number of Bell telephones have been displaced from postoffices by the order, as well as independent telephones. "Each case is taken up on the merits as presented," he said. "You can readily see that long-distance service is a factor, and I think that I am justified in assuming that double service paid for by the Government is unnecessary and the expenditure not justified. Double service in all the postoffices in the United States would cost the Government an enormous amount of money, which I think would not be good business administration."

MR. A. H. VAN CLEVE.—The official anouncement of the appointment of Mr. A. Howell Van Cleve to be resident engineer of the Niagara Falls Power Company and its allied companies has been made by Vice-President Rankine. Mr. Van Cleve will succeed Mr. William A. Brackenridge, who has resigned to accept the appointment as a member of the Advisory Canal Board, recently tendered him by Governor Odell. Mr. Van Cleve has been connected with the engineer corps of the Niagara Falls Power Company continuously since April, 1892, and at the time of his appointment as resident engineer to succeed Mr. Brackenridge he held the position of assistant engineer. He is a graduate of Lehigh University, a member of the class of 1890, with the degree of C.E. Before his connection with the Niagara Falls Power Company he had served on the engineer corps of the Lehigh Valley and the Brooklyn Elevated railroads. He is a member of the Board of Public Works of Niagara Falls.

DIRECTOR OI.—The following item from the Pittsburg *Dispatch* deals with a man well known and admired in this country, and throws light on the progressive methods by which the Japanese have brought themselves abreast of the civilization of Europe and America: "Away back in the early '80s," said a well-known electrician of this city, "there came to me with a letter of introduction from the president of the company, a young Jap, and the note directed me that he be given every opportunity to work in all the departments of the factory, so that he might be proficient in every branch. He was apt, willing, always wore a grin and remained at the place about two years. The boy had been working as a lineman before he appeared at the factory. His name was Oi. He went back to Japan, and only at Christmas time, by a present, was the electrical engineer reminded of him. Many years later the engineer was waited upon by three Japanese who wanted to know all about the very latest devices for telephones and telegraphs. They were electrical engineers and had been taught all they know at the Imperial University in Tokio by a Prof. Oi, from whom they carried a letter of introduction to the engineer. They were Imperial Commissioners, and the engineer took them all over this country explaining things. The brightest of the three was called Wadachi and the others were Nakayama and Okonoto. They told their mentor that Oi was now Minister of Posts and Telegraphs in Japan, and this important position he now holds during war times." The many friends of Prof. Oi in this country know he will not be found wanting in emergencies.

Trade Notes.

THE MAINTENANCE COMPANY, of New York City, has removed its general offices to 54 and 56 Franklin Street.

THE J. B. McKEAGUE COMPANY, which is the Chicago representative of the Empire Electrical Instrument Company and F. A. La Roche Company, has recently changed its address to 324 Dearborn Street, Chicago, Ill.

PRATT & VAN WINKLE, the consulting engineers, of 160 Fifth Avenue, New York City, have issued a neat bulletin as to the merits and special advantages of the Pratt elevator safety for which they are agents. It is illustrated in detail.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just issued a folder picturing and describing the Greenwood safety wire guard for which it is selling agent. It claims that this guard has many features of value to any electric light man and contractor.

EMPIRE INSULATING CLOTHS AND PAPERS.—The Mica Insulator Company, 218 Water Street, New York, has issued a booklet containing samples of its varied line of Empire insulating cloths and papers. Each sample is accompanied by data relating thereto.

ROTARY PLANERS.—An excellent catalogue has been issued by the Newton Machine Tool Works, Philadelphia, on their rotary planers. These rotary planing machines are built in 11 sizes with heads from 14 inches to 84 inches in diameter over tools. They are built either fixed, portable or on a round base, and either belt or motor driven. Some excellent half tones show the construction of these machines.

H. T. PAISTE COMPANY, Philadelphia, Pa., has issued a neat circular with a view of the Government Printing Office, Washington, D. C., recently described in these pages, and calls attention to the fact that it supplied for that plant no fewer than 16,000 P. K. sockets and 10,000 P. K. fusible ceiling rosettes. These were essentially of the type needed for such a building subject to great vibration on account of the heavy printing press machinery, binders, etc.

THE CENTRAL TELEPHONE AND ELECTRIC COMPANY, 909 Market St., St. Louis, Mo., has issued its World's Fair art catalogue, No. 18, of telephone instruments and switchboards. The various styles of instruments manufactured by this company are clearly illustrated and their special features briefly described. On the right hand pages are shown views of the different principal buildings of the World's Fair. There are also shown some examples of the statuary used in the adornment of these structures.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in a recent bulletin, shows in illustration of and describes an electrically operated single-spindle slate drill press. The power of this machine is supplied by an Emerson direct-current ¼-hp motor, and is applied directly to the spindle. Another bulletin issued by the company gives the company's terms of sale and telegraph code. The code is very concise and comprehensive, and the idea of putting it in a separate bulletin is a good one.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt St., New York, in its catalogue No. 16, just issued, shows a very extensive and varied line of electrical apparatus. About everything excepting dynamos is embraced in the list, which includes a very complete line of telegraph, telephone, electric light and construction supplies and novelties. Fan motors of different standard makes are also given due prominence. The catalogue is very comprehensive in scope, and it is surprising how much can be concentrated in 80 pages. It is very completely illustrated, and gives the prices of the multitude of articles described.

INDUSTRIAL RAILWAY CATALOGUE.—The C. W. Hunt Engineering Company, of West New Brighton, Staten Island, has just issued a very handsome new catalogue, to which it feels warranted in calling special attention as the most complete work of the kind that has been published. In addition to the large number of illustrations, showing the many and varied types of cars, standard and special, which the concern builds, the catalogue also contains much valuable information relating to the "Industrial" railway not to be found elsewhere, particularly of interest to engineers and architects. It will be of much use also to intending purchasers.

"MODERN METHODS" is the appropriate title of a very attractive and interesting pamphlet just issued by the North Electric Company, of Cleveland, O., as its Bulletin No. B-22. It contains 48 pages of text and illustrations and discusses on broad lines telephone policy, equipment, apparatus, management, etc. The admirable apparatus of the North Company is brought out in great detail, and the cuts must be highly commended for their wonderful clearness. The views of the complete switchboards are also excellent to a degree far beyond the ordinary. The handsome cover in colors shows a rural telephone line, and the interior of a busy exchange.

JEFFREY MACHINERY.—The Jeffrey Manufacturing Company, Columbus, O., has recently issued Catalogue No. 57a which will be of interest to certain lines of electrical manufacturing. It is on the subject of machinery for the saw-mill, lumber and wood-working industries. It gives a general idea of the company's elevating and conveying machinery, which can be adapted to almost every known industry. The catalogue is profusely illustrated with views of actual installations and of the apparatus and parts thereof. It contains 144 pages, which give a vast amount of information on the subject in general and specifically. The catalogue is gotten up in the company's usual first-class style, both as to arrangement and completeness.

UNIVERSAL ELECTRICAL DIRECTORY.—This valuable directory for 1904, issued by H. Alabaster, Gatehouse & Co., 4 Ludgate Hill, London, is a remarkable compilation, as usual. It contains the names and addresses of members of the electrical and allied trades and professions throughout the world, and is the oldest and largest electrical directory. It is divided into four sections, *i.e.*, British, with 11,560 names; Continental, with 9420 names; U. S. A., with 7500 names; Colonial, with 3610 names, making a total of 32,090. Each of these sections are again divided into alphabetical and classified sections, and in the case of the British a geographical section is also given. The entire book is carefully revised each year, and the financial information and central station particulars are brought up to date as far as possible.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., have recently sent out a batch of trade literature. Bulletin No. 1051 contains a list of plants operating single-phase "Wood" alternators in the United States on Dec. 1, 1903. Bulletin No. 1052 is devoted to a description and illustrations of the multiple alternating current street arc lighting system. This is a very complete description of the system and is well illustrated with half-tone views of the apparatus and diagrams and curves showing connections and efficiencies. The Fort Wayne Works have also issued instruction books regarding their enclosed alternating current arc lamps of the multiple type and enclosed alternating current multiple system arc lamps of the special transformer type.

THE IMPROVED CINCINNATI AIR COMPRESSOR.—Bulletin L-508 of the Laidaw-Dunn-Gordon Company, of New York, bearing the foregoing title, is devoted to a new type of air compressor, the distinguishing feature of which is the novel manner in which the opening and closing of the exhaust ports are controlled. The exhaust opens through poppet valves, which is desirable, especially where the pressure pumped against is variable. The closing of the exhaust is determined by Corliss valves located in the passages between the cylinder and the poppet valves. These prevent all leakage of air back through the poppet valves while they are closing and also, by providing a cushion of air under full pressure, allow them to seat easily and without noise. The opening and closing of the admission are determined by the Corliss valves entirely.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, has issued a catalogue which—without indulging in a pun—can be designated as a triumph of the engravers' and printers' art. Moreover, the beauty of the production is enhanced by a lack of the striving for effect that often nullifies the object in view, the main factor in the success achieved being a well-balanced combination of excellent engraving and printing, well selected type and fine quality of paper. The few ornamental embellishments are properly subordinated, consisting of initial cuts, front and tail pieces. The catalogue describes and illustrates in detail the line of Triumph electrical machinery, and its application to various uses, direct-connected machine tools occupying considerable space. The half-tone engraving has most successfully stood the severe test entailed in representing this particular class of illustration.

POWER STATION SPECIALTIES.—This pamphlet describes power house auxiliary machinery for vacuum making and boiler feeding recently developed by the Geo. F. Blake Manufacturing Company, 114 Liberty St., New York City. The lists include rotary dry vacuum pumps, vertical cross-compound simplex boiler feed pumps, Admiralty type surface condensers with combined air and circulating pumps, vertical twin air pumps, comined pot-valve outside-packed-plunger duplex feed pumps and centrifugal pumps for circulating condenser water. This apparatus has been designed to meet the exact requirements of steam turbine and reciprocating engine units of 5000 to 10,000 hp capacity, using steam of 200 to 300 lbs. pressure per square inch. For the highest efficiency of each equipment, the vacuum must be as close to the barometer as mechanical means can produce, and it is to secure this end that the machines described in this pamphlet have been designed. The publication is numbered B-62, and will be sent upon request to those interested.

THE ELECTRICAL TESTING LABORATORIES, formerly known as Lamp Testing Bureau, have taken possession of their new quarters at 546 East 80th Street, New York City, and are now prepared to undertake many kinds of electrical and photometrical tests. All of the apparatus formerly installed at 4 Jay Street has been set up in the new laboratories, as also several new instruments which add much to their facilities. The equipment of these laboratories is most liberal and thoroughly up to date, while the technical staff consists of trained specialists and expert assistants. Tests made by the Electrical Testing Laboratories may be relied upon as being highly accurate and altogether satisfactory as to methods and thoroughness. All tests are treated with the strictest confidence, the data and reports being considered the property of the customer for whom the test is made, and are not available for the use of others. Tests are carried out with absolute impartiality, without favor to any one, and with the single object of accurately determining facts as they exist for the information of him who pays for the work.

IMPERIAL CROWN LAMPS.—The Bryan-Marsh Company has furnished us with advanced data as to its Impreial Crown lamp. This lamp consists essentially of the same component parts as the incandescent lamp. It is provided with an aluminum reflector fitting on the top of the bulb that increases the effective illumination and equalizes the distribution of light. It is designed expressly to meet the demand for a larger unit of illumination than afforded by the incandescent lamp where an arc lamp is inconvenient or unsatisfactory. The efficiency of the illumination of the Imperial Crown lamp is, it is claimed, greater than that secured from any other source. The light is uniform, steady, soft and perfectly diffused. The Imperial Crown lamp is suitable for use in connection with the most elaborate scheme of interior decoration. Its artistic outline lends grace and harmony to its surroundings. It is also suitable for concealed illumination and may be built into the walls or ceilings to conceal its outline without affecting its illuminating power. When thus concealed, it is unnoticed except for its light. The Imperial Crown lamp is furnished in two sizes with suitable fixtures.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 23, 1904.
[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

752,589. ELECTROMAGNETIC REVERSING DEVICE; John Riddell, Schenectady, N. Y. App. filed May 28, 1900. Two oppositely rotating magnets for driving a planer, an armature located between them and a switch for throwing the circuit from one to the other at the end of each traverse of the table.

752,643. ELECTRIC PUMP FOR SWITCHING MECHANISMS; Walter J. Bell, Los Angeles, Cal. App. filed July 31, 1903. A solenoid magnet and an automatic circuit controller controlling the flow of oil to the cylinder of a motor which moves a railway switch.

752,649. TELEPHONE ATTACHMENT; George Briggs Buchanan, Haverstraw, N. Y. App. filed Sept. 15, 1902. (See page 476.)

752,659. SAFETY AND SIGNALING DEVICE FOR HOISTING MECHANISM; William N. Dickinson, Jr., Chicago, Ill. App. filed Jan. 4, 1902. A platform switch located at each landing of a dumb waiter, to prevent the car from being moved from any landing at which it is being loaded or unloaded.

752,689. ELECTRICALLY PROPELLED VEHICLE; Louis Krieger, Courbevoie, France. App. filed Feb. 26, 1903. A motor vehicle carrying a gas engine, a dynamo and an electric motor, the dynamo having shunt and series field coils wound in opposition, the series coil being wound to decrease the field excitation as the current increases. It is stated that as the intensity of the current depends upon the effort of traction, if this increases in consequence of an incline of the road, the difference of potential at the terminals of the dynamo at the same time decreases and the vehicle slows down automatically.

752,690. METHOD OF PRODUCING SPARKS IN THE CYLINDERS OF INTERNAL COMBUSTION ENGINES; Leon J. Le Pontois, New Rochelle, N. Y. App. filed Aug. 22, 1903. The method consists in simultaneously breaking two or more alternating currents, differing in phase from each other, thereby insuring a constant heat value of the spark at any given time.

752,691. INDUCTION ALTERNATOR; Leon J. Le Pontois, New Rochelle, N. Y. App. filed Aug. 22, 1903. A design for an alternator whereby sufficient current is produced at low speed to furnish a spark for starting an explosive engine, while at the higher speeds the armature reaction tends to maintain the current constant, notwithstanding speed variations.

752,692. POLYPHASE MAGNETO ALTERNATOR; Leon J. Le Pontois, New Rochelle, N. Y. App. filed Nov. 7, 1903. Details of construction of a generator designed to deliver two or more alternating current differing in phase from each other, such currents being employed for the purpose set forth in patent 752,690.

752,696. ELECTRIC CORD ADJUSTER; Jonathan E. Masterson, Spokane, Wash. App. filed May 23, 1903. A spring drum adapted to take up the slack.

752,705. AUDIPHONE RECEIVER; Hermann G. Pape, Brooklyn, N. Y. App. filed Oct. 21, 1902. (See page 476.)

752,710. MEANS FOR SYNCHRONIZING THE INSTRUMENTS OF TELEPHONE SYSTEMS; Hope Redmon, Rufust L. Hall and Robert H. Conway, Cynthiana, Ky. App. filed Sept. 17, 1903. (See page 476.)

752,719. AUTOMATIC SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; Harry B. Snell, Cement City, Mich. App. filed July 17, 1903. A dial plate and index is located at each end of a block and operated to show motormen the number of cars in a block.

752,722. SWITCHBOARD; Alfred Stromberg, Chicago, Ill. App. filed May 13, 1902. (See page 476.)

752,834. ELECTRICAL RECEPTACLE; Philip H. Fielding, New York, N. Y. App. filed June 27, 1903. A receptacle adapted for application to the surface of a tubular wiring conduit, it having a projection carrying the binding screws which enters an orifice made through the wall of the conduit, enabling the wires therein to be attached without cutting and without exposed contacts.

752,839. SYSTEM OF ELECTRIC TRAIN LIGHTING; David C. Henry, Denver, Col. App. filed Sept. 23, 1901. A distribution system comprising a generator, a regulator consisting of two differentially-acting motors, a gear system and a variable resistance operated by the gear system and an automatic switch for including the motors in, or excluding them from, the circuit at predetermined voltages.

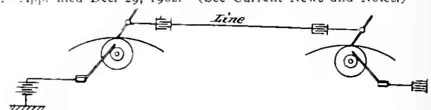
752,840. FLEXIBLE CONDUCTING-CORD; Howard B. Holmes, Evanston, Ill. App. filed Jan. 27, 1902. (See page 476.)

752,843. SIGNALING APPARATUS; Robert B. Kernohan, Pittsburg, Pa. App. filed May 23, 1903. A steam whistle is blown when the circuit is closed through a solenoid magnet.

752,844. MEANS FOR PROVIDING ZINC IN RADIATORS; William Raymond Kinnear, New York, N. Y. App. filed Sept. 8, 1903. (See page 476.)

752,865. ELECTRIC ARC LAMP; Carl Schuster and Christian N. Bergmann, Pittsburg, Pa. App. filed March 20, 1902. Details.

752,894. SELECTIVE SIGNALING; Reginald A. Fessenden, Fort Monroe Va. App. filed Dec. 29, 1902. (See Current News and Notes.)



752,923.—Electric Telegraph System.

752,895. SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed March 14, 1903. (See Current News and Notes.)

752,909. TELEPHONE SIGNALING MECHANISM; Oscar Olsen Lee, Chicago, Ill. App. filed Jan. 11, 1900. (See page 476.)

752,921. AUDIPHONE-RECEIVER; Hermann G. Pape, Brooklyn, N. Y. App. filed Sept. 13, 1902. (See page 476.)

752,923. ELECTRIC TELEGRAPH SYSTEM; Charles Adams-Randall, New York, N. Y. App. filed Sept. 6, 1902. A single circuit line including transmitters and receivers and a source of energy, the circuit being open or mechanically ungrounded at one end and grounded at the other end.

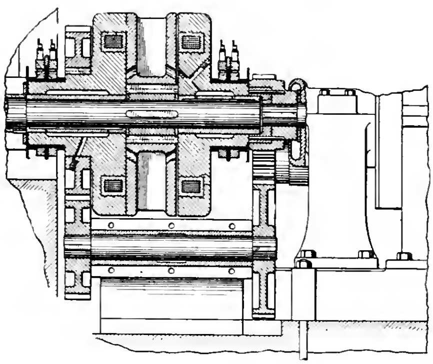
752,942. END-CELL SWITCH; John W. Achard, Philadelphia, Pa. App. filed May 17, 1902.

753,027. OSCILLATING ELECTRIC FAN; Jacob Amrom, New York, N. Y. App. filed June 27, 1903. The fan-carrying arms are oscillated in one direction by an electro-magnet and in the other by a spring, the invention consisting of the details of construction.

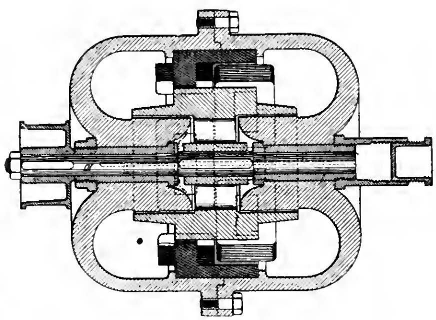
753,035. COMBINED PERCUSSION AND ELECTRIC PRIMER; Thomas G. Bennett and William Mason, New Haven, Conn. App. filed Nov. 23, 1903. The object is to produce a strong, reliable and sensitive primer constructed with particular reference to preventing the rearward escape of gas through leakage or piercing.

753,062. MICROPHONE; Pierre Germain, Fontenay Aux Roses, France. App. filed Oct. 7, 1899. (See page 476.)

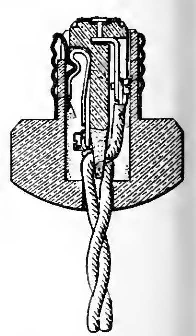
753,067. TELEPHONE OR TELEGRAPH SYSTEM; Robert Hamilton, Milton, Mass. App. filed Feb. 10, 1903. (See page 476.)



752,589.—Electromagnetic Reversing Device.



752,692.—Polyphase Magneto Alternator.



752,833.—Attachment Plug.

752,761. MULTIPLE-SWITCHBOARD SYSTEM; William M. Davis, Chicago, Ill. App. filed Dec. 7, 1900. (See page 476.)

752,812. ELECTRIC BLOCK SYSTEM; Charles W. S. Turner, Mountville, Va. App. filed April 3, 1903. Details of a system in which cars on the same block are able to communicate with each other.

752,820. DYNAMO-BRUSH; Max Bunnig, Gardelegen, Germany. App. filed Oct. 5, 1903. (See page 476.)

752,822. ALARM SIGNAL FOR RAILWAY TRAINS; Hugh E. Butler and Joab L. McCollum, Atlanta, Ga. App. filed Nov. 12, 1903. A cord extending through a train and connected with an alarm apparatus on the last car of the train which is set into operation by the breaking of the cord when the train separates.

752,824. ELECTRIC RAILWAY SWITCH; Harry H. Chandler, Waltham, Mass. App. filed Oct. 24, 1903. Details of a magnet for throwing a switch tongue.

752,833. ATTACHMENT PLUG; Philip H. Fielding, New York, N. Y. App. filed June 27, 1903. The connections with the flexible cord are made on a plug which passes into a central chamber in the attachment plug itself, thereby covering all of the contact screws but affording ready access thereto.

753,136. ALARM SYSTEM; John W. Hasburg, Chicago, Ill. App. filed July 23, 1903. Details.

753,138. PORTABLE ELECTRIC LAMP; Harry C. Hubbell, Brooklyn, N. Y. App. filed July 2, 1903.

753,157. RAILWAY BLOCK SYSTEM; Joseph Morton, New Westminster, Canada. App. filed Oct. 19, 1903. A signal man throws a projection at the track side into position to be struck by a corresponding projection on the train, to thereby operate an alarm on the train.

753,183. TELEPHONE SELECTING DEVICE; Willam D. Watkins, San Jose, Cal. App. filed Aug. 29, 1902. (See page 476.)

753,191. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 11, 1901. (See Current News and Notes.)

753,192. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 18, 1901. (See Current News and Notes.)

753,193. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed Oct. 23, 1903. (See Current News and Notes.)

753,194. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed Jan. 2, 1904. (See Current News and Notes.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, MARCH 12, 1904. No. 11.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, MARCH 12, 1904.

CONTENTS.

A COMMEMORATIVE ISSUE.

The anniversary issue which we published last week celebrating the close of the first thirty years of existence of the ELECTRICAL WORLD AND ENGINEER and the beginning of its fourth decade, has been received in a most cordial and appreciative manner by our friends and readers, many of whom have been good enough to address us letters of congratulation upon the event and wishing us God-speed for the future. In doing so, several of them have expressed surprise at the size of the number, as well as at the variety of the contents and the quantity of advertising. These remarks and felicitations encourage us to make one or two notes as to the difference between the earliest issues of this journal and that of March 5. A comparison might be made with the old *Operator,* even more emphatic as to the growth of the journal, but it will suffice to give a few figures as to the first issue of January, 1883—when the paper became the *Operator and Electrical World*—and the last one just published.

Twenty-one years ago this journal, therefore, gratifying its worthy ambitions and rising from the status of a paper merely for operators to that of one covering the entire electrical field, although it had previously given a great deal of space to general electrical topics, was proud to call attention to the fact that it consisted of no fewer than 16 pages. Eight of these pages were devoted to text and eight to advertisements. As the form was then that of a folio, these pages were nearly twice the size of the present quarto, making, therefore, roughly, about 16 pages of text and 16 pages of advertisements. Last week the ELECTRICAL WORLD AND ENGINEER published 90 pages of text with a four-page supplement, and 196 pages of advertisements. In the first issue of January, 1883, the 16 pages of advertising contained 66 advertisements, including one or two of the publisher with regard to books. The last issue contained no fewer than 593 advertisements. The contrast between two such issues is indeed remarkable, but is only in keeping with the wonderful growth and expansion of the electrical arts in general.

THE DEVELOPMENT OF INDUSTRIAL ELECTROCHEMISTRY.

In the swift advancement of all branches of electrical engineering during the thirty years of the life of this journal, elecrochemical industries have vigorously participated only during the latter half of this period. It may perhaps not be surprising to read in Dr. Roeber's article published in our last issue that thirty years ago commercial electrochemistry was represented only by some branches of electroplating and by primary battery engineering; yet it is probably not generally known that the first American electrolytic copper refining plant was erected so recently as in 1882 while now 85 per cent. of all the pure copper of the world is electrolytically refined in this country. Most of the other electrochemical processes are of still more recent date. The electrical engineer has become intimately connected with electrochemical engineering by the introduction of the storage battery into central stations and sub-stations; he has there learned that electrochemical methods are the most suitable ones for storing electrical energy. But this storage of large amounts of energy is a feature also characteristic of the industries which represent the reverse problem of battery engineering, namely the production of chemical effects by electrical means.

A cursory review of these industries shows an astonishing variety of methods available for producing a certain chemical effect. We have electrothermic reactions in the electric furnace, electrolytic reactions, combinations of electrothermic and electrolytic reactions, and the methods of discharges through gases. To take a single case, to get caustic soda and bleaching powder from common salt, we have three essentially different classes of electrolysis of an aqueous solution of sodium chloride—the mercury cathode, diaphragm, and gravity processes—besides the electrolysis of fused salt with a lead cathode. All these processes are worked on a commercial scale and the classes of mercury cathode and diaphragm processes alone cover quite a number of essentially different methods. All these different processes, however, are characterized by one common feature, namely, that care is taken to keep the anodic and cathodic products of electrolysis separate from each other. That this is possible in so many different ways, characterizes the variety of electrochemical methods. On the other hand, if we provide means which facilitate the reaction between the anodic and cathodic products in the electrolysis of sodium chloride, we get hypochlorites or bleaching liquor. This shows how by an apparently slight modification of the process we get other products.

The effect of varying the result by changing the condition of the same experiment is perhaps most beautifully illustrated by the simple reaction between silica and carbon in the electric furnace, which may yield either carborundum or "white stuff" or silicon or graphite or silixicon. But while this example illustrates the enormous possibilities of electrochemical methods it also illustrates the inherent difficulties of electrochemical engineering, since it shows the necessity of carefully establishing and maintaining the proper conditions of operation in every process. The abundance in this country of valuable raw materials, and especially metals, to which electrochemical methods can be advantageously applied, coupled with the fact that our electrochemical and electrometallurgical engineers, every one of whom is a pioneer in a new field, are not working by the rule of thumb but according to exact principles, appears to fully justify the very high hopes entertained by those most competent to judge for the future of industrial electrochemistry. Here we believe will be a large part of the valuable work to be done during the next thirty years of this journal.

Thirty Years Progress in Electromagnetic Theory.

It is very interesting to consider the growth and development of electric theory during the past three decades. It has not been so much in the physical or pure theory as in the applied theory that the advance has been made. In the fundamental theory of the science, as reflected in the works of Gauss, Weber and Maxwell, thirty years ago, there is comparatively little increase; but in electrotechnical theory there has been a great advance and development. For example, the theory of the magnetic circuit has been developed during the last thirty years, and without this theory very little practical development could have been made in the art of constructing dynamos. All advances in construction would have been by empirical groping. Thirty years ago there was no alternating-current technology worth mentioning. Our recent industrial development of power transmission has rendered necessary an applied science of alternating-currents which is already extensive, and is constantly extending.

In the direction of electromagnetic waves, science has made notable advances in three decades. In that time the proposition has been set up and established that radiant energy is of electromagnetic nature, viz.: an oscillatory electromagnetic disturbance in the ether. Waves of radiant energy have been artificially produced by electric means with wave lengths as small as a few inches; but no artificial electric mechanism has yet been devised to produce wave lengths as short as a few microns, the condition necessary in order that the retina may respond, and the stimulus of light be produced. Of recent years the electronic theory has made great strides as a working hypothesis. It is still only in the stage of partial development. It is very comprehensive in its scope, since it may be said to offer an explanation of all matter, on the basis of electrical point sources in the ether. It also attempts to explain the phenomena of mechanical inertia, or the vis-inertia of matter, on the basis of self-induction in moving electrons; i. e., the moving charges that by postulation form matter. According to this theory, all electric charges are associated with ions or portions of atoms. No communication of electric charge can occur without the movement of such ions. Electric waves in free ether are, however, capable of carrying away the energy of such ions. All this theory has been created during less than thirty years, and if not yet demonstrated it must at least be admitted that each succeeding year gives more support to the theory.

Concerning the fundamental nature of electricity itself, there is still no certainty, but there are several hypotheses. There are several theories for explaining both electricity and magnetism in terms of the ether. None of these theories seem capable of being submitted to experimental demonstration. It is certain, however, that, since the interconnection between electricity and magnetism is known, a demonstration of the nature of the one must, by corollary, include a disclosure of the nature of the other. Moreover, it would now seem likely that the complete unraveling of the nature of electricity would necessarily include a revelation of the nature both of matter and of gravitation. All that can be said with reasonable certainty at present seems to be that electricity and magnetism are states of disturbance in the universal ether, although the exact kind of disturbance cannot yet be defined, partly because the mechanism of the ether itself must be sufficiently known in order to differentiate its disturbed conditions from its normal conditions. In the case of air, as an atmosphere on the surface of our globe, we have a sufficiently clear idea of its nature to enable us to say that a streaming disturbance of the air, necessarily accompanied by spinning or vorticity, constitutes the phenomenon that we all recognize as wind. Wind may, therefore, be defined as a particular disturbance of the air. Sound, as it reaches our ears, we attribute to a different kind of disturbance in air. So it seems clear, in like manner, that magnetism and electricity are particular disturbances in the ether. Just what the disturbances are is not clear. But we know that the two disturbances are mutually related in the manner that streaming is related to spin or vorticity in an incompressible fluid. Consequently, as the material for producing wind is always present, if we have suitable mechanism, say a fan, and power to drive it; so the material for producing electricity or magnetism is always present in the universal ether, if we have suitable mechanism, say a dynamo, and power to drive it.

Predetermination of Transformer Regulation.

The alternating-current transformer is a most useful and a marvelously simple machine for exchanging volts into amperes, when the terms of the statement are treated broadly, and not read through technically-adjusted spectacles. The transformer, however, has one objection, namely, that no practical plan of compounding it has yet been found. As the load comes on a so-called "constant-potential transformer," it forgets, to some extent, its duties to constant potential, in paying attention to the load. The pressure at terminals drops under load, like that of a shunt dynamo. The drop is small in large, well-constructed transformers, on non-inductive loads; but it is quite appreciable on inductive load, and, moreover, there is also the inevitable drop in secondary wiring. The result is that an automatically compounded transformer to maintain constant pressure under all loads at the mean distance lamp would be a great boon. Something might be done by suspending the secondary coil, and allowing it to approach the primary coil under load, as in the "tub-system"; but this would destroy the beautiful simplicity of the transformer mechanism. It is known that a constant-potential transformer, in addition to its pressure-varying properties, behaves like a single choking coil in the primary circuit. This proposition has been published in our columns. It is known that the resistance of the equivalent choking coil is the total resistance of the coils of the transformer, when reduced to a level transformer. It is also known that the inductance and reactance of the equivalent choking coil can be obtained from measurements made with short-circuited secondary.

In an article appearing on page 515 of this issue, Mr. E. G. Reed gives an empirical formula by which the inductance of the equivalent choking coil can be computed for a transformer of a particular type of construction. The formula involves the square of the number of primary turns and some geometrical relations that may be taken from the working drawings. This is a very convenient formula, and is given in one of the text-books on the subject. Mr. Reed gives a table of numerical data for a series of commercial core-type transformers, setting forth the inductances as computed in the above manner. The results are said to correspond very closely with the experimentally observed values. It appears from Mr. Reed's interesting table that the reactance factor of this line of transformers increases from 0.5 in 0.5-kw size, to 3.64 in 50-kw size. Also that above 10 kw the reactance factor very nearly follows a straight-line law, with respect to size of transformer, increasing 0.5 for every 10 kw. The reactance factor of this line of transformers, according to the table, may, in fact, be expressed, for sizes above 10 kw, by the equation $f = 1 + P/20$, where f is the reactance factor and P the capacity of the transformer in kilowatts. It is evident from an inspection of the values given in the table that the percentage resistance drop diminishes nearly according to a straight-line law beyond 20-kw capacity, being then expressed, approximately, by the equation, $n = 1.6 - 0.011 (P - 20)$. On the other hand, the reactance drop steadily increases with the capacity. This would mean that such transformers would regulate better in increasing sizes on non-inductive loads, but would not regulate better, and even somewhat worse, in increasing sizes, on heavily inductive loads.

HIGH-TENSION CONSTRUCTION.

Mr. Semenza's paper on this topic at the last Institute meeting is a most instructive presentation of the results following from European conditions. In almost every department of engineering the differing conditions here and abroad affect current practice deeply, and line construction is no exception to the rule. As the author very truly remarks, the importance of good line construction was slow to be recognized and insufficient precaution were taken against trouble. A few years served to teach the lesson of thoroughness, and line work as now carried out both here and abroad is reduced to a matter of careful and thorough engineering. But conditions vary from country to country and the practice advocated by Mr. Semenza would, we fear, generally lead to difficulties here. In the first place, they seem to have a curious fashion of figuring rights of way in Mr. Semenza's country, at so much per pole. Here it is generally regarded as very bad practice to secure anything less than a full right of way for complete access to the line at all times, and on important systems the right of way amounts to a considerable acreage. Preferably, we take to highways through our less settled and more heavily wooded country as the only way of securing proper access to the line without prohibitive expense. In either case, a full private right of way or utilization of a public way, there is nothing of any material account to be saved by increasing the span so far as cost of way is concerned. Then we are, of course, compelled here to face climatic difficulties to an extent unknown in Italy. Our extremes of temperature and the dangers from snow, sleet and wind are so serious that a factor of safety which would be permissible in a milder climate is quite out of the question here. This alone would account for many of the differences in line construction.

The ordinary American preference for rather thick wooden poles and rather short spans is mainly due to fear of the strength of long spans in our rather ferocious climate. We are just beginning to use long spans and steel towers, an extension of Mr. Semenza's methods, and their success here is still very problematical. Again, we are apparently able to get a far better wooden pole here than in Italy, for the life quoted by Mr. Semenza for wooden poles of two to ten years is far shorter than is found in American practice. In fact, ten years would be about the minimum life for wooden poles such as are used on the best American transmission lines, and it is an open question whether steel lattice poles would not be dangerously weakened by rust in a time not very much longer when exposed to a really bad sample of American climate. Again, on our long high-voltage lines running through a sparsely settled country, the insulating properties of wooden poles and cross arms are a valuable asset. Every manager of a transmission system can call to mind cases where an insulator has broken without serious results, the wire falling upon the cross arm harmlessly or with only inconsiderable burning, and staying in this position until repaired. A similar accident with a steel supporting structure would quite certainly put the line out of commission for some hours. Of course, in this connection the cross arm is more important than the pole, and steel poles, if they ever come into considerable use here, will quite certainly be used with wooden cross arms very thoroughly treated. In short, it seems very doubtful whether steel poles can be used under American conditions with any such advantage as is claimed for them by Mr. Semenza in Italian practice.

It would be very interesting to know the relative properties of American and European insulators. Here glass is used on some very high-tension lines with capital results, but as Mr. Semenza indicates, it is a material under suspicion as to durability. The cheaper labor abroad and the experience of many years in porcelain manufacture certainly should make it possible to obtain high-grade insulators far more cheaply there than here. On our great transmission systems the steady upward tendency of voltages keeps the insulator maker constantly upon the jump. No sooner does he standardize a good insulator for 30,000 volts than a call comes for an insulator to stand 50,000 or 60,000 volts. The present tendency in design of insulators is bad so far as successful production is concerned. Too much stress has been laid on dimensions in the mistaken notion that two square feet of bad insulating surface is better than one square foot of first-class material, and the result has been huge insulators of dimensions which make proper mixing and firing of the clay extremely difficult, and add new difficulties to line construction. Of the voltages now in use wide separation of the line is imperative and even at moderate voltages wide separation is advisable to lessen the chance of interruptions of service by wind-blown branches or by birds fouling the wires, and the weight of these big insulators becomes a rather serious matter. We like the insulator designs shown by Mr. Semenza. They seem well fitted to prevent surface leakage, and neither present undue surface to creeping discharges nor needless weight to render proper support difficult. The foreign practice, too, of cementing in the pins seems better than our common method of screwing them in, although in this connection it is of course not unusual to cement in pins here. In the electrical design of the lines Mr. Semenza follows much the same practice that is current here, although on most of our lines regulation is the controlling factor in the choice of line loss. As a practical problem, figuring the theoretical best cost of copper is a very troublesome proposition here on account of the very uncertain selling price of the energy transmitted.

Developments in the Allis-Chalmers Situation.

The recent announcements in these columns with regard to the intention of the Allis-Chalmers Company to enter the field of heavy electrical machinery, as well as to develop the production of steam turbines, hydraulic turbines, gas engines, etc., in addition to its other well-known and standard lines of prime-movers, has been noted with the greatest interest by every one throughout the country occupied in electric light, power and traction. It would appear, however, that the Allis-Chalmers management is by no means at the end of the radical and decisive moves which it is to make under the new régime just entered upon, for as we go to press other developments are announced or rumored.

One of the most important events within the past few days has been the conclusion of an alliance between the Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Some time ago the Bullock Company secured a heavy contract for the equipment of the new Allis-Chalmers shops in the vicinity of Milwaukee, an event which may possibly have led up to the present deal owing to the satisfactory results obtained with the apparatus under test. Be this as it may, it now appears that the Bullock Electric Manufacturing Company, of Cincinnati, which is a New Jersey corporation, has been leased by a new Bullock Company organized under the laws of Ohio. This new corporation is one in which the Allis-Chalmers Company is financially interested as principal owner, and it takes over the business of its predecessor as a going concern. In this manner the Allis-Chalmers Company is at once able to fill orders ranging throughout the entire field of direct-current and alternating-current generating apparatus, Mr. B. A. Behrend, the engineer of the company, having added to the well-known standard line of direct-current motors and generators, rotary converters and some of the largest types of polyphase alternators and synchronous motors complying with the most exacting requirements in this country. It is also understood that the Bullock output now includes street railway motors, and that some of these have already been supplied to a road in Indiana. In this connection it is interesting to record that the new company has made a personal contract with President George Bullock, under whom the old company was vigorously and successfully built up, so that the administration of the company will remain unchanged, a contract having also been made with Mr. Neave for the retention of his services as vice-president. Some curiosity has been expressed in electrical circles as to the manner in which the Allis-Chalmers Company would be able to come at once into the market with electrical apparatus, instead of waiting one or two years to develop productions of its own, but it will be seen that this move provides for it a very satisfactory solution of the problem, enabling it to bid at once on whatever contract may be offered.

In connection with the affairs of the Allis-Chalmers Company, itself, and its own internal management, it would appear that some vital and important changes are being made. The first and most noteworthy of these is the resignation of President Chas. Allis, whose wife has been in seriously ill health and is now proceeding to the Mediterranean under medical advice for an indefinite stay. Mr. Allis felt that under these private conditions he could not possibly give all the attention to the business of the company that its affairs demanded at this juncture, and preferred, therefore, to take this step. His place in the management is to be filled by Mr. B. H. Warren, formerly vice-president of the Westinghouse Electric & Manufacturing Company and a man of distinguished engineering and business attainments, as well as of marked energy and executive ability. It is also understood that Mr. Edward D. Adams, the banker, who has been identified with the company since its organization a few years ago, has consented to take the chairmanship of the executive committee, this step involving the abolition of some of the previously existing committees and the concentration of a great deal of responsibility and power in his hands. Mr. Adams will, in fact, make his offices at the New York headquarters in the Empire Building and give a large amount of his time and thought to Allis-Chalmers affairs. No more striking proof could be given of the vigor with which the business of the company is to be pushed than these two events.

It has already been stated in these columns that Mr. John F. Kelly, formerly of the Stanley Company, has been made head of the electrical engineering department of the company, with Mr. William Stanley, Jr., as consulting electrical engineer; and to this may now be added the fact that Mr. Kelly has already begun his work and taken up affairs at the Allis-Chalmers offices. The company has other important plans and arrangements under contemplation, but the announcement of these above will suffice to keep the eyes of the electrical community fixed upon the action of the newcomer, whose entrance into the field must obviously be most profoundly felt.

In connection with Bullock Company affairs, we quote Mr. Joseph S. Neave, vice-president of the corporation, as follows: "The present Bullock Electric Manufacturing Company will remain intact. The same officers will be continued, and also the same management. The old company is incorporated according to the laws of New Jersey. There will be another Bullock Electric Manufacturing Company formed according to the laws of Ohio. This will be the leasing company of the plant, and this company will run the Bullock plant as it is run at the present time. In fact, the Bullock Electric Electric Manufacturing Company and the Allis-Chalmers plants will be run as if they were one concern. The Allis-Chalmers Company guarantees to pay the 6 per cent. dividend on the preferred stock of the Bullock Company. It goes further; the Allis-Chalmers Company agrees to pay 6 per cent. on the common stock of the old Bullock Electric Manufacturing Company for all the assets of the Bullock Electric Company that are over and above the valuation of the preferred stock.

"As an explanation of the payment of dividends for the common on the quick assets of the company, it might be stated that the preferred stock of the present Bullock Company amounts to $1,100,000, and the common to $1,000,000. Thus, after the valuation of the plant has covered the preferred stock and there should be, for instance, $500,000 of what is termed quick assets over, the Allis-Chalmers Company guarantees, during the life of the lease, 6 per cent. on this amount for the Bullock common stock.

"Besides the payment of these dividends," continued Mr. Neave, "the Allis-Chalmers Company agrees to divide the profits of the concern between the new company and the common stock of the old company. This will tend to make the earning power of the common stock of the old company a great deal more than it is at the present time.

"As a result of this deal with the Allis-Chalmers Company, the present capacity of the Bullock electrical works is to be enlarged. The first thing that will be done will be to erect another large shop, with an area of 40,000 sq. ft., where motors for street cars will be manufactured. This will mean the employment of about 400 more hands. It is the intention of the new leasing company to enter actively into the street car equipment field. The lease is for 25 years with the privilege of renewal for another 25 years on the same terms. It is my opinion that when the plants that are now under way have been completed the Bullock electrical works will give employment to from 2,000 to 3,000 hands.

"While the papers in the deal have all been signed, the deal will not go legally into effect until after the stockholders of the present Bullock Electric Company have had their special meeting at Jersey City on Wednesday, March 16. Mr. George Bullock and myself will be at that meeting with the proxies to ratify the deal."

Telegraph Between Irkutsk and Pekin.

The Commercial Cable Company is advised that by an arrangement with the Great Northern Telegraph Company, the direct wire between Irkutsk, Siberia, and Pekin, China, is open for the interchange of business.

Trolley Beats Steam.

A special dispatch to the daily press from Kansas City, Mo., of March 4, says: "In a two-and-a-half-mile race between a Missouri Pacific express train and an electric car on the Leavenworth-Kansas City line last night, the railroad locomotive was beaten by two car lengths. The roads are parallel, and the electric line manager waited with a party of road officials at the beginning of the stretch. The railway engineer put on all steam, and the cars ran even until the last quarter of a mile, when the electric car slowly forged ahead, and bounded across the finish line at fifty miles an hour, winner by 120 feet." We do not see that this proves anything in particular, or of any value, although it may be a good "ad" for the local trolley service.

The Electric Power and Transmission System of Schaffhausen, Switzerland.—I.

ONE of the most remarkable of Switzerland's hydro-electric plants is that located at the famous Schaffhausen Falls on the headwaters of the Rhine in northern Switzerland. As early as 1863 Heinrich Moser built a water power plant for the municipality of Schaffhausen. In this plant three turbines aggregating 700 hp were installed, and power was delivered to Schaffhausen, three miles distant by wire-rope transmission, the ropes running over sheaves supported on piers erected several hundred feet apart. In 1887 a second power house was erected below the first one and five 300-hp turbines were installed.

In 1891 the Oerlikon Company furnished the Schaffhausen Insane Asylum with a lighting dynamo arranged to be driven by a branch of the rope system. A citizens' committee was formed at the same time to decide whether the old system should be repaired and retained or electric transmission installed. After extended study the municipality closed a contract with the Oerlikon Company, in 1896, for a complete electric generating and transmission system. This order called for two 2,000-volt alternators connected by bevel gearing to two 300-hp turbines rented by the municipality from the Schaffhausen Water Works Company. Current from these generators is transmitted by buried cables to the several transformers in the town. Outside the town limits wires carrying secondary voltages only are strung on wooden poles.

By December 31, 1897, current was being furnished to 26 hp in motors and for arc and incandescent lamps equivalent to 86,940 cp. The electrical machinery cost $23,493.94 (121,730.24 francs). During the first year power was produced at the cost of 11.14 cents per kw-hour. In 1898 the municipality of Schaffhausen purchased for $123,520 (640,000 francs) the two power plants and dam owned by the Schaffhausen Water Works Company and immediately set about to install a completely electrified system. The following changes were to be made by the Oerlikon Company: Replacing the three old turbines in the upper station by new ones suitable for direct connection to generators, and adding another turbine and generator to the lower station, making in all for that station five turbines, including three turbo-generator sets, one of the latter being a reserve unit.

The rebuilding of the upper station was begun in March, 1900. Before the old structure was torn down the machinery was temporarily enclosed in a wooden building erected inside of the old one. The new station is of steel skeleton construction and has a roof made of wood and cement. The new turbines and alternators were placed in service in January, 1901. During the same year two Oerlikon rotary converters for the Neuhausen-Schaffhausen Street Railway were also placed in this station.

The new equipment has given such satisfaction that the municipality is seriously considering the replacement of the old turbines in the lower station by new ones, and later purchasing and modernizing the remaining power plant of the Schaffhausen Water Works Company.

This station is 460 ft. below the upper one and is connected to the right shore of the Rhine by an iron bridge, which is also used to carry the high-tension cables. The pit is built of concrete, and the rest of the building of brick. In the western part of the machinery room a wire partition encloses the power unit leased by the Schaffhausen Worsted Works.

The water flow to the five turbines is regulated through iron double-turning doors from the floor of the machinery room. The northern half of the eastern part of the machine room is served by a six-ton crane, and the southern half by a five-ton crane. Five 14-amp. arc lamps and forty 25-cp incandescent lamps are used to light the station.

The power equipment of the Schaffhausen Worsted Works consists of two Jonval turbines built by J. J. Rieter, two Oerlikon dynamos and Oerlikon controlling apparatus.

FIG. 1.—GENERAL VIEW OF BOTH POWER HOUSES ON THE RHINE AT SCHAFFHAUSEN.

With a fall varying from 14 ft. to 16 ft. and 2,000 to 2,250 gallons, the turbines give 350 hp at 60 r.p.m. The turbines are fitted with two concentric wheels, both being used at high water and the outside one only at low water periods. When both wheels are used the hand cover on the inner one is removed. The outside diameter of the turbine is 11 ft., the inner diameter 6 ft. (1.79 m.). The leading wheels, which carry a forged-iron suction casing at the lower end, have each 40 cast-iron vanes 1½ in. thick. The running wheels, the lower parts of which are 1.4 above lowest water, have each 42 vanes ½ in. thick.

Power is transmitted from the turbines to the dynamos by bevel gearing and rope shafts, which are 13 ft. in diameter, and have 10 grooves for carrying the rope drive, consisting of hemp ropes, each 2 in. in diameter.

The two Oerlikon direct-current generators used were built in 1890; they have six poles and a capacity each of 300 hp, 700 to 750 volts, at 200 r.p.m.

The controlling apparatus for these machines is mounted on an iron-supported switchboard having a marble front, the other sides being covered with perforated tin. There is one double-pole switch, one ammeter and one voltmeter for each machine. The outgoing cables can be cut out through two double-pole switches. During lightning storms the current is cut off and the overhead cables are grounded through another double-pole switch. Two shunt regulators and two primary current resistances are used in starting the dynamos. The four outgoing cables are protected by four lightning arresters, and are divided into two pairs, each of which is connected in parallel.

The eastern part of the machine room contains the three hydro-electric sets, two of which generate single-phase current and the third or reserve unit either single-phase or polyphase current. The turbines are of Jonval type and were built by Escher, Wyss & Co., of Zurich. The two turbines for running the single-phase machines have vertical shafts and are built for a head of 15 ft. and a flow of 1,700 second-gallons. Their speed is 48 r.p.m.

At high water the head decreases to 11 ft., and it is, therefore, necessary to increase the flow to 2,250 second-gallons to get the required power. This is accomplished by using two concentric wheels having respectively 36 and 24 vanes. The outside wheel only is used during low-water periods, but both wheels are required at high water. It may be mentioned in this connection that these turbines were not originally intended for electric service.

Power is transmitted from the vertical shafts by horizontal intermediate shafting and head gearing, as it was found inadvisable to couple the turbine and generators on the same shaft, owing to the low peripheral speed of the turbines and the limited space between them.

The 300-hp. single-phase alternators are of the inductor type and at 167 r.p.m. generate 100 amp. at 2,000 volts and 50 cycles. The efficiency of these machines is 92 per cent. at full load and 87 per cent. at half load.

The inductor has no wire windings, but carries 2 x 18 pole shoes made of an alloy of tin and iron. These poles are arranged in pairs lying in the same axis for generating the induction in the armature windings and thus forming the required magnetic yoke.

The inductor has a diameter of 8.75 ft. and revolves inside the armature housing, the inside diameter of which is 8.7 ft. In the armature housing 2 x 36 armature spools are set in grooves. These spools are thoroughly insulated and consist of seven windings made of copper strips 25 mm. broad and 1.4 mm. thick. The spools of both armature halves are connected in series and are wound in the same direction. The armature housing can be so manipulated as to permit the ready inspection or substitution of all armature parts. The exciter spool is mounted between the two armature halves. It consists of a massive casing containing 305 windings of copper wire 7 mm. thick.

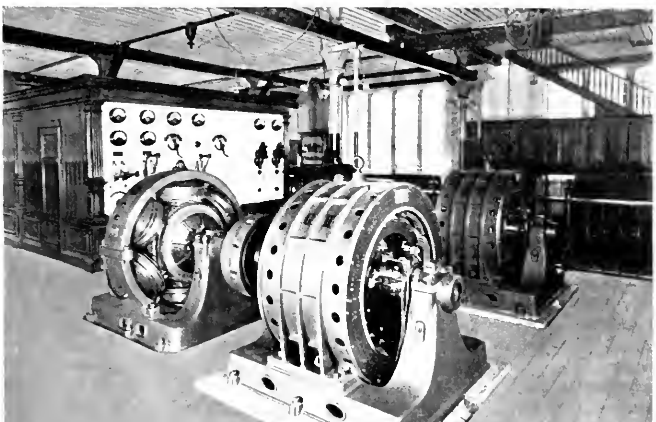


FIG. 2.—VIEW OF INTERIOR OF LOWER POWER STATION, SCHAFFHAUSEN.

The base plate of each exciter is cast solid, with the corresponding alternator. The exciters are all of double-pole type, giving at 420 r.p.m. 120 amp. at 50 volts. Each is driven by four ropes, each 15 mm. in diameter from a rope sheave mounted on the shaft of the corresponding generator. If necessary, one of these machines can be used to excite two alternators. The voltage of the alternators is regulated in the excited circuits.

The third generator has a rated capacity of 350 hp and is built for single-phase and polyphase work. As a single-phase machine it gives at 167 r.p.m. 210 kilovolt-amperes at 2,000 volts, and as a polyphase alternator 300 kilovolt-amperes at same speed and voltage. The frequency in each case is 50 cycles. The general arrangements of this machine are similar to those of the other two just mentioned, with which it must be operated in parallel. The armature is divided into two parts connected in series, each part having 108 grooves and 54 spools. Each spool is made up of 18 windings, each winding consisting of two parallel wires 3/16 in. in diameter. The exciter spool consists of 300 windings of insulated copper strips measuring 1 x 60 mm. The insulation between each winding is composed of asbestos bands about 1/64 in. thick.

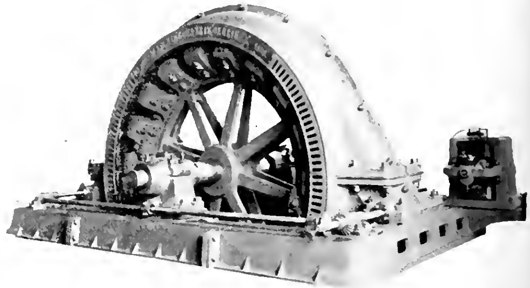


FIG. 3.—300-HP SINGLE-PHASE ALTERNATOR.

The inductor and armature housing are like those of the 300-hp machines described. The exciter is also the same as the others. The armature has 54 grooves, each of which serves to take four leads, each consisting of four parallel wires of 2.2 to 2.8 mm. diameter. The two parallel-connected magnet spools consist of 1,200 windings of wire measuring 1.6 mm. to 2 mm. in diameter.

All of the controlling apparatus is enclosed in several wooden housings, with marble fronts. These several housings and boards were built at different times as the station developed. Owing to the number of machines to be looked after, the designers concluded that they could be better handled if controlled from separate and nearby switchboards rather than from a central and more distant board.

The single-phase switchboard includes also instruments for the third generator when used for single-phase. The board is divided into seven panels. Each of these panels contains the following instruments for each generator: Ammeter, voltmeter, hand switch, lever, double-pole switch, phase lamp for paralleling the generators, hand wheel for regulating, and carbon-contact circuit-breaker. The two regular single-phase machines can be regulated simultaneously by a Gall's chain. The fourth panel carries an ammeter for measuring all the single-phase current, a constant voltmeter with optical and acoustic signals, voltmeter switch and two double-pole switches for paralleling two alternators.

There is a separate panel for each exciter furnished with ammeter, voltmeter, hand lever for double-pole switch and for carbon-contact circuit-breaker, as well as hand wheel for shunt regulation. The board is also furnished with a large voltmeter, which indicates the voltage on the city lighting lines, and thus enables the station attendant to keep the voltage at the proper point. The housing also contains a number of other controlling devices.

The second switchboard serves as a center for the control of the third generator when used for polyphase working, and also for the polyphase current transmitted from the upper works. This board consists of four panels. The one for the reserve generator carries a voltmeter, ammeter, regulating wheel and levers for three-pole switch and carbon-contact circuit-breaker. The next panel controls the polyphase current from the upper station and carries a voltmeter, ammeter and lever of three-pole switch. The other panels carry instruments for measuring all the current in circuit. Other controlling apparatus is mounted inside the switchboard housing.

The southeast portion of the station contains two motor-generator sets for railroad service. One of these sets is always held in reserve. The motors receive current either from the upper station or from the reserve generator in the lower station.

The twelve-pole polyphase motors of these sets are built for 150 hp at 490 r.p.m., using 2,000 volts at 50 p.p.s. The stator has 144 slots, each of which receives 8 leads. Each wire is 4.8 mm. in diameter. The rotor has 180 slots, taking 4 naked wires 4 mm. in diameter.

Each motor is connected to the corresponding direct-current generator by a flexible coupling. Each dynamo generates 182 amp. at 550 volts. The armature contains 200 slots, each containing two spool halves, each consisting of three parallel wires 3.6 to 4.2 mm. in diameter.

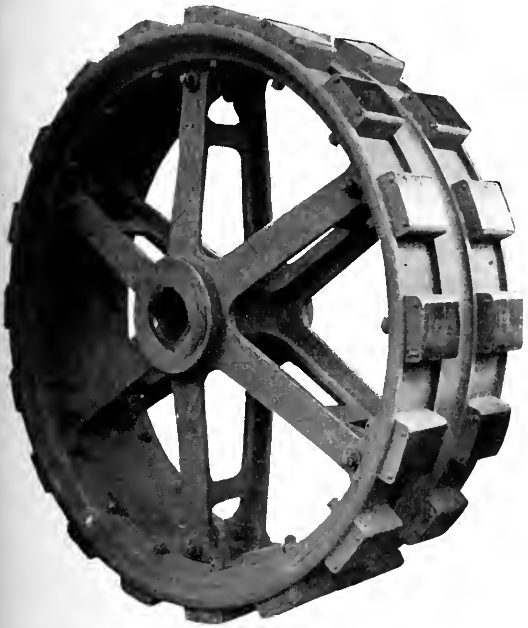


FIG. 4.—INDUCTOR FOR ALTERNATOR.

The field has six spools connected in series and containing 3,300 turns of 1.6 to 2 mm. wire shunt winding and 3.5 turns of 1.5 x 100 mm. copper-tin compound winding.

This portion of the building contains a switchboard for control of the motor-generator sets and of the polyphase current from the upper works. The latter is transmitted underground by two cables of 3 x 60 mm. cross-section. Besides switches for controlling these cables the board contains an ammeter for each motor, three-pole circuit-breaker, voltmeter, wattmeter and safety devices. The direct-current part of the board contains for each generator an ammeter, voltmeter, two-pole switch and regulator. A two-pole switch is used to connect the generators and buffer battery in parallel. Two double-pole switches are used to permit the generators to run either as shunt or compound machines, the first being the case when the generators are in parallel with the battery and the second when the battery is out of service. Another double-pole switch serves to connect the battery halves in parallel or series. An ammeter and voltmeter are used to measure the current generated. Each of the outgoing feeders is controlled by an ammeter, wattmeter and a switch having a device for testing for short-circuits. Lightning arresters and other devices are placed in the housing.

UPPER POWER STATION.

This station is built of iron and brick with a roof of wood and cement. The interior of the building contains a 10-ton crane operated by hand. The station is illuminated by two 14-amp. series arc lamps and 16 incandescent lamps.

One of the turbo-generator sets is owned by the Schaffhausen Cord Works, which, like the Schaffhausen Worsted Works, leases power from the city. Two turbo-generator sets are used for general distribution. The generators are all connected to the turbines by gearing. The latter two turbines were built by Escher, Wyss & Co., and the first mentioned by J. J. Rieter & Co., each for a capacity of 350 hp at 60 r.p.m. and a flow varying from 1,950 to 2,100 second-gallons.

The first-mentioned turbine is of the Jonval type and is connected to a 350-hp. three-phase generator, which at 170 r.p.m. gives 420 amp. per phase, 400 volts and 51 cycles. This generator is directly coupled to a 4-pole exciter, giving at 170 r.p.m. 150 amp. at 40 volts. A separate switchboard is used for this private installation.

The two other turbines are of Francis type and run at 60 r.p.m. The generators coupled to them are of the same size and type as the one used with the Worsted Works turbine. The exciters are direct-coupled and are similar to the one last described.

The switchboard for the control of these two generators and exciters consists of an iron framework having a white marble front. The exciter panel carries for each exciter one ammeter, voltmeter, double-pole switch lever and regulating hand wheel. Each generator panel carries an ammeter, voltmeter, wattmeter, lever for operating high-tension switch, handle for carbon circuit-breaker and hand wheel for regulating. The regulating wheels of the generators are connected by a Gall's chain. The general panel carries an ammeter and voltmeter for measuring the power sent to the lower station and a contact voltmeter with relays and acoustic signal. The panel housing contains transformers, resistances, etc.

Favoring Submarine Boats.

A report has been received at the War Department from a board of artillery officers, composed of Major Arthur Murray, Capt. C. J. Bailey and Capt. C. F. Parker, in regard to the recent test of the submarine boat *Protector* at Fort Adams, Mass. The report has been referred to the General Staff for consideration. The board recommends, in consequence of its conclusions, that five of these boats be purchased for use in submarine defence, as follows: One for the school of submarine defence, for experimental work; one for the eastern entrance of Long Island Sound, one for the entrance of Chesapeake Bay, one for San Francisco harbor and one for Puget Sound. The report says:

"The board believes that this type of submarine boat is a most valuable auxiliary to the fixed mine defence, and in cases where channels cannot be mined owing to depth, rough water, swift tides or width of channels, it will give the nearest approach to absolute protection now known to the board. The boat can lie for an indefinite time adjacent to the point to be defended in either cruising, awash or submerged condition, by its anchors or on the bottom ready for instant use, and practically independent of the state of the water and in telephonic connection with the shore, or can patrol a mined or unmined channel invisible to the enemy and able to discharge its torpedoes at all times. In narrow channels the boat or boats would have a fixed position with a telephone cable buoyed or anchored at the bottom. In wide channels they would patrol or lie in mid channel or where they could readily meet approaching vessels. With picket or scout boat, outside the mine field, or even at extreme range of gun fire, telephone communication can be sustained and information received and instructions sent for attacking approaching vessels.

"For an attack the boat shows great superiority over any existing means of attacking mine fields known to the board. It can run by any field, as installed at present, with but little or no danger from the explosion of any particular mine or from gun fire during the few seconds it exposes the sighting hood for observations and can attack at its pleasure vessels in the harbor. The board personally witnessed the ease with which cables can be grappled, raised and cut. While the boat is manœuvring on the bottom mine cables can be swept for, found and cut, or a diver can be sent out for that purpose. The board recommends consideration of the foregoing by the General Staff.

"The question of the use of the Whitehead torpedoes as part of the fixed mine defence, fired from tubes on shore, is now receiving consideration. Where channels are wide and water is swift this use of the Whitehead will be very limited. With boats of this type the Whitehead can, it is believed, be carried within certain effective range in all ordinary channels, and this alone will warrant the consideration asked for."

Petrus Peregrinus—Author of the Earliest Treatise on the Magnet, 1269.

BY BROTHER POTAMIAN, D.SC., LOND.
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THE magnetic lore of classic antiquity was scanty indeed, being limited to the attraction which the lodestone manifests for iron. Lucretius (99-55 B.C.), however, in his poetical dissertation on the magnet, contained in *De Rerum Naturo,* Book VI[1], recognizes magnetic repulsion and to some extent the magnetic field with its lines of force, for in verse 1040 he writes:

> Oft from the magnet, too, the steel recedes,
> Repelled by turns and re-attracted close.

And in 1042:

> And oft in brazen vessels, may we mark
> Ringlets of Samothrace, or fragments fine,
> Struck from the valid iron bounding high,
> When, close below, the magnet points its powers.

The poet Claudian (365-408 A.D.) wrote a short idyl on the attractive virtue of the lodestone and its symbolism; St. Augustine (354-430), in his work *De Civitate Dei,* records the fact that a lodestone, held under a silver plate, draws after it a scrap of iron lying on the plate. Abbot Neckam, the Augustinian (1157-1217), distinguishes between the properties of the two ends of the lodestone, and gives in his *De Utensilibus,* what is perhaps the earliest reference to the mariner's compass that we have. Albertus Magnus, the Dominican (1193-1280), in his treatise, *De Mineralibus,* enumerates different kinds of natural magnets and states some of the properties commonly attributed to them; the minstrel, Guyot de Provins, in a famous satirical poem, written about 1208, refers to the directive quality of the lodestone and its use in navigation, as do also Cardinal de Vitry in his *Historia Orientalis* (1215-1220); Brunetto Latini, poet, orator and philosopher, in his *Trésor de toutes Choses,* printed in Paris in 1260; Raymond Lully, the Enlightened Doctor, in his treatise, *De Contemplatione,* begun in 1272, and Guido Guinicelli, the poet-priest of Bologna, who died in 1276.

The authors of these learned works were too busy with their pen to find time to devote to the close and prolonged study of natural phenomena necessary for fruitful discovery, and so had to content themselves with recording and discussing in their tomes the scientific knowledge of their age without making any notable additions to it.

But this was not the case with such contemporaries of theirs, as Roger Bacon, the Franciscan, and his Gallic friend, Pierre de Maricourt, commonly called Petrus Peregrinus, the subject of the present notice, a man of academic culture and of a practical rather than speculative turn of mind. Of the early years of Peregrinus, nothing is known save that he studied, probably, at the University of Paris, and that he graduated with the highest scholastic honors. He owes his surname to the village of Maricourt, in Picardy, and the appellation Peregrinus, or Pilgrim, to his having visited the Holy Land as a member of one of the crusading expeditions of the time.

In 1269 we find him in the engineering corps of the French army then besieging Lucera, in southern Italy, which had revolted from the authority of its French master, Charles of Anjou. To Peregrinus was assigned the work of fortifying the camp and laying mines as well as of constructing engines for projecting stones and fire-balls into the beleaguered city.

It was in the midst of such warlike preoccupations that the idea seems to have occurred to him of devising a piece of mechanism to keep the astronomical sphere of Archimedes in uniform rotation for a definite time. In the course of his work over the new motor, Peregrinus was gradually led to consider the more fascinating problem of perpetual motion itself with the result that he showed, at least diagrammatically, and to his own evident satisfaction, how a wheel might be driven round forever by the power of magnetic attraction. "This is the first recorded contrivance of the kind," writes Dr. Park Benjamin, in his "Intellectual Rise in Electricity," "which came into the world and probably served a good purpose," p. 166. "It was the beginning of that arch-delusion in mechanics which ran for centuries parallel with the arch-delusion in chemistry and with consequences very similar," p. 168.

Elated over his imaginary success, Peregrinus hastened to inform a friend of his at home; and that his friend might the more readily comprehend the mechanism of the motor and the functions of its parts, he proceeds to set forth in a methodical manner all the properties of the lodestone, most of which he himself had discovered. It is a fortunate circumstance that this Picard friend of his was not a man learned in the sciences, otherwise we would probably never have had the remarkable exposition which Peregrinus gives of the phenomena and laws of magnetism. This letter of 3,500 words is the first great landmark in the domain of magnetic philosophy, the next being Gilbert's *De Magnete,* in 1600.

The letter was addressed to Sigerus de Foucaucourt, his "amicorum intimus," the dearest of friends. A more enlightened friend, however, than the knight of Foucaucourt was Roger Bacon, who

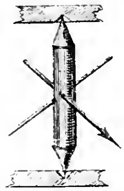


FIG. 1.—DOUBLE-PIVOTED NEEDLE OF PEREGRINUS, AFTER BERTELLI.

(*The magnet is arrow-shaped. The second needle is made of silver or copper, a non-magnetic substance; it was probably intended to be used as a pointer.*)

held Peregrinus in the very highest esteem, as the following glowing testimony shows: "There are but two perfect mathematicians," wrote the English monk, "John of London and Petrus de Maharne-Curia, a Picard." Further on in his *Opus Tertium,* Bacon thus appraises the merits of the Picard: "I know of only one person who deserves praise for his work in experimental philosophy, for he does not care for the discourses of men and their wordy warfare, but quietly and diligently pursues the works of wisdom. Therefore, what others grope after blindly, as bats in the evening twilight, this man contemplates in all their brilliancy because he is a master of experiment. Hence, he knows all natural science whether pertaining to medicine and alchemy, or to matters celestial and terrestrial. He has worked diligently in the smelting of ores as also in the working of minerals; he is thoroughly acquainted with all sorts of arms and implements used in military service and in hunting, besides which he is skilled in agriculture and in the measurement of lands. It is impossible to write a useful or correct treatise in experimental philosophy without mentioning this man's name. Moreover, he

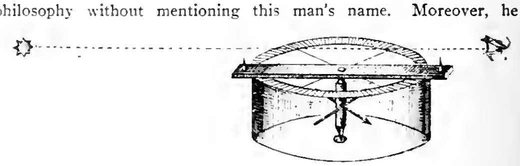


FIG. 2.—GRADUATED COMPASS OF PEREGRINUS, AFTER BERTELLI.

(*The Azimuth bar moves independently of the magnet, and carries a pair of terminal pins for sighting a star near the horizon.*)

pursues knowledge for its own sake; for if he wished to obtain royal favor he could easily find sovereigns who would honor and enrich him."

This last statement is worthy of the best utterances of the twentieth or any other century. Say what they will, the most ardent pleaders of our day for original work and laboratory methods cannot surpass the Franciscan monk of the thirteenth century, in his denunciation of mere book learning or in his advocacy of experiment and research, while in Peregrinus, the mediævalist, they have Bacon's impersonation of what a student of science ought to be. He was a hard worker, not a mere theorizer, preferring, Procrustean-like, to make theory fit the facts rather than facts the theory; he was a brilliant discoverer who knew at the same time how to use his discoveries for the benefit of mankind; he was a pioneer of science and a leader in the progress of the world.

An analysis of the "Epistola" shows that

[1] With very few exceptions all the works referred to in this notice will be found in the Wheeler Collection in the Library of the American Institute of Electrical Engineers.

(*a*) Peregrinus was the first to assign a definite position to the poles of a lodestone, and to give directions for determining which is north and which south;

(*b*) He proved that unlike poles attract each other, and that similar ones repel;

(*c*) He established by experiment that every fragment of a lodestone, however small, is a complete magnet, thus anticipating one of our fundamental laboratory illustrations of the molecular theory;

(*d*) He recognized that a pole of a magnet may neutralize a weaker one of the same name, and even reverse its polarity;

(*e*) He was the first to pivot a magnetized needle and surround it with a graduated circle, Figs. 1 and 2;[2]

(*f*) He determined the position of an object by its magnetic bearing as done to-day in compass surveying; and

(*g*) He introduced into his perpetual-motion machine, Fig. 3, the idea of a magnetic motor, a clever idea, indeed, for a thirteenth century engineer.

This rapid summary will serve to show that the letter of Peregrinus is one of great interest in physics as well as in navigation and geodesy. For nearly three centuries it lay unnoticed among the libraries of Europe, but it did not escape Gilbert, who makes frequent mention of it in his *De Magnete*, 1600; nor the illustrious

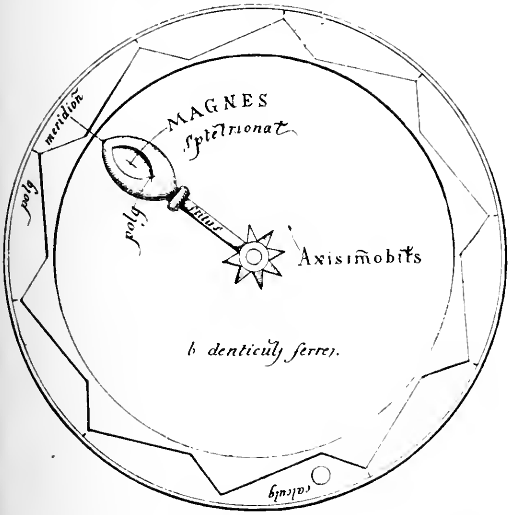


FIG. 3.—THE CONTINUOUSLY-MOVING WHEEL, OR MAGNETIC MOTOR, OF PEREGRINUS, AFTER GASSER.

Jesuit writers, Cabæus, who refers to it in his *Philosophia Magnetica*, 1629, and Kircher, who quotes from it in his *De Arte Magnetica*, 1641; it was well known to Jean Taisnier, the Belgian plagiarist, who transferred a great part of it verbatim to the pages of his *De Natura Magnetis*, 1562, without a word of acknowledgement. By this piece of fraud Taisnier acquired considerable celebrity, a fact that goes to show the meritorious character of the work which he unscrupulously copied.

This memorable letter is divided into two parts: the first contains ten chapters on the general properties of the lodestone; the second has but three chapters, and shows how the author proposed to use a lodestone for the purpose of producing continuous rotation.

There are many manuscript copies of the letter in European libraries: the Bodleian has six; the Vatican, two; Trinity College, Dublin, one; the Bibliothèque Nationale, Paris, one; Leyden, Geneva and Turin, one each. The Leyden MS. has acquired special notoriety from a passage which appears near the end of it in which reference is made to magnetic declination and its value given; but Prof. W. Wenkebach, of The Hague, has shown[3] that the lines are spurious, having been interpolated in the manuscript in the early part of the sixteenth century.

The Leyden manuscript has also led some writers to believe in a fictitious author of the letter, one Peter Adsiger, or Petrus Adsigerus.

[2] It is probable that Flavio Gioja, some fifty years later added the compass-card and attached it to the magnet.
[3] Annali di Matematica Pura ed Applicata, 1865.

As said above, Sigerus was the name of his countryman, to whom Peregrinus addressed his letter, the *Epistola ad Sigerum*, from the trenches at Lucera, in August, 1269.

The first printed edition, now very rare, was prepared by Achilles Gasser, a physician of Lindau, a man well versed in mathematics, astronomy, history and philosophy. The work was printed in Augsburg in 1558. A copy of this early print is among the treasures of the Wheeler collection in the library of the American Institute of Electrical Engineers, New York. It was from this text that the translation which will follow this introductory notice was made.

Besides the Latin edition of Gasser, 1558, there is also that of Bertelli, 1868, and Hellmann, 1898. Bertelli's is an exhaustive and learned work in which the Barnabite monk, sometimes called by mistake, Barnabita, instead of Bertelli, collates and compares the readings of the two Vatican codices with other texts, adding copious references and explanatory notes. It appeared in the *Bulletino di Biografia e di Storia delle Scienze Mathematiche e Fisiche* for 1868.

Of translations, we have that which Richard Eden made from Taisnier's pirated extracts, the first dated edition appearing in 1579. Cavallo's *Treatise on Magnetism*, 1800, also contains some of the more remarkable passages; Libri's *Histoire des Mathématiques*, 1838, has a full version made from an original manuscript in the Bibliothèque Nationale. The only complete English translation that we have, appeared in 1902 from the scholarly pen of Prof. Silvanus P. Thompson, of London. It is an *édition de luxe* beautifully rubricated, but limited to 250 copies. The translation was based on the texts of Gasser and Hellmann, amended by reference to a manuscript in the author's possession, dated 1391. We are informed that Mr. Fleury P. Mottelay, of New York, the learned translator of Gilbert's *De Magnete*, possesses a manuscript version by Prof. Peirce, of Harvard, of the Paris codex, of which he made a careful study in an endeavor to decipher the illegible parts.

Predetermination of Transformer Regulation.

BY EMERSON G. REED.

THE predetermination of the regulation of a given transformer from its design is a very simple matter in the case of a non-inductive load. With such a load the lost voltage, neglecting the effects of hysteresis and eddy currents, is the resistance drop in primary and secondary winding. Due to the effects of magnetic leakage, that is leakage of lines of force between primary and secondary winding, it becomes a more difficult matter to predetermine the regulation with an inductive or capacity load. The amount of this leakage depends upon the shape of the transformer, the relative

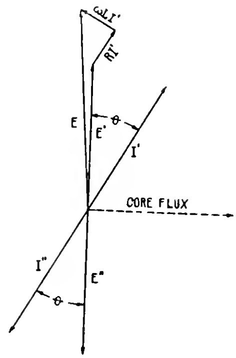


FIG. 1.—TRANSFORMER REGULATION.

position of primary and secondary windings, the number of primary turns and upon the current in the coils.

It is the object of this article to give some examples of a method of calculating the effects of this leakage which the writer has used with success in a large number of cases.

It can be shown that the effect of this magnetic leakage is equivalent to an outside inductance, L, connected in series with the primary winding.

Imagine a transformer (Fig. 1) whose secondary e.m.f. is E'', supplying current I'' through such a load that the angle of lag between

E'' and I'' is θ. The angle between I' and E', the primary counterparts of E'' and I'', is also θ.

The primary impressed e.m.f., E, is made up of three components, the part E', the resistance drop $R\,I'$, and the part $\omega\,L\,I'$ lost in the inductance L. The quantity R may be called the equivalent primary resistance of the transformer and in like manner the quantity L may be called the equivalent primary inductance ($\omega = 2\pi\ f$, f being the frequency of the alternating current).

We may reconstruct the part of Fig. 1, in which we are particularly interested, to larger scale and study it in detail. (See Fig. 2.)

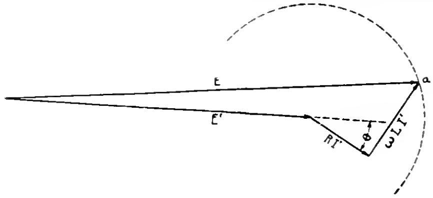


FIG. 2.—TRANSFORMER REGULATION.

The point a may take any position on the dotted circle depending on the value of the angle θ. The part in which we are now interested is the calculation of the quantity L.

It can be shown that

$$L = 4\pi\,n^2\,\frac{\lambda}{l}\left[\frac{X+Y}{3}+g\right]$$

(See Franklin & Williamson's "Alternating Currents" and J. P. Jackson's "Alternating-Current Machinery.")

In this equation, n is the number of primary turns and the quantities X, Y, g and λ are shown in Fig. 3. When the quantities are

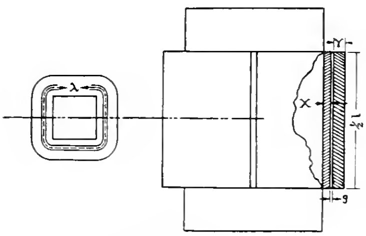


FIG. 3.—TRANSFORMER REGULATION.

given in c.g.s. units, L will be expressed in centimeters, which, when divided by 10^9, gives henrys.

When L has been determined, it is an easy matter to work out graphically from Fig. 2 the value of E, and from thence the regulation. It is more accurate to determine analytically the value of E, as the quantity $E\,I'$ and $\omega\,L\,I'$ are small compared to E'.

DATA ON LINE OF COMMERCIAL TRANSFORMERS.

K.W. capacity.	Per cent core loss.	$\frac{\lambda}{l}$	$\frac{X+Y}{3}+g$	L	Per cent $R\,I'$	Per cent $\omega\,L\,I'$	Per cent impedance drop.
½	4.40	1.10	1.05	.363	3.60	1.73	4.00
1	2.80	1.07	1.08	.192	3.20	1.80	3.68
1½	2.34	1.05	1.12	.135	2.90	1.90	3.47
2	2.00	1.03	1.15	.104	2.60	1.95	3.25
2½	1.80	1.00	1.17	.0852	2.42	2.00	3.14
3	1.67	.99	1.20	.0750	2.33	2.10	3.13
4	1.52	.95	1.25	.0585	2.18	2.20	3.10
5	1.40	.92	1.30	.0490	2.09	2.30	3.11
7½	1.23	.85	1.41	.0355	1.93	2.50	3.16
10	1.12	.81	1.50	.0288	1.83	2.70	3.26
12½	1.05	.78	1.60	.0245	1.74	2.88	3.36
15	.98	.76	1.67	.0215	1.68	3.03	3.46
20	.87	.73	1.80	.0178	1.60	3.35	3.71
25	.80	.71	1.92	.0154	1.55	3.60	3.92
30	.76	.70	2.02	.0137	1.50	3.85	4.13
40	.69	.69	2.20	.0115	1.38	4.30	4.52
50	.65	.68	2.40	.0101	1.29	4.70	4.90

To check the calculated results after the transformer has been built, the secondary may be short-circuited and voltage applied to the primary until full lead current flows through the secondary. The primary applied or the impedance voltage is the vector sum of $R\,I'$ and $\omega\,L\,I'$.

The preceding table gives the calculated data on a line of commercial core-type transformers. The calculated values of impedance voltage were found to correspond very closely to the experimental values.

Calculation of the Equivalent Ampere-Turns of Windings for Single and Polyphase Currents.—I.

By C. F. Guilbert.

The calculation of the mean ampere-turns produced by alternating currents in the armature of an alternator, or in the primary or secondary windings of an asynchronous motor, has been treated by several authors, and for the first time by Prof. Blondel in his interesting study on "rotary fields."[1]

Unfortunately, Prof. Blondel, as well as most writers who have followed him, gives only the result of calculations in the form of tabulations, and then only for the case of windings where the slots of the same phase are placed, for each pole, one following the other. Such cases we shall designate as separate phase windings. Though this type of winding is equally applicable to coils and bars, at times it is desirable to utilize in an alternator with a revolving armature, a direct-current winding. This is particularly true in the case of self-exciting alternators, and sometimes, notwithstanding the recognized inherent defects of this kind of winding, for the rotor and stator of asynchronous motors. Such direct-current windings we shall designate as superposed phase windings. The study printed in these columns in issues of October, November and December, 1902, on the reaction of alternator armatures, led to a general formula admitting of the calculation of the equivalent m.m.f. per pole of a single-phase or polyphase winding, of the separate phase type in the latter case. This formula includes the case treated by Prof. Blondel.

The determination of the equivalent m.m.f. of an elementary coil of a winding, which was the starting point of the study just mentioned, also enables the establishment of formulas relating to the case of superposed windings. The present object is to deduce formulas of simple form for the cases apt to occur. First, however, we shall give briefly and in a manner much more simple than in the above-mentioned articles, the method of finding an expression for the equivalent m.m.f. of any elementary coil of an alternating-current winding, limiting it, however, to the case of asynchronous motors—that is, to the case in which the width of the flux is always equal to the polar step.

EQUIVALENT M.M.F. OF AN ELEMENTARY COIL.

To determine the equivalent m.m.f. of a coil of N turns during a half period—that is to say, the continuous m.m.f. producing a flux equal to the useful turning flux—we will calculate the m.m.f. of the field for any point of the armature (supposed to have a speed corresponding to that of synchronism) for all the relative positions having a half period; then the mean value of that m.m.f. at the point considered, and finally the mean m.m.f. for all the points comprised in the width of a polar step, a.

$$\text{Let } i = I_0 \cos\frac{\pi x}{a} \qquad x = \frac{2at}{T}$$

be the expression for the assumed maximum current at the moment when the axes of the field and armature poles coincide, I_0 being the maximum value of the current $I_0' = I\sqrt{2}$ for an output of current I, and x the variable phase displacement, during rotation, of the axis of one field pole with respect to the corresponding armature pole. Consider (Fig. 1) a point A of the armature at a distance y from the pole axis, and the variation at that point of the m.m.f. during a half period.

Let b be the peripheral length of a coil between the axes of two slots containing it. So long as the displacement is less than $\frac{b}{2} - y$, the point remains under the inducing coil and the m.m.f. decreases

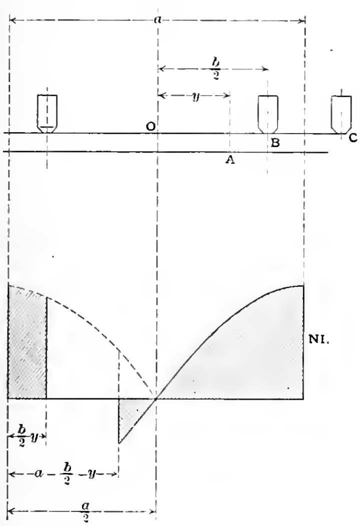
[1] A. Blondel. Quelques propriétés générales des champs magnétiques tournants. *Eclairage Electrique*, tome IV., page 24; 1895.

simply as $\cos\frac{\pi x}{a}$ (Fig. 2). For $x = \frac{b}{2} - y$, the line of force passing the given point does not leave the inducing coil, the m.m.f. falls to zero and remains so until the displacement becomes greater than

$$O B + B C = \frac{b}{2} - y + a = a - y - \frac{b}{2}$$

From this moment the m.m.f. changes sign, since it passes under the elementary coil of the following field pole. It diminishes in absolute value to zero for a displacement equal to $\frac{a}{2}$, then increases again, after having changed sign with the current, until the end of the half period.

We will obtain the mean value of the m.m.f. at the given point by



FIGS. I AND 2.—CALCULATION OF AMPERE-TURNS.

referring to the hatched surface and taking account of the negative part. It is easily seen that this surface has for expression,

$$2 \int_{0}^{a-y-\frac{b}{2}} N I_0 \cos\frac{\pi x}{a}\,dx - \int_{\frac{b}{2}-y}^{a-\frac{b}{2}-y} N I_0 \cos\frac{\pi x}{a}\,dx$$

which reduces to $\frac{2}{\pi}\sin\frac{b}{a}\frac{\pi}{2}\cos\frac{\pi y}{a} N I_0$.

To obtain the mean m.m.f. over the width of the polar step, it suffices to take, as previously stated, the mean of all the means when y varies from $-\frac{a}{2}$ to $+\frac{a}{2}$, whence

$$\mathfrak{F} = \frac{1}{b}\frac{2}{\pi}\sin\frac{b}{a}\frac{n}{2} N I_0 \int_{-\frac{a}{2}}^{+\frac{a}{2}} \cos\frac{\pi y}{a}\,dy,$$

which reduces to $\frac{4}{\pi^2}\sin\frac{b}{a}\frac{\pi}{2} N I_0$; and substituting the value $I\sqrt{2}$ for I_0 we have

$$\mathfrak{F} = \frac{4}{\pi^2}\sin\frac{b}{a}\frac{\pi}{2} N I \sqrt{2}.$$

When each coil of the armature comprises several concentric coils and separated from each other by two slots, it suffices, evidently, to apply the formula to each and take the sum of the results, in virtue of the principle that the integral of a sum is equal to the sum of the integrals of the parts. This will be done in the next part of this article.

The Gas Engine for Central Station Service.

At the February meeting of the New York Electrical Society Mr. Ralph D. Mershon read a paper with the above title, giving the results of a recent study of the engineering aspects of the gas engine question, in the course of which Mr. Mershon visited most of the large gas engine installations and manufactories both in this country and abroad. The paper sketches the theory of the gas engine, points out the important bearing of compression as affecting the initial temperature, and describes in detail the four-cycle and two-cycle types of engines.

Taking up the subject of governing, it is stated that only two methods have been used to any great extent practically. One of these is the method used with the original Otto engine and still much employed, especially with engines of the older type. This method consists in causing the engine to miss one or more working strokes. That is, instead of there being a working stroke in every four there would at light loads be a working stroke in every eight or every twelve, depending upon the load which the engine was carrying. This method of governing has the disadvantage of requiring a heavy fly-wheel, and that even with a heavy fly-wheel there will be considerable variation in speed. It has the advantage, however, of high efficiency at all loads, since whether the load be heavy or light the quality of the mixture and the compression previous to ignition are the same. The irregularity of the speed, however, consequent on this method of operation is such as to render it unsuitable for many kinds of work, especially for the driving of alternators in parallel.

The method usually employed, therefore, in governing gas engines, especially those of large sizes, and for electrical work, is that of varying the amount of mixture admitted to the cylinder at the same time endeavoring to keep its quality constant. With heavy loads when the engine is taking a cylinder full or practically full of explosive mixtures, the mixture can be suited for the compression which takes place, but with lighter loads it is evident that since the cylinder must be full the only way to preserve the quality of the mixture the same or approximately the same will be to endeavor to stratify the contents of the cylinder. That is, to first admit air to the cylinder and then a layer of the mixture, endeavoring to admit the mixture in such a way that it will not mix with the air, or at any rate to only a small extent, and so that at the back end of the cylinder, at least, there shall be a mixture sufficiently rich to properly ignite under the compression which has taken place. Whether or not this stratification actually does take place has been the subject of considerable dispute, but whether this theory be wholly or only partially correct or not correct at all, the fact remains that engines are operated successfully in the manner described. In one engine, at least, that of M. Letombe, the endeavor has been made to secure reliability in the matter of ignition independently of any question of stratification by making the compression higher at light loads, thus not only making the ignition more certain, but also increasing the efficiency of the engine at light loads over what it would be without the increase of compression.

After developing the principles of gas generators, the paper describes a particular form, represented in Fig. 1. At the left is shown the generator filled with the fuel from which the gas is to be obtained. This fuel burns at the bottom of the generator by reason of the air admitted to it at that point through the grate bars shown. The air, however, is not admitted by itself but is forced in along with and by means of a steam jet entering the fire box below the grate bars by way of the pipe shown, the steam being supplied by the boiler *B*. The mixture of air and steam coming in contact with the hot fuel at the grate bars, the air burns a portion of the fuel, thus forming carbonic oxide gas and supplying heat to split up the steam into its elements, the oxygen of the steam combining with a certain proportion of the incandescent carbon to form carbonous oxide. As this combination of carbonic oxide, carbonous oxide and hydrogen passes up through the hot bed of carbon, the carbonic oxide takes up an additional atom of carbon, forming carbonous oxide. There passes over the generator, therefore, by way of the pipe *B*, a mixture of hydrogen, carbonous oxide and the nitrogen contained in the air required for the process along with a small proportion of carbonic oxide. The generator is fed as shown by a properly sealed opening at the top, so that it may be charged without interfering with its operation.

After leaving the gas generator the hot gases pass out through the pipe *B*, heating in their course the water in the boiler as previously

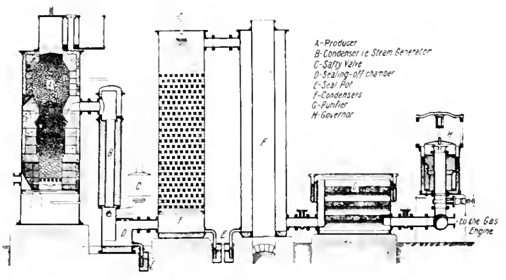


FIG. 1.—GAS GENERATOR.

mentioned and forming the steam for use in the generator. The gases then pass into the scrubber and the cooling chamber, *F*, *F*, in which the gas is cooled and cleaned by a spray of water sent through a checker work or through loosely piled coke. It then passes through the purifier, *G*, which removes such dust as there may remain in it and takes out the superfluous moisture. *H* is a small gas tank or equalizer for reducing the pulsation in the main occurring at the time when the engine is drawing a supply of gas.

There are many other forms of gas generators, but most of them operate on a principle simliar to that above described. This particular generator gives satisfactory results only with anthracite coal or coke. The generators for using bituminous coal require a somewhat different method of construction and operation from that described, because of the fact that with bituminous coal there are given off a number of tar products which must be either all converted into gas or completely washed from the gas before it is used in the engine. If the gas contains any considerable amount of these tar products, there will be a great deal of trouble in the operation of the engine due to the gumming up of the cylinders and valves. The problem of a gas generator for bituminous coal has not in the past received as much attention as that for anthracite coal or coke, and is not now so generally in use. There are, however, a number of bituminous coal gas generators on the market at this time, although most of them depend for their success upon a complete washing of all tar products from the gas before it is used. There are some generators, however, which may be now considered as having passed the experimental stage in which all or practically all of the products of the coal are converted into gas and the amount of washing or scrubbing required is, therefore, comparatively small. It seems pretty certain that a number of these generators of different makes will shortly be upon the market. Mr. Mershon stated that while in Germany he saw two generators of this kind in operation, one of which, both as to the principle used and as to the results which had been so far obtained, seemed to give every evidence of fulfilling the requirements. In a number of the bituminous generators in which the products of distillation are not all converted into gas there are obtained in the course of purification by-products of sufficient value to enable in some cases a return of about one dollar per ton of coal used over and above the expenses of operating the plant; such a showing as this cannot, however, be made except in plants of considerable size, and in small plants the installation of a by-product plant is not worth considering. The thermal efficiency of these gas generating plants is generally about 80 per cent.; that is, the gas produced by them contains about 80 per cent. of the total calorific power of the coal used.

Mr. Mershon stated that the cost of the gas engine is considerably in excess of that of the steam engine, and as compared with the steam turbine the discrepancy is even greater. There is a point of difference between the steam prime-movers and the gas engine which further exaggerates any relative cost which may be given per horse-power. The steam turbine and steam engine have a certain amount of overload capacity. That is to say, they are capable of operating, though at somewhat impaired efficiency, at loads considerably in excess of their rated output or the output at which they give the best performance. The gas engine, however, has, properly, no overload capacity. Its performance improves up to the point where it cannot carry any further load and at which any further loading causes it to slow down. This is not strictly true for engines of the two-stroke type, which have a slight overload capacity beyond the point of best performance, but this overload capacity does not exceed 20 per cent. of the rating capacity and is probably less. With the four-stroke engine, however, the statement as regards overloads holds.

It is necessary, then, in purchasing gas engines to provide for a rated capacity approximately equal to the overload which will have to be carried at any time, so that a comparison of prices on the basis of the cost per horse-power does not always give a correct idea of the relative costs, because in the case of the gas engine we must provide for a greater total number of rated horse-power. The quoted prices on the gas engines in this country at the present time vary quite surprisingly. Depending on the maker quoting, the prices on a horse-power basis range from 60 per cent. greater than for a steam engine to over twice the steam engine figures. In comparing the gas engine with the steam turbine prices we find a still greater discrepancy. In order to make the comparison it is necessary to add to the cost of the gas engine, the price of a suitable alternator, since the steam turbines are always furnished with the alternator which they drive. If this is done it will result in a cost per kilowatt of output at least twice as great in the case of the gas engine as in the case of the steam turbine, and if the comparison be made on the basis of a suitable overload capacity, the discrepancy will be even greater.

The cost of the gas generating plant for use in connection with

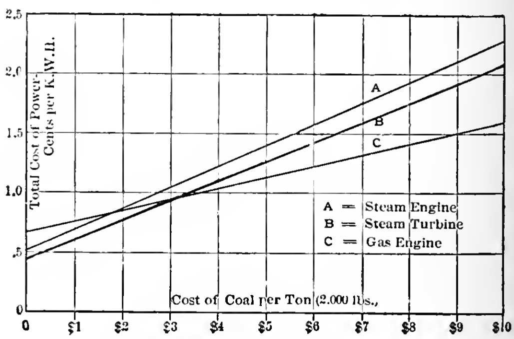


FIG. 2.—COMPARATIVE CURVES.

the gas engine may be taken as being about twice the cost of the steam boilers necessary for use in connection with a steam prime-motor. This is for a simple gas generator and cleaning plant, without any installation for the production of by-products.

It will be seen, therefore, that the cost of a gas engine plant, including the necessary gas generator, is considerably in excess of the cost of a steam plant for the same service, especially if the steam prime-movers be turbines. The cost of maintenance and the figure which must be taken for depreciation on such plant is, therefore, correspondingly higher, and the cost of the attendance also greater, since it requires a somewhat better class of men to handle a gas plant. On the other hand, the efficiency of the gas plant is very much better than that of the steam plant, the gas plant requiring for the same service about half the coal required by the steam engine plant and a little more than half that required by the steam turbine plant.

In order to give an idea as to the relative costs of electric power by the three types of plant, and the influence that the cost of fuel has upon the cost of power, figures were presented for a steam engine plant, a steam turbine plant and a gas engine plant, for the same service. In these figures everything is included properly chargeable against the cost of power.

It is assuming in each case that current is to be supplied to a load having a load factor of .5, and that the peak load is 1,500 kw. It is assumed that this load will be carried by four generators having a rated capacity of 400 kw each, and operating when necessary at 25 per cent. overload. The generators are to be cut in and out of service in such a way that the average efficiency of each unit will be the same as though it ran continuously at 75 per cent. of its rated capacity. The thermal value of the coal is taken as 12,500 B.T.U. per pound, and it is assumed that this coal will evaporate seven pounds of steam when burned under the boilers, and when used in the gas generators will produce gas having a total thermal value of 10,000 B.T.U. It is assumed that a steam pressure of 150 pounds is to be used and that the steam is to be superheated to 150° F. above its normal temperature. Under these conditions the following figures for performance are taken, being such as will be guaranteed by the makers of the various pieces of apparatus: Steam engine, 12 pounds per brake hp-hour; steam turbine, 18 pounds per kw-hour; gas engine, 10,000 B.T.U. per brake hp-hour.

Suitable modifications of these values were made to take care of the fact that the units are to run at 75 per cent. of their rating capacity, and to take care of condensation and auxiliaries in the case of the steam plants. Making use of these figures in connection with the costs necessary for such estimates, there were obtained the results embodied in the curves in Fig. 2. It is to be understood that these curves include everything properly chargeable against the cost of power, including interest, depreciation and renewals on the whole installation and supplies, labor and fuel. The line *A* shows the cost for a steam engine plant, *B* for a steam turbine plant, and *C* for a gas engine plant. The slope of these lines shows in each case the increase in power cost as the cost of the fuel increases. The point at which the line *C* crosses the other two lines shows the cost of fuel at which the gas engine plant is on a parity with the steam engine plant and the steam turbine, respectively, as regards the total cost of power. These curves give us an idea, therefore, of the cost of fuel at which it would begin to pay, under the present prices for apparatus, to install a gas engine plant rather than a steam plant. As will be seen from the curves, the gas engine plant and the steam engine are at a parity with coal costing about $1.85, while the point of equality with respect to the steam turbine plant is with coal at about $3.

It is believed that these curves show the relative performance of such plants under the condition assumed pretty fairly no matter what modifications might be made in the estimates, since while the modifications might change to some extent, the actual value for the cost of power, the relative value will not be much changed by a modification common to all of the plants. It should be borne in mind also that these figures are made on the assumption of a load having a load factor of .5, and that for more continuous service the gas engine will make a much better showing. It should also be borne in mind that these estimates are made without reference to any recovery of by-products, and that such recovery would very materially alter the showing made.

An inspection of these curves at the point where the value of the fuel is zero shows very plainly that, if, as it has sometimes been proposed to do, plants be installed at coal mines for the generation of power, a steam turbine and not a gas engine plant should be used unless a plant for the recovery of by-products be made a part of the installation.

The relative values here arrived at will no doubt have to be changed with the progress in the gas engine art. The gas engine equipment will become cheaper as its use becomes more general, and Mr. Mershon considers that this, in connection with the fact that some hard work is being done in the endeavor to produce a gas turbine, permits one to look forward to a time not far off when gas prime-movers of some sort will be installed instead of steam prime-movers.

Western Union and Wireless Telegraphy.

The Western Union Telegraph Company is now collecting and distributing messages for the marine service of the Marconi Wireless Telegraph Company of America. Postal Telegraph and Marconi have for some time past been working under a similar arrangement. The Marconi message for transmission to ocean steamers may now be accepted at any telegraph office in the United States or Canada.

Calculation of Motor Starting Rheostats.

By F. MEURER AND A. SIMON.

IN the ELECTRICAL WORLD AND ENGINEER of January 9 Mr. A. H. Ford gives a method for the calculation of motor-starting rheostats, which appears to be the same method suggested in *Elektrotechnische Zeitschrift,* 1894, page 644, by Prof. Görges, for shunt motors. At the same time Mr. Görges gave a diagram for the various steps of the rheostat. This method seems to be little known in America, but has been familiar to engineers of Germany for years, where it is held in favor on account of its simplicity. The method is as follows, using the same notation as Mr. Ford:

It will be seen from equation (a) that the steps

$$R_m = a R_a \ (1 + a)^{m-1}$$

follow a geometrical progression. The sum of the first m steps is:

$$R_1 + R_2 + R_3 + \ldots R_m = a \ R_a \ \frac{(1+a)^m - 1}{(1+a) - 1}$$

$$= R_a \ [(1+a)^m - 1].$$

Including the resistance of armature and connections, we have:

$$R_a + R_1 + R_2 + \ldots R_m = R_a \ (1 + a)^m.$$

This equation follows also a geometrical progression, when m has in

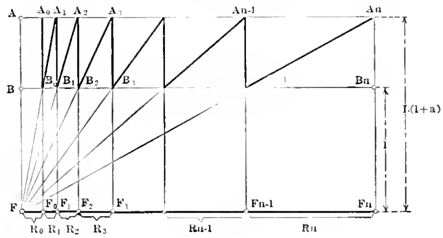


FIG. 1.

turn values 1, 2, 3 . . . m . . . . n, and will give a geometrical construction of the steps of the resistance. Referring to Fig. 1,

$$F F_0 = R_a$$

and $\triangle \ F B_0 F_0 \propto F A_1 F_1$:

therefore,

$$\frac{F F_1}{F F_0} = \frac{F_1 A_1}{F_0 B_0} = \frac{I \ (1 + a)}{I} = 1 + a.$$

Further, $F F_1 = R_a \ (1 + a) = R_a + R_1,$

and

$$\frac{F F_2}{F F_1} = \frac{F_2 A_2}{F_1 B_1} = \frac{I \ (1 + a)}{I} = 1 + a,$$

or $F F_2 = F F_1 \ (1 + a) = R_a \ (1 + a)^2 = R_a + R_1 + R_2$, etc. Knowing R_a and assuming the minimum (I) and normal current (I_0) and $a > o$, the number of steps, n, is found from formula (b). In the above diagram the value of the various steps are, therefore, found sufficiently correct, without any calculation.

The same diagram also shows the speed of the armature at the time when the various steps are short-circuited, in the points B_{n-1} . . . . . . B_3, B_2, B_1, B_0, corresponding to the currents I and the time during which the lever has to touch the contact of this step, before the latter is cut out. At the moment, when the *mth* step is cut out,

$$E_{am} = E - I \ (R_a + R_1 + \ldots . + R_m)$$

$$= I R_a \ [(1 + a)^n - (1 + a)^m]$$

E_{am} the counter e.m.f. is proportional to the speed v; therefore, v_m *prop* $(1 + a)^n - (1 + a)^m$.

Transferring the above developed relations to the diagram, the geometrical measuring is easily understood. Fig. 2 is the diagram of the speeds. The end of the starting period is of especial interest. In point B_0 the last step is short-circuited, the current rises for the last time to the value $I \ (1 + a)$ to point A_0, and then it decreases according to the rule,

$$I_t = I_0 + [I\ (1 + a) - I_0]\ e^{-\frac{t}{T}},$$

accelerating the armature according to

$$v_t = v - (v - v_n)\ e^{-\frac{t}{T}},$$

where v is the constant speed for I_0; v_t and I_t the speed and current t seconds after the short-circuiting of the starter; T a constant depending on the moment of inertia of the rotating masses, the angular velocity and the resistance, R_a.

Owing to the asymptotic character of these equations, the constant and normal current and speed are reached after an infinite time; in

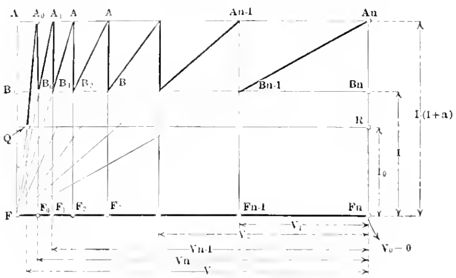


FIG. 2.

practice, however, this condition is reached in a short time. In Fig. 2 the constant speed for the current I_0 and the voltage E is $Q\ R$.

In the time that elapses between the touching of two successive steps there is an average excessive current above the normal current I_0 which is between the values $I\ (1 + a) - I_0$ and $I - I_0$. This current, which is of the same amount for all steps, accelerates the armature with an average acceleration as follows:

$$v_m - v_{m-1} = p.t,$$

$$v_m - v_{m-1}\ prop.\ [(1 + a)^n - (1 + a)^{m-1} - (1 + a)^n + (1 + a)^m],$$

$$v_m - v_{m-1}\ prop.\ (1 + a)^m - (1 + a)^{m-1},$$
$$prop.\ a\ (1 + a)^{m-1}.$$

According to equation (a),

$$R_m = a\ R_a\ (1 + a)^{m-1};$$

therefore, t is proportional to R_m. It is found that the time, during which the lever has to touch each contact before touching the following one, is proportional to the resistance of the respective step. This relation is important for the dimensioning of the capacity of the resistance of each step, when the starter is to be designed for intermittent duty.

The three diagrams may be united in a single one, which contains all the points of interest in calculating a motor starter, the resistances of the various steps, the speeds and the starting times.

A simple way of finding the different steps with the slide rule is given by E. Pochin (*Elektrotechnische Zeitschrift* 97, p. 346). After

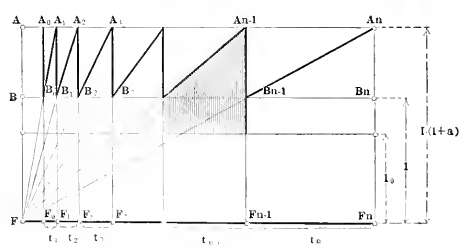


FIG. 3.

Mr. Görges, F. Erens (*Elektrotechnische Zeitschrift* 99), Neidt (*Elektrotechnische Zeitschrift* 99, No. 2), and Bragstadt gave simple diagrams for series motors, and Max Müller (*Elektrotechnische Zeitschrift* 02, p. 513), for dynamic brake rheostats for series motors. Similar diagrams have been developed for field rheostats for shunt dynamos and motors by Mr. Krause and others. On account of limited space, we cannot attempt to detail all of these methods, but would refer to the excellent book, "Die Gleichstrommaschine," by E. Arnold, Vol. II, where they are lucidly described.

The Design of Motor Starting Rheostats.

BY MAX FREIMARK.

The article of Mr. Arthur H. Ford in your issue of January 9 leads me to submit a similar and well-known method for designing motor-starting rheostats.

Assuming that the object is to make the starting current, always equal to the normal current i, $i_s = i$. If, in this case, R is the entire resistance of the armature, connections and starter, E the line e.m.f. (see Fig. 1), then we have the equation:

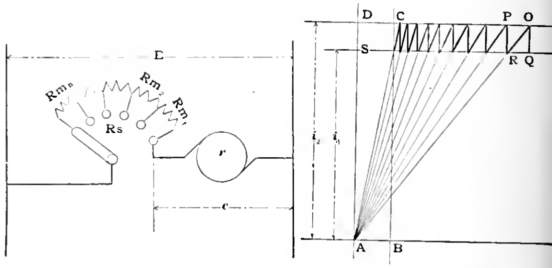
$$R = \frac{E}{i} = \frac{E}{i_s}.$$

If e is the motor e.m.f., r = the resistance of the motor, then $E - e$ $= i\,R$, or $i_1 = \dfrac{E - e}{R_s + r}$, R_s being the starter resistance,

$$i_2 = \frac{E - e}{R_s + r - R_{m_n}},$$

when one section (R_{m_n}) is cut out.

As stated by Mr. Ford, there will be a continual increase and



FIGS. 1 AND 2.

decrease of the current between i_1 and i_2, as is to be seen from Fig. 2.

The ratio of these extreme currents may be λ

$$\lambda = \frac{i_2}{i_1}, \text{ or } \lambda = \frac{R_s + r}{R_s + r - R_{m_n}} = \frac{R}{R - R_{m_n}} = \frac{R}{R_{n-1}},$$

n being the number of sections.

$r_1 = r + R_{m_1};$

$r_2 = r + R_{m_1} + R_{m_2};\ \ldots\ldots$

$r_n = r + R_{m_1} + R_{m_2} + \ldots + R_{m\,(n-1)} + R_{m_n} = R$

$$\frac{r_n}{r_{n-1}} = \frac{r_1}{r} = \frac{r_2}{r_1}, \text{ etc.}$$

$r_1 = \lambda\ .\ r;$

$r_2 = \lambda\ r_1 = r\ .\ \lambda^2$ as $r_1 = \lambda\ .\ r;\ \ldots\ldots$

$r_n = \lambda\ .\ r_{n-1} = r\ .\ \lambda^n$

That is to say, the resistance must increase geometrically with λ.

$$\frac{r}{R} = a$$

When $i_s = i$ then $a = \varepsilon =$ per cent. e.m.f. loss, since

$$E = i_s\ R,$$

$$\varepsilon\ .\ E = i\ .\ r,$$

$$= \frac{i}{i_s} \cdot \frac{r}{R} = a$$

As now $n = \dfrac{-\log a}{\log \lambda}$, the number n of sections is fixed by the allowed drop of pressure in the armature.

The following table gives some usual values of a and n, and shows the influence of λ the ratio of i_2 and i_1:

a = 0.03	0.04	0.05	
λ			n
2.02	1.91	1.82	5
1.42	1.58	1.35	10
1.26	1.24	1.22	15
1.19	1 17	1.16	20
1.12	1.11	1.10	30
1.09	1.08	1.08	40
1.06	1.055	1.05	60

The conditions are shown graphically in Fig. 2, where

$$AB = CD = r,$$

$$QS = r_n\ ;\ RS = r_{n-1},\ \text{etc},$$

$$\frac{OD}{RS} = \frac{AD}{AS} = \frac{i_2}{i_1},$$

$$\frac{OD}{RS} = \frac{r_n}{r_{n-1}},$$

$$\frac{OD}{PD} = \frac{r_n}{r_{n-1}} = \lambda$$

The Choice of Wattmeters.

BY H. P. DAVIS.

I HAVE read with interest the views regarding the choice of wattmeters expressed by Messrs. MacGahan and Howe in recent issues of your journal. The important part played in electrical economy by the service meter makes this subject one worthy of careful consideration, and as it is possible that a comparison of the statements made by these gentlemen may be of some value, I beg to submit the following conclusions reached by a study of the subject as thus presented.

It is well to note that Mr. MacGahan and Mr. Howe agree in fundamentals, but differ in the application of theory to practice. They unite in saying that the prime requisite in a wattmeter is accuracy over a long period of time. They, however, take issue in regard to the way in which long-lived accuracy is to be attained, and the relative value placed upon various functions and features common to such instruments, and it seems to me that their differences are mainly those caused by the difference in their point of view. Mr. MacGahan favors a meter for which he claims accuracy within 2 per cent.; Mr. Howe insists that he does not find that such a claim is borne out by the meter with which he is familiar. Mr. MacGahan espouses a sealed meter in which the factory calibration is preserved intact; Mr. Howe thinks it preferable to furnish meters unsealed, that customers may have the ready access to the adjustments which he finds necessary. Mr. MacGahan asserts that the friction of the counting train is negligible; but Mr. Howe's observations lead him to believe to the contrary. Mr. MacGahan prefers a high ratio of torque to friction in conjunction with a light, movable element and reduced friction; Mr. Howe thinks the desired long-lived efficiency can best be secured by increasing the torque through the use of a heavier movable element with the increased jewel wear. Each of these gentlemen doubtless states the facts as he finds them in his personal experience, and a ready assent can be given to their assertions in the main, so far as they are the results of personal investigation in a limited field. It is only when a general application is made that their claims require especial comment.

Mr. MacGahan says that all the variations of actual service should not produce a maximum error in registration of over 2 per cent. of the rated capacity. This Mr. Howe denies, claiming that a variation in standards will ordinarily be 1 per cent., while a 10 per cent. variation in frequency or voltage will cause an error of an equal amount, making it possible for other influences to combine to produce an error in excess of the 2 per cent. Mr. Howe may find such conditions prevailing in his field, but meter experts who are accustomed to the handling and testing of the sealed type of meters of high sensibility and with light, movable elements, can testify that the maximum aberration for a 10 per cent. variation in frequency and voltage rarely exceed ½ per cent., leaving practically 1½ per cent. of margin for variations in standards, errors in observations, etc.

Mr. MacGahan's contention that a sealed meter possesses material advantages over one not sealed, and Mr. Howe's arguments in favor of an open instrument simply carry along an old discussion which must, after all, be decided by the individual companies using wattmeters, and by their meter experts. Mr. Howe assumes that a sealed meter is a delicate and intricate one, which the manufacturers dare not leave open, and that the presence of the seal discourages the owner from making his own repairs. Would it not be more logical to assume that a meter which can be finally adjusted at the factory for use upon a circuit, can be shipped to destination, carried to the point of installation in the lineman's wagon and put into service with no attention from the meter expert, possesses an unusual degree of strength and stability? Instead of the absence of a seal being a virtue and a feature to be desired, is not the ordinary meter expert liable to think it a weakness, particularly when he reflects that the meter was left unsealed because he must make a final adjustment of the movable element after the meter is installed, its construction being such that it cannot be shipped ready for service?

All manufacturers of wattmeters, whether sealed or open, guarantee the materials and workmanship of their instruments. If the purchaser of a sealed meter does not care for the advantages thus gained, he can easily break the seals, and obtain exactly the same conditions as those given by an unsealed meter. He will have an instrument, the workmanship and material of which are guaranteed, but without any means of knowing whether the adjustments have been tampered with, and, therefore, no guaranty of the calibration.

The benefits derived from preserving the factory calibration made by trained experts are constantly winning new recognition, as instances multiply where this calibration has proven of value. In one installation, after 1,400 wattmeters had been used for over two years under the factory seal, only 18 of them required any attention, and these were easily restored to their original accuracy by the local meter expert, who did not find the seal any impediment to his making new adjustments or repairs. The ordinary meter man, who desires to give his employers the best of results, would naturally be expected to prefer a guaranteed calibration of known accuracy to the dubious privilege of freely changing adjustments when such changes are made an inevitable part of the operation of installation.

Mr. MacGahan claims that the friction of the counting train is negligible, but Mr. Howe affirms that such is not the case. Apparently the difference is again one of construction. Mr. MacGahan's statement is evidently based upon the use of a pinion upon the shaft of the moving element, which engages the counting train, the inevitable worm being placed where the speed is lower and the leverage of the gears increased; while Mr. Howe's counter statement is as evidently based upon the fact that he has in consideration a meter with a worm upon the shaft, with greatly increased friction. Any meter expert who has at his command meters with the different forms of construction can easily demonstrate that while with the pinion and gear he cannot detect any difference in operation whether the counting train is connected or removed, there is a very appreciable decrease in friction when the counting train is removed from a meter which employs a worm on the shaft.

Mr. MacGahan declares for a high ratio of torque to friction, and Mr. Howe for a high torque with heavier movable element and consequent increase in friction. Now, both state that the prime requisite is length of accurate service. If it be true—as experience has amply shown—that wattmeters first develop weakness through wear in the jeweled bearing, does it not logically follow that any increase in friction which shortens the life of this bearing reduces the length of accurate service? A powerful drag or pull upon the rotating medium is of value in overcoming friction, particularly upon light loads, when the ratio of friction to torque is highest, since friction is a fixed quantity, while torque varies with the load; but any increase in torque gained at the expense of the life of the jewel is an injury rather than a benefit. The wise designer will first reduce the friction to the lowest possible point by using the best bearings he can devise and by lightening the weight of the movable element as much as he can and still have ample torque for accurate registry upon light loads for any length of time under normal conditions of jewel wear.

Hiccoughs Cured by Electricity.

Frank Green, of Trenton, N. J., was recently attacked with severe hiccoughing. After three days of suffering an electric current was, according to a dispatch from that city, applied to his body. At first light currents were used and afterwards increased in strength. Improvement was noted from the first application, and finally, with a sudden shock, the paroxysms ceased.

Telephone Transmitters.—VII.

By Arthur V. Abbott, C.E.

Testing Transmitters and Receivers.—To determine the merit of transmitters or receivers is one of the most difficult of tests. This is chiefly because there is no recognized standard or unit of measure. People vary enormously both in their ability to talk and to understand, over a telephone line entirely apart from the ability of the apparatus to transmit and reproduce sound. Hence, what to one person seems sufficient will be perhaps more than adequate to another, and unsatisfactory to a third. It is common to test transmitters and receivers by arranging a circuit between two rooms out of earshot of each other, in one of which the transmitters are placed and in the other the receivers. An inspector at the transmitter end counts from one to ten in a rather loud, sustained tone into one instrument after the other, while another inspector at the receiving end forms the best conclusion he may as to the relative efficiency of the various instruments. While trained observers develop an astonishing skill in detecting differences in transmission, such a method compared with the more exact measurements of other branches of electrical engineering appears crude in the extreme.

To the practical man quality of transmission is proportional to the ability to understand each word individually without requiring his correspondent to repeat it, and that combination of transmitter and receiver is the best which, over lines of varying lengths, requires on the whole the least repetition. For testing purposes, therefore, it is necessary to provide a transmitter and receiver with which with all other instruments may be compared, and a variable line over which tests can be made. As there is no established standard instrument, it matters little what ones are selected for this purpose, for all results will be relative only. In a general way two of the best instruments obtainable should be taken, set aside for the purpose and used for nothing else. For the line nothing can excel an actual working line, but as tests should include trials over at least a thousand miles of wire, there are few who can avail themselves of such a plant, and it is equally difficult to carry on experiments on a commercial circuit. It is, therefore, better to build an artificial line exclusively for test purposes. For this purpose a number of coils of wire can be made each of which shall represent, by having the same resistance, inductance and capacity, a certain section, say ten or one hundred miles of line.

The artificial line is best made by preparing 220 spools of wood. Each spool should have a 1-in. hole through its center and be about 3½ in. over all in diameter and 3½ in. high. The flanges and core should be about ¼ in. thick, leaving a winding space about 3 in. x 3 in. The spools should be made of soft wood thoroughly baked and boiled in paraffine. To represent aerial lines No. 20 wire is a convenient size to use, while for cable lines No. 28 or No. 30. Each spool should be wound with sufficient wire to represent 10 miles of open wire or 1 mile of cable. To secure the proper inductance more or less of the wire can be wound non-inductively, so that each spool when finished shall have accurately the resistance and inductance of either 10 miles of open wire or 1 mile of cable. The necessary capacity is best secured by making a small condenser of tin-foil and paraffined paper, exactly like a sub-station condenser. For each pair of wire spools the condenser should have a capacity of .1 mf. and for each cable wire spool .08 mf. When completed a frame is to be prepared having two long rubber or glass rods. On each rod 110 coils, 10 representing 10 miles of cable wire, and 100 each representing 10 miles of open wire, are placed. Between the two rods a substantial wooden strip is arranged underneath which the condensers are secured, and on top of which there are a number of brass plugs similar to those used in Wheatstone bridges. A condenser is joined between each pair of coils, and all coils are connected in series through the plugs, so that each plug when in its place short-circuits a pair of coils. Thus any combination of cable and open wire up to 1,010 miles can be obtained. Such an apparatus can be built for about $500, and while seemingly elaborate and expensive is essential for the proper testing of telephone apparatus.

For actual trials there should be three inspectors—a speaker, a listener and a manipulator—for in order to avoid the unconscious error due to personal equation, neither the speaker nor the listener should know anything about the apparatus they are testing, which should be arranged in all cases entirely independently of their knowledge. The three rooms are necessarily entirely distinct from each other, both visibly and audibly. The transmitters should be placed in room No. 1, the artificial line in No. 2 (the middle one), and the receivers in No. 3. In the following method of testing the listener must be an expert stenographer, and the method consists in finding the percentage of errors between sentences uttered in the transmitter and those received with varying line length. The first thing is to determine the *error coefficient* of the speaker and listener. The speaker reads to the listener in the usual conversational tone, and at a fair rate of speed, 10 sections of 1,000 words each, of 10 different subjects. The listener then transcribes the 10 selections, and the manipulator compares the transcription with the original and counts the number of errors made. This is the *error coefficient* and is usually from 3 per cent. to 5 per cent. The manipulator then, unknown to both speaker and listener, adjusts either a transmitter or a receiver to be tested, for only one instrument can be tried at once. The speaker then reads to the listener over the telephone line 10 different selections of 1,000 words each. After each set of 1,000 words the manipulator changes the length of the line. The listener then transcribes the shorthand notes, the manipulator compares with the original and counts errors. The results may then be plotted as a function of line length, and by making a number of such tests with different transmitters and receivers quite accurate relative results can be secured.

The curves of Fig. 54 are illustrative of the method. The horizontal scale is the length of the artificial line in miles, while the left-hand scale is percentage of error. The line marked "error line" is the percentage of normal errors, when the speaker read directly to the stenographer. Curves *A*, *B* and *C* show the results of tests on three rather well-known types of transmitters working with the same receiver. Transmitter *A* showed the least percentage of error. Instrument *B* showed about 2 per cent. more error on short lines and 30 per cent. more on long lines, indicating a deficiency in volume. Instrument *C* was poorer than *B* on lines up to 200 miles, and subsequently gave marked falling off in volume.

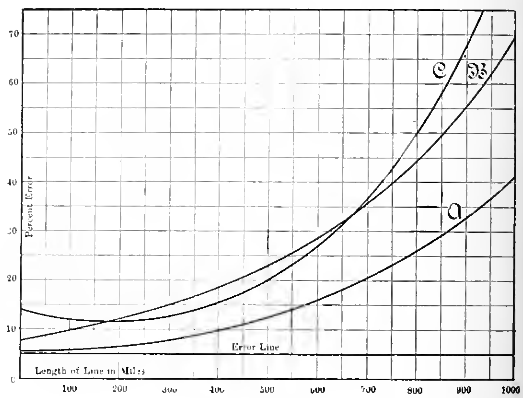


FIG. 54.—CURVES OF TESTS.

Tests as thus described show what may be termed the *general efficiency* of transmission. It is also well to compare volume by actuating the transmitter by an organ pipe, blown by a blast of constant pressure, and measuring the distance from the ear of an observer at which the sound first becomes audible. The listener should be blindfolded and the manipulator should noiselessly move the receiver to and from the ear of the listener along a graduated scale, noting both the distance at which the sound is first perceived, when the instrument *approaches* the ear, and the point at which sound *fails* to be heard when it recedes. The mean of a number of such tests gives relative volume. To test for articulation the speaker should read to the listener a list of a thousand words of great similarity, such as fine, rhyme, dine, sign, mine, etc.; mowing, rowing, throwing, going, etc. Also the letters of the alphabet in heterogeneous order. These tests should be conducted on different lengths of line and the percentages of errors calculated and plotted as previously described. Finally, a comparison of the general test, and tests for loudness and articulation showing the net result of all three, will give quite acurate ideas of relative excellence.

Methods of Signaling and Operating in Telephone Exchanges.—V.

By KEMPSTER B. MILLER AND CHARLES S. WINSTON.

WESTERN ELECTRIC TOLL SYSTEMS.

THE systems for handling toll business installed by the Western Electric Company are numerous, and differ as widely as the methods it has employed in handling most other branches of telephone service. However, during the period beginning at about the time when the common battery multiple switchboard came into general use and ending about two years ago, two methods stand out conspicuously from the others, as they have been used in many large installations with generally better results. While these two systems were similar in operation and in the results accomplished, they differ materially in many respects.

In each of these systems the connecting links between the toll board and the common battery board are made by means of toll trunk circuits. These circuits end in plugs and lamps at one or more toll-switching positions on the local multiple board, and appear at the toll board in lamps and keys at a recording operator's position, and in jacks multipled through the toll line sections.

These two systems, which will be designated for convenience as "A" and "B," differ mainly in that one of them, system "A," only two wires are used in each trunk circuit extending between the toll board and the local multiple board, while in the other, system "B," three wires are required for the same purpose. Of course, where the toll and local boards are located in the same building, the cost of installing and maintaining three wires for each toll trunk circuit instead of two is of comparatively little moment, and is to be tolerated, if, by doing so, any material reduction in the complexity of the apparatus or gain in the method of operation is to be effected. Where, however, the toll board is located at a considerable distance from the local board or boards, as is usually the case in large cities, the use of three wires for each toll trunk circuit becomes a serious matter, and is generally avoided.

System "A" probably owes its existence to this difference more than to any other one thing.

In neither system are cord circuits provided at the recording operators' positions, as keys, in the toll trunk circuits, which are located in the face of the board, furnish means for doing all of the work required.

The clearing-out drop ordinarily used in the cord circuits in both systems is an electrically restoring drop of the well-known Western Electric type, which is restored whenever the operator throws the listening key which is connected with the corresponding cord circuit. Each of these drops is wired through an additional key so that it may be cut out of circuit in case of a very long-distance connection over which talking is difficult, in which the bridge afforded by the drop across the circuit might interfere with the transmission.

WESTERN ELECTRIC TOLL SYSTEM "A," USING TWO WIRES IN TOLL TRUNK CIRCUITS.

In this system, which is the one used until recently by the Bell Companies in cities where the toll board was at a considerable distance from the local board, a repeating coil is located in each toll trunk circuit, and on this account the toll switching operator at the local board rings the bells of common battery subscribers for whom long-distance calls are received. The cord circuits used by the toll operators in establishing connections between toll and common battery subscribers are the same as those used in making toll-to-toll connections. In order to inform the toll-switching operator at the local board when the subscriber whom she has been ringing answers, a ringing lamp is provided in connection with each toll trunk plug at the toll switching position; and in order to give this operator a signal for taking down the connection, a disconnect lamp also is associated with each of the trunk plugs at her position.

The operation of this system is as follows, reference being made to Fig. 9. A common battery or local subscriber desiring to converse with a toll subscriber will signal his operator in the ordinary manner, and on the response of the operator will ask for "long distance." The operator will then speak over an order wire to a toll switching operator at the local board, and tell her that a certain subscriber desires a toll connection. The toll trunk operator will then insert a toll trunk plug which is not in use into the multiple jack of that line, and the subscriber's operator will remove the answering plug from the answering jack of the subscriber's line. The act on the part of the toll trunk operator of inserting the toll trunk plug into the multiple jack will, since the subscriber of that line has his receiver off the hook, light a lamp with a white cap, located in the face of the toll board at the recording operator's position. The lighting of this lamp corresponding to any toll trunk line is therefore dependent, first, on the toll trunk operator having made a connection between the end of that line and the line of a subscriber; second, on that subscriber having his receiver off the hook. The recording operator, in response to this signal, will throw the listening key associated with

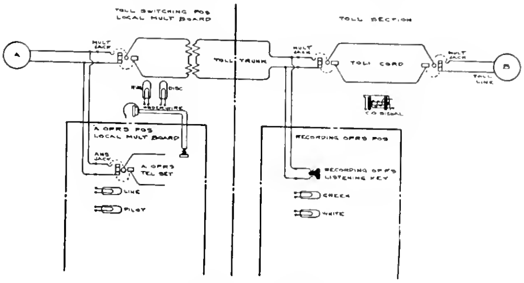


FIG. 9.—SHOWING CONNECTION OF LOCAL TO TOLL SUBSCRIBERS. WESTERN ELECTRIC "A."

this lamp and located directly below it. This act will extinguish the white lamp and light in its place a green one. It will also connect the operator's telephone circuit to the toll trunk line, and therefore enable her to communicate over it with the subscriber. She is thus enabled to make out a ticket containing the proper data for the toll connection, and will pass it on to one of the toll line operators. Having done this she will restore her listening key, but in doing so she will not extinguish the green lamp, as it remains lighted until the toll operator in taking up the connection inserts a plug into the multiple jack of the toll trunk line.

The purpose in furnishing two lamps at the recording operator's position is to make it impossible for the recording operator, after she has answered the call and before the toll operator has taken up the connection, to forget that she has already responded to the signal of the white lamp, and again speak to the subscriber. If one lamp only were furnished, it would be necessary to arrange it so that it would relight when the recording operator threw the listening key back to its normal position; in order to enable the subscriber to signal while waiting for the toll operator to respond.

The toll line operator having received a ticket from the recording operator, will insert the answering plug of a toll cord into a multiple jack of the toll trunk line. This, as before stated, will extinguish the green lamp at the recording operator's position. She will then insert the calling plug into the multiple jack of the desired line, and thus, after ringing, bring the two subscribers together for conversation.

At the end of the conversation the clearing out signal will be received at the toll board by the falling of the drop in the toll cord circuit. Having received the clearing-out signal, the toll operator will remove the calling and answering plugs from the toll line jack and the toll trunk jack, respectively. The act of withdrawing the answering plug from the trunk jack will light the disconnect lamp at the toll trunk position, and the toll trunk operator will remove the plug from the multiple jack. The act of taking down the connection at both the toll position and the toll switching position has no effect upon the signals at the recording operator's position, that operator having finished all duties in regard to the connection when she passed the ticket to the toll operator.

When a toll subscriber desires to converse with a multiple board subscriber, he will signal the toll line operator in the regular manner by throwing down the line drop at the toll board. Of course, this may be done by the toll operator at a distant exchange. The toll operator will then insert an answering plug into the toll line jack, and after throwing the listening key to find out the number of the common battery line with which the connection is to be established, she will speak over an order wire to the toll trunk operator telling her that a toll connection is to be established with a certain common battery line. The toll trunk operator will designate the trunk for use in establishing the connection, and with the plug of this trunk will test the jack of that line. In case the line is busy, she will insert the trunk plug into a busy back jack which will notify the toll operator by "tone" that the line is busy. In case the line is free, she will insert the trunk plug into the multiple jack. The ringing lamp associated with the trunk plug at the toll trunk position will light immediately, and the toll trunk operator will ring the subscriber. When the subscriber answers the call, this ringing lamp goes out and cannot be relighted without first withdrawing the trunk plug from the jack. This connection is shown in Fig. 10.

At the end of conversation the toll line operator receives the disconnect signal in the same manner as at the end of a local to toll connection, and upon withdrawing the toll trunk plug from the toll trunk jack, lights the disconnect signal at the toll switching position on the multiple board, in the same manner.

The recording operator has nothing to do with establishing a connection from a toll to a local subscriber. In this case the toll line operator does all of the work at the toll board and makes out the ticket without the help of any other operator. Thus, it will be seen, that unless the charge is to be "reversed" the recording operator

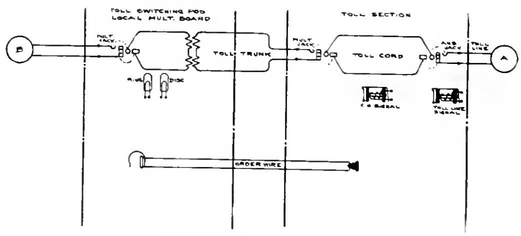


FIG. 10.—SHOWING CONNECTION OF TOLL TO LOCAL SUBSCRIBERS. WESTERN ELECTRIC "A."

always makes out the ticket when the charge is to be made against a common battery line, and the toll line operator when the toll station is to be charged for the connection. This is a guard against making mistakes and charging the wrong party for the conversation. If for any reason after a common battery subscriber has called for a toll connection and the switching operator has inserted a trunk plug into the multiple jack of the calling line and thus lighted the lamp at the recording operator's position, the recording operator does not desire to have the connection made, she will press a push button key associated with the toll trunk line in use, thus extinguishing the lamp at the recording operator's position and lighting the disconnect lamp at the toll switching operator's position.

WESTERN ELECTRIC TOLL SYSTEM B, USING THREE WIRES IN TOLL TRUNK CIRCUIT.

In this system the repeating coil, instead of being included in the trunk line circuit, as in system A, is included in the cord circuit at the toll board. One-half of each of these cord circuits is wired the same as half of a cord circuit at the local multiple board, the other half being wired, as in ordinary magneto practice, the clearing-out drop being bridged across the two strands of the cord. Each cord circuit is equipped with a key which is so wired that when thrown the repeating coil is cut out of the circuit and a straight circuit established between the two plugs so that the same pair of plugs can be used for establishing toll-to-toll connections, as is used for establishing toll to local connections, the only difference being in the position of the repeating coil key.

In this system a disconnect lamp but no ringing lamp appears in connection with the plug of each toll trunk circuit at the multiple switchboard end, but the toll trunk circuit contains no repeating coil, and therefore the toll line operators ring the bells of the local subscribers over these lines instead of having the toll trunk operator do this, as in system A. This is, of course, a better arrangement, and enables the toll operator to be the true master of the situation and to more properly supervise a call than where the toll trunk operator is compelled to do the ringing.

This system has not, to our knowledge, been used except in cases where the toll sections and multiple switchboard are located in the same building.

The operation of establishing a connection between a local and a toll subscriber is exactly the same in this as in Western Electric system A. The parts involved in such a connection are represented in Fig. 11, it being seen that the services of the subscriber's operator, the toll switching operator, the recording operator and the toll operator are all required.

At the end of the conversation a double clearing-out signal will be received at the toll board. The toll subscriber will, by turning his generator crank, throw the clearing-out drop, and, the local subscriber, by hanging up his receiver, will light the supervisory lamp associated with the local side of the toll cord circuit. The toll operator will then throw her listening key so as to restore the clearing-out drop, and listen in to satisfy herself that some one at the toll station does not desire another connection. She will then withdraw the plugs from the toll trunk and toll line jacks. The act of withdrawing the plug from the trunk jack will automatically light the disconnect signal at the switching operator's position on the local multiple board, and this operator will remove the trunk plug from the multiple jack of the local subscriber.

A push-button key is provided at the recording operator's position in connection with each toll trunk circuit, wired so that the recording operator can give the disconnect signal at the multiple switchboard, and extinguish the lamp associated with the trunk line at her own position in case she does not desire to have the connection established.

A toll to local connection is established in practically the same manner as in system A, the toll operator ordering up the connection at the toll switching position by order wire. As in that system, the A operator and the recording operator play no part in a toll to local connection. In this, however, the toll operator, instead of the toll switching operator, rings the local subscriber.

The method of making connections between toll subscribers in these two systems, A and B, is almost identical. In both cases a toll subscriber signals the toll board by turning the generator crank and thus throwing the line drop at the toll board. The operator will insert an answering plug, and after throwing her listening key, speak to the subscriber and find out that a connection is desired with some other toll station. In system A, the cord circuit can be used for making either a toll-to-toll or toll-to-local connection without change, but in system B the cord circuits are normally suited for making

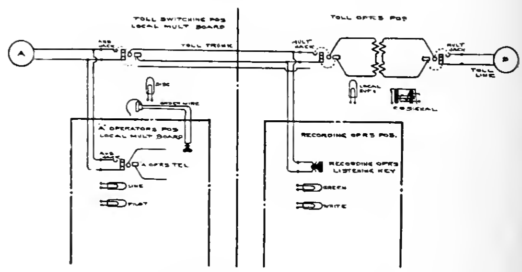


FIG. 11.—SHOWING CONNECTION OF LOCAL TO TOLL SUBSCRIBERS. WESTERN ELECTRIC "B."

connections between toll and local subscribers. On this account it is necessary for the toll operator in system B to throw a key associated with the cord circuit before this cord circuit can be used for connecting two toll subscribers. Having done this the remainder of the operation is the same as in system A. After testing, the operator will insert the calling plug, associated with the answering plug in use, into the multiple jack of the desired line, and ring. Until the subscriber answers, it is necessary for the operator to listen in at short intervals so as to know when the call is answered. The operator who has charge of the calling toll line will make out a ticket and record on it the duration of the conversation, the number of the calling and the number of the called toll stations and the names of the calling and called parties.

Each of these two systems has advantages over the other. A costs less than B, not only on account of having two wires in the trunk circuits instead of three, but because the number of repeating coils is less when located in the trunk circuits than when located in the toll cord circuits. In system A the method of operation at the toll line positions is less complicated, as the same pair of cords is adaptable without change to either toll-to-toll or toll-to-local connections, and the operator is, therefore, required to make no change in her cord circuits. In system B it is necessary after a circuit has been used for one class of service, for the operator to throw the repeating coil key before she can use the pair of cords for the other class of connections.

On the other hand, however, the second system enables the toll operator to properly supervise all toll connections, to ring up a common battery subscriber herself, and at the end of the conversation to receive a lamp disconnect signal directly from the common battery subscriber. This latter much facilitates the work of keeping track of the duration of conversation, as in this case there is no doubt in the mind of the toll operator, whose duty it is to measure the lapse of time, as to when the common battery subscriber is through talking.

New Telephone Patents.

METALLIC FRAME JACK STRIP.

Metallic frame jack strips are without doubt the present standard, and new types and variations of present ones are periodically appearing. The latest development in this line is a jack invented and patented by L. M. Ericsson, of Sweden. This jack is built up in rubber strips secured to a frame plate of sheet brass. The plate is slightly longer than the rubber strip and its projecting ends are designed to slide into slots in the jack stiles, so that the strip is thereby supported. The strip of jacks mounts from the front, being held against the stiles by cover plates, which hide the ends of the jack strips. The cover plates are in lengths equal to the width of five strips, and are secured by screws passing into the jack stiles.

DESK TELEPHONE STAND.

Another invention of Mr. Ericsson is a design for a desk telephone stand of a kind little used in this country. This stand is adapted for use with the hand microphone; that is, a transmitter and receiver mounted upon a handle so that when the former confronts the mouth the latter will be against the ear. Mr. Ericsson's stand is a four-legged metal frame from the top of which a sliding rod projects. The bottom of this contacts with springs which serve the purpose of the ordinary hook switch, while the top carries a cross bar with prongs adapted to receive the hand microphone. The action is almost obvious, the weight of the microphone of course throwing the circuit changer.

CASING FOR TELEPHONES.

In this connection it may be well to consider a patent covering a "Casing for Telephones," as this is designed for instruments of the hand microphone type. Fig. 1 shows a side view of the instrument

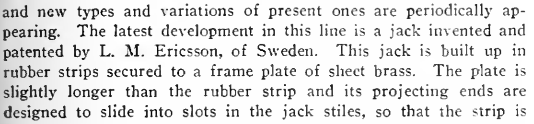


FIG. 1.—HARDEGEN TELEPHONE CASING.

The chief novelty lies in a deparature from the time-honored means of securing receiver caps. The casing of the instrument is of punched metal with a flange left at the rim. The ear piece, of metal also, lies over this, being secured by semi-circular spring pieces which snap in behind the flange of the casing. Paul Hardegen, of Berlin, is the patentee of this instrument.

TRANSMITTER DISINFECTING DEVICE.

A new type of transmitter disinfecting device is that of C. Bravi-Bertini, of Perth Amboy, N. J. This consists of a sprayer in the transmitter fed with disinfectant solution from a small pump which is driven by a linkage secured to the switch hook.

TELEPHONE REPEATER.

The telephone repeater has received still further developments at the hands of Merritt Gally, of Brooklyn. Mr. Gally's earlier work in this direction has been noted in these columns and doubtless his type of repeater will be recalled. His latest work, which is covered by two patents recently issued, is along the same lines, dealing with a bipolar magnet form of his repeater and the circuit best suited to its operation.

RECEIVER SUPPORT.

Another receiver support has been patented. This time means are provided for the automatic return of the receiver to the hook. The receiver support may be deflected in a horizontal direction by the ear of the user and becomes locked in this position. This movement of the supporting arm switches the circuit to the talking condition. If the arm be not restored by the user, central may send a current over the line and through the agency of an electromagnet and release pin, the telephone is allowed to return to the normal position.

AUTOMATIC SYSTEM.

An automatic exchange apparatus, a modification of earlier work, has been jointly invented by Messrs. J. K. Norstrom and J. J. Brownrigg, of Chicago, the patent which they have obtained being assigned to the Globe Automatic Telephone Company. The most interesting feature of this new system lies in the busy test apparatus. This is a relay in series with the subscriber's instrument and located on his premises. In case a desired line is busy the circuits are such that the busy relay at the calling station opens the talking circuit of this station until such time as the receiver has been momentarily at least returned to the switch hook and the switching devices thereby returned to the zero position.

ANOTHER CABLE SUPPORTING CLIP.

This week we have again for consideration a cable supporting clip. This is clearly shown in Fig. 2. It comprises the now usual zinc

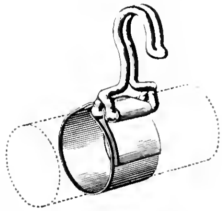


FIG. 2.—VILLARD AND COPELAND CABLE HANGER.

cable-encircling strip and a bent wire supporting hook. In this instance a double form of hook is used so shaped that not only is a locking of the tape about the cable obtained, but the weight of the cable serves to keep the tape tight. Messrs. R. H. Villard and H. P. Copeland, of Jersey City, are the joint inventors of this clip.

A Memorial to James Watt.

A most interesting and laudable movement has just been set on foot by Mr. Andrew Carnegie—ever foremost in good works—namely, to erect a memorial statue at Greenock, Scotland, on the site of the humble cottage in which James Watt, creator of the steam era, was born. The American Committee of the James Watt Memorial has Mr. Carnegie as its chairman and Mr. Theodore Dwight as its secretary and treasurer, with offices at 99 John Street, New York City. The circular just issued states that for the object named: "Subscriptions of small amounts are being solicited in many countries, as it is felt that the memorial should represent the contributions of the thousands who know and appreciate what the invention of the steam engine has meant to the material progress of the world. Should you desire to associate yourself with this movement, kindly send five dollars, or less, and accompany the contribution with your autograph on the enclosed slip. The later is desired for transmission to Greenock to show the number of the American contributions. Our country has, probably, been the greatest beneficiary of Watt's labors, and the committee hopes that the response from the United States will exceed that of any other country in point of numbers, as the number of subscribers is a greater tribute than the amount subscribed."

A great deal of interest is being taken in the project here and the committee formed under Mr. Carnegie comprises Albert R. Ledoux, president American Institute of Mining Engineers; Ambrose Swasey, president American Society of Mechanical Engineers; Charles Hermany, president American Society of Civil Engineers; Bion J. Arnold, president American Institute of Electrical Engineers; Chas. F. Scott, Westinghouse Electric Manufacturing Company; John H. Converse, president Baldwin Locomotive Works; Charles Allis, past president Allis-Chalmers Company; Charles Wallace Hunt, president C. W. Hunt & Co.; S. R. Calloway, president American Locomotive Company; R. A. McKee, International Union Steam Engineers; John C. Kafer, Engineers' Club, New York; J. D. Farasey, American Boiler Manufacturing Association; C. L. Salmons, Brotherhood of Locomotive Engineers; J. J. Hannahan, Brotherhood of Locomotive Firemen; W. J. Gitthorpe, Boilermakers and Iron Shipbuilders of America; C. L. Shamp, International Brotherhood of Stationary Firemen.

Indiana Independent Toll Line Association.

Several independent telephone men from northern Indiana and southern Michigan held a meeting in South Bend, Ind., on February 27 and organized the Northern Indiana and Southern Michigan Toll Line Association. The delegates represented a territory in which there are 15,000 independent telephones and 2,000 or more miles of toll lines. That city has been chosen as headquarters for the clearing house. The officers are: Theodore Tharward, manager of the clearing house; J. K. Johnson, secretary and treasurer. C. A. Reeves, J. S. Scott and C. R. Stoops and the officers compose the traffic committee which will perfect plans. The cities in the combination and the number of telephones in operation are: South Bend, 520; Elkhart and Goshen, 1,742; Michigan City, 750; Knox and Hamlet, 200; Winamac and Kewanna, 350; Makarusa, 175; Millersburg, 785; Dunlap, 150; Warsaw, 400; Plymouth, 300; Rochester, 430; Bremen, 136; Nappanee, 275; Millford, 276; Columbia City, 900; Silver Lake, 125; Star Point, 200; Argus, 65; North Judson, 50; Teegarden, 105; Bristol, 100; Lagrange, 1,600, and Benton Harbor, Mich., 1,575.

CURRENT NEWS AND NOTES.

HIGH TENSION MEETING IN CHICAGO.—The Chicago branch of the American Institute of Electrical Engineers will hold a meeting March 18 to discuss the subject of high-voltage lines.

CANAL TOWING.—A bill has been introduced in the New York Legislature providing that no permit to conduct electric towing experiments shall be granted by Superintendent Boyd for a stretch of canal over five miles long or for a period exceeding three years.

OPENINGS IN JAVA.—Mr. B. S. Rairden, of Batavia, Java, writes: "I believe there is a good opportunity for some enterprising American company interested in electrical material to make good connections here, although it must be prepared to fight German competitors, who are, I am so informed, largely interested in the electrical companies established in Batavia, etc."

TESTING OYSTERS FOR PEARLS.—A new use for the Roentgen rays is announced from Paris. M. Dubois has just read a paper before the Academy of Sciences, which shows that it is possible, by means of the Roentgen rays, to examine the living oyster, without in any way injuring it, and to ascertain whether or not it contains a pearl. If it contains only a tiny pearl the oyster is returned, and is allowed to live until the disease has sufficiently advanced.

ELECTRODE FOR ELECTROLYTIC PURPOSES.—A patent granted on March 1 to Mr. G. J. Atkins, of Tottenham, England, refers to details of construction of a carbon electrode. The current is introduced through a metallic sheet, which is covered by the carbon electrode. Since, however, carbon is always porous and the electrolyte would pass through the pores and attack the metal, the inventor interposes between the carbon and the metal a conducting but water-proof substratum made of finely divided carbon mixed with mineral lubricating oil.

CARBON RESISTANCE.—A patent granted on March 1 to Mr. G. I. Leonard, of Pasadena, Cal., refers to the construction of a plumbago resistance. A sheet of asbestos is coated on both faces with plumbago, applied in the state of a paint or paste with water and sufficient sugar to adhere to the support. The coating is made so thick that the resistance is somewhat higher than desired; after the plumbago is dried it is treated by frictional or rubbing pressure by a scraper or roller until the resistance is brought down to the desired value. The resistance is claimed to remain constant.

METHOD OF FORMATION OF STORAGE BATTERY PLATES.—In a patent granted on March 1 to Mr. O. Frank, of Detroit, Mich., the inventor proposes to treat the lead plates in an aqueous solution of 5 per cent. sodium sulphate and 0.7 per cent. potassium chlorate with a current of 1 amp. (the size of the plates being not given) for 50 hours at about 20° C. The plates are then washed in distilled water and the positive plates are placed in a weak solution of sulphuric acid and used as negatives against positives of lead, the current being "2 amp. for 50 hours." The plates are then washed and dried at a temperature of 300° C.

WIRELESS TELEGRAPH AND WEATHER.—The special correspondent of the New York *Times* cables as follows: "I will mention in this connection a memorial soon to be forwarded to Parliament by the fishermen of Mousehole and Newlyn, who want the weather changed and think the change can be brought about by act of Parliament. It is the candid and deliberate judgment of these fisherfolk that the Marconi wireless telegraph station located near them is the cause of the deluges that are descending on them. 'Take it away,' they say in their memorial to Parliament. Somebody will have to tell these poor petitioners that they are no worse off than the rest of Great Britain, for the whole country is watersoaked."

TAXING CANADIAN POWER.—Assemblyman Remsen, of Brooklyn, has introduced a measure in the New York Legislature which, if passed, he says, will produce $150,000 in revenue for the State. It puts a tariff of $2 on each electrical horse power produced in a foreign country and transmitted, sold or furnished to concerns in this State. It applies, of course, to Canadian concerns. There are a couple of power concerns at Niagara Falls, soon to be put in operation, which propose to furnish electricity for power in this State, and another at Cornwall on the St. Lawrence. Mr. Remsen proposes to tax them heavily. Failure to comply with the proposed law will subject any concern doing business in this State to a forfeiture of its charter and a fine of $100 a day.

A CURIE LECTURE.—Special correspondence to the *New York Times* from Paris of February 23 says: "M. Curie's promised lecture on radium drew vast crowds to the Sorbonne one evening this week. Although the hall in which the world-famed chemist was to speak is built to seat 3,000 persons, numbers who had stood for hours at the door in the Rue des Ecoles were finally turned away, every corner available being occupied by a deeply interested crowd. When the lecturer appeared upon the platform with Mme. Curie they received a magnificent ovation, and every word M. Curie spoke was followed with the closest attention. His account of the work done by M. Becquerel upon uranium, which formed the starting point for his own and Mme. Curie's experiments, was very clearly given, and his lecture was illustrated by tests of the properties of the newly discovered metal. In one series of experiments M. Curie demonstrated that radium emits three sorts of rays, two of which give off such powerful electric emanations that they cause phosphorescence and produce perpetual motion. Then, plunging a tube of radium into liquid air, M. Curie demonstrated in the darkness of the hall that it was a light-radiating body, and that it also gave out heat."

METER.—Four patents for details on electric meter construction were granted on February 23 to Mr. Thomas Duncan. In the first patent a construction is described by which an ordinary integrating meter is associated with a supplementing measuring mechanism which is operated by the main measuring mechanism. The meter with the main measuring mechanism may be located at a somewhat inaccessible place, while the supplementary measuring mechism is placed in a more convenient situation, for instance, in the library or office of the consumer. To allow recalibration, step-by-step adjusting means are provided in combination with supplementary field windings for effecting additive or counteracting torque. The second patent relates to motor-meters, suitable to be used on circuits of different voltages. This is effected by using an auxiliary field winding of which more or less may be switched into the circuit. He also describes details of construction by which he is enabled to polish readily the commutators and brushes of commutator-motor meters, without disturbing the tension adjustment of the brushes. The third patent relates also to details of construction of motor-meters and refers especially to the construction of the spindle bearing point, the manufacture of the spindle in three parts, and the construction of the upper bearing. The fourth patent again refers to the construction of the bearings. In order to render the jewel posts incapable of assuming any except predetermined positions with the meter bases, he relieves the posts of any threaded engagement with the remainder of the meter structures.

IOWA ELECTRICAL ASSOCIATION.—The Iowa Electrical Association will hold its convention this year at Des Moines, Iowa, April 13 and 14. W. S. Porter, of Eldora, is secretary.

VERMONT ELECTRICAL ASSOCIATION.—The annual meeting of the Vermont Electrical Association was held at Rutland on February 24, about 40 members being present. At the evening session Mr. F. J. Vaughn gave an address on "Central Station Meters." There was a display of electrical supplies. The officers elected for the ensuing year are: President, M. Patterson, of Fair Haven; first vice-president, E. D. Blackwell, of Brandon; second vice-president, E. E. Gage, of St. Johnsbury; secretary and treasurer, C. C. Wells, of Middlebury; chairman of executive committee, Frank Barney, Jr., of Springfield.

RADIUM IN TEXAS.—With regard to the recent reports of the discovery of radium-producing minerals in Texas, a correspondent in that State writes that the Nernst Lamp Company is mining rare earths in the locality known as Barringer Hill, which is situated 11 miles from Kingsland, Tex. This region yields gadolinite and five other new and rare minerals. The mining of yttria ore on a large scale, it is stated, gave rise to the reports that radium was being sought. It is stated that the Nernst Lamp Company is trying to purchase more land containing the earths and minerals which it utilizes in the manufacture of its lamps, but the owners have raised the prices to almost prohibitive figures. It is asserted by representatives of the lamp company that the gadolinite which it is mining does not contain radium or radioactive properties. The landowners say, however, that this statement does not agree with the reports of disinterested scientists who have recently conducted tests and examinations of the mineral. These assert that the earths possess a greater amount of radioactive properties than those of any other known region in the world.

SELECTIVE SIGNALING IN WIRELESS TELEGRAPHY.—Two patents were granted on February 23 to Prof. Reginald A. Fessenden. The first relates to a new method of tuning the sending and receiving stations to the same frequency. Electric tuning is efficient, but requires a great deal of care in its operation. Prof. Fessenden prefers, therefore, mechanical tuning. His method is essentially as follows: At the transmitting station electromagnetic waves are generated with a certain predetermined frequency—say, 2,000,000 per second—in groups of a lower frequency—say, 126 per second. For this purpose an induction coil with spark-gap may be used in connection with a make-and-break mechanism for the induction coil actuated by a tuning fork operative at the group frequency of 126 periods per second. At the receiving station the wave-responding device is connected to an indicating mechanism responding only to the group frequency 126. Such a device may consist of an electrically-operated tuning fork torque attached to a telephone tuned to the group frequency 126. Thus, unless the tuning fork or telephone at the receiving station is tuned to the frequency 126, no indications or signals will be produced. Of course, different modifications of this method and combinations are quite feasible. The second patent granted to Prof. Fessenden relates to a device for preventing disturbances from another station in the neighborhood, so that stations may be worked simultaneously while situated close to each other. For this purpose he provides, besides the main conductor of the system, second or auxiliary conductors. They are so proportioned that the effect on the main conductor, of waves emitted from the disturbing station, will be opposed and neutralized by the effect of the disturbing waves upon the auxiliary conductor.

LETTERS TO THE EDITORS.

Alternating Current Commutating Motors.

To the Editors of Electrical World and Engineer:

SIRS:—The question of priority of invention raised by the letter published on page 327 of the ELECTRICAL WORLD AND ENGINEER of February 13 should be considered from the two following points of view: 1st, validity of my patents; 2d, scientific discoveries involved.

Referring to the first point of view, I do not need to show in these columns the novelty of the dispositions described in my United States patent applications, since this matter is to be decided by the United States Patent Office.

Referring to the second point of view, the old United States patent, 476,346, evidently does not concern in any manner the phenomena which I have recently discovered and pointed out, and which alone form the basis of the conception of my series compensated motor as described in several publications. Those phenomena are: (*a*) The disappearance of self-induction in an armature with commutator and short-circuited brushes when running in the vicinity of synchronous speed. (*b*) The induction by such an armature of a rotary field at synchronous speed, if it is revolved in a stator without any magnetic axis of symmetry. (*c*) Perfect commutation at brushes under the above conditions; and, furthermore, (*d*) The screening effect of short-circuited brushes for the ampere-turns of the stator in which the armature is revolved.

The last paragraph of my letter published in your issue of March 5 may lead to a misunderstanding. In fact, the power factor of a repulsion motor is, *for the same air-gap*, much greater than that of a single-phase induction motor. The formula which I have published on the subject of the repulsion motor (*Elektrotechnische Zeitschrift*, 11 June, 1903) proves that the magnetizing current taken by a repulsion motor without load amounts to only half of the current taken by the corresponding single-phase induction motor. (The current corresponding to a zero load in a repulsion motor is obtained by making $\Theta = 0$ in my formula, giving the current taken by the motor at synchronous speed.)

But as a motor for tractive purposes must have a considerable air-gap, the power factor of a repulsion motor for traction approaches that of an ordinary single-phase induction motor.

It is only by using low frequencies, as I have pointed out in the German article above referred to, that it is possible to obtain $\tan \phi = \frac{1}{2}$; that is, $\cos \phi = 0.895$.

NEW YORK. MARIUS LATOUR.

Thawing Out Water Pipes Electrically.

To the Editors of Electrical World and Engineer:

SIRS:—Seeing an article in the February 13 number of your paper, I take the liberty to call your attention to the fact that Mr. Greene, of Altoona, Pa., gives the credit of thawing out water pipes electrically to Messrs. Jackson and Wood. I wish to state that the scheme originated with Frank H. Soden, of Chicago, in the winter of 1898. It was over a year, I believe, before Prof. D. C. Jackson, of the University of Wisconsin, came out with articles claiming that he was the one who first worked it out successfully, and originated the scheme. Furthermore, at the time Mr. Soden hit on his scheme and made it work he applied for a patent, but the Commissioner of Patents would not grant him one, claiming it was too simple.

At the time Mr. Soden demonstrated the practical use of thawing out water pipes by electricity, all of the daily and electrical papers in Chicago had great accounts of it, showing cuts and describing it at length. He had to go to nearly all of the managers of power plants in Chicago to ask permission to try his scheme. They all laughed at him except the Commonwealth Electric Company, on the South Side. It was there he demonstrated the feasibility of thawing out frozen water pipes by electricity.

Mr. Soden is a man of great ability, and was one of the earliest engineers with the old Thomson-Houston Company. He is at present at Pony, Mont., with an electrical process of treating ore, for which the Pony Electric Light Company, of which I am manager, is furnishing him all the current needed gratis, as well as a stamp mill.

PONY, MONT. E. R. AVERY.

Carbon Resistances.

To the Editors of Electrical World and Engineer:

SIRS:—Your issue of February 20 contains in the Digest news, under the heading, "Units, Measurements and Instruments," "Carbon Resistance, Gray," a description of a high resistance made by depositing soot on a glass plate or some other insulating surface. Johnson & Phillips, of Charlton, England, used to make just such resistance when I was a pupil with them away back in 1879. I believe they stopped manufacture, because the soot so deposited had a tendency to crack whenever the glass expanded and so make an open circuit. I think the Nalders, also of England, make a similar kind, but their resistance is set to 1,000,000 ohms, or whatever is required, while the older ones were kept to whatever they measured at first.

Curiously, only last month while I was down in Philadelphia, I suggested the same thing to a foreman of an electric construction company, who wanted a cheap high resistance, to make tests for insulation on completed lines.

WILKESBARRE, PA. E. W. STEVENSON.

Individual Motor Drive.

To the Editors of Electrical World and Engineer:

SIRS:—Your issue of February 20 contains in the Digest of Current Electrical Literature an abstract from an article by Cooper on "Individual Motor Drive," published in full in the current number of *Cassier's,* and also essentially in your convention issue of last June 6. That part of the article covered by the abstract treats essentially of certain rules and deductions laid down by Mr. Cooper for determining the proper size of motor to use in accordance with the methods of speed control adopted. These rules are based primarily upon a certain assumption of Mr. Cooper's, with which many electrical engineers cannot agree. Mr. Cooper's rules, moreover, are being broadly published as established facts by numerous technical and engineering publications. It would appear proper, therefore, to have the leading publication of electrical engineering discuss this article and put the same in a clearer light before the public. If it can be shown that Mr. Cooper's premises upon which he bases his deductions are wrong, or at least not fully proved, his rules will fall to the ground.

In discussing the effect of weakening the field of a motor, Mr. Cooper states as follows: "If it is desired to increase the speed 100 per cent. by field weakening, one must have 100 per cent. margin for sparking at normal speed if the motor is to carry full load at the increased speed." He then jumps to the conclusion, without giving the slightest reason, that in order to obtain this necessary 100 per cent. margin for sparking it is absolutely necessary to double the size of the motor. Nobody will disagree with Mr. Cooper that this method will accomplish effectually the elimination of sparking, and that it is a most excellent one to adopt by those who look with disfavor upon the variable field method of speed control. But is this fair? Is it good engineering or necessary to go to such extremes as this? It is right on this assumption that proof is asked for and found wanting.

Let us get clearly before us what causes sparking with a weakened field, and see if we can find any logical reason for Mr. Cooper's bold jump to conclusions. The magnetic field, due to field winding, and the magnetic field, due to armature winding, make an angle with each other, and the position of the resultant field created thereby shifts relatively in accordance with the relative magnetic strength of the field and armature. If the field magnetism is weakened, the armature magnetism remaining the same, the resultant field will tend to approach more nearly the direction of the field produced by the armature winding when acting alone. This tends to produce sparking by retarding the neutral position back of the brushes. The converse is also true that when a motor is running under light load with full field, the resultant field will then advance towards the direction of the field produced by the field winding when acting alone. This condition also tends to produce sparking at the commutator by moving the neutral point ahead of the brushes. Sparking under this condition is not noticeable, however, chiefly because the quantity of current flowing is small. The destructiveness of a spark is measured by the product of the current into the electromotive force producing it.

Sparking on the commutator is caused by cutting in and out of the line circuit each one of the coils on the armature, as its commutator segments pass under and out from the brushes. The commutator segments connected to each armature coil cause the coil to become short-circuited on itself when its segments pass under the brushes. Each coil will consequently at that time have generated in it an electromotive force which will cause current to flow through the coil in a direction determined by the relative position of the resultant field set up by the combined effect of the field and armature windings. If the armature winding predominates, the current will flow in the short-circuited armature coils in the opposite direction to that of the applied current taken from the lines. If the field winding predominates, the current will flow in the same direction as the line current, and if both windings are such as to bring the coil into the neutral field when said coil is short-circuited by the brushes, no electromotive force will be induced and no current will flow in the coil. It is only under the first conditions, however, that sparking is reduced to a minimum, namely, when current is actually caused to flow in the coil in the opposite direction to that of the line current. When the segments pass from under the brushes, current will then be flowing in the same direction as the line current, since this reverses in every coil as it passes from under the brushes. If this current, therefore, had not been previously created in the coil, its self-induction would resist instantaneous reversal, and the current would largely shunt directly across the segments and produce destructive sparking. This condition, of course, would be still further aggravated if current was caused to flow in the short-circuited coils in the same direction as the line current before the segments of the coils pass from under the brushes. Sparking is still further effected by hysteresis, or the lagging behind of the reversals of magnetism in the armature discs. It is apparent that the effect of hysteresis will increase directly with the armature speed. It seems possible, however, to take advantage of this increased hysteresis at the higher speeds and utilize it to assist in offsetting the effect of a weakened field in increasing the tendency to spark. The effect of weakening the field is to increase the speed and also to allow the armature winding to pull the resultant field back of the non-sparking position of the brushes, while the effect of hysteresis, as the speed increases thereby, is to cause the reversal of magnetism to lag behind, and thus, to a certain degree, counteract the effect of the increased tendency to spark caused by the relatively predominating influence of the armature windings, thus preventing the inducing of too great a current in the short-circuited coils, which otherwise would produce sparking. In a proper design, then, the above two causes which tend to shift the sparking point of the brushes may be so nicely balanced as to allow a very large variation of speed by field weakening. Of course, there are many other details of design to be carefully worked out, and the above theory is merely set forth to show that even the usual theoretical conception of the cause of sparking under variable field conditions is not so difficult of a practical solution as might otherwise appear.

Mr. Cooper goes on to say "that the limit of power of a motor operating under full field strength is the heating effect of the current flowing through the armature, but the limit of power of a motor with a weakened field is the sparking at the commutator." With the cause of sparking clearly before us, it would seem as though these two statements contradict each other. Abnormal currents in the armature produce a similar distortion of field as results from weakening the field magnetism, and the resultant sparking is far more destructive on account of the relatively larger currents producing them. Well-designed motors will not spark seriously at their commutators when carrying double their normal load at full field strength, and their limit of power, as Mr. Cooper states, is the heating effect of the armature current. Such motors practically have a 100 per cent. margin for sparking. Why is it not then perfectly practical to build motors that will develop their full rated horse-power at double their normal speed, with a weakened field, without undue sparking? The current producing the sparking in the latter case is only half as great as in the first, and the cause of the tendency to spark is, perhaps, no greater in one case than in the other.

Theoretically speaking, weakening the field of a motor merely weakens its torque or turning effort, and as the speed increases in direct proportion as the decrease in torque, the horse-power capacity of the motor remains constant within reasonable limits of field weakening. It is certainly true of a great many makes of motors now on the market that they will actually develop the same horse-power at double their normal speed with weakened field, but most of them will spark badly at the commutator on the higher speeds when transmitting their rated horse-power, simply because they were designed to run at a constant speed. It is true, however, that motors can now be purchased that will develop their full rated horse-power over a speed range of 4 to 1 by field weakening, without abnormal sparking, over this entire range of speed. A quotation was received a few days ago from one of the large motor manufacturers for furnishing a suitable frame capable of developing 15 hp at 900 r.p.m. under full field strength, but so wound specially that it would develop 5 hp at 300 r.p.m. with full field and 5 hp at 1,200 r.p.m. with weakened field, without undue sparking at the commutator. This manufacturer consequently starts with a slow-speed motor, capable of developing 5 hp *only* at 300 r.p.m., and makes this motor continue to deliver 5 hp at any speed up to 1,200 r.p.m., without injurious sparking at the commutator.

Mr. Cooper's rule for determining the size of a motor to fill the above specifications reads as follows: "The relative size of motor, as referred to the maximum speed, is as the square of the speed variation when using field regulation." This means that if a 5-hp motor is capable of developing sufficient horse-power at its maximum speed of 1,200 r.p.m. under full field strengh, it will be necessary to employ a size of frame equal to 5 multiplied by 4 square, or 80 hp, in order to develop satisfactorily 5 hp of work over the entire range of speed from 300 to 1,200 r.p.m. That is to say, under Mr. Cooper's rule it would be necessary to use a motor of four times the size as the one guaranteed to do this work in the quotation cited above. Whether or not Mr. Cooper's deductions are practically correct depends entirely, then, upon *who builds the motor.*

In the light of the above statements of theory and fact Mr. Cooper's rules for determining the size of motors are apparently limited to an attempt to obtain a variable speed from a motor distinctly designed to operate at a constant speed.

If motor users will take the trouble to purchase motors designed to operate at variable speed under variable field strength, guaranteed not to spark under full load conditions, at all speeds, Mr. Cooper's rules will be found entirely inapplicable, and the following may be substituted in their place:

(1) The total range of speed using both variable voltage and field regulation will be directly proportional to the range of voltages multiplied by the increase due to field weakening.

(2) The change of horse-power capacity will be directly proportional to the change of voltage on the armature.

(3) The horse-power capacity under variable field strength will remain constant.

(4) The relative size of motor as referred to the maximum speed will be directly proportional to its speed variation when using variable voltages.

(5) The relative size of motor as referred to the maximum speed will be directly proportional to its speed variation when using field regulation.

(6) The size of motor required to develop a constant horse-power over the entire range of speed is *identical,* whether the multiple voltage or weakened field system be used, or any combination of the two.

MILWAUKEE, WIS. H. H. CUTLER.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Voltage Regulation in Alternating-Current Systems.—MEYER.—The first part of a paper read before the Liverpool Engineering Society. He discusses the inherent regulation of generators which is usually defined as the percentage increase in the terminal voltage when full load is taken off the machine, the excitation remaining unaltered, and due allowance being made for variations in speed as caused by the engine regulation. In England sometimes another definition is used, namely, the percentage fall in voltage upon throwing on full load, keeping speed and no-load excitation constant. This definition, however, leads to entirely different figures and should be abandoned. To get close regulation of a machine the ratio of field ampere-turns to armature ampere-turns should be as large as is possible with an economic design. A low armature self-induction is useful by reducing the inductive drop in the armature conductors. For this purpose the winding has to be properly subdivided and so arranged that at the same time the effect of the end connections is minimized, which is of particular importance in machines with a large pole pitch and a small width. The leakage between poles should be as small as possible. For this purpose one has to choose short poles, a large pole pitch and the pole arc in maximum 66 per cent. of the pitch, although these requirements lead to a larger diameter and consequently to a more expensive design. The leakage coefficient is further covered by the length of the air-gap and the iron densities in the machine and increases with the load in about the same proportion as the excitation. The magnetic densities in the poles should be high, so as to introduce a saturated part in the magnetic bath, which will limit the rise in voltage when the load is taken off the machine. Densities of 110,000 to 115,000 lines per square inch are here quite allowable, provided the designer knows exactly the leakage coefficient of his machine and the quality of his material. It is advisable to differentiate between machines which are intended to work on unity power factor or on a power factor, say, not below 0.90, and those intended to work chiefly on a low power factor. In the latter case it is better to use lower densities than mentioned above, although this leads to a more costly design. Finally all parts in the machine should be so proportioned that the resultant wave shape of e.m.f. and current resembles as closely as possible a sine wave. Some of these points are illustrated by the author by means of diagrams and tables. Not only the size and cost of alternators are unfavorably influenced by too close a regulation, but the efficiency and stability of regulation are equally affected. A reduction in efficiency from 1 to 1½ per cent. may be expected when changing the machine with an inherent regulation of say 7 per cent. into one with 4 per cent. without resorting to saturation. In regard to stability of operation it is noted that very close regulating machines—due to their low armature reaction and self-induction—have a large short-circuiting current. With close regulating machines working in parallel large cross currents and a considerable exchange of energy between the bus-bars and the generators take place if the cyclic irregularity inherent to all reciprocating engines is not kept to a very small amount by means of an extra large fly-wheel effect, which, of course, increases the cost of the plant. But even then troubles in parallel may readily occur with too close regulating machines due to the natural period of the alternator becoming such as to introduce the danger of resonance with the forced oscillations of the engine. Large currents on short-circuit also tend to cause troubles in plants as required for rolling mills and mining works, where, due to the rough service, heavy overloads and even short-circuits may frequently occur. While within the above discussed limits a close regulation should be aimed at in all normal machines, there are also cases where a poor regulation is essential. This refers to alternators for constant power or constant current work, as required for certain electrolytic processes where the current is used for feeding an arc.—Lond. *Elec.*, February 19.

Sparking Dynamo.—BROWNE.—An account, from the records of an electrolytic refinery, of the troubles experienced for several weeks with a sparking dynamo. It was afterwards traced to the fact that several of the electrolytic tanks had been cut off since they were not properly working. This changed the total line voltage with a resulting weakening of the magnetic field and consequent sparking at the commutator. A diagram is given of a switch by which four different methods of field excitation are possible; self-excitated series and multiple field and separately excited series and multiple field, so that under all conditions of operation the field of the dynamo may always receive the proper exciting current.—*Electrochem. Ind.*, March.

REFERENCES.

Asymmetric Attraction of the Rotor in an Induction Motor.—REY.—The author first gives the theory of the subject and develops a formula for the attraction, which he then applies to a numerical case. His figures indicate that the asymmetric attraction may have important consequences. In the case of motors running at considerable peripheral speeds such as those used for traction or for operating rotary engines, centrifugal pumps, etc., these efforts combined with the weight of the movable parts may create dangerous vibrations. It is necessary to take them into account in the calculation of the pieces, since absolute symmetry can scarcely be realized in practice and the wear and tear gradually introduces a certain eccentricity.—*L'Eclairage Elec.*, February 20.

Single-Phase Series Motor.—NEWBURY.—An article in which, by the aid of diagrams, the author explains the operation of the alternating-current series motor. While in general it works on the same principles as the direct-current series motor, the following phenomena characterize the alternating-current motor; an e.m.f. generated in the armature winding by the alternating magnetic field, in addition to the e.m.f. generated by the rotation of the armature; a local current circulating in the armature coils short-circuited by the brushes due to the e.m.f. just mentioned; an iron loss occurring in the entire magnetic circuit, due to the alternating magnetic field; an active e.m.f. existing between the turns of the field coils, what may be called the counter e.m.f. of the field coils. The author gives the voltage diagram of the motor.—*Elec. Club Jour.*, February.

Single-Phase Commutator Motors.—Blanc.—An illustrated note supplementing the summary of various types of single-phase commutator motors, recently given by Osnos.—*Elek. Zeit.*, February 18.

Repulsion Motor.—Osnos.—An article illustrated by diagrams in which the author develops a complete theory of the repulsion motors of Atkinson.—*Zeit. f. Elek.* (Vienna), February 14 and 21.

Lights and Lighting.

Arc Between Metallic Oxides.—Stark.—An account of experiments in which he found that under certain circumstances an arc is more easily established between metallic oxides than between the metals themselves. He uses a vacuum tube in which the main current passes between the anode and the cathode and produces the ordinary glow phenomena, while the secondary current passes between electrodes at right angles to the primary electrodes, and is extinguished as soon as the main current is interrupted. At a pressure of over 50 volts and a vacuum of less than 0.5 mm., the presence of a film of metallic oxide, or of a few fragments of it, facilitates the production of an arc between the secondary electrodes. The author gives the following explanation of this effect: The lines of electric force proceed straight from the anode to the cathode, but if the latter bears a fragment of metallic oxide, they curve round it and enter the cathode at some other point. Nevertheless, the positive ions, having acquired a certain amount of momentum, go straight on and impinge upon the oxide, thus increasing its temperature and causing it not only to conduct electricity, but to evolve electrons in large quantities. Wehnelt has already shown that metallic oxides project more electrons than pure metals at high temperatures, and hence the arc, which requires a liberal supply of electrons, is more easily formed at the oxide than at the pure metal. At atmospheric pressure the author obtained a small arc between a carbon anode and a cathode of thorium oxide at a pressure of 1,800 volts and with a current of 7 milliamperes. The anode remained quite dark.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 19.

Reference.

Arc Lamps Giving Illumination in a Certain Direction.—Richter.—An account of photometric measurements of arc lamps giving light in a certain direction. For this purpose the two carbons were placed with their axles parallel to each other, but in such a way that they did not form one straight line, the one axle being parallel to, but laterally displaced from the other.—*Elek. Zeit.*, February 4.

Power.

Turbines for Low Falls.—Steiger.—An abstract of a paper in which the author draws attention to the prejudice which exists against the utilization of water power with low falls, and which is traceable to many unsatisfactory installations of absolutely unsuitable turbines. The demands of the generation of electricity by water power, such as high speed, rapid regulation and concentration of large power in one unit, have influenced very considerably the art of building turbines. In the first place, the desire for high speeds has led to a more general adoption of radial-flow turbines of which the inward-flow is preferable, being the more efficient. An example of radial outward-flow turbines was cited, with the special reasons which had led to their adoption in one case of a relatively low fall and the manner in which a quite satisfactory efficiency had been obtained from this otherwise less efficient type. One new type, the cone turbine, was referred to as taking the place of the so-called "mixed-flow turbine," with a view to obtain a high speed under low falls, even for large units. With special regard to electrical requirements, reference was made to the arrangement of several wheels on one common turbine shaft, vertical or horizontal, giving a few instances of the vertical arrangement which, in certain circumstances, was particularly advantageous, as the weight revolving on the footstep could be entirely balanced, and so the loss of power by friction was reduced almost to nil. The necessity of placing the footstep of a turbine in an accessible position was alluded to.—Lond. *Elec.*, February 19.

Electric Power for Rolling Mills.—Köttgen.—A long paper read before the Society of German Iron Metallurgists. The author discusses at length details of the equipment of electrically-driven rolling mills. Either the direct-current or the three-phase-current system is applicable. By field regulation in the former case or by inserting resistances in the rotor circuit in the latter case, the speed can be changed. In order to make use of the fly-wheel effect of the large masses used in rolling mills, the motors should show some reduction of number of revolutions when load is thrown on. If the electric current is supplied from a lighting network, care should be taken to provide means so that the fluctuations of load do not react upon the lighting network. In such cases an intermediate converter plant either with a heavy fly-wheel or with a storage battery would be used. The author discusses at some length the economy of generating the electric power by using the blast furnace gases for driving gas engines coupled with dynamos. If the rolling mill is very near the blast furnaces it could, of course, be driven directly by gas engines; but if it is at some distance it is preferable to use the gas engines for generating electrical energy. He gives an estimate of cost of operation of a rolling mill with a yearly output of 300,000 tons under such conditions, and finds that the cost of operation per year would be about $20,000 with the electrical system, against $52,000 to $90,000 with a steam plant. Since the first cost of installation of the electrical plant is estimated as about $90,000, it is seen that this cost will be covered within a few years by the saving in the cost of operation.—*Stahl und Eisen*, February 15.

Indian Railway Workshops.—A note on the recently built workshops of the Bengal-Nagpur Railway at Kharagpur, India. Three 200-kw steam dynamos generate direct current at 220 volts and three-phase current at 140 volts. Direct current for power purposes is distributed by means of lead-sheathed cables, laid in stone troughs filled in with bitumen. The lighting wires are carried overhead on porcelain insulators supported on iron poles; 110 direct-current motors, ranging in power from 1 to 50 hp, are employed for driving the machine tools, cranes, etc. Many of the larger motors may be regulated in speed in the ratio of 2:1 by means of field rheostats. Small tools are driven in groups from short lengths of shafting. Three-phase currents at 2,200 volts are transmitted by two independent overhead lines to the pump house (three miles distant) where two pumps, each capable of delivering 30,000 gallons per hour, against a total head of 165 ft., are driven by two 45-hp, three-phase induction motors.—Lond. *Elec.*, February 19.

Traction.

Slot Point.—An illustrated description of the new slot point to be used on the lines of the London County Council tramways. In conduit tramways the divergence of the two slots at junctions has always been a source of trouble, due to the fact that the merging of the slots one into the other creates an objectionable width of opening, which, with ¾-in. slots, sometimes amounts to 2 in. The narrow rubber tires of light vehicles drop into this opening, causing a very unfavorable wrench when the wheel leaves the slot. The slot tongues which are used to divert the plough are made in the form

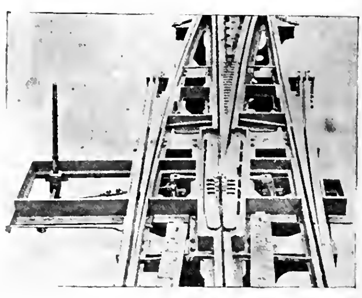


FIG. 1.—SLOT POINT.

of flat steel plates sliding backwards and forwards in resistances in the side castings. These work at a distance of 1⅝ in. from the top surface of the slot rail. On these plates a number of projections are arranged so as to come within ⅜ in. of the road surface at the fixed slot point, thereby reducing the depth at the opening by 1¼ in. The nose of the fixed slot point is tapered off to the level of the projections, so that any wheel riding on the slot tongue is easily carried on to the point. The projections are divided by radial slots, in order to clear the strengthening ribs on the long cast-steel cover. In Fig. 1 the lids of the slot points and the covers of the road boxes have been removed to show the arrangement of the slot tongues.—Lond. *Elec.,* February 19.

Single-Phase Traction.—SCOTT.—A discussion of the general features of the Lamme single-phase series motor. Large as well as small motors may now be operated successfully on a period of 25 cycles, and under certain conditions the motors may be operated on ordinary direct-current railway circuits. A feature of this motor is, in fact, its conformity to the standard type of direct-current motor. If wound for 250 volts, two in series are suitable for operation on a 500-volt direct-current circuit, and a four-motor equipment may be operated with an ordinary type of series-parallel control. Such an equipment of single-phase motors with rheostatic control may be operated either upon a 500-volt direct-current circuit, or upon a 500-volt alternating-current circuit, or upon a high-voltage trolley circuit of say 1,000 to 3,000 volts, the voltage being reduced by a transformer on the car. This enables interurban cars to be operated on direct current in cities and on altenating current across the country.—*Elec. Club Jour.,* February.

Mountain Railroad.—THOMANN.—The first parts of a detailed description of the Mendel road in Southern Tirol (which is well known to every traveler going from Verona to Tirol). This is the longest and steepest of all cable roads so far built. The road is divided into two sections. The first, from Kaltern to St. Anton (difference in level between the two ends 105 meters) is an ordinary adhesion road with 6.2 per cent. maximum grade, 500-volt direct current being supplied from a trolley wire and the rails being used for the return current. The second section has a difference of 854 meters between the levels of the two ends and is operated as a cable road with 64 per cent. maximum grade. The arrangement is that ordinarily used, one car going up while the other car runs down.—*Elek. Bahnen.,* Nos. 3 and 4, February.

REFERENCES.

Conductor Rails.—STEVENS.—Illustrations of a section of the new track on the Liverpool overhead railway.—Lond. *Elec.,* February 19.

Hamburg.—An account of the discussions which have been going on for a long while in Hamburg concerning the question whether for the city and suburban roads, traction on rails or a suspended train (as in Barmen-Elberfeld) should be adopted. The final decision was in favor of a road on rails.—*Elek. Bahnen.,* No. 4, February.

British Tramways.—A description of the Bath tramways which were recently opened. The line is equivalent to 16 miles of single track. The power house contains three steam-driven, 200-kw compound generators. The trolley system is used.—Lond. *Elec.,* February 19.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Automatic Devices.—A long editorial in which it is claimed that in view of the importance of labor-saving devices in American industries due to the labor conditions in this country, the development of automatic devices has been far in excess of the requirements of other countries and even in some respects in excess of the requirements of the United States. It is thought that every branch of electrical engineering has been attacked by the craze for automatics to such a point that a word of warning is now in place. While the use of several motor cars instead of a single locomotive is preferable, the simplest means of controlling all motors from one controller would necessitate the employment of several cables conveying heavy currents along the whole length of the train. To avoid this the multiple-unit systems have been devised and while the systems already in use apparently work well, yet a step further in the long chain of independent automatic devices would as likely as not so weaken the whole connection as to cause electric raliway engineers to return in a panic to a more primitive system. While the "remote control" switchboard is recommended to some extent, it is thought that some modern switchboard designs, especially in telephony, are bewildering in their ingenuity and perplexity. While a certain amount of automatic devices are necessary in electric works, yet it is dangerous to follow the fashion too far. The writer quotes the old saying attributed to Edison that the best automatic device is a "nigger."—Lond. *Elec.,* February 19.

WIRES, WIRING AND CONDUITS.

Electric Perforation.—KROGH.—A communication referring to the law of Baur, who gives the relation between thickness of material and perforation voltage by the following formula: $V = c\,d^{2/3}$. The present author says that while this formula gives very good results for all practical purposes, it cannot be considered as an exact law, since by testing liquid insulation materials distinct although small discrepancies from this law can be traced.—*Elek. Zeit.,* February 18.

REFERENCE.

Capacity of Conductors and Cables.—LICHTENSTEIN.—The conclusion of his article. He summarizes in a table the mathematical formulas which he has derived for the capacity of two parallel overhead conductors, of a three-phase overhead line, of a two-wire cable, of a three-phase cable, and of a concentric single-phase cable. He applies the formulas to some numerical examples.—*Elek. Zeit.,* February 18.

ELECTRO-PHYSICS AND MAGNETISM.

Radioactivity.—RUTHERFORD AND BARNES.—In a Physical Society paper Rutherford discusses the question whether the radioactivity of radium depends upon its concentration, radium bromide being used either in pure solid form or dissolved in a solution of radium chloride. He found that the radioactivity is independent of the concentration. This shows that the rate of disintegration of radium and its products is not appreciably altered by the bombardment of its own powerful radiations, and renders it probable that the conductivity of radium is, in all cases, directly proportional to the amount of that element present. In another paper, by Rutherford and Barnes, the heat emission of radium is studied. This is shown to be an accompaniment of the expulsion of α particles and the time variation of the heating effect of each of the different active products is the same as the time variation of the activity measured by the α rays. The heat emission of radium is probably due in part to the kinetic energy of the expelled α particles and in part to the energy released consequent upon the rearrangement of the components of the systems left behind after the expulsion of the α particles. The following estimation of the energy given out by radioactive bodies is interesting: One gram of the emanation radiates during its life an amount of energy lying between 2,000,000,000 and 20,000,000,000 gram calories. One pound weight of the emanation would initially radiate energy at the rate of 10,000, to 100,000 hp and would emit during its life an amount of energy between 60,000 and 600,000 hp-days. There can thus be no doubt that matter, under special conditions, is capable of emitting an amount of energy enormous compared with that realized in the most intense chemical reactions. On the disintegration hypothesis this energy is derived from the energy latent in the radium atoms and is released during the successive stages of their disintegration.—*Phys. Rev.,* February.

REFERENCES.

N-Rays.—Various papers on recent developments on this subject. Lambert has found that soluble ferments emit N-rays, especially the ferments concerned in the digestion of albuminoid matter. Meyer has found that plants emit N-rays whether they are kept in the dark or exposed to light, and that there is no difference due to the action of light. Gutton has found that the effect produced by N-rays upon a luminescent screen may be imitated by means of a non-uniform magnetic field. Charpentier has discovered two new effects of N-rays. If a strong source of N-rays is placed 4 cm. behind the top of the skull and a little above it, not only are faintly luminous objects perceived with greater brightness and detail, but in absolute obscurity a faint luminous cloud is perceived. The other new effect is the enlargement of the pupil when the conducting plate is placed over the seventh cervical vertebra.—*Comptes Rendus,* January 25 and February 1; abstracted in Lond. *Elec.,* February 19.

Velocity of Light in a Magnetic Field.—MILLS.—An account of experiments in which, as in former investigations, the method was to note the shifting of the interference bands formed by the divided portions of the same beam, one portion of which has traversed a medium in a magnetic field. He used the apparatus of Morley and Miller. A distinct shifting of the fringes was noticed and these shiftings increased with the current.—*Phys. Rev.,* February.

Electro-Chemistry and Batteries.

Conductivity of Solutions in Methyl Alcohol in the Neighborhood of the Critical Points.—Krauss.—The conclusion of his paper; he now discusses the results. Solutions in methyl and ethyl alcohol possess maxima of electric conductivity, the former in the neighborhood of 150° C. Solutions in ethyl and methyl conduct beyond the critical point, the former conducting much the better. The temperature coefficient of a solution in methyl alcohol undergoes a certain change at a critical point. The vapor of a solvent may become a very good conductor in the neighborhood of the critical point. The conductivity increases very largely for a saturated vapor as the critical point is approached, owing to increasing density of both solvent and solute.—*Phys. Rev.*, February.

Alloys of Copper and Cuprous Oxide.—Hofman, Green and Yerxa.—A fully-illustrated account of a "laboratory study of the stages in the refining of copper." The authors studied by metallographical methods the various alloys of copper and cuprous oxide and show that area measurements of enlarged micrographs of pure coppers containing less oxygen than the eutectic give good valuations of the oxygen contained. It also seems entirely feasible to make a close estimation of the percentage of cuprous oxide contained in a sample of copper by simply examining a polished surface with the microscope when once some experience has been gained.—*Electrochem. Ind.*, March.

REFERENCES.

Electrode Voltage.—Johnson.—An article in which the author gives the theory of the electrode voltage first on the basis of the principles of thermodynamics and afterwards on the basis of the osmotic theory of solutions.—*Electrochem. Ind.*, March.

Cadmium Cell.—Barnett.—An account, illustrated by diagrams, of some experiments on the polarization and recovery of cadmium cells.—*Phys. Rev.*, February.

Units, Measurements and Instruments.

Electric Units.—Bauch.—A communication referring to the recent proposal of Teichmüller, with whom he agrees in most points. He does not approve, however, his proposal to substitute the name weber for gilbert. He makes instead the following proposition: By the name gauss we indicate at present the numbers of lines of force per square centimeter as well as the m.m.f. per centimeter length. These are now two different things, and the distinction between them is not purely academical, but has practical importance. For instance, everybody who designs machines knows that we may have at the same time density of lines of force per square centimeter in air-gap = 8,000 c.g.s. units and m.m.f. per centimeter in air-gap = 6,000 c.g.s. units. If one writes this, using the name gauss in both cases one has air-gap = 8,000 gausses in one case, and in the other case air-gap = 6,000 gausses. Errors in the further calculations are then easily made. The present author suggests to call m.m.f. per centimeter, gauss, and the density of lines of force per square centimeter, weber, then one has to write in the above example air-gap = 8,000 weber and air-gap = 6,000 gausses. To use the two names, gauss and weber, for two similar units indicates that these two scientists worked jointly in many important investigations. Concerning the possible objection that the two quantities differ only by the factor μ (which is often considered as a pure number), he says that horse-power and watt also differ by a constant factor only. Nevertheless, we measure the output of a motor in horse-power and the power supplied to it in watt.—*Elek. Zeit.*, February 18.

Applications of the Oscillograph.—Morris and Catterson-Smith.—An account of some experiments in which the oscillograph was made use of for recording magnetization curves of transformers during working. The method is an application of the double oscillograph of the Duddell pattern and the device consists in passing through one of the oscillograph strips a current proportional to the magnetizing force, and through the other a current proportional to the induction density. A parallel beam of light from an electric arc is reflected from the mirror attached to the one strip, so that the reflected beam is subject to an angular vibration in a horizontal plane proportional to the magnetizing force. This reflected beam is received on one of the smaller faces of a right-angle prism placed so that its large surface is inclined at 45°. The vibrations of the beam are thus transformed into movements in a vertical plane. The light is then received on a silvered lens (acting as a concave mirror of about 18 in. radius) and focussed back on the second oscillograph mirror, so that the final reflected ray partakes of both vibrations as co-ordinates in the usual manner of B.-H. curves. The method of superposing the vibrations of two oscillograph strips in planes at angles is also applicable to the estimation of small power factors, since a straight line can only be obtained as the resultant vibration when the two waves in these strips are exactly in phase. They also made experiments on the currents in a direct-current shunt-wound motor and in a rotary converter under varying conditions of load.—Lond. *Elec.*, February 19.

REFERENCE.

Testing the Magnetic Properties of Sheet Iron.—An illustrated description of the method of Richter, used by the Siemens and Halske Co. for determining the iron losses in whole sheets, which has already been noticed in the Digest.—Lond. *Elec.*, February 19.

Telegraphy, Telephony and Signals.

Telephony.—Stosberg.—An article in which the author proposes to provide a resistance in shunt with the microphone. The resistance of a microphone when unused is about 20 ohms, and that of the primary windings of the induction coil about 1 ohm. If in this circuit two cells are used in series, each of 1.3 volts and 1.5 ohms internal resistance, the current will be 118 milliamperes, or 60 milliamperes if only one cell is used. The disadvantage is that the contact points of the carbon particles as well as the carbon surfaces of the membrane are burned. If the carbon of a microphone, which has been used for some time is investigated, it is found that it is surrounded by an ash-like powder of low conductivity. While it is impossible to increase the primary resistance, the above disadvantage may be overcome by connecting a resistance of say 60 ohms in shunt with the microphone. The joint resistance of the circuit then becomes about 16 ohms. With two cells the current becomes 161 milliamperes, of which 120 flow through the microphone resistance and 40 through the sunt resistance. With one cell of 1.3 volts, the current becomes 82 milliamperes, of which 61 pass through the microphone and 21 through the shunt resistance. He has found that the formation of sparks is thus entirely avoided and the carbon is not burned. The shunt resistance is best made of nickel wire with silk insulation, of a diameter of about 0.16 mm; 4 meters of this wire are sufficient to give the 60 ohms, and may be easily rolled up to form a ring of 5 cm. diameter. In exchanges it is preferable to use instead of the artificial resistance a galvanoscope of 60 ohms resistance. This allows the attendant to control at any time the condition of the microphone battery; it would be automatically connected to the circuit while a speech is transmitted.—*Elek. Zeit.*, February 4.

Miscellaneous.

Tests of Lubricating Oils.—Wilkens.—An illustrated paper read before the Berlin Electrical Society in which he describes methods, used by the Allgem. Elek. Ges. of Berlin, for testing lubricating oils. The author points out that for all methods of operation it is of importance that a sufficiently thick film of lubricating oil is always between the two sliding surfaces; for this purpose the oil should have sufficient consistency. For some methods of operation this is much more important than a low internal friction coefficient of the oil. For instance, in modern electric central stations with large, directly-coupled machine sets of 1,000 or more hp, it is of small account whether the few bearings in it get heated to 40° or 45° C., since the increased friction loss, due to the increased temperature, is scarcely noticeable in the fuel consumption. On the other hand, in all cases where friction losses represent a large proportion of the total power consumption, for instance, in plants with much shafting, a small increase of the friction resistance at every sliding surface will have an important influence upon the total power consumption and on the economy of operation. For this class of plants an oil of a low internal friction coefficient should be chosen. The author emphasizes the importance of the tests of the physical properties of lubricating oils, the most important properties being the internal friction resistance and the consistency of the oil. The internal friction resistance is determined by the apparatus shown in Fig. 2. K is a closed chamber filled with the lubricating oil to be tested and provided with a wheel, F, the axle of which is driven by an electric motor. This chamber communicates with two columns, $R\,R'$, which are filled about to one-half with the oil. When the wheel revolves the oil inside the spokes of the wheel moves along an outside layer of oil, which is in direct connection with the oil in the two columns. On account of friction between the two oil surfaces this outside layer of oil is set into motion and the level of the oil rises in the one column and falls in the other, until a stationary condition is reached which depends upon the speed of the wheel and the properties of the oil tested. From the difference of the levels in the two columns, the specific gravity and the speed of the wheel, the internal coefficient of the oil may be found. To test the internal friction of the oil for various temperature and speeds, the temperature of the oil is varied by means of an electric heating device and the speed of the motor is changed. A large number of curves are reproduced which were determined in this way for different oils. From the torque of the motor the consistency of the oil can be determined. If k is the torque for petroleum for a certain speed and K the torque of an oil to be tested for the same speed, then the consistency of the latter oil in per cents of the consistency of petroleum is $100 (K - k) \div K$. The results obtained by this apparatus were found to give correct indications of the suitability of an oil for certain purposes.—*Elek. Zeit.*, February 18.

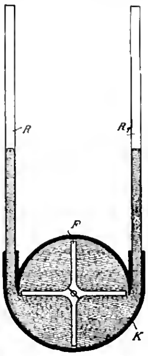


FIG. 2.—TESTING OIL.

REFERENCES.

American Engineering Schools.—WALMSLEY.—A paper read before the British Institute of Electrical Engineers on "Transatlantic Engineering Schools and Engineering." In comparing American with English colleges, he endeavors to show that candidates for entrance to American engineering colleges are older and better fitted to receive the training than those in England. He recommends the abolition of the premium system in English technical schools, their better equipping and staffing, more encouragement at home for graduates and wider knowledge that college training is absolutely essential. Some form of the sandwich system should be adopted.—Lond. *Elec.*, February 19.

Electric Club Journal.—This is a new monthly published by the Electric Club, of Pittsburg. The first number contains a good portrait of George Westinghouse, with an account of his life by Taylor. Other articles are abstracted elsewhere in the Digest.—*Elec. Club Jour.*, February.

Restoring Full Telephone Service in Baltimore.

Details were given recently in these pages of the great fire in Baltimore, and its damage to the various electrical services, including the telephone, which was, of course, in universal use in the burned district. The principal office of the Chesapeake & Potomac Telephone Company was destroyed and some 7,500 of its telephones were silenced by the fire. No one imagined that anything like a complete restoration would be accomplished within four weeks from the date of the fire. Not only was the St. Paul central office totally wrecked, but the building in which it was located was so badly damaged as to be entirely unfit for use.

On the Saturday night before the fire two new central offices had been opened. On the Sunday night following, while the fire was still raging, it was decided to enlarge one of the new offices which had been equipped to serve about 4,000 telephones, so as to serve over 12,000 lines. Parts of a new switchboard then in Washington ready for installation in that city were immediately shipped to Baltimore and the necessary cables were ordered from the Chicago factories of the Western Electric Company. Within two weeks the equipment for 4,000 telephones was in place and the telephones were rapidly connected. The entire installation was completed on February 29, 21 days after the fire originated.

To accomplish this men were taken to Baltimore from Philadelphia, Washington, New York, Boston and other cities. The men were organized to work in three shifts of eight hours each, and the work was pushed forward continuously day and night. A special commissary department to supply lunches and coffee was organized, and all important shipments of supplies from New York and Chicago which did not come by express were accompanied by men to prevent delays and the possibility of loss on the way.

The new switchboard is 135 ft. in length and contains 160,000 "jacks." In constructing the board 500,000 hand-soldered connections were made. Thirty-five miles of switchboard cable, containing 2,000 miles of wire, were used.

One week after the fire it was decided by the company's officers to reopen the South office, to serve subscribers in the southern part of the city below Pratt Street. The work of altering the building to accommodate a larger equipment than had previously been used there, and of installing equipment to serve about 4,000 telephones, was pushed forward vigorously, an emergency board being expressed from Chicago for this purpose. The installation was completed February 29 and put in service March 2.

The loss of the telephone company was not confined to the property actually destroyed, as its cables and lines in the burned district were rendered useless for the time being. The cable factories were set in motion, and as much as 8,000 miles of wire were made into cables, taken to Baltimore, drawn into the subways and spliced. This work was interfered with to a considerable extent by the wrecking gangs who were engaged in tearing down walls in the vicinity of the manholes.

In carrying out its plans made at the beginning of the year the company had just contracted for the erection of a three-story fireproof building 42 x 80 ft., designed for telephone use exclusively, to be located near Wolfe and East Fayette Streets. This office, when completed, will serve East Baltimore, and meanwhile subscribers in that part of the city will be connected to the Mount Vernon exchange. None of the work done in the restoration of the system is of a temporary character, the cables and equipment used being of the most modern type and the work of installation being done in the most skillful manner.

Storage Batteries Used for Thawing Water Pipes.

A novel departure in the process of thawing out frozen water pipes is reported by the Storage Battery Supply Company, of 239 East Twenty-seventh Street, New York City. We give below a description of its process as adopted recently in thawing out pipes in Borough Park, Brooklyn. President T. D. Bunce says:

"Our method consists in taking a load of storage batteries, arranged for high amperage work with variable connections, adjustable for high amperage and low voltage on large pipes and low amperage on small pipes. In the present case we supposed the service pipe, which was ½ in. in diameter, was all that was frozen, so we connected our feeders to the water main in the street and the outlet in the cellar of the party's house. The pipe was about 80 ft. long and with about 15 volts and 300 amp.; we had raised the temperature of the service pipe to about 150°, where it was exposed in the cellar.

"We continued this for about twenty minutes, but no water came, so we concluded that the main was frozen, the party being the last man on it, and as the adjacent house had a supply of water we dug another hole and connected our feeders at this point and also at the first location on the mains in the street. This main was 2-in. galvanized pipe and the distance was about 20 ft. We used a pressure of 6 volts, but do not know how many amperes were used, as our meter did not read high enough. I presume it must have been in the neighborhood of 1,000 or more. From the time we threw on our current it required three minutes to have running water in the house."

Underground Cables in Baltimore Fire.

The Baltimore fire has been the unfortunate means of settling many disputed points for the engineers of this country, and it has, among other points, emphasized most forcibly, in the minds of interested observers, the superiority of underground cables for electrical transmission of power, as compared with old overhead methods.

The Standard Underground Cable Company has installed during the past few years in Baltimore many miles of underground cable, in the municipal subway, for the Western Union, Baltimore & Ohio Telegraph Companies, the Maryland Telephone Company, the City Fire and Police Departments and the United Railways & Electric Company. The main conduit lines run the entire length of the burned district and the manhole covers were in many cases covered with piles of hot brick and stone to a depth of twenty feet.

In spite of the intense heat there is, so far as is known, not a single instance of trouble on the cables in manholes or subway except where exposed ends of cables were destroyed by the fire; and the cable system is in perfect condition to-day.

The three-conductor cables installed for the United Railways & Electric Company over a year ago, and which terminated in the new and unburned portion of the Pratt Street power house, extended the entire length of the burned district; and were carrying current to the sub-station at 13,000 volts the second day after the fire, without any interruption to service.

Electric Power Distribution in a Sash and Door Mill.

The new mill of the Baltimore Sash & Door Company, Baltimore, Md., is a good example of modern methods, and illustrates the great advance made in machine installation and factory equipment during recent years. The arrangement of apparatus shows careful and

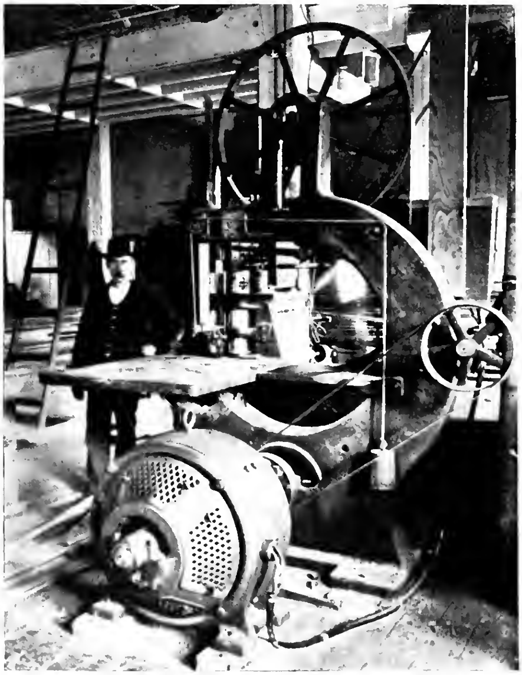


FIG. 1.—BAND SAW.

skillful planning and permits easy handling of material, with a maximum saving of time and labor. No space is wasted, and yet about each machine there is abundant room for operation, together with free head room and a noticeable absence of the intricate belting and shafting usually found in wood-working establishments. Good light abounds everywhere. These obvious advantages are largely due to the foresight of the managers of this company in adopting a system of electric distribution of power, and a well-thought-out plan of motor drive. The plan of driving larger machines each by its own motor, is skillfully combined with group driving for lighter apparatus, the conditions peculiar to the work to be done being the determining factor in this division.

The mill has a present capacity of 500 doors and 600 complete window sashes per day of ten hours, or approximately 150,000 doors and 180,000 sashes in an ordinary working year. A specialty is made of high-grade cypress and white pine.

The main building contains two floors, the first occupied by the door and moulding departments, while the second is largely devoted to the manufacture of sashes. An electrically-operated elevator connects the two and provides adequate facilities for handling the necessary material and machinery.

Exhaust pipes over each machine collect the sawdust and shavings and feed into a storage tank over the boiler house outside the main building. In this way cleanliness is always secured, and fuel, sufficient for the power needed, is delivered to the boilers, practically without handling and at an almost negligible cost. Draught for this purpose is provided by a Sturtevant blower, mounted on a platform under the ceiling of the first floor and driven by a 42-hp Westinghouse open type multipolar motor. The entire system of blower,

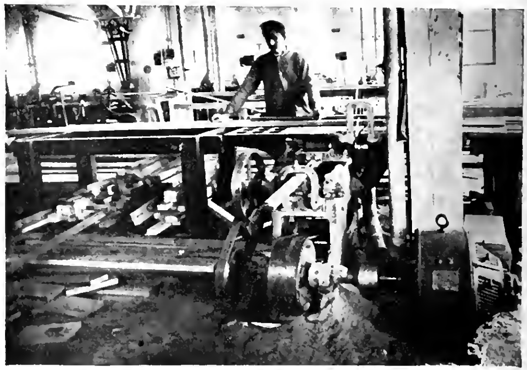


FIG. 2.—CUT-OFF SAW.

piping, storage tank, etc., was installed by the Dixey Blowpipe Company, of Baltimore.

The power plant is located in a separate building. Steam at 80 pounds pressure is developed in a pair of horizontal return tubular boilers, installed by the Thomas Brassher Co., of Baltimore, and equipped with the appliances necessary for burning sawdust fuel. All dust and dirt of fuel are confined within automatic feed pipes leading to the furnace. Boiler and engine room adjoin but are separated by a brick partition.

A 155-hp Ball & Wood simple automatic engine, direct-connected to a 100-kw, 250-volt, direct-current Westinghouse generator is at

FIG. 3.—DRILL STILE BORER.

present in service. A second unit will be added later, as the mill is to be enlarged. A marble switchboard, with all requisite apparatus, furnishes control for the power and lighting circuits, which are run to distributing panels on each floor of the main building. From these distributing centers branch lines run to the various motors and lamps in each department. Means are also provided for the control of each motor at the machine or group of machines which it drives.

Semi-enclosed Westinghouse direct-current "Type S" motors have been adopted as standard, though a few of the multipolar open type are also used. Strong and compact design, high efficiency, large overload capacity and cool operation combine to make this type of motor peculiarly suited to the requirements of machine driving. The

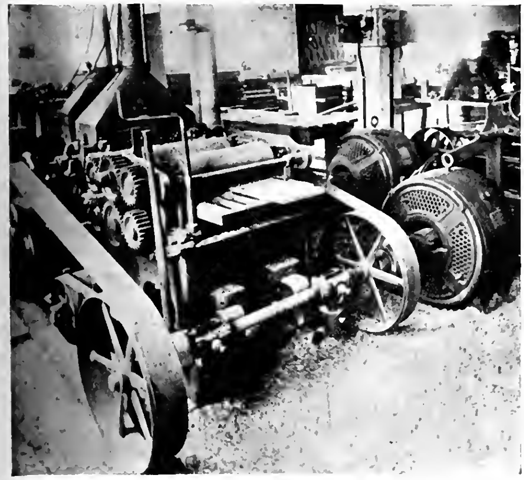


FIG. 4.—MOULDER AND PANEL RAISER.

larger motors are generally compound, the smaller shunt wound. There are, at present, about thirty motors with approximate total capacity of 250 hp. The machine equipment is, in part, as follows:

16-in. cut-off saw, 4,000 ft. per minute, made by J. A. Fay & Co., with 3½-hp, 700-r.p.m. motor. End paneler, made by E. B. Hays Machine Co., with 3½-hp, 700-r.p.m. motor. Panel raiser, capacity 600 panels per day, E. B. Hays Machine Co., with 15-hp, 600-r.p.m.

FIG. 5.—SASH STICKER.

motor. 14-in. moulder, J. A. Fay & Co., with 15-hp, 900-r.p.m. motor. 9-in. moulder, J. A. Fay & Co., with 10-hp, 1,000-r.p.m. motor. No. 4 "American" 40-in. band resaw, with 10-hp, 630-r.p.m. motor. "American" double surfacer, with 7-hp, 900-r.p.m. motor. 42-in. band saw, with 10-hp, 600-r.p.m. motor. 16-in. swing saw, with 3½-hp, 1,600-r.p.m. motor. Vertical shaft variety moulder, 3,000 r.p.m., J. A. Fay & Co., with 2-hp, 1,200-r.p.m. motor. 42-in. sander, J. A. Fay & Co., with 15-hp, 650-r.p.m. motor. Scroll saw, with 2-hp, 1,200-r.p.m. motor. Eight-drill rail borer, E. B. Hays Machine Company, capacity 600 rails per day, with 6-hp, 700-r.p.m. motor. Door clamp, E. B. Hays Machine Co., one door per minute, with 3½-hp, 1,120-r.p.m. motor. Dowel driver, E. B. Hays Machine Co., with 3½-hp, 700-r.p.m. motor. Double-end tenoning machine, E. B. Hays Machine Company, with 16-hp, 1,100-r.p.m. motor. 28-in. drill stile borer, E. B. Hays Machine Co., with 10-hp, 630-r.p.m. motor. This machine will in one day turn out material for 1,200 doors.

On the first floor a 3½-hp motor operates a small group of emery wheels and saw files in the repair shop. In the sash department

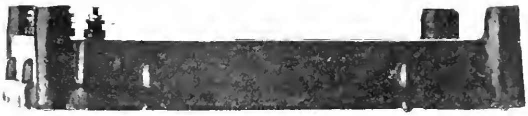
FIG. 6.—SPINDLE RAIL BORER.

10-hp and 15-hp motors, respectively, operate two short line shafts, to one of which are belted two "American" sash stickers, one hollow chisel, one franking machine, one buzz planer and one gang rip saw, while the other drives a six-in., four-sided moulder, one combination saw, one single-end tenoning machine, one "American" sash dovetailer, one chain mortiser, one pony planer, and one emery grinder.

During six months operation the mill has more than met with the expectations of its owners, and has again demonstrated the convenience and economy of motor drive for work of this character. Large orders have already covered the entire output and made an increase in capacity necessary. Additions are being prepared and largely increased facilities provided to meet the growing demand for a well-made product.

Rheostats for Trolley Brakes and Elevators.

The Ward Leonard Electric Company, of Bronxville, N. Y., has devoted some time to the subject of rheostats for use with electrically-operated brakes for trolleys, elevators, etc. Its resistance box for this purpose is constructed with a resistance ribbon in a thoroughly enameled iron box filled with sand, the terminals being brought out. The resistance ribbon or strip is of a special alloy having a practically zero coefficient and is practically of a capacity sufficient to carry overload. Enamel being the best insulator known, protects the rheostat against any possibility of grounding. The sand holds the resistance ribbon firmly in place against any mechanical defects, and as it has a high specific capacity for absorbing heat energy, it will,



RESISTANCE RIBBON.

in the case of excessive overload, absorb the heat energy generated and transmit it to the iron casting, where it will be radiated at a low temperature.

As the box is entirely enclosed in enamel and filled with sand, it is positively protected against the action of the atmosphere, conditions of moisture, etc. These resistance boxes will stand great mechanical stresses, giving out only upon breakage of the casting, but can be readily opened for inspection by removing the cover.

Automatic Motor Starters.

J. L. Schureman & Co., of Chicago, have just incorporated some improvements in their automatic elevator motor starters. One of these is in the dashpot of the single-speed elevator controller, shown in Fig. 1. On this controller, as all who are familiar with the device know, the motor circuit is closed to give forward or reverse motion by a double-throw switch on the top of the rheostat. This switch is operated from the elevator. As soon as the motor circuit is closed, the solenoid mounted on the front of the rheostat, Fig. 1,

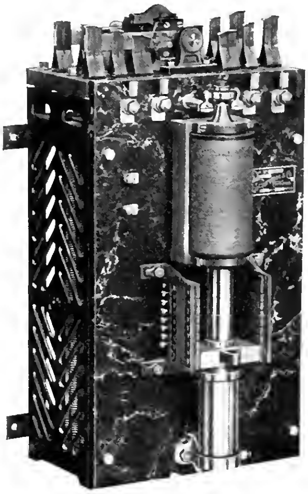


FIG. 1.—RHEOSTAT.

raises the piston slowly, carrying the contacts which gradually short circuit the rheostat. The speed of movement of the piston is determined by the resistance offered by the dashpot. Heretofore an oil dashpot has been used, but in order to get away from any difficulties incidental to the handling of the oil, or the substitution of something else in place of oil by those unacquainted with the device, the company has adopted a vacuum dashpot. The piston working on this dashpot is packed with soft leather, which is held in place by a compressed spiral spring, which forces the leather gently against the walls of the dashpot. The piston in rising creates a vacuum in the lower end of the cylinder. The rate of operation is regulated by a valve in the bottom of the cylinder, which allows the air to flow into

FIGS. 2 AND 3.—AUTOMATIC STARTERS.

the vacuum chamber. On this dashpot a solid iron solenoid core can be used instead of the hollow solenoid core used with the oil dashpot. This permits the plunger to be operated with a smaller amount of energy than on the older type, and the solenoid core does not have to be worked at as high a current density as with the oil dashpot. When the plunger has reached the top of its travel so that the rheostat is short circuited, it can be held in place with much less current flowing in the solenoid core than is required to raise the plunger. Accordingly, a contact is provided just above the solenoid, so that when the plunger reaches the top of its stroke, the contact opens and a high resistance is inserted in series with the solenoid core. This high resistance is short circuited by the contact until the plunger reaches the top of its stroke. Formerly a carbon contact was used for this purpose. This contact has been replaced by small brass contact pieces which are easily renewed and can also be reversed, so as to be worn out on both sides; and the magnetic field created by the solenoid is used to break the arc at this point.

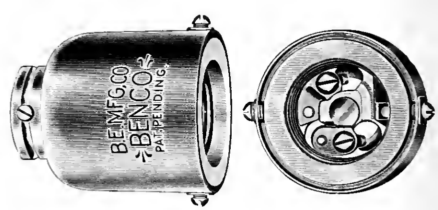
In Fig. 2 is shown an automatic starter for various kinds of stationary motors. This starter can be put to a great number of uses. Where a motor is to be started from a distance with an automatic starter of this kind, it can be done in either of two ways. The circuit to the motor can be closed; in which case the automatic starter will move the rheostat arm around at a proper speed until the motor is up to speed, or if it is desirable not to handle the main circuit, the circuit to the solenoid can be opened or closed to stop and start the motor. Even where it may not be necessary to stop and start a motor from a distance, it may be desirable on account of unskilled labor employed to take the rate of turning on current out of the attendant's hands. This can easily be done with an automatic starter of this kind. One common application of this starter is in connection with electric pumping outfits for maintaining an approximately constant level of water in the tank. In such a case, the gravity float switch, shown in Fig. 4, is operated by the float to open and close the motor circuit. The automatic starter, shown in Fig. 2, does the rest.

FIG. 4.—GRAVITY FLOAT SWITCH.

Fig. 3 is an automatic starter to be used in connection with an air compressor or any other device where the operation of the motor is to be made automatically dependent upon air, water, or steam pressure. The diaphragm valve, shown at the right, Fig. 4, can be set so as to close the circuit through the solenoid of the controller at any predetermined pressure. The motor will then start and continue to operate until the predetermined maximum pressure has been reached, when the diaphragm valve will cause the solenoid to be short circuited, which will allow the rheostat arm to fall back and stop the motor. On this controller the solenoid circuit is closed by the rheostat arm as soon as the motor starts, so that the contact made by the action of the diaphragm valve can be broken at any time after the motor starts. The motor can only be stopped by short circuiting the solenoid. It will be noted that in this pressure regulator, the circuit is never broken by the contacts of the pressure valve, as these contacts only act to close the circuits.

"All-Weather" Socket

The Benjamin Electric Manufacturing Company, of Chicago, is now making a weather-proof socket having a one-piece porcelain receptacle and a one-piece shell of aluminum or brass adapted for



ALL-WEATHER SOCKET.

½-in. or ⅜-in. iron pipe. It is large enough so that wires can be "looped" into it. The binding screws are accessible from the front. It is intended for use in places where exposed to rain or moisture. Two views of one of these sockets are shown herewith, which will give a good idea of the method of construction and the success attained in excluding moisture of any kind.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Inactivity characterized the stock market dealings although prices were firm at slight improvements, due to a better feeling as to the foreign situation. Another circumstance which influences the market was the continued and increasing ease of money, the accumulation of funds being held to indicate a slackening in trade and a decrease of demands. Decreases in railroad earnings as a result of the abnormally severe winter weather and the generally lighter traffic of many roads is still noted. A little activity was shown in Amalgamated Copper and Brooklyn Rapid Transit. The United States Steel stocks and 5 per cent. bonds were well supported. The electric stocks closed with net gains in all cases, while the net changes in the traction list were all on the negative side. There was uncommon activity in Commercial Cable, the sales of this stock aggregating 1,100 shares, at the uniform price of 191, which was also the closing quotation, representing a net gain of 4 points. General Electric followed next in point of net gain, being in this case, 3 points. Eleven hundred shares were dealt in at prices ranging between 159½ and 162, the closing price being 161. The faith in this stock is gratifying to say the least, in the face of the active preparations for entry into the electrical manufacturing field of another large and well-established concern. Westinghouse closed at the highest figure of the week—161—being a net gain of 2 points. Western Union made a net gain of ½ point, closing at 88. In the traction list, Brooklyn Rapid Transit closed at 39⅞, a net loss of ½ point, and Metropolitan Street Railway, 114, a like loss. The curb market for outside securities showed greater activity for a few issues, although most stocks were dull. Buying of Electric Boat shares was stimulated by the belief in some quarters that the government would order more submarine boats. The common stock closed at 24, and preferred at 55, these being net gains of 4 and 5 points, respectively. Otis Elevator also showed some activity. Following are the closing quotations on the stock exchange, March 8:

NEW YORK.

	Mar. 1	Mar. 8		Mar. 1	Mar. 8
American Tel. & Cable	84	85	General Electric	159	160
American Tel. & Tel	121	121	Hudson River Tel	..	..
American Dist. Tel	22	22	Metropolitan St. Ry	114¾	113½
Brooklyn Rapid Transit	40⅛	40¼	N. E. Elec. Veh. Trns	..	..
Commercial Cable	188	185	N. Y. & N. J. Tel	..	..
Electric Boat	20	23	Marconi Tel	..	..
Electric Boat pfd	49	53	Western Union Tel	87⅝	88
Electric Lead Reduction	¾	⅛	Westinghouse com	156½	157
Electric Vehicle	7½	7½	Westinghouse pfd	175	180
Electric Vehicle pfd	10	10			

BOSTON.

	Mar. 1	Mar. 8		Mar. 1	Mar. 8
American Tel. & Tel	120¾	121	Western Tel. & Tel. pfd	78	79
Cumberland Telephone	114½	114¾	Mexican Telephone	1½	1¼
Edison Elec. Illum	230	*235	New England Telephone	118	118
General Electric	157	161	Mass. Elec. Ry	18	18
Western Tel. & Tel	8½	8½	Mass. Elec. Ry. pfd	73¾	73

PHILADELPHIA.

	Mar. 1	Mar. 8		Mar. 1	Mar. 8
American Railways	43	43	Phila. Traction	..	97¼
Elec. Storage Battery	52	52	Phila. Electric	5¾	5¾
Elec. Storage Battery pfd	52	52	Phila. Rapid Trans	14⅜	14
Elec. Co. of America	7¾	7¾			

CHICAGO.

	Mar. 1	Mar. 8		Mar. 1	Mar. 8
Central Union Tel	..	..	National Carbon pfd	98	98
Chicago Edison	..	..	Metropolitan Elev. com	..	15¼
Chicago City Ry	160	156	Union Traction	4¼	4½
Chicago Tel. Co	..	..	Union Traction pfd	30	30½
National Carbon	25¾	25¾			

*Asked

TELEGRAPH-TELEPHONE CONSOLIDATION.—According to the *Wall Street Journal,* an authority who has studied the telegraph and telephone situation says: "I see within a surprisingly short period of time a consolidation of the Commercial Cable Postal Telegraph Company and the American Telegraph and Telephone Company, and this is the basis of my calculation: Commercial Cable has just increased its capitalization by practically stock dividends of 300 per cent. T. Jefferson Coolidge, Jr., a director in the Bell, is named as one of the trustees of the new company to take over the Commercial Cable and the Postal. New York parties have recently bought Bell stock in this market. It is through this channel that the Bell people may get a wide market for their securities and a consolidation would lessen construction requirements fully $10,000,000 per annum. It is possible that the new Commercial Cable Company, organized under Massachusetts laws, will be the means of bringing the Bell Company back to Boston. The situation will bear careful watching. In event of a consolidation of the Bell and the Postal, I look for a consolidation of the Western Union and all the independent telephone companies in the United States. Such consolidations all around will save money for every concern interested."

SAN FRANCISCO LIGHTING.—The San Francisco Gas and Electric Company has placed on file its statement of its earnings and disbursements for the year 1903. The revenues amounted to $2,505,212.25, made up of gas sales, $1,445,304.60; electric current sales, $997,407.01; other sources, $62,500.64. The cost of gas was $1,146,873.82, and of electric current $783,381.83, a total of $1,930,-255.65, leaving a net revenue of $574,956.60, from which dividends to the amount of $396,210.83 were paid, leaving at the end of the year a surplus of $178,745.77. It is represented that the original cost of the plant was $9,887,847.33 for gas, and $3,154,731.22 for the electric, a total of $13,042,578.55, and that the present cost of the plant amounts to $25,704,944.84, made up as follows: Gas—Plant, $9,476,-879.05; pipes, $7,075,868.95; meters, $813,651.76; lamps, $77,489.67. Electric—Plant, $6,131,058.56; conduits, $1,933,320.46; meters, $196,-676.39. It is declared that the present value of the plant cannot be determined. The capital stock outstanding is $15,794,284.36; bonds outstanding, $9,813,000; floating debt, $1,091,492.65.

DIVIDENDS.—The Electric Boat Company has declared a quarterly dividend of 2 per cent. on the preferred stock payable April 1. The directors of the Laclede Gas Company have declared the regular semi-annual dividend of 2 per cent. on the common stock, payable March 15. The International Steam Pump Company will close the common books March 21 for the payment of the fourth instalment of 1 per cent. of the 4 per cent. dividend declared on the common stock last June, which is payable April 1. Twin City Rapid Transit directors have declared the regular 1¾ per cent. quarterly dividend on the preferred, payable April 1. Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent., payable March 31. The directors of the Tri-State Telephone Company (the long-distance lines of the Twin City Telephone Company) have declared the third quarterly dividend, at the rate of 6 per cent. per annum, payable March 1, 1904. Manhattan Elevated has declared the quarterly dividend of 1½ per cent. and 1 per cent. extra, making 7 per cent. for the year. The executive committee of Western Union has recommended the regular quarterly dividend of 1¼ per cent. A dividend of $2 per share has been declared on Philadelphia Traction stock, payable April 1.

COMMERCIAL CABLE REPORT.—At a special meeting of the stockholders of the Commercial Cable Company, held on March 7 the proposed changes in the articles of association and bylaws of the company—providing for eighteen directors instead of fifteen, and that only stockholders can act as directors—were adopted. At the annual meeting, held after the special meeting, the retiring Board of Directors were re-elected. The statement of earnings for the year ended December 31, 1903, showed gross receipts of $11,025,634 and net earnings of $2,508,526. This with the surplus carried over from the previous year amounted to $2,056,055, out of which there were paid interest on bonds amounting to $800,000 and dividends on stock $1,200,000. Of the balance, $350,000 was placed in the reserve fund and $150,000 was added to the fund for the insurance of stations, apparatus, and repair steamer. The balance of income carried down amounts to $156,055. The total reserve fund at the end of the year was $5,372,520, and the insurance fund $1,020,862.

LARGE INDEPENDENT TELEPHONE DEAL.—Advices from San Antonio, Texas, of March 5 say: "E. H. Huntington has closed a deal through Frank C. Smith whereby he becomes owner of thirteen additional independent telephone exchanges in Texas. The new exchanges purchased are the Austin, Taylor, Temple, Belton, Sour Lake, Saratoga, Kountz, Woodville, Village, Kirbyville, Coll, Jasper and Bronson and the long-distance lines of the Commercial and Lone Star Companies. The price paid for these, together with the Houston, Galveston, Corsicana, Nacogdoches, San Marcos, Port Arthur and Liberty exchanges, previously acquired, exceeds $1,000,000.

UNITED STATES TELEPHONE BONDS.—Officials of the Federal Telephone Company are endeavoring to pool the entire issue of United States Telephone Company's bonds at 85 and interest for one year. A committee composed of Calvery Morris, H. R. Newcomb and F. S. Dickson will have power to sell these bonds. The Federal Company owns about $400,000 of these bonds, the Everett-Moore Syndicate $800,000,, outsiders $665,000, while $105,000 remains in the treasury.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports indicate that trade and industry are still irregular, being active in favored sections, but hampered in others by the prolongation of winter weather, with incidental delays in transportation, car shortages and floods. Southern trade advices announce sustained activity; southwestern reports show improvement, and in the West the feeling is optimistic. In the East wholesale and retail trade are backward. There was more activity in iron and steel, and prices of some grades of iron are firmer, but the iron ore situation is yet unsettled. The agricultural situation is, on the whole, one of great strength, and there will be a record-breaking acreage in cotton. The general feeling prevails that settled weather will stimulate and revive general business, and be particularly helpful to building and other lines of out-of-door work, if undisturbed by foolish strikes. Collections are fair to good, and money is exceptionally easy for this season of the year. The features in iron and steel have been the purchase of nearly 100,000 tons by the leading interest, and reports of other sales aggregating as much more. In finished products, reports are more favorable, with mills running to their full capacity. The copper market is dull and uninteresting, and prices are unchanged. Quotations are: Lake 12½ @ 13¾ c.; electrotytic and casting stock 12⅜ @ 12⅝ c. The total exports of copper for February were 16,842 gross tons. *Bradstreet's* reports the number of business failures during the week ending March 3 as 195, as against 200 the previous week, and 171 the corresponding week last year.

LARGE EXPORT TRADE.—Exports of manufactures in January and in the seven months ending with January show a larger total than ever before in the same portions of the year. They amounted to $38,213,352, while the highest January record on any former occasion was that of 1900, when they were $35,586,940. For the seven months ending with January they amount to $250,214,936, and the highest record for that seven months' period in any preceding year was that ending with January, 1901, when the total was $239,564,064. Thus the total for January is two and a half million dollars in excess of any preceding January, and for the seven months ending with January is about eleven millions more than in any preceding seven months ending with January. These figures are shown by an analysis of the January exports just prepared by the Department of Commerce and Labor through its Bureau of Statistics. By far the largest increase occurs in manufactured copper, of which the exports in the seven months ending with January, 1904, are reported at $31,552,677, against $22,514,843 for the corresponding months last year, and $19,038,328 for the corresponding period of the year preceding. Iron and steel stand next in the list of manufactured articles showing an increase in exports. The total value of iron and steel exported in the seven months ending with January, 1904, is $59,125,780, against $55,997,942 in the corresponding months ending with January, 1903, and $57,310,128 in the corresponding months of the preceding year. For January alone the exports of iron and steel are $8,171,738, against $7,437,298 in January, 1903, making the increase for the single month $734,440, and for the seven months about three millions.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, has recently closed the following contracts for batteries of "Chloride" accumulator for lighting and power. The Union Electric Light and Power Company, St. Louis, Mo., for a battery having a capacity of 462 kw hours in its exciter sub-station. The St. Louis Transit Company will have installed 55 cells of Chloride in its new sub-station for the purpose of operating time switches. The World's Fair Automobile Transit Company have given an order for 100 sets of "Exide" batteries, each set consisting of 44 cells, to be used for the operation of the bus line, which will be in service at the Fair. Isolated lighting and power plants have been contracted for by the Union Trust Building Company, Detroit, Mich.; Morton F. Plant, Groton, Conn.; Bank of Renovo, Renovo, Pa., the the Tucker Electrical Construction Company, for the residence of A. G. Huntington at Bay Chester, N. Y. The Consolidated Railway Electric Light and Equipment Company has contracted for 1020-240 amp.-hour batteries for car lighting. The Herreshoff Manufacturing Company will install on Mr. Herreshoff's private yacht a complete lighting and power battery for operating the search lights, ventilating fans, and electric light throughout the boat. A smaller battery will also be used in connection with an electric launch to be used as a tender for this yacht. The yacht "Marjorie" and the yacht "Roxana" will each have a battery of "Chloride" accumulators installed for lighting purposes.

SOME C & C ORDERS.—The C & C Electric Company, 143 Liberty Street, reports receipt of a number of orders for generators, motors, series parallel equipments, etc. The Aluminum Press Company has ordered a 50-hp, also a 30-hp motor for driving machinery in its Dunellen, N. J., plant. The Greenwood Pottery Company, of Trenton, N. J., has requisitioned additional equipment in the shape of a 20-kw belted generator and a 15-hp motor, also a switchboard, for both light and power purposes. The Boston Navy Yard is to be shipped a 15-hp special motor and special controller for machine tool driving. The Garwood (N. J.) Foundry & Machine Company has ordered a 35-kw belted generator and switchboard for light and crane service. Six motors, varying from 2 hp to 6 hp and of special slow speed type, are to be installed for operating blowers in the University of Pennsylvania Engineering Building, Philadelphia. The Binghamton (N. Y.) *Press* plant is to have a 40-hp series parallel equipment for driving a Hoe printing press. A 20-hp motor, with special control, has been ordered by the Baltimore *Sun*, also to operate a Hoe press. A 75-kw direct-connected generator has been called for by the Miller Lock Company of Frankford, Pa., whose initial generating equipment is of C & C build.

MARCONI WIRELESS.—Communication has been established by the Marconi Wireless Telegraph Company between Broomfield, Essex, England, and Amsterdam, Holland, a distance of 200 miles over sea and 60 miles over land, for commercial wireless service. Arrangements have been made with a Dutch newspaper, the *Handelsblad*, to publish news transmitted daily from England. An agent of the Marconi system has a room in the Stock Exchange at Amsterdam, with private telephone connection with the wireless station, for the purpose of transmitting the daily Stock Exchange quotations to London. The La Gascogne and La Champagne, of the French line, and Grosser Kurfurst, Kaserin Maria Theresa, of the North German Lloyd line, have been equipped with the Marconi system, making the fleet between New York and Europe thus equipped, 38 vessels.

GENEVA ELECTRIC EQUIPMENT AND CONSTRUCTION COMPANY.—A petition in bankruptcy has been filed against the Geneva Electric Equipment and Construction Company, of 469 Fourth Avenue, New York City, by the following creditors: Alfred Gautier, $500; James Steinhauser, $500, and Samuel W. Levine, $150. It is alleged that the company is insolvent, and on February 27 admitted in writing its inability to pay its debts. The business was started in 1894, and the company succeeded to it in May, 1900, when it was incorporated with a capital stock of $10,000. It has never done a large business.

ELECTRIC BOAT ACTIVITY.—The Electric Boat Company is said to have orders for submarine boats the net profits on which will represent several hundred thousand dollars. Already the British Admiralty has bought nineteen boats from the company, and this number, it is stated, is to be increased to twenty-nine boats. A number of the Continental powers have purchased one or more submarine vessels from the company and the United States Government has several in commission.

IMPORTANT MEXICAN ELECTRIC RAILWAY PROJECTED.—It has been decided to construct an electric railway between Morelia, capital of the State of Michoacan, and Guadalajara, the principal city of the State of Palisco, Mexico. The distance between these two places is about 120 miles. Archbishop Silva, of Morelia, is primarily interested in the project. Carlos F. de Sandero, a Morelia engineer, has been commissioned to obtain the usual government concessions.

BALL ENGINE COMPANY, of Erie, Pa., is moving into new works on the western city limits and has its old plant for sale, equipped with power, tools, cranes, shafting, hot air heating system, electric light outfit, etc. It began building engines twenty-one years ago, and has sent them all over the world, particularly for electric light and power purposes. The new plant is unexcelled for capacity and facilities of production.

ELECTRIC TRACTION FOR PACHUCA, MEXICO.—An electric traction system is to be installed in Pachuca, a mining city of some 50,000 inhabitants, located in the State of Hidalgo, Mexico. The Hidalgo Railroad, which connects Mexico City with Pachuca, is completing the purchase of the mule tramways about 12 miles long, and they are to be converted into electric motive power.

STROWGER AUTOMATIC.—Stockholders of the Strowger Automatic Telephone Company at the annual meeting elected J. L. Kesner president, to succeed Elmer Washburne, put in charge by the court after a fight over the annual meeting last year. A. D. Nast succeeded Washburne as director. A. G. Wheeler, Jr., was elected vice-president, J. Siegel treasurer, and M. Sello, secretary.

LIGHTING PLANT FOR MAZATLAN.—The prosperous Mexican seaport town of Mazatlan, located in the State of Sinaloa, is to have an up-to-date Yankee electric lighting plant. Contracts are to be awarded early next month.

CEREAL PLANT TO BE ELECTRICALLY OPERATED.—The Patent Cereals Company of Geneva, N. Y., will shortly install a plant for the purpose of operating its factory electrically. The initial capacity will be about 300 hp.

General News.

THE TELEPHONE.

ABINGTON, ILL.—The Oak Grove Telephone Company has been incorporated with a capital stock of $500. The directors are: T. H. Castle, H. R. Griffith and others.

ANCHOR, ILL.—The Anchor Telephone Company has been incorporated, with a capital stock of $1400, to operate a telephone system. The directors are J. F. Ward and others.

HAZELTON, IND.—The Princeton & Vincennes Independent Telephone Company has been organized here, with C. S. Stevens as president.

INDIANAPOLIS, IND.—The Salmonia Telephone Company has been incorporated with a capital stock of $5000. The directors are: J. J. Kidder, Adam Lee and others.

INDIANAPOLIS, IND.—The Morning Star Telephone Company has been incorporated with a capital stock of $5000. The directors are: Jos. Allen, W. H. Williams and others.

EXIRA, IA.—On March 28 a vote will be taken upon the application of the Marne & Elkhorn Telephone Company, of Rorbeck, Ia., for a local exchange.

PILOT MOUND, IA.—The Pilot Mound Farmers' Mutual Telephone Company, with a capital stock of $10,000, has been incorporated by William Larson, O. W. Hinnan, George O. Durrell, George Owen and L. A. Carlson.

OWENSBORO, KY.—The Stromberg-Carlson Manufacturing Company is installing a 500-line switchboard for the Home Telephone Company. The exchange will connect with an extensive long distance system in this district.

BARBERSVILLE, KY.—The Hayden Telephone Company will build a line between Barbersville and Hayden. An exchange will be established at Manchester, and several toll lines built. John Woodward is general manager of the company.

FALL RIVER, MASS.—The Automatic Telephone Equipment Company has been organized here to operate an automatic telephone exchange and toll line.

BESSEMER, MICH.—The Wisconsin Independent Telephone Company is to extend its lines from Ashland to the Gogebic towns.

EATON RAPIDS, MICH.—The Eaton County Telephone Company is planning to build a line from Charlotte to this city.

CLARISSA, MINN.—A mutual telephone exchange is being promoted here.

EDGERTON, MINN.—The Edgerton Telephone Company has been granted a franchise.

WINONA, MINN.—The Winona Telephone Company will build a 20-mile exchange to Wiscoy.

NEW ULM, MINN.—The Minnesota Central Telephone Company will spend $12,000 on the exchange here.

PELICAN RAPIDS, MINN.—A local telephone company has been organized with a capital stock of $25,000. It proposes to start work in the near future.

STEWART, MINN.—The Electric 'Phone Company has been incorporated with a capital stock of $25,000. Mr. H. E. Posley is one of the incorporators.

LAKE CRYSTAL, MINN.—The Farmers' Telephone Company is the name of a new company just organized here with $25,000 capital. E. Upson is president.

HILLSBORO, MO.—The Festus Telephone Company has been incorporated by F. W. Brickey, W. F. Holt and others.

HARRISONVILLE, MO.—The Cass County Telephone Company, of Harrisonville, has been incorporated, to construct a telephone line, with a capital stock of $50,000. The incorporators are: W. B. Scruggs, R. W. Adams, Duston Adams, W. H. Scruggs and H. B. Moody.

ALBUQUERQUE, N. M.—The Pecos Valley Telephone Company has been incorporated with a capital stock of $50,000. The directors are: J. W. Poe, R. Chaves and others.

DUNDEE, N. Y.—The Dundee, Rock Stream & Reading Center Telephone Company has been organized here.

SYRACUSE, N. Y.—The Syracuse Telephone Company will probably issue bonds for $400,000 for the extension and improvement of its service in this city.

NORTH BOSTON, N. Y.—The Boston Valley Telephone Company has been organized to build a line between Boston and Hamburg. The officers of the company are: President, Fred Frank; vice-president, Philip D. Weber; secretary, Frank X. Weber; treasurer, Edward Heinrich.

BERGHOLTZ, OHIO.—The Bergholtz Telephone Company has increased its capital from $5000 to $20,000.

MANSFIELD, OHIO.—The Central Union Telephone Company will expend $30,000 in improvements on its plant here.

HICKSVILLE, OHIO.—The Hicksville Telephone Company has increased its capital from $25,000 to $40,000, and will make improvements.

WALDO, OHIO.—The Waldo Home Telephone Company has been organized with $25,000 capital stock, and will build a local exchange.

AKRON, OHIO.—The Springfield Township Rural Telephone Company, capital $10,000, has been organized by farmers of Springfield township.

CALDWELL, OHIO.—The Farmers' Independent Telephone Company has been organized here by Judge L. W. Wheeler, H. W. Kuntz and E. W. Spannagel.

KINGSVILLE, OHIO.—The Central Union Telephone Company has installed an exchange at Kingsville and is building a farmers' line throughout a wide district.

MARIETTA, OHIO.—The Marietta Telephone Company has been organized, with A. L. Gracey, president; F. P. Moats, treasurer, and A. C. Davis, secretary and general manager.

MIDDLETOWN, OHIO.—The Middletown Home Telephone Company, capital stock $10,000, has been incorporated by C. H. Osler, F. N. Ramsey, Albert Emanuel, R. E. Kline and H. P. Miller.

AUSTINBURG, OHIO.—The Austinburg Telephone Company has secured right of way from Austinburg to Geneva, and is asking for a franchise in Geneva. G. W. Mooney is at the head of the company.

PERRYSBURG, OHIO.—The Maumee Valley Telephone Company has been organized by Norman L. Harrison and others, with a capital stock of $15,000. Telephone lines will be built through Wood, Henry and Lucas counties.

TIFFIN, OHIO.—The Tiffin Home Telephone Company has increased its capital stock from $60,000 to $125,000. F. B. Myers has been elected president, and J. J. Kintz, secretary and manager. The company is planning improvements.

CHAGRIN FALLS, OHIO.—Fire in the exchange of the Chagrin Falls Telephone Company, a few days ago, damaged the office and practically destroyed the switchboard. The system supplies connection for farmers throughout a wide district.

HAMILTON, OHIO.—The Hamilton Home Telephone Company, the Oxford & Indiana Telephone Company, the Morning Sun Telephone Company and the Darretown Telephone Company have completed arrangements for the free interchange of calls. Towns within a radius of 40 miles will be connected.

STEUBENVILLE, OHIO.—Farmers of this vicinity have organized the Fernwood Telephone Company. John Gault has been elected president, and Joseph Scott, general manager. They have made an arrangement with the Reed's Mills Telephone Company to connect with all the towns in this vicinity. They are in the market for a small switchboard, as well as other material.

CARPENTER, OKLA.—The Elk City Northern Telephone Company has been incorporated with a capital stock of $5000. The directors are: Jos. Moad, D. L. Cliff and others.

MORGANSTOWN, PA.—At the annual meeting of the Conestoga Telephone & Telegraph Company recently held here, the board of directors was organized by the election of the following named officers: President, M. H. Hertzler; vice-president and secretary, Jacob Hartz; treasurer, H. B. Best.

CHARLESTON, S. C.—The extensive system of the Gordon Telephone Company, of Charleston, has been bought out by the Southern Bell Company and the two interests will be merged as soon as possible. The Gordon Company, it is said, desired to sell. The price paid, while small, was sufficient to meet all obligations of the Gordon Company, of which M. C. Duncan will remain in charge.

NASHVILLE, TENN.—The Cumberland Telephone & Telegraph Company is seeking permission to place its wires underground in the business portion of the city.

DENTON, TEX.—The People's Home Telephone Company has just completed the installation of its new exchange at Denton and will begin operations with about 250 telephones in a few days.

AUSTIN, TEX.—The Comptroller of Public Accounts of the State of Texas has taken steps looking to the enforcement of the law requiring all telephone companies operating in that state to pay an annual tax on each telephone instrument in use. It is conservatively estimated that there are fully 250 telephone companies operating in Texas. Of this number only 29 have complied with the law requiring the payment of taxes on the telephones which they had in operation on January 1, 1904.

SALT LAKE CITY, UTAH.—At the recent meeting of the stockholders of the Rocky Mountain Bell Telephone Company a report was submitted showing an increase in business of 25 per cent. over the previous fiscal year. The net gain reported was $215,042.73. The present board of directors was re-elected with the exception of Charles W. Clark, whose place was filled by the selection of Governor B. F. White, of Montana.

WINCHESTER, VA.—The Southern Bell Telephone Company has secured a franchise at Winchester, paying $250 therefor.

MONROE, WIS.—The Monroe Telephone Company has increased its capital stock from $20,000 to $50,000.

GLIDDEN, WIS.—The Glidden Telephone Company has been incorporated with a capital stock of $24,000 by J. R. Whittaker, W. L. Schuppert, E. B. Gordon, David Bodway, J. W. Hoops and George L. McCurdy.

MILWAUKEE, WIS.—It is stated that the Independent Consolidated Telephone Company will establish an exchange in this city within a year. It is calculated that an adequate system will cost over $1,000,000, but the company, it is stated, is prepared to go ahead with the work.

TLANALPAN, MEX.—A telephone line is being constructed from Tlanalpan to the town of Tepeapulpo.

CULIACAN, MEX.—The Government of the State of Sinaloa has granted a concession to Antonio Echevarria to establish a telephone system in the Mocorinto district of the state. All the principal towns and villages in the district will be connected by long distance lines.

MONTREAL, QUE.—At the annual meeting at Montreal on February 25 of the shareholders of the Bell Telephone Company of Canada, the directors were authorized to issue $2,000,000 new stock at $125, in five installments of $25 each. This will bring the capitalization up to $8,000,000. The additional capital is required for line extensions and general additional equipment to keep up with the rapid growth of the country. The annual report of the company shows that 8,691 subscribers have been added to the list during the past year. The total number of instruments now earning rental in the Dominion is 57,172. The company now owns and operates 421 exchanges and 672 agencies. About 4121 miles of wire were added to the long distance system in 1903, and the long distance lines now opened and operated by the company comprise 30,969 miles of wire on 7685 miles of poles.

Electric Light and Power.

EAST LAKE, ALA.—The citizens of East Lake will vote on March 28 on the question of issuing $13,500 bonds for an electric lighting plant.

ANNISTON, ALA.—The Anniston Stove Works Company is to build a $50,000 plant which will be probably operated by electric power, each machine having an independent motor. Mr. O. W. Snyder is manager.

GILROY, CAL.—The Council is considering the establishment of an electric light system.

SEBASTOPOL, CAL.—G. W. Swain has petitioned for a franchise to establish a light and power plant.

SAN FRANCISCO, CAL.—The California Gas & Electric Company on February 29 absorbed the Standard Electric Company and United Gas & Electric Company. The company has more than 1100 miles of line and it sends power to many cities within a radius of 250 miles of San Francisco.

LOS ANGELES, CAL.—The Union Power Company has been incorporated with $2,000,000 capital, $15,000 paid in, to produce electric light, power and heat by the utilization of the waters of the Santa Ana River. The directors are: J. B. Miller J. C. Drake, A. C. Balch, F. Forman and Kaspare Cohn, of Los Angeles, and J. S. Torrance, of Pasadena.

GEORGETOWN, CAL.—Negotiations are reported under way with the American River Electric Company to extend a line from a point near the Delmatia Mine, in the Kelsey district, to Georgetown for power and lighting purposes. The line will be about 9 miles in length. Superintendent Everson, of the El Dorado Copper Mining Company, is at the head of the movement.

WASHINGTON, D. C.—A bill has passed the United States Senate authorizing the Minnesota Power Company to construct a dam across the Mississippi River between Wright and Sherburne Counties, Minnesota.

PENSACOLA, FLA.—Bids are wanted for $50,000 water, light and ice factory bonds. Address P. O. Box 632, Pensacola.

HIGH SPRINGS, FLA.—The Council has under consideration the matter of issuing bonds for water works and an electric light plant.

BERN, IND.—H. H. Stucky has petitioned for a franchise for an electric light plant.

FT. WAYNE, IND.—The Ft. Wayne Electric Light & Power Company is considering plans for a power plant.

SOUTH BEND, IND.—The Oliver Chilled Plow Works, of South Bend, will run its power wires underground from the new power plant to the factory, requiring about 6000 feet of conduit.

INDIANAPOLIS, IND.—The Board of Public Works has awarded the contract to light this city for the next ten years to the Indianapolis Light & Power Company, which was the lowest of the three bidders. The contract price is $75 a year for each light on both direct and alternating-current enclosed arc lamps, and $74 on direct-current open arc lamps. The company also bid $35 a year on 50-cp incandescent lamps. The competitive bids were made by George E. Fisher, of Detroit, and E. C. Bruckman, of New York, who bid $78.50 on arc lamps, $32.50 on incandescent lamps, $83.82 on the alternating-current enclosed arc lamps and $26.25 for the 50-cp incandescent, respectively. The former price paid to the successful company was $85 a year for each light on a moonlight schedule. The new contract is for an all-night schedule.

SAPULPA, I. T.—It is reported that an electric light plant will be constructed here, at a cost of $27,500.

LENOX, IA.—The Town Council has granted a 25-year franchise to S. E. Wainright to construct and operate an electric light plant, to cost about $7000.

ANNAPOLIS, MD.—A bill has been introduced in the State Senate incorporating the Towson Electric Co.

KENSINGTON, MD.—A bill has been introduced in the State Legislature to authorize this city to issue bonds for water works and an electric light plant.

GLADSTONE, MICH.—The Village Council has granted a franchise to local parties for an electric light plant.

GOBLEVILLE, MICH.—The matter of issuing $20,000 bonds for municipal water works and a lighting plant is under consideration.

MERIDIAN, MISS.—The Meridian Light & Power Company will increase its capital stock from $750,000 to $1,000,000.

ABERDEEN, MISS.—The Aberdeen Electric Light & Power Co., of Aberdeen, has been incorporated with a capital of $15,000, by E. M. Jones, J. R. Jones, C. C. Tubbs and others.

ST. LOUIS, MO.—The Laclede Power Company, of St. Louis, has won its fight with the City Water Department on the question of its right to draw its own water from the Mississippi River.

SEDALIA, MO.—It is reported that Mayor Babcock will soon lay before the City Council plans for an electric light plant, and will recommend that it be built, and the contracts at present existing not be renewed.

LIBBY, MONT.—Bids will probably be received in July for an electric light plant, to cost about $6000.

PENN YAN, N. Y.—Horace B. Smith is at work on plans and specifications for a municipal electric light plant.

VICTOR, N. Y.—The Rochester & Eastern Railway Company has submitted a proposition to the Village Board to furnish incandescent lights for both public and private use.

PENFIELD, N. Y.—The business men and citizens are interested in the construction of an electric light system. It is proposed to procure the current from the plant at Lincoln Mills.

LOCKPORT, N. Y.—A resolution has been passed by the Common Council directing an election on the proposition to install a municipal electric light plant, at a cost not to exceed $50,000.

SODUS, N. Y.—Two applications have been made to the Town Board of Trustees for franchises for an electric light plant. One from Omar Curtis, of Wolcott; the other from the Sodus Gas & Electric Light Company, recently formed.

BROOKLYN, N. Y.—Bids will be received until March 14 by C. B. J. Snyder, superintendent of school buildings, New York City, for installing electric light wiring, fixtures and electric bell system in School No. 47, Borough of Brooklyn.

NEW YORK, N. Y.—Bids will be received March 15 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the navy yard here a quantity of electric motors, motor-generators, generating sets, conduits and fittings, wire, wiring appliances, incandescent lamps, electric light fixtures, copper pipe, brass fittings, valves, etc. H. T. B. Harris, Paymaster-General, U. S. N.

NEW YORK, N. Y.—Commissioner John T. Oakley, of the Department of Water Supply, Gas and Electricity, has advertised for bids for the city lighting for a year from March 16. This includes the lighting of streets, parks and public buildings by both gas and electricity, and in advertising for contracts dated from March 16 instead of dating back to Jan. 1 the city officials let it be known that they will let the companies continue their fight in the courts for payment for the light supplied in 1903 and up to March 15 of the current year. The lighting appropriation for last year amounted to $3,306,346.

GOLDSBORO, N. C.—It is proposed to increase the capacity of the electric light plant. Address C. Dewey, chairman of the Board of Public Works.

CHARLOTTE, N. C.—W. S. Lee, Jr., of Rock Hill, S. C., vice-president and chief engineer of the Catawba Electric Power Company, of Rock Hill, S. C., writes that it is proposed to construct a sub-station at Charlotte, and to build 18 miles of high potential transmission line.

FARGO, N. D.—The Union Light, Heat & Power Company will improve and enlarge its plant.

DRAYTON, N. D.—John R. Hogg is interested in the construction of an electric lighting plant.

WEST MANSFIELD, OHIO.—Bids are wanted April 1 for $11,000 electric light bonds. C. D. Atkinson is clerk.

BELLEFONTAINE, OHIO.—The Board of Public Works has had plans prepared for a municipal lighting plant to cost $60,000.

CONNEAUT, OHIO.—The city will make some improvements to its electric light plant. Some pumping machinery will also be installed.

WAPAKONETA, OHIO.—The Village Council will issue $7000 worth of 5 per cent. bonds for the purpose of enlarging and improving the village lighting plant.

CARDINGTON, OHIO.—The Cardington Electric Light & Power Company, capital $15,000, has been incorporated by G. M. Schambs, J. W. Glauner, W. P. Vaughan and others.

SALEM, OHIO.—J. S. Kleinfelter, of the proposed Salem Electric Light, Heating & Ice Company, states that a location for the plant has been secured and that the ice and electric lighting plant will be in operation about June 1.

WILKESBARRE, PA.—Mayor Price has signed the bill granting a franchise to the Ashley Electric Light Company. The ordinance granting a franchise to the West Side Electric Light Company has been reconsidered by the Council and passed on final reading.

SOUR LAKE, TEX.—It is reported that another electric light and power plant is to be installed here. D. O. Lively can probably give information.

AMERICAN FORK, UTAH.—The local electric light company will build a line to the pumps on Jordan River. The capacity of the plant is being greatly enlarged.

EAST MILWAUKEE, WIS.—The residents of the scattered village of East Milwaukee are concerned in the move by the Milwaukee Light, Heat & Traction Company to secure a franchise for lighting the village with 18 electric arc lights at $84 per year for each light, the same proposition as was made to West Allis. As East Milwaukee is a country settlement, and there are not a half dozen houses near together in the village, which embraces all of the town of Milwaukee between the lake and the river, and from the northern city limits at Keefe Ave. to the southern limits of Whitefish Bay, some of the residents object to electric lighting as something not needed.

SAN LUIS POTOSI, MEX.—The Governor of the State of San Luis Potosi has called for bids for a municipal electric light and power plant for this city.

MONTEREY, MEX.—The Monterey Electric Light & Power Company has given an order to the General Electric Company for a steam turbine and electrical equipment for the plant in this city.

MONCLOVA, MEX.—The City Council of Monclova has awarded the contract for the installation of an electric light and power plant at this place to Victor M. Braschi & Bro., of the City of Mexico. The plant will cost about $100,000 gold.

PUEBLA, MEX.—The Mexican Government has granted a concession to Archbishop Gillow, of Puebla, for the construction and operation of an electric light and power plant on his Chiautla hacienda, situated in this state. Water power will be used to generate the electrical energy.

KINGSTON, ONT.—Cable advices from London, Eng., announce that the city of Kingston has won before the Imperial Privy Council in the appeal of the Light, Heat & Power Company. This case has been before the courts for over two years. In 1901, the arbitrators fixed the value of the company's plant, which the city is taking over, at the sum of $170,373. They decided that there was no franchise, and left the company to appeal to the courts upon that point. If there could be shown to be a franchise, then the value was fixed at $80,000. The company appealed first to the high courts in Canada, and finally to the Privy Council of Great Britain. All the appeals were decided against the company, and now the city gets the plant at the arbitrators' award of $170,373, less a sum to be fixed for depreciation since 1901.

The Electric Railway.

BESSEMER, ALA.—The Birmingham Railway, Light & Power Company, it is said, will take up the matter planned some time ago, to construct a suburban railway to Jonesboro.

ARKANSAS CITY, ARK.—The contract for the building of the Interurban Railway between this city and Winfield and between this city and the Indian schools at Chilocco, Okla., has been awarded to a St. Louis company. It is expected that the work will cost between $500,000 and $650,000. The power house, general offices, etc., will be in Arkansas City. Mr. L. H. Northrup is the promoter.

SAN FRANCISCO, CAL.—The United Railroads of San Francisco has asked permission to reconstruct as an electric road the steam road which extends from the Cliff House.

LOUISVILLE, KY.—The Louisville Railway Company directors recently re-elected the present officers, as follows: T. J. Minary, president; St. John Boyle, vice-president and general counsel, and Samuel G. Boyle, secretary and treasurer. The annual statement shows nearly $2,000,000 gross earnings. During the past year an underground conduit system has been begun, a large addition to the power house has been made and the construction of the three suburban lines has been pushed as rapidly as possible. Three sub-stations for these lines have been erected. Bonds to the extent of $210,000 were sold.

DULUTH, MINN.—The Duluth Street Railway Company will probably install an air or electric hoist in its new repair and paint shops, as well as a few small machine tools.

ST. PAUL, MINN.—A bill is before Congress granting permission to the Minnesota Power & Trolley Company to construct a dam across the Mississippi River two miles above Elk River, 950 feet long, which it is estimated will develop from 15,000 to 20,000 horse-power. This is to be used primarily for trolley lines, and the surplus for commercial purposes. An interurban and a belt line is contemplated.

MERIDIAN, MISS.—The "Jim Crow" law recently enacted in Mississippi has severely hurt the street railway business in this state. There are but 28 miles of electric railway in the entire state, of which seven are in Meridian. The law compels the street car companies within 90 days either to provide separate cars for the colored people, or to place portable screens in the cars to separate them from the white passengers. The law will have a tendency to stop further street railway extensions and improvements contemplated.

SUMMIT, N. J.—The Cross Steam & Electric Railway Company, which is believed by many to be the successor of the new Orange Railway Company, which about a year ago purchased considerable property through the eastern section of Summit for a railway line and later abandoned the project, has made application to the Summit Common Council for trackage rights in several Summit streets. The company proposes to connect Summit and Elizabeth by a steam railroad. Louis Keller, organizer of the Baltusrol Golf Club, signed the application. In the application it is set forth that all necessary rights of way through private property had been purchased, and should Summit grant the trackage rights asked for the company would agree to begin the work of construction of the line early during the coming summer.

NEW YORK, N. Y.—Proposals will be received by the Cienfuegos, Palmira & Cruces Electric Power & Railway Company, at its office, Havana, Cuba, or at the office of its consulting engineer, C. C. Vermeule, 203 Broadway, New York, until March 15 at noon, for the following material, delivered f. o. b. ship in the harbor of Cienfuegos, Cuba: 4400 tons of steel T-rails, 70 lbs. per yard; 1200 kegs of spikes, 14,100 (0000) electric rail bonds, 105,000 creosoted railroad ties, 4100 trolley poles, 15,000 barrels Portland cement. Specifications for the above material will be furnished at either of the above offices. Proposals will also be received for grading, bridges, culverts, track-laying, etc., for 39 miles of railway between Cienfuegos, Cruces and Cumanayagua; also for constructing a dam, 4000 ft. of tunnel, a flume, and power house on the Rio Hanabanilla, with an auxiliary dam on the Rio Negro, and clearing about 2200 acres of reservoir lands. Plans, specifications and quantities for the above construction work will be furnished by F. W. Bennett, chief engineer, 128 Calle San Carlos, Cienfuegos, and bidders for construction must inspect the location of the work.

CLEVELAND, OHIO.—The holdings in the Cleveland Electric Street Railway Company of the late Marcus A. Hanna are stated to be worth about $2,000,000.

DAYTON, OHIO.—John H. Boroff, representing the Interstate Traction Company, has applied to the Montgomery County Commissioners for a franchise for an electric railway from Dayton to Indianapolis.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company is preparing to make $10,000 worth of improvements at Buckeye Lake, but it has given up the plan of building a new hotel at the resort.

COLUMBUS, OHIO.—The Findlay, Forest & Marion Railway Company, of Columbus, has been incorporated with $10,000 capital stock. Incorporators are: Claude Meaker, W. B. Beebe, H. E. Armbruster and W. B. Earnhart.

MANSFIELD, OHIO.—The Mansfield & Mt. Vernon Traction Company, with a capital stock of $10,000, has been incorporated by Wm. W. Branyan, A. B. Beverstock, Mark H. Arnold, E. R. Rumpler, W. A. Hambleton, Frank Fairchild and C. G. Cooper.

CINCINNATI, OHIO.—The Cincinnati Suburban Belt Line and the Cincinnati, Chester Park & Red Bank Belt Line have practically agreed on terms of consolidation. Thomas P. Egan, of the Fay & Egan Company, has been tendered the presidency of the consolidated company.

DAYTON, OHIO.—The Dayton & Muncie Traction Company has elected these officers: J. E. Lowes, president; A. Newsalt, vice-president; J. E. Feight, secretary; W. B. Gebhart, treasurer. The road is under construction from Greenville, O., to Muncie, Ind., and will probably be completed by August.

YORK, PA.—It is proposed to petition the Maryland & Pennsylvania Railroad Company to change the motive power on its line from steam to electricity.

YORK, PA.—Nearly all the rights of way have been promised for an extension of the York County Traction system from Red Lion to Airville.

HARRISBURG, PA.—The Wilkins & Braddock Electric Street Railway Company has been chartered to build an electric railway 3½ miles long in Allegheny County. The capital stock is $21,000.

HARRISBURG, PA.—The Valley Traction Company has begun work on the enlargement and improvement of the Bridgeport power house. A new boiler house is being built and an extension added to the present plant. When completed the capacity of the plant will be more than doubled. The boiler house will be 100x40 ft., and equipped with five Babcock & Wilcox high-pressure boilers. The extension to the main building will be 30 ft. long.

BLOOMSBURG, PA.—The Danville & Bloomsburg Street Railway Company has given out contracts as follows: For boilers and engines, to the E. Keeler Company, of Williamsport; generators, to the Crocker-Wheeler Company, Ampere, N. J. The power house will be built at Grovania. At a recent meeting of the company further arrangements were made for the early commencement of work on the new 12-mile line. The contract for building the line has been awarded to the Standard Construction Company, of Allentown.

NASHVILLE, TENN.—At the annual meeting of the stockholders of the Nashville Railway & Light Company all of the former officers and members of the board of directors were re-elected.

KNOXVILLE, TENN.—The Knoxville Street Railway & Electric Light Company has been sold to Ford, Bacon & Davis, of New York. It is stated that extensive improvements will be made in the near future.

EL PASO, TEX.—It is announced that interests closely identified with the Union Traction Company, of Indianapolis, Ind., will build an electric interurban railway from El Paso to Las Cruces, New Mex.

TEMPLE, TEX.—The Pennsylvania men who contemplated building an interurban electric railway between this place and Belton have abandoned the project after making a personal investigation of the situation.

SALT LAKE CITY, UTAH.—The Salt Lake & Brigham City Electric Railway Company has been granted a franchise to construct its proposed electric system through Davis County. The road will connect Salt Lake and Ogden. It will eventually be extended from Ogden to the northern boundary of the State.

NORFOLK, VA.—The Norfolk Railway & Light Company and the Norfolk & Atlantic Terminal Company have discontinued their service to Old Point on account of lack of patronage. The schedule to Old Point may be resumed later.

COLFAX, WASH.—A franchise has been granted to the Palouse & Spokane Electric Railway Company by the County Commissioners for the construction of its system from Spokane to this city and from here to Penawawa, in the extreme east of the State. The company has already done considerable grading for the proposed road.

WHEELING, W. VA.—It is stated that the Wheeling Traction Company has awarded Coulter & Furtwangler the contract for the extension of its lines from Pasco to Barton.

HUNTINGTON, W. VA.—The Huntington & Charleston Railroad Company has been chartered with $20,000 capital, to build a steam or electric road between these cities. W. R. Thompson, E. M. Eatts and others, of Huntington, are the incorporators.

WAUPACA, WIS.—The Waupaca Electric Light & Railway Company, which owns and operates a five-mile street and interurban railway and an electric lighting plant at Waupaca, has just held its annual meeting and elected the following officers: President and general manager, Irving P. Lord; vice-president, W. H. Lord; secretary, John D. Caughell; treasurer, P. M. Olfson. These gentlemen, together with J. W. Evans, constitute the board of directors. The total income of the company for 1903 was $18,092.68; operating expenses, including taxes, insurance and maintenance account, $8366.06; interest on bonded indebtedness, $2040; showing net earnings for the year of $7686.62, or a trifle over 10 per cent. on the capital stock of $75,000. The company has increased its capital to $125,000 and intends to make some extensions this spring.

OTTAWA, ONT.—It is announced officially that the Ottawa & New York Railway, operating between Ottawa and Tupper Lake, N. Y., is to be converted into an electric road during the current year.

WATERLOO, ONT.—A company now seeking incorporation asks for permission to build an electric railway from Wellesley, in Waterloo County, via Stratford and St. Marys to Clinton, thence in a southwesterly direction to Bayfield.

OTTAWA, ONT.—The incorporation of a company to build an electric railway from Brantford to Hamilton, Ont., will be sought from the Dominion Parliament at its approaching session. Authority will also be asked to permit the company to convey electrical power over the right of way, and to sell and distribute the same within the municipalities traversed by the line.

OTTAWA, ONT.—According to the official returns of the department of railways and canals for Canada, just issued, giving statistical information for the past fiscal year in respect to railways in Canada, it is shown that the mileage of electric railways in Canada was 759, as against 558 in the previous year. In addition to this there were 32 miles of sidings. The gross earnings of electric railways totalled $7,223,677, as against $6,406,438 for the previous year. The net earnings were $2,760,819. There were also large increases in the number of passengers and freight carried. Last year there were 155,662,812 passengers carried and 371,182 tons of freight moved.

MONTREAL, QUE.—A party of engineers is now locating the route of the new Montreal-Ottawa Electric Railway.

QUEBEC, QUE.—Hon. John Sharples, J. Bell Forsyth, A. C. Dobell and others purpose forming a company with a capital of $100,000, to connect the parishes of St. Colomban, Sillery, Bergerville and Charlesbourg with the city of Quebec by means of an electric railway.

LEGAL.

SWITCHBOARD SUIT.—The Western Electric Company has brought suit against the Rochester Telephone Company, of Rochester, N. Y., based on the allegation that the Rochester Company's switchboard is an infringement on a patent controlled by the Western Electric Company.

WHAT IS A CORPORATE GIFT?—Charles C. Worthington has been sued by the corporation of Henry R. Worthington, of which he was president until November, 1900, for $12,570, the cost of the scientific apparatus which Mr. Worthington in 1897 presented to the School of Mines of Columbia University as a memorial to his father, the founder of the firm. The corporation, with which Mr. Worthington has severed his connection altogether, claims that he ordered the apparatus—consisting of steam pump machinery and various auxiliaries—agreeing to pay for them. Mr. Worthington denies any personal liability for the material and apparatus. He contends that they were presented as a corporate gift, and that the firm is liable for the cost.

HORSE AS A MISSILE.—New York Supreme Court Justice Nash has decided that a street railway company is not necessarily liable if a horse, belonging to somebody else, pokes its head through a car window and injures or frightens any of the passengers. The decision arose out of the suit brought by Christine T. Grant against the Metropolitan Street Railway Company to recover for injuries she sustained in just such an accident about a year ago. She was riding in a Fourth Avenue car, which stopped suddenly at Twenty-third Street. A horse that was crossing Twenty-third Street was going too fast to be stopped in time, and its head crashed through the window where Miss Grant was sitting. She was struck by flying pieces of glass and suffered from shock. She held that the company was necessarily liable, but Justice Nash holds that where, as in this case, the accident is the result of contact with some object over which the company had no control, the legal status is just the same as if Miss Grant had been injured by a flying missile thrown at the car.

CUTTING TREES FOR WIRE STRINGING.—The Supreme Court of Iowa has recently held that the measure of damages for unreasonable cutting of trees for the erection of a telephone line is the difference between the value of the land as it would have been if the cutting had been reasonable and what it was after the cutting, not the difference between the value before and after the cutting. In a case recently before the Supreme Court of Wisconsin, a somewhat similar point was up in regard to the Waukesha Electric Light Company. It appeared that Revised Statutes 1898, sections 925-88, applicable to cities of a certain class, provides that the time "and manner" of using streets for placing electric light poles "shall" be determined by the Board of Public Works, subject to review by the Common Council. An ordinance granted an electric light company the privilege of using the streets, subject to the direction and supervision of the Board of Public Works, in the setting of poles, etc. The board made an order authorizing the use of certain streets, but not designating any particular places where poles should be put. The Supreme Court held that the company had no right to set a pole in front of an abutting owner's property, so as to require the trimming of his shade trees, without his consent.

OBITUARY.

MR. ANDREW HOWARD, president of the Phœnix Glass Company, died Feb. 27 at Wilkinsburg, Pa., of pneumonia, after an illness of ten days. Mr. Howard was born in Pittsburg in 1837, and started life as a clerk with the transportation firm of Clark & Thaw, which afterward was merged in the Star Union Line, Mr. Howard becoming cashier of the latter. He resigned this position in 1880 to organize the Phœnix Glass Company, for the manufacture of a patent glass insulator, which product, however, was abandoned and the manufacture of lamp chimneys taken up. From this beginning, and principally through Mr. Howard's enterprise and energy, the Phœnix Glass Company steadily progressed to its present large proportions. Mr. Howard enjoyed great popularity among his numerous employees, an evidence of which were the lavish floral offerings from these at the funeral.

MR. JOHN S. KING.—Mr. John S. King, treasurer of the David Williams Company, of this city, died on March 4 at his home in Brooklyn. He was born at Middletown, N. Y., in 1841, and learned the trade of a printer there. He went to the front in the civil war as a private in the Eighteenth New York Regiment, and was seriously wounded by one of the last shots fired in the battles before Richmond, immediately before the surrender of that city. He was acting adjutant of his regiment at the time. In 1898 he was made treasurer of the David Williams Company, and continued as business manager of *The Iron Age*, *The Metal Worker* and *Carpentery and Building*. He was also made treasurer and general manager of the Williams Printing Company upon its organization. Mr. King was a member of a great many Masonic organizations and of the Sons of American Revolution, Grand Army of the Republic, Loyal Legion, Society of the Army of the Potomac, Hardware Club and the Union League and Aurora Grata Clubs of Brooklyn. Mr. King is survived by his wife, who was Miss Gertrude Murray, of Hudson, O., and six children. The funeral services were held from his late residence.

MR. J. D. EASTERLIN.—We regret to note the death of Mr. John D. Easterlin, the special agent of the Southern Bell Telephone & Telegraph Company, this sad event taking place at Marietta, Ga., after a short illness, on February 17. His illness began with a slight earache, but his condition rapidly became more serious and he succumbed in a few days to mastoiditis. He was born at Bamberg, S. C., June 21, 1844, and began his electrical career as a telegraph operator, becoming at an early age manager of the office at Charleston, S. C. He was for many years manager for the Southern Bell Telephone & Telegraph Company in the same city and afterwards district superintendent there, as well as at Macon, Ga. In 1890 he went to Atlanta, occupying the same position, but for the last five years larger responsibilities had been put upon him and he had been made special agent to assist the general manager of the company. In this work his long experience, sound judgment, indefatigable industry, and genial manners, secured him success which rounded out his long career of usefulness. His death is greatly felt by his old friends and associates. Mr. Easterlin was deacon in the Jackson Hill Baptist Church of his city, and was also a Royal Arch Mason. He leaves behind him a wife, two sons and one daughter, and two grandchildren. The funeral services were held in Charleston, S. C.

PERSONAL.

FIRST LIEUTENANT F. E. LYMAN, JR., has resigned from the U. S. Signal Corps, to take effect March 25.

MR. LOUIS ALBERGER, of the Alberger Condenser Company, Liberty Street, New York, has returned from a three weeks' trip to Cuba.

MR. JOHN S. LAPP, secretary and treasurer of the Locke Insulator Manufacturing Company, Victor, N. Y., was a recent visitor to New York.

MR. CHARLES E. LAWRENCE has become president of the Charlestown, Mass., Gas & Electric Company, in the place of Mr. J. P. Hunnewell, who has resigned.

MR. A. C. RAHE, of the Smith Storage Battery Company, Binghamton, N. Y., was in New York City recently, accompanied by Col. E. H. Hewins, of Boston.

MR. S. G. McMEEN, the telephone expert, has returned to Chicago after completing the preliminary work of mapping Mexico City for the new underground telephone system.

MR. HENRY M. WATSON, formerly president of the Buffalo Railway Company, has been re-elected president of the Bell Telephone Company of Western New York, with headquarters in Buffalo.

MR. W. K. PALMER, M. E., consulting engineer, Kansas City, Mo., has moved his office in that city to Suite 402, Lyceum Building, where he will give attention to lighting and power plants, etc.

MR. MARIUS LATOUR, the well-known French electrical engineer, is now visiting this country, as to his inventions. This journal has recently published one or two communications from him on the subject of his work.

MR. ROBERT T. E. LOZIER, for some time past so prominently connected with the Bullock Electric Manufacturing Company, in charge of its sales department, has resigned in order to engage in electric motor work on his own account.

MR. J. B. COWEN, of the General Incandescent Arc Light Company, has recently returned from an eight months' business trip to Europe, and has assumed charge of the sales department of the above named company in New York.

MR. T. W. CROWLEY has been appointed superintendent of telegraph of the Delaware & Hudson Railroad Company to succeed Mr. J. W. Burdick, who will henceforth devote his entire attention and time to the duties of general passenger agent.

MR. A. KENNEDY ASHWORTH has resigned as assistant manager of the Underfeed Stoker Company, Chicago, to accept the New England agency of the Buckeye Engine Company, Salem, O., with headquarters in the Hancock Building, Boston, Mass.

MR. H. HINE, formerly of the Stanley interests and now president of the Guanajuato Power & Electric Company, which is to considerably extend its operations in Mexico, has left New York for Colorado Springs. He expects to return in about a fortnight.

MR. WALTER ABBOT, one of the directors of the London United Tramways, now controlled by the Underground Electric Railways Company of London, Ltd., of which Charles T. Yerkes is chairman, is now on a visit to this side. He is at present in Boston.

MR. A. J. WURTS, manager and engineer of the Nernst Lamp Company, has been seriously ill for some time past at Pittsburg, and had to go to Atlantic City to recover his strength. We are glad to report that he has now returned to work and has entirely recovered.

MR. W. W. KER, of the Hebrew Technical Institute, is delivering for the New York Board of Education at the Alfred Corning Clark Neighborhood House, another course of free lectures, beginning March 1, devoted to the principles and practice of electrical engineering. There will be eight of the lectures.

MR. WILLIAM T. BENALLACK, of Detroit, Mich., is delivering a course of lectures before the Indiana underwriters' and electrical contractors on "Faulty Wiring." The speaker is president of the National Electrical Inspectors' Association, as well as the head of the electrical inspection of the Michigan Board of Fire Underwriters.

MR. GEORGE WESTINGHOUSE is the theme of a most interesting and very ably written article in the New York *Times* of March 5, by Mr. Arthur Warren, who has studied his subject at close quarters, and has all the qualities needed by a biographer. It is a fine revelation of a great and fascinating personality—of a really great American.

MESSRS. G. C. HENRY and WALTER CASTANEDO, of Atlanta, Ga., who represent the southern interests of the Bullock Electric Manufacturing Company and the Harrisburg Foundry & Machine Works, respectively, are now in New York with a view to closing contracts for the equipment of a 900-hp lighting and railway plant to be built in Florida.

MR. C. P. BRUCH, assistant secretary and assistant general manager of the Postal Telegraph-Cable Company, has received recently a fine gavel as chairman of the conference of officials of that company, from his colleagues, members of the conference. The woods are varied and choice, including a handle made very appropriately from an olive branch.

DR. MAX VON RECKLINGHAUSEN, who has been associated with Nernst and Cooper Hewitt lamp development in this country, has gone to Europe to establish a Cooper Hewitt factory there, so as to meet the demand which has already been created for the lamp. It is hoped that at no distant date the Doctor will return to a country where he has made so many friends.

MR. L. D. GARDNER, recently of the New York *Sun*, and an active member of the Technology Club of New York, has organized the L. D. Gardner Company at 521 Temple Court, this city, to build up a business in radium specialties of all kinds. He has lately been giving attention to the matter, and is the coiner of the phrase "liquid sunshine," as applied to fluorescent liquids, which has so caught the public fancy.

MESSRS. GEORGE BULLOCK, president, and Joseph S. Neave, vice-president, of the Bullock Electric Manufacturing Company, of Cincinnati, are now in New York. They came east primarily for the purpose of attending the special meeting of the stockholders of the company, which will meet in Jersey City, March 16, to ratify the Allis-Chalmers-Bullock deal, to which reference is made elsewhere in this issue. They are guests at the Gregorian Hotel, West 35th Street.

MR. RICHARD E. SACK, formerly of the editorial staff of the ELECTRICAL WORLD AND ENGINEER at the Chicago office, has recently accepted the position of contract agent for the Albert Lea Light & Power Company, Albert Lea, Minn. Mr. Sack will devote his energies to building up the business of this company, especially in the direction of increasing the number of electric motors in use, and securing customers for the new gas plant which the company is just starting. His engineering training and ability should stand him in good stead.

SIR WEETMAN D. PEARSON, Bart., M. P., chairman of the British contracting firm of S. Pearson & Company, Limited, which is undertaking some huge contracts in Mexico entailing the purchase of considerable electrical equipment in the United States, is now in New York en route for England. He is president of the Ferrocarriles de Veracruz, Limitada, which operates some 12 miles of horse tramways in Vera Cruz, Mex. These lines are to be converted to electricity and extended. Sir Weetman is a guest at the Waldorf-Astoria. He expects to remain here for about a week.

MR. P. FARNSWORTH.—Mr. Philip Farnsworth, formerly of New Haven, Conn., has removed to 150 Nassau Street, New York City, where he will continue the practice of general patent law. He has been retained as counsel in several important patent suits. He has had an unusually valuable experience in the practice of patent law, having been associated for several years with Mr. F. H. Betts. Previously, Mr. Farnsworth acted for several years as local counsel at Schenectady for the General Electric Company. He graduated from the Sheffield Scientific School in 1894, and from the Yale Law School in 1897, after which he practiced in Washington, D. C.

MR. HARRY D. PARSONS, who has been superintendent of construction and electrician for the Meridian, Miss., Light & Railway Company, has resigned from that company to accept a position of salesman for the Commercial Electrical Supply Company, of St. Louis, Mo. It may be recalled that Mr. Parsons about five years ago figured in newspaper accounts as the victim of an accident from a 10,000-volt transmission circuit in Texas, being so badly burned that he had to undergo the operation of having almost 300 square inches of flesh grafted upon his body from other people's bodies. The medical journals at that time stated that this was the most successful piece of skin grafting ever accomplished.

MR. W. G. LEVISON.—The March meeting of the New York Mineralogical Club will be held on Wednesday, March 16, 1904, at the residence of Mr. Wallace Goold Levison, 1435 Pacific Street, corner of Brooklyn Avenue, Borough of Brooklyn. The following will speak: Dr. George F. Kunz—"Further observations on substances that respond by phosphorescence to natural radioactive substances," with exhibition of "Actinium"; Mr. George L. English—"Exhibition and description of some twin calcite crystals from a new find at Joplin, Mo." Mr. Levison will exhibit a series of specimens of fluorescent Willemite from Franklin, N. J.; radioactive pitch blende from Bedford, N. Y., and minerals from New York City and other selections from his collection.

MR. B. A. BEHREND, chief engineer of the Bullock Electric Manufacturing Company, is visiting New York this week. In the recent combination of the Allis-Chalmers and Bullock interests, Vice-President W. J. Chalmers has retained and secured the services of Mr. B. A. Behrend as chief electrical engineer. Mr. Behrend's successful work during the past four years in the design of some two hundred thousand kilowatts of large alternating and direct-current machines, has established the engineering reputation of the Bullock Company as a factor in the building of electric power plants of the largest size. Among the more notable designs of Mr. Behrend are the municipal plant at Nashville, Tenn.; 5000 kw of alternating-current generators in Denver, Col.; five 5000-kw generators for the Kern River Power Company, California; the generators for the Pacific Electric Railway Company, Los Angeles; the generators for the Mutual Electric Company, San Francisco; the frequency changers in Montreal, representing 10,000 kw, and numerous other plants of note and interest. The 3500-kw generating unit which will be exhibited by the Allis-Chalmers and Bullock companies at the World's Fair at St. Louis, the largest power unit at the Exposition, was also designed by Mr. Behrend, whose work has also found recognition outside his immediate sphere of activity. Only 29 years of age, he is a full member of the Institute, a member of the Committee of Standardization, chairman of the Cincinnati Branch of the Institute, a fellow of the American Association for the Advancement of Science, and a member of the Advisory Committee, appointed by President Francis, of the International Electrical Congress. Mr. Behrend's treatise on "The Induction Motor" has been translated into French and German, and he has lectured at the universities of Wisconsin, McGill and Leland Stanford.

Trade Notes.

EXHAUST HEADS.—A large plate glass factory at Alexandria, Ind., has placed an order with the Burt Manufacturing Company, Akron, O., for three 16-inch exhaust heads.

MICA INSULATOR COMPANY, Chicago and New York, has issued recently its 1904 price list of micanite, linotape, Empire cloths and papers, "M. I. C." compound, etc. The list goes into details of parts for a wide range of well-known apparatus.

THE ELYRIA ENGINE COMPANY, Elyria, Ohio, has purchased a site in that city and will erect a new plant to cost $100,000. The main building will be 75x175 feet. The company manufactures gas engines. Heman Ely, of Elyria, is at the head of the company.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY has issued a tasteful and striking folder as to its dry core lead-covered telephone cables, which it makes exclusively for independent telephone companies, in addition to its other wires, cords, cables, etc.

NEW THINGS.—The "New Discoveries in Electricity" which have opened before men new vistas of human possibilities, are described in an 8-page article in *The Living Age* for Feb. 27, with such clearness that even the unscientific reader will find no difficulty in appreciating them.

AL-LECTRO.—The L. B. Allen Company, Inc., Chicago, is handling Allectro, which is a polish for gold, silver, nickel, brass, copper, aluminum, cut glass, etc. It is used by the leading railways, automobile makers, power stations, etc., and is said to be very satisfactory in its results.

WHITEHEAD MACHINERY COMPANY has opened an office at 517 Park Building, Pittsburg, to care for its increasing eastern business. It will be in charge of Mr. Harry G. Adams, formerly with Wickes Bros., of Saginaw, who is thoroughly familiar with the second-hand machinery trade.

THE NATIONAL WIRE CORPORATION, New Haven, Conn., has issued a condensed catalogue of its products, with price lists, tables of wire, etc. This booklet contains a number of valuable tables and a lot of useful information about the wire business. Copies will be furnished free of charge to anyone interested.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY reports that it is meeting with great success in the introduction of the "Union" line of outlet boxes for rectangular push button switches of different makes. These boxes are designed primarily for use in finished buildings, or what is known as "old work," and for this purpose they afford great economy, as a hole may be cut and the box inserted without breaking the plaster or woodwork any more than will be covered by the ordinary switch plate. These boxes are carried in stock at the company's stores in Chicago, New York and Buffalo.

GOLD CAR HEATING & LIGHTING COMPANY has moved its offices to the Whitehall Building, 17 Battery Place, New York City, in order to secure more room, so badly necessitated by the remarkable growth of its business in electric and other car heating and in car lighting. The Gold Company has moved its Chicago offices and concentrated them with the New York ones at the new address. The company has also made another important move by securing a contract from Mr. T. A. Edison, under which it has the exclusive sale in the United States of the Edison storage battery for train lighting purposes.

"THINKABLE THINKLETS" is the title of an interesting pamphlet just issued by the Warren Electric Manufacturing Company, Sandusky, Ohio. As the name implies, the contents give some things to think about concerning the Warren alternator, which is so well known. This machine is of the induction type, and its simplicity of construction is well brought out in this unique folder. A list is given of the users of this make of machine, and it is a very long one. The machine is thoroughly illustrated, each of the principal parts being shown up with much clearness. These "thinkable thinklets" should be well thought over by those interested in this line of apparatus, as much can be learned from them.

PHOENIX ENGINES.—One of the most artistically designed catalogues we have ever seen has come to us from the Phoenix Iron Works Company, Meadville, Pa., and while it is artistically and mechanically a model, practical value and utility have not been sacrificed. Utilitarianism and art can be combined in a catalogue as well as anything else requiring expert knowledge and experience in its production. So much for the artistic features of the catalogue. The business side has received as much care. The contents represent the latest and highest development of the Phoenix engine, which is so well known in electric power transmission and lighting enterprises. These engines are built in the simple, tandem-compound and cross-compound types, and are designed to withstand the most exacting service in the generation of electric energy. Each class is illustrated by a typical engine, and it is in the illustrations where the greater part of the artistic skill has been applied. Equally excellent illustrations give views of the most important details of the engines, and cross-section views show in an exceedingly clear manner the internal construction of the cylinders and the assembling and relation of the parts. These illustrations, besides being of great utility to the business man, have educational advantages in that the design and construction of the machines are so clearly displayed. In other words, they give a clear and true conception of the actual mechanism of the steam engine. The text explains briefly the constructional features of these well-known machines, and after a careful study of the contents of the catalogue one is left with a very good idea of the merits of these engines. There are three pages giving reproductions of indicator cars intended to illustrate the advantages resulting from the use of the Phoenix compound valve gear. Views are also given of direct-connected units, the catalogue closing with a set of tables showing dimensions, power ratings, etc., of the various classes of engines under consideration.

ACTON ENGINE ROOM SPECIALTIES.—John Acton, who is one of the well-known manufacturers of engine room and other specialties, has a 32-page catalogue, fully illustrated, giving details of a number of things he makes. Mr. Acton says he has now on his books orders for 12 months ahead. The factory at 118 John St., Brooklyn, N. Y., is running steadily, and the merit of his apparatus has caused him to be flooded with orders.

OTTO WEISS MACHINE DEPARTMENT of the Chase Machine Company, of Cleveland, Ohio, writes as follows through Mr. Thomas A. Aiton, manager: "We manufacture machinery used for forming electric wires and cables and for insulating the same. We manufacture a large range of these machines for all kinds of insulation from silk to lead. I worked from some four years in Berlin, Germany, as assistant to Mr. Otto Weiss, who was for many years the head engineer at Siemens Bros., London, and who manufactured and laid a great number of submarine cables. Later he established his own company in Berlin, for the manufacture of machines used in this line of work. Perhaps it would interest you to know that I have just placed a 4-head cabling machine with the Waclark Wire Company, at Bay Way, N. J. This machine is 96 feet long and weighs 55,000 pounds, and is used for making 61-wire strands up to two million circular mills. We have also placed several of these machines, as likewise similar ones, though smaller, in many of the wire and cable works of this country."

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., reports an unusual business in its solid back long distance transmitters for toll lines, magneto exchanges and common battery exchanges.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 1, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

753,252. TELEPHONE-REPEATER; Merritt Gally, Brooklyn, N. Y. App. filed March 18, 1903. (See page 525.)

753,258. ELECTRIC SWITCH; Gerald W. Hart, Hartford, Conn. App. filed Nov. 23, 1903. Means for insulating and mounting the current-carrying parts.

753,276. LAMP SOCKET AND PLUG; Daniel A. Kimbark, Chicago, Ill. App. filed May 21, 1902. A socket and plug designed especially for use on berth-lights; the invention being in the details of construction.

753,278. WINDING FOR ELECTRICAL MACHINES; Frederick J. Lindeman, Pittsburg, Pa. App. filed April 11, 1903. (See Current News and Notes.)

753,321. LAMP SOCKET; Duny A. Schutt, Peru, Ind. App. filed April 7, 1903. A holding device for the two-part cover consisting of a cross-bar embedded in the porcelain to which the shell and cap are secured.

753,345. AUTOMATIC RELEASING DEVICE FOR SAFETY TROLLEYS; Andrew C. Wolfe, Pittsburg, Pa. App. filed July 6, 1903. Details of construction.

753,356. BRUSH HOLDER; Charles O. Bulock, Milwaukee, Wis. App. filed Aug. 21, 1903. A coil-spring supplying the pressure upon the brush is adjustable in tension by engaging any one of its turns with a projection adapted to pass between them.

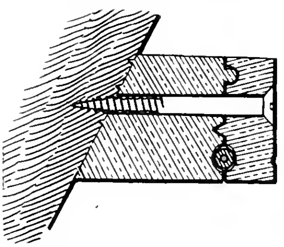
753,365. ELECTROMAGNETIC SIGNAL; William U. Colthar, Springfield, O. App. filed July 24, 1903. The semaphore is moved by causing a cylindrical armature to roll along a track, its rotary motion serving to raise or lower the signal.

753,383. PROCESS OF PREPARING ELECTRODES FOR STORAGE-BATTERY CELLS; Oskar Frank, Detroit, Mich. App. filed May 2, 1903. (See page 526.)

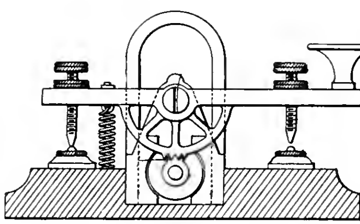
753,391. CASING FOR TELEPHONES OR MICROPHONES; Paul Hardengen, Berlin, Germany. App. filed Sept. 3, 1902. (See page 525.)

753,398. CLEAT FOR ELECTRIC WIRING; Emory C. Hunt, Belle Plaine, Ia. App. filed Nov. 8, 1902. An insulator having an inclined base for attachment to the wall.

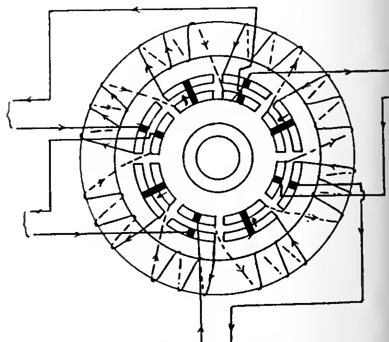
753,399. COMBINATION BRACKET AND KNOB FOR ELECTRIC CONDUCTORS; Emory C. Hunt, Belle Plaine, Ia. App. filed Nov. 8, 1902. An insulator knob is formed integrally with a bracket through which the supporting screw passes.



753,398.—Cleat for Electric Wiring.



753,429.—Electrodynamic Generator.



753,690.—Electric Telegraph Apparatus.

753,422. ARMATURE-WINDING; James F. McElroy, Albany, N. Y. App. filed Nov. 11, 1902. (See Current News and Notes.)

753,429. ELECTRODYNAMIC GENERATOR; George M. Pelton, Chagrin Falls, O. App. filed Sept. 29, 1902. The machine has two sets of commutator segments, each corresponding in number to the number of armature coils; the brushes engaging the commutators are so related that all of the coils may be connected in series or any number in parallel, or two independent circuits may be supplied therefrom.

753,434. RAIL JOINT; Benton C. Rowell, Chicago, Ill. App. filed April 9, 1903. Details.

753,461. ELECTRICAL CONDUCTOR AND COIL; James C. Anderson, Jersey City, N. J. App. filed April 30, 1903. The conductor is a ribbon wire covered with a straight envelope of paper, the edges of which are separated on one side of the ribbon; the turns of the coil are wound with the open side of the covering outward, so that the tension alone will retain the insulation in place in the completed coil.

753,466. DISINFECTING ATTACHMENT FOR TELEPHONES; Carlo Bravi-Bertini, Amboy, N. J. App. filed Sept. 16, 1903. (See page 525.)

753,493. TELEPHONE; Stephen C. Houghton, San Francisco, Cal. App. filed April 3, 1903. (See page 525.)

753,509. ELECTROTHERAPEUTIC DEVICE; Charles K. Munns, Corning, Ia. App. filed Oct. 24, 1903. A cabinet containing devices for generating currents for electrotherapeutic purposes, with switchboard and auxiliaries.

753,533. RHEOSTAT; John C. Barclay, New York, N. Y. App. filed Sept. 9, 1903. (See Current News and Notes.)

753,536. CONTACT DEVICE FOR ELECTRICALLY PROPELLED RAILWAYS; Henri Berthoud, Neuchatel, Switzerland. App. filed July 10, 1902. Each car carries on its roof a contact strip running the full length which overlaps the strip on the adjacent cars, the electrical terminals suspended above drag upon these conductors to deliver current to the vehicle.

753,542. TROLLEY; Alexander C. Calderwood, Gloversville, N. Y. App. filed Aug. 6, 1903. The trolley replacer is tripped and allowed to move into operative position when the wheel leaves the wire.

753,552. TROLLEY FOR ELECTRIC CARS; William A. Daggett, Vineland, N. J. App. filed Sept. 3, 1903. Details.

753,554. TROLLEY; Arthur S. Deem, Reading, Pa. App. filed Aug. 8, 1903. Two trolley wheels, one arranged behind the other and one being pivoted on a horizontal axis while the other is pivoted on a vertical axis.

753,556. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed Dec. 29, 1903. The object is to provide a construction whereby parts of the rotating elements may be made saparable to enable the substitution of new parts without sending the meter to the factory.

753,562. JACK-FIELD FOR TELEPHONES; Lars Magnus Ericsson, Stockholm, Sweden. App. filed June 18, 1902. (See page 525.)

753,563. PORTABLE OR TABLE TELEPHONE INSTRUMENT; Lars Magnus Ericsson, Stockholm, Sweden. App. filed Sept. 30, 1902. (See page 525.)

753,582. LIGHTNING ARRESTER; Harold N. Keifer, Topeka, Kan. App. filed June 30, 1903. A part of the circuit is wound in grooves on an insulating cylinder, and a flat plate is held against the face of the cylinder within striking distance of the turns thereon, the plate being grounded.

753,595. INSULATED PIPE JOINT; Waldo A. Learned, Watertown, Mass. App. filed Sept. 8, 1903. Details.

753,617. TROLLEY REPLACER; Francis A. Nolan, St. Paul, Minn. App. filed Jan. 16, 1902. Details.

753,666. RAILWAY SIGNAL; Tony Bruck, New York, N. Y. App. filed Jan. 26, 1903. The moving cars strike cam-shaped levers pivoted in the road bed to control the circuits of the signaling system.

753,690. ELECTRIC TELEGRAPH APPARATUS; Agacio Falcone, Florence, Italy. App. filed May 6, 1903. A Morse transmitting key oscillates the armature of a magneto, which at each movement sends an impulse to line.

753,704. AUTOMATIC MAGNETIC CIRCUIT BREAKER; Frank O. Hartman, Mansfield, O. App. filed April 10, 1902. Details of an oil-switch.

753,714. CONDUIT FOR ELECTRICAL CONDUCTORS; Hubert Krantz, New York, N. Y. App. filed Sept. 9, 1903. A metallic conduit having sides terminating in inwardly turned shelves, forming a constricted opening through which the wire may be temporarily passed and held by the shelves until a cover is applied.

753,716. CARBON RESISTANCE AND METHOD OF PRODUCING AND ADJUSTING SAME; George I. Leonard, Pasadena, Cal. App. filed Feb. 3, 1903. (See page 526.)

753,757. SELF-WINDING ELECTRIC CLOCK; Frank T. Talcott and Benjamin F. Kerr, Ashtabula, O. App. filed March 11, 1903. Details of a clock in which the pendulum is actuated by the attraction and repulsion of electro-magnets.

753,759. ELECTRICAL CONNECTION; Edward G. Thomas, Cambridge, Mass. App. filed July 15, 1902. For soldering terminals of rail-bonds to the under face of the rail, said terminals have spout-shaped extensions into which the melted solder is poured and by which it is conveyed to the abutting surfaces of the bond and rail.

753,809. AUTOMATIC PLAYING APPARATUS FOR MUSICAL INSTRUMENTS; Timothy B. Powers and Major R. Jewell, New York, N. Y. App. filed Aug. 14, 1901. Various devices for controlling the resistances in circuit with the magnets which operate the keys so that all the variations and combinations of tone, expression, etc., indicated by a composer can be obtained.

753,819. ELECTRODE; George Jones Atkins, Tottenham, England. App. filed April 8, 1903. (See page 526.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, MARCH 19, 1904. No. 12.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
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NEW YORK, SATURDAY, MARCH 19, 1904.

CONTENTS.

A GREAT TRUST FOR ENGINEERING.

It is with unmitigated pleasure that we announce this week the news that carrying out and broadening plans to which he first gave publicity about a year ago, Mr. Andrew Carnegie has now taken the final steps to create a great trust for engineering in the hands of the three national engineering societies—the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers. Our readers will remember that at the outset Mr. Carnegie proposed to give $1,000,000 for the erection of a Union Engineering Building in New York City. Matters have now so shaped themselves that the original plans have necessarily undergone extension, so that the three societies find themselves trustees under Mr. Carnegie's gift of a sum of $1,500,000, to be administered by them for the promotion and benefit of engineering work in America. The Engineers' Club, which is rapidly becoming a widespread national body as to membership, is also, as originally intended by Mr. Carnegie, a beneficiary as to its own home, while the Union Engineering Building will now be able to subserve the wants and necessities of a large number of technical engineering societies which have hitherto had neither resting place nor meeting place. A total expenditure of about $2,500,000 is involved in the present plans.

We ventured to predict a few weeks ago that this would be the outcome of the complications of the past twelve months, and were satisfied that as on other occasions of great moment, Mr. Carnegie would rise to the emergency and deal with it in all its broadness of opportunity and obligation. He has, indeed, done a great and noble thing for engineering, one whose merits and benefits will grow as the years run by, and yet something which has been so sorely needed during the past twenty-five years that it is wonderful that no man with the means and the spirit had previously been equal to the occasion. Not only is a great engineering center thus created at the very heart of the Western metropolis, but Mr. Carnegie at once enables a large number of technical societies with a membership of perhaps not less than 15,000 to exercise their functions on the highest scale of efficiency. With each society sharing a common roof, and while the three trustee societies assume notable burdens in providing the land for the building, it is easy to see at once that many new ideas and benefits previously undreamed of must fructify. The national engineering societies, while maintaining their autonomy strictly, will find that co-operation enables them to address themselves more strictly to the needs of their members and the welfare of the public than was possible with each society dwelling in narrow quarters of its own or occupying rented rooms in some small house or office building utterly inappropriate for the purpose.

We believe that there is wisdom, enthusiasm and courage enough in the three national societies, thus so generously endowed by Mr. Carnegie, to execute this scheme on the best possible basis; and we trust that every engineer in the country, whatever his branch of work, will feel it his duty to rally to their aid and support. We consider it also a matter of happy augury that in this new engineering center, and adjacent to the great Union Engineering Building, will be found the Engineers' Club; for the social aspects of the professions are in many respects of equal importance with the technical, and the club now has a mandate which should stimulate it to the very fullest achievement of all the possibilities which lie in these practical conditions. Hereafter from whatever part of the country or from whatever region abroad the engineer may come, he will feel drawn by every claim and association to the center now called into being. So far as the American Institute of Electrical Engineers is concerned, its members have from the first shown themselves enthusiastic over the project, and it is now their duty, as it will undoubtedly be their pride, to co-operate heartily with Mr. Carnegie in doing their share, which is not a small one, to secure the early consummation of the work in hand.

Invention vs. Current Engineering Development.

One of the most difficult matters with which patent courts have had to contend has been a determination as to what constitutes invention, and particularly as to what constitutes an invention as differentiated from a natural development occurring in the ordinary course of the evolution of an art. The fundamental principle applying, as laid down in an opinion by the United States Supreme Court, is that an invention must be the product of some exercise of the inventive faculty. Lacking a definition of what constitutes inventive faculty and a distinction between the inventive and ordinary constructive faculties, this dictum is of the kind that darkens rather than illuminates counsel. The courts being thus without direct guidance, and the determination of what constitutes invention being one of opinion rather than the result of a weighing of evidence, the natural consequence is a great and growing diversity of precedent on the subject. Naturally, the patent office is governed by precedents established by courts having patent jurisdiction, and is further circumscribed by a body of rulings laid down by past and present officials of the office. The net result appears to be that the criterion as to real inventive merit is so difficult to apply that any application for a patent covering anything new, provided that the alleged invention stands test with respect to priority and is not palpably a mere construction or obviously the result of ordinary mechanical skill, will receive favorable consideration and a patent duly issue. There are other and even more flagrant diversions of the intent in establishing the patent monopoly, arising through the grant of patents on what may be called "speculative" inventions, designed to cover future developments in an art, several notable instances of which have worked much harm in the electrical field. Of this class, however, it is not our intention to speak at present.

The great evil of the present looseness in the grant of patents is that undue advantage accrues to those who are in close contact with manufacturing operations and agents in the evolution of new types or in passing from smaller to larger constructions as changes are demanded by an industry. In such cases changes from current practice are usually definitely fixed by the conditions of each particular case, yet we venture to say that in the vast majority of instances, and even when change or improvement is not obvious to the mere onlooker, these conditions indicate what it shall be. In other words, the one who, through the Patent Office, profits by the opportunity, is apt to be merely a fortuitous factor in a situation brought about by the trend of progress, and the work he accomplishes could as well have been achieved by any one of his fellows. Were it not for the statutory monopoly of the fruits of such a situation which inures to the agent, there would be no cause for complaint, since the natural benefit of an opportunity cannot be denied to the one who grasps it. But the grant of patents on engineering improvements as they are in natural course indicated, is an injustice to those manufacturers whose line of work may later enter the field thus covered, and a still greater injustice to the public, which is made the victim of the monopoly which it instituted for beneficial ends. As to the remedy, this we believe will not be in legislation, but in a final appreciation by the courts of the situation which has developed during the past ten years, and which will result in drastic rulings sweeping away the abuse. The fact appears to be that electrical engineering so far as relates to its more important applications, is becoming more and more narrow as a field for invention, using that word in the sense implied in the statute awarding a monopoly to the maker of an invention. On the other hand, the field for the real inventor—the one who explores far away from beaten tracks—remains almost limitless. But the result of his work will not be mere improvements in design and construction clearly indicated by a set of new conditions, but radical departures or new and fundamental conceptions such as actually involve the exercise of the inventive faculty. This needs no further arguing in the day of radium.

The Transformer as a Fire Risk.

Mr. Rice's paper on the above subject, published elsewhere in our columns, raises some very interesting questions. Every one knows the good points of the air-cooled transformer in cheapness, efficiency and convenience, but on the other hand oil insulation has in itself remarkably valuable properties. At very high voltages oil is the only thing to use, but at the pressures in most general use air-cooled transformers are entirely applicable. So far as risks from internal causes go, we think the oil, particularly if rather heavy, has a considerable advantage. An air-insulated transformer can very easily catch fire from a short-circuited coil, and while the insulation is by no means easily inflammable, it will burn very persistently under sufficient provocation even for hours after the forced air supply is cut off. Oil, on the other hand, catches from internal causes only with great difficulty, but if once started in any way burns with a ferocity difficult to overstate. Given a sufficient degree of initial heat and even an oil-soaked brick floor becomes a raging furnace. Floors, in fact, are the most difficult proposition in fire-proof station construction for this very reason. Mr. Rice's suggestion of a separate transformer room, perhaps with an oil pit around the transformers, is thoroughly sound and in accordance with good recent practice. The separate building for transformers is secure in itself, but we think that the trouble of adequately securing the cables leading to it is not justified by any additional security gained in case of fire at the transformers. The leads from generators to transformers and from transformers out of the building, are the weakest points in a good many otherwise very excellent plants, like the switchboard connections. More plants are crippled from troubles of such sort than by accidents to any of the heavy machinery. Modern generators and transformers are wonderfully reliable, and no pains should be spared to make the working connections equally safe.

High Tension Insulation.

No structure electrical or other is stronger than its weakest point, and it is a matter of commonplace electrical knowledge that surface leakage is the weak spot of insulation for high voltage. So far as mere resistance to puncture goes, it is a perfectly simple matter to find insulation capable of withstanding many times the voltages now in customary use. Mr. Moody's preliminary paper to the A. I. E. E. discussion next week on high-tension work, in which he deals with the terminal precautions to be taken with high-pressure transformers, gives a vivid impression of the difficulties which recent practice has heaped upon the already rough path of the electrical designer. It is fairly easy, thanks to oil, to preserve the insulation of the transformer windings themselves at any voltage yet demanded, but to get the high-tension current out upon the line is quite another matter. At pressures of 50,000 volts and upwards there is a vigorous brush discharge from all the wires, and the surface resistance of ordinary insulators becomes greatly reduced, so that there might be sneaking discharges over comparatively long distances. The insulaton of the transformer leads then becomes a problem even tougher than the insulation of the line, since the available distances are very limited in even a large transformer case. The scheme which Mr. Moody seems to have found most efficacious is to provide the lead itself with a local insulating sleeve strong enough to stand up under the working voltage, and then to bring out this insulated lead through a long porcelain bushing sufficient to give an adequate factor of safety. Aside from this, good results have been reached by bringing out the leads through oil tubes.

This matter of what one may call local insulation of high-tension conductors aside from the insulating supports, is one that deserves thorough study just now. Of insulating compounds having good mechanical properties and able to withstand moderate voltages, there are many, but when it comes to dealing with many thousand volts the number dwindles to evanescence. The really good insulators as regards withstanding surface leakage are very few, and none of them are all that they should be mechanically. Hence, Mr. Moody's general scheme of keeping down the potential available for causing surface discharges by insulation applied directly to the conductor as a coating, is both logical and effective. It is worth mentioning that the recent demand for extreme voltages is raising again the question of insulated wire, which has been practically abandoned for high-tension work. We are rather inclined to the opinion that no continuous insulation can be long relied upon even for the purpose of checking the coronal discharge into the air found at high pressures. There are serious oxidation effects at voltages producing a brush discharge in air which no ordinary form of flexible insulation can long withstand. An interesting corollary of the question here discussed is the proper factor of safety to be used in high-voltage insulation. Ordinary current practice requires a factor of 2 or 3, rarely more. The lower figure seems rather small unless one can be assured immunity from abnormal potentials on the line. At voltages from 20,000 to 40,000 the methods of insulation now in use, both on the line and in apparatus, seem to be fully adequate, but there are so few plants running at pressures above 40,000 volts that it is hard to get a line on the real behavior of insulation. In the region of pressures where coronal discharge is prominent, the situation is greatly complicated and insulation is a formidable question. The oil transformer renders it possible to get the pressures with reasonable facility, but insulation outside of the protecting oil is quite another matter.

The Inaugural Address of the President of the Institution of Electrical Engineers.

The inaugural address last November of President R. K. Gray, of the Institution of Electrical Engineers in London has been published in a recent number of the *Transactions* of that body, and contains some very interesting facts and suggestions. The Institution of London was founded in 1871, thirteen years before the foundation of the American Institute of Electrical Engineers. The American Institute had at the beginning of the year a total membership of 2,800 after nearly twenty years of existence. The total membership of the British Institution at the same time was about 4,800 after nearly 33 years of growth. It is pointed out in the report that two-thirds of all the electric lighting in the United Kingdom is in municipal plants and only one-third in the plants of companies. In fact, if London, the main home of the companies, be excluded from consideration, nearly seven-eighths of the lighting is in the hands of municipalities. In the United States only about 5 per cent. of the lighting is municipal. The average rated capacity of a British station is about 1,400 kw, while that of the United States is only 340 kw. The total rated station capacity in Great Britain is, however, given only as 480,000 kw, while in the United States the total in June, 1902, was 1,200,000 kw. Consequently, while the average British station is four times as large as a United States station, the United States lighting is nearly three times as large as the British.

A noticeable feature in the address is that while candle-powers of lamps are less in Britain than with us, so that the standard lamp is the 8-cp lamp, yet the distributing pressures are generally higher, and 200-volt lamps much more common. In this country the large stations which commenced operations upon 110-volt lamps with the three-wire system, have not judged it to their advantage to change to 220-volt pressures. Nernst lamps are spoken of as a factor in British electric lighting, and also osmium lamps, which latter are curiosities in this country. They are described as having, in 25 and 30-volt pressures, an efficiency of ⅔ candle per watt and as showing but little diminution in light or efficiency after 800 or 1,000 hours of burning. The vertical-shaft design of steam turbine, now familiar in this country, is criticised, in comparison with the horizontal-shaft design, without, however, any facts in support of the judgment. The project of utilizing the Zambesi Falls for electric power transmission is alluded to. It is not generally known by Niagara worshippers in this country that the Victoria Falls of the Zambesi waste power to the estimated extent of 26,000 megawatts, or are five times as wasteful as the Niagara Falls, which before engineers attacked them wasted about 5,200 megawatts, or 7,000,000 hp. The plans under operation and present contemplation at Niagara propose to save about one-seventh of this for the world, or some 750 megawatts.

The total length of submarine cable laid in the globe is stated as 222,253 nautical miles, employing 47 cable ships, all told. It is some comfort to reflect that there is now as much cable laid on the globe as would reach in one length to the moon and leave a fair excess for slack. It is sad to see a President of an Institution of Engineers trying to withstay the inevitable stride of progress by advocating the general retention of the absurd old English weights and measures, that we also are yoked to. The statement is gravely made that in France precious stones are still bought in carats, milk in pintes, gravel in toises, and so on for about twenty indictments. The statement is true to the extent that these old units are still occasionally met with in France, just as here, in the United States, we occasionally yet find prices in terms of the shilling. But it is recognized by persons who have lived in France that it is just as unreasonable to speak of the general use of the old terms and units in that country as to say that the pound, shilling and penny still prevail here.

It is actually urged that the litre and the gramme are too limited to apply to all the things met with in daily life. The kilogramme is all very well for physics, but it is not adapted to charcoal. If we carry this proposition to its natural terminus, we should make the English weights and measures still more diffuse. Land should be exclusively measured, for example, in square chains, water in nothing but fathoms, houses only in feet, machines only in inches, horses in hands, men in cubits, and so on indefinitely. Particularly avoid common factors. What visions of rapture this exclusiveness of quantitative relation must conjure up in the bewildered imagination of the schoolboy! Whatever we learn, let it be hard; and whatever we say, let it be ambiguous. A large share of this excellent address is devoted to the recent advances in electrochemistry. The rate of growth of electric railways and the rate of increase in available electric pressures for transmission are also commented on at some length. The general breadth of topics and treatment is one of the noticeable features of the address.

A Union Engineering Building in New York.

New York City, already adorned with some fine buildings devoted to the arts and sciences, is now to enjoy the possession of a great central home for engineering, due, very appropriately, to the initiative and generosity of Mr. Andrew Carnegie, and carrying out ideas with which the public has become more or less familiar during the past year. The following letter gives the facts briefly:

Andrew Carnegie, 2 East 91st St., New York.
March 14th, 1904.

Gentlemen of the Mechanical Engineers; Institute of Mining Engineers; Institute of Electrical Engineers; Engineers' Club of New York:

It will give me great pleasure to devote, say, one and a half million of dollars for the erection of a suitable Union Home for you all in New York City. With best wishes, truly yours,

(Signed) Andrew Carnegie.

It may be stated that the three national engineering societies named and the Engineers' Club, which, by reason of its widespread membership is also increasingly national in character, have, with the unanimous approval of all the memberships, already taken active steps to put into being the splendid trust for engineering thus created by a man whose own career has illustrated the upgrowth of the engineering and industrial arts in America. Mr. Carnegie is also a member of the Mechanical and Mining Engineers and of the Club. The total amount involved is not less than $2,500,000, for, in addition to the amount given by Mr. Carnegie, a sum of over $500,000 represents the investment in land for the three societies on West Thirty-ninth Street, between Fifth and Sixth Avenues; while the Engineers' Club has also acquired valuable land for its own purposes on West Fortieth Street, immediately facing the New York Public Library. The Union Engineering Building will probably be 12 stories in height, and will be laid out expressly with an eye to the services required of it. In many respects it will be unique. The three national engineering societies made trustees by Mr. Carnegie will have large headquarters there; and already several kindred bodies have made urgent requests for accommodation. There will be four or five auditoriums of different size, notably one to seat 1,200 to 1,500 persons; and all will be appropriately equipped for scientific meetings, lectures and demonstrations. Above all, there will be an engineering museum and a noble library hall, where all the libraries concerned will be grouped and consolidated, yet each section administered by its respective Society librarian and each adding to its own specific literature, so as to avoid duplication of outlay for books or periodicals. It is proposed, moreover, to co-operate intimately with the New York Public Library, nearby, along these lines of work, so that nowhere else in the world can the student or practitioner find thus freely available the whole literature of engineering and technical industry. The three libraries assembled in this manner will even at the outset include some 50,000 volumes, many of them great rarities of inestimable price.

The three societies, each of course maintaining its identity and autonomy, will themselves need considerable room in the new building, which it is hoped to have ready in 1906. They have a total membership to-day of over 9,000, and are growing at a rate of between 10 and 15 per cent. annually. They administer a total income of $135,000 annually and in assets of all kinds have property to the value of between $250,000 and $300,000, a sum to which the gifts of individual members are now adding rapidly. The sister technical societies asking for quarters and facilities represent also another great body of over 5,000 members, engaged in all branches of civil, mechanical, electrical, municipal engineering, etc. Large, therefore, as the Union Engineering Building, with its frontage of 125 ft. on five lots, may seem, it bids fair from the start to find every inch put to fructifying use. The Engineers' Club Building, a separate entity, will immediately flank the Union Building, the two sharing the same resources of light, heat and power, and being most advantageously situated for intercommunication and mutual social benefit. The club, with a long waiting list, has just increased its membership to 1,200, and administers a budget of about $120,000 a year. The buildings, facing thus on two streets, are to harmonize as to architecture, as they do virtually in function, as homes of engineering, and their central position commanding all lines of travel at the very heart of the city, insures the acme of convenience to visitors from outside the city or from abroad, as well as to all local members.

The three societies provide the land, but in the meantime Mr. Carnegie has promptly acquired it for them. The leases run out about July 1 and work will then begin forthwith and be pushed ceaselessly to completion, as the building is in reality sorely needed by the bodies that are to occupy it, and that now chiefly occupy rented quarters ill-suited to their purposes. The Engineers' Club has also already made purchases of land for itself on West Fortieth Street, not far from the new Republican Club opened recently. Plans for the architectural part of the undertaking have already been drafted, and the architects will soon be selected. The representatives of the four bodies interested as the direct beneficiaries and trustees of Mr. Carnegie's splendid gift to engineering are as follows: American Society of Mechanical Engineers—Prof. F. R. Hutton, C. Wallace Hunt, J. M. Dodge. American Institute of Mining Engineers—Dr. A. R. Ledoux, Theodore Dwight, C. Kirchhoff. American Institute of Electrical Engineers—C. F. Scott, Dr. S. S. Wheeler, Bion J. Arnold. The Engineers' Club—J. C. Kafer, W. H. Fletcher, T. C. Martin. These as a conference committee have carried the matter patiently through its earlier stages and are now vigorously engaged in working out all the details of an enterprise which, recognizing frankly the close interdependence of all branches of engineering, endows them jointly with means for professional and educational work never before enjoyed in any country by such organizations, or on such broad conditions of public welfare; leaving, nevertheless, to the societies their distinctive and individual conditions of existence.

Tesla's Split Phase Motor Patent Decision.

Judge Hazel, of the United States Circuit Court of the Western District of New York, has handed down an opinion sustaining the two Tesla fundamental patents (Nos. 511,559 and 511,569), covering the split-phase motor. The suit was instituted by the owners of the patents against the manufacturer of a wattmeter, and the court held that the wattmeter infringed the patents for the reason that it depended for its action on two currents differing in phase, derived from a single supply circuit.

The patents involved were the same that figured in the Catskill case, in which suit they were sustained by the Circuit Court, but declared invalid upon appeal. This reversal was on the grounds that the publication of a magazine article on April 22, 1888, by Prof. Galileo Ferraris fully described and disclosed the system covered by the patents. This publication was held to be prior to the date of the invention in suit and constituted an anticipation.

Judge Hazel, in his opinion, disagrees very materially with Judge Townsend, who wrote the opinion on appeal, declaring the patents invalid. The conflict arises from the different weight which the two judges gave to the testimony of the several leading witnesses, this testimony being held by Judge Townsend to be inconclusive, and by Judge Hazel to establish clearly that Tesla conceived the invention prior to the publication of the Ferraris article. Judge Hazel considers that, according to the testimony, Tesla conceived his split-phase invention in his laboratory at 89 Liberty Street, New York, and completed the same in the month of September, 1887; and that he made the disclosure thereof to others during the fall of 1887, especially to Mr. Brown and Mr. Nellis, and subsequently in the month of April prior to the Ferraris publication to his solicitor, Mr. Page.

Washington Meeting of the American Electrochemical Society.

The fifth general meeting of the American Electrochemical Society will be held at Washington, D. C., April 7, 8 and 9, 1904, in the hall of Columbian University. Thursday and Friday afternoons will be devoted to visits to scientific laboratories, government institutions and various points of interest in and about Washington. On Thursday evening the presidential address will be delivered and will be followed by a complimentary smoker. Friday evening there will be a subscription banquet at the Shoreham, corner Fifteenth and H Streets, N. W., at which hotel headquarters will be maintained. Among the papers announced are the following:

"The Composition and Resolution of Voltages," by Dr. J. W. Richards; "Notes on the Industrial Electrolysis of Water," by Mr. W. S. Landis; "Standard Cells," by Dr. F. A. Wolff; "Electric Smelting Experiments for the Manufacture of Ferro-Nickel from Pyrrhotite," by Ernest A. Sjostedt.

Reconstruction of the Zanesville, O., Railway, Light & Power Company's Property.

THE property of the Zanesville Railway, Light & Power Company has been undergoing an almost complete reconstruction during the past eighteen months. As many other properties are in a position where such reconstruction is being considered, the present article, telling how this reconstruction was accomplished in Zaneville and the results, will no doubt be of interest. The old power plant of this company consisted mainly of high speed simple non-condensing engines and a conglomeration of belts and line shafting for transmitting the power to generators such as is familiar to most of our readers. This plant is to be entirely abandoned.

The new plant consists entirely of steam and water turbines. There are no reciprocating engines driving generating machinery in the plant.

LOCATION.

A remarkably fortunate location was selected for the new plant, as shown in Fig. 1. It is on the bank of the Muskingum River, between the river and a canal maintained by the Government. In order to supply water to this canal, the government maintains a wooden crib dam in the Muskingum River just above the power plant, as seen in Fig. 1. The water power obtained by this company is therefore secured at no expense for the maintenance or construction of a dam or canal. The only expense connected with the development of the water power has been the building of the water power station itself. In this plant, water power is not depended upon entirely, as there are times when, owing to the great amount of flood water going over the dam, the head of water at the power house practically disappears. A steam power plant sufficient to carry the full capacity is therefore placed in the same building, but it is expected that water power will be sufficient during a large portion of the time to operate the plant. Since in this case the expense of the hydraulic development was comparatively small, the engineers considered that they could well afford to install a hydraulic plant for the sake of power that could be obtained, even though this power could not be relied on every day in the year.

Just below the power house is a bridge, and from the street railway tracks on this bridge a spur is run to the power house for the purpose of carrying coal and other supplies. A side track of the Baltimore & Ohio Railroad also reaches the plant at one end. The power house is located on a solid ledge of rock, as can be seen from Fig. 3, which was taken during construction. This shows the ledge of rock on which the power house and the excavation made for the tail-race and also the concrete arch construction over the tail-race.

Fig. 1.—General View of Power Plant at Zanesville, Ohio.

CONSTRUCTION AND ARRANGEMENT OF BUILDING.

The water passes under the down stream end of the building. The ordinary level of the tail water is thirteen feet below that of the head water, giving a 13-ft. head on the wheels. This head disappears in times of freshets, as maximum high water comes very nearly to the top of the concrete foundation wall, which is carried up to the level of the engine and boiler room floors.

The up-stream end of the station contains the steam turbine units. Fig. 2 is a section through this end of the station. At the right are stairs leading to the switchboard gallery. The basement floor is thirteen feet below the engine room floor; the basement containing the turbines and condensers, while the generators on the vertical turbin shaft are above the level of the main floor. All the foundations of the building are concrete laid on solid rock. The roof is slate with copper gutters. The floors are black and white tile with white tile wainscotting. The building is of Zanesville pressed brick.

APPARATUS IN STATION.

The five water wheels seen in the sectional elevation in Fig. 2 are each 51-in., 275-hp vertical shaft turbines, of the open-flume type, made by the Stilwell, Bierce & Smith-Vaile Company. These turbines run 80 revolutions per minute and are geared through bevel gears to a line shaft running 200 revolutions per minute. On each end of this line shaft is a 375-kw General Electric, 60-cycle, 2,300-volt generator. Fig. 5 is a view in the shaft house, showing the shaft, bevel gears and Lombard water wheel governors. The shaft house is partitioned off from the generators at either end.

In the steam turbine room, Fig. 6, are two 500-kw Curtis steam turbines, designed to operate at 180 pounds steam pressure, in connection with Stilwell-Bierce surface condensers. Fig. 7 shows one of these turbine units with its condenser piping. The centrifugal circulating pump is motor driven. Provision has been made in the generator room for two more steam turbine units of this size. The rotary converters mentioned later are also in this room.

In the boiler room resting on a concrete floor over the head-race are two 380-hp Heine water tube boilers, with two Stilwell-Bierce feed pumps. The boilers are hand-fired. Coal is shoveled directly from the cars on the siding into the space in front of the boilers. Provision has been made for doubling this boiler capacity.

About 25 per cent. of the load of the station is supplied to alternating-current lighting circuits. The remainder is used in rotary converters to give 550-volt current for railway use and 110 volts for the three-wire direct-current network.

For railway purposes one three-phase transformer takes the 2,300-volt current and reduces the voltage for use in a six-phase, 60-cycle rotary converter for supplying the street railway.

To supply the direct-current lighting network two three-phase transformers step down the 2,300-volt three-phase current for use in two 240-volt rotary converters. The balancing is done by a connection of the neutral of the star-connected rotary converters.

Both the railway and lighting rotary converters are supplied from the same generators. This has been made possible by connecting in multiple with the railway bus-bars, 256 cells of Chloride accumulator. This storage battery is connected in series with a differential booster, which causes the battery to take the fluctuations of railway load and leave a practically steady load on the generators. The cells of this battery are type G, with 17 plates per cell. The tanks are large enough to allow 50 per cent. increase in plate surface. The differential booster is large enough for the ultimate capacity of the cells. This battery is rated at 640 amperes at the one-hour rate of discharge. Provision has also been made in the battery room for a battery to operate in connection with the three-wire direct-current lighting system. The battery room is shown in Fig. 4.

The value of a battery was forcibly demonstrated last winter during the holidays. The maximum railway load amounted to 660 kw. If there had been no battery, this would have been beyond the capacity of the water supply which was then available for use. The average load was only 220 kw. The battery took the fluctuations so that the plant was operated with one wheel at full gate and one wheel at sixteenths full gate.

No exciters have been provided for this station for the present. The engineers considered that with the battery in case all the direct-current machinery should be shut down, current for excitation can be obtained therefrom.

The battery room is on a floor above the generator room. It has the regular floor now commonly employed in storage battery rooms, consisting of tile laid in asphaltum, and is drained with lead-lined iron pipes.

The high-tension switchboard in the gallery was furnished by the General Incandescent Arc Light Company, and has "G. I." hand-operated oil switches. Two General Electric potential regulators will be employed on the alternating-current lighting feeders. These regulators will be operated to raise and lower the voltage, by means of small alternate-current motors. The transformers are air-cooled.

As stated before, the water wheels are governed by Lombard governors. The speed of the wheels can be varied from the switchboard by means of a direct-current motor at the governor for shifting the governor weight.

Street lighting for the city which has been done formerly by direct-current arcs will be done hereafter with 6.6 ampere G. I. differential enclosed arcs, 250 in number, 25 on a circuit.

ECONOMIES BY THE RECONSTRUCTION.

Of course, a great economy in operation is anticipated as a result of the abandonment of the old power station. As said before, much of the total output in a year will be generated by water power, and therefore at no fuel expense. That portion of the power supplied by steam should certainly be generated with much greater economy than in the old plant. The old plant used twelve pounds of coal per kilowatt hour. The new 500-kw Curtis turbine units are guaranteed to operate with twenty pounds of steam per kilowatt hour. If eight pounds of water can be evaporated per pound of coal in the boiler plant (which the engineers assume is a reasonable figure), the turbines would give a kilowatt hour for two and one-half pounds of coal. The repairs in the old plant were enormous. In the new plant it is believed that they will be very low, as there are so few moving parts, as compared with the old, and the electrical apparatus is confined to large units of modern construction. In the old plant seventeen men were required for its operation. In the new plant six men are required.

Making allowance for interest and depreciation, the engineers estimate that there will be a yearly saving of $18,000, as compared with the operation of the old plant. The cost of reconstruction, which includes also rebuilding of much of the street railway track and the purchase of entirely new rolling stock, so as to bring the street railway system to a standard guage, was $400,000. The present connected load is the equivalent of about 14,000 16-candle power lamps. Excluding the small sized motors, there is a motor load of 300 kw, distributed among 35 motors.

Since the present management took charge the earnings have increased about 20 per cent. Last year railway earnings were about $110,000 and light $65,000. The operating expenses are about 55 per cent. of the gross earnings. The base rate for power and light is 10 cents per kilowatt hour. About 350 kw additional power load is soon to be taken on, and it is further anticipated to transmit power to nearby pottery towns which, as is well known, are good power consumers. Coal costs the company $1.40, delivered. The company now has outstanding $1,000,000 in bonds and $1,000,000 in stock.

Rudolph Kleybolte & Company, bankers of Cincinnati, New York

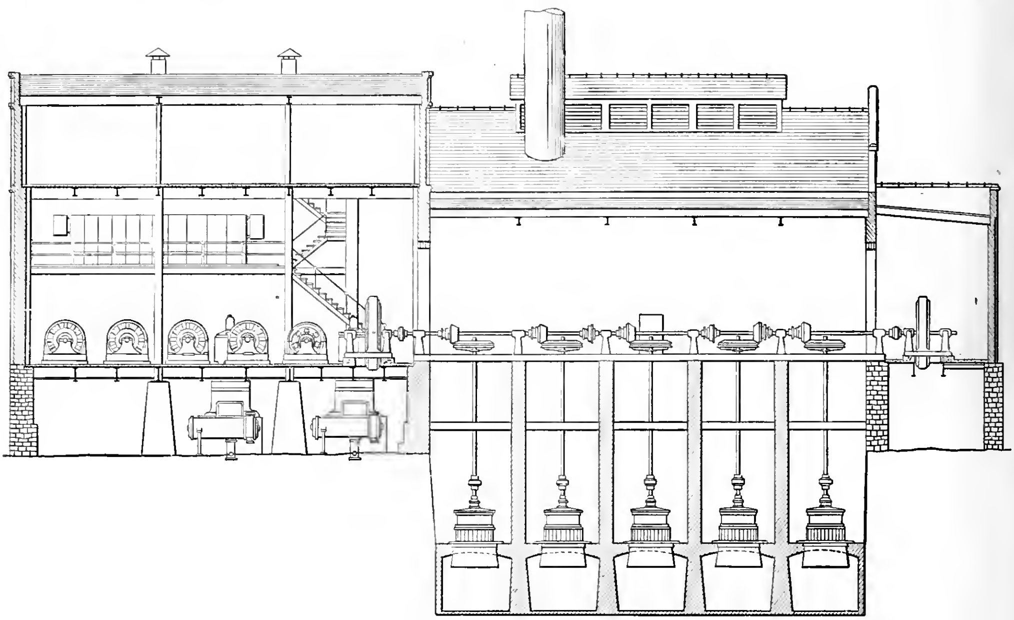


Fig. 2.—Sectional Elevation of Power House.

FIG. 3.—ROCK FOUNDATION OF POWER HOUSE.

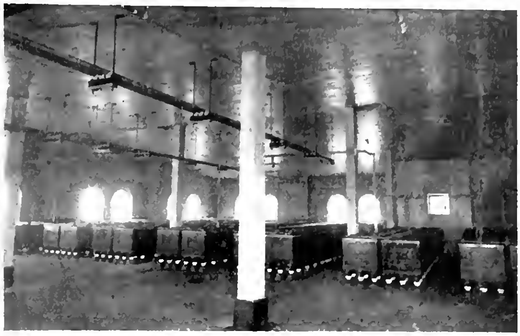


FIG. 4.—GENERAL VIEW OF STORAGE BATTERY ROOM

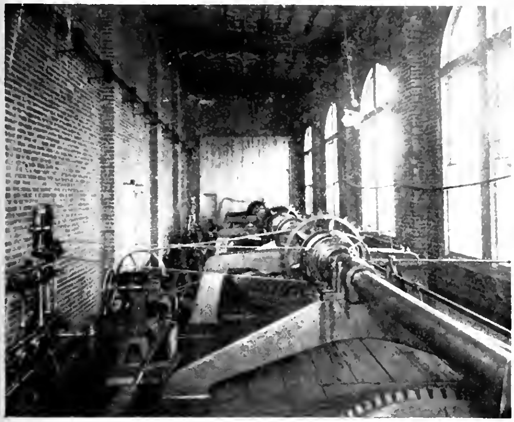


FIG. 5.—VIEW OF SHAFT HOUSE.

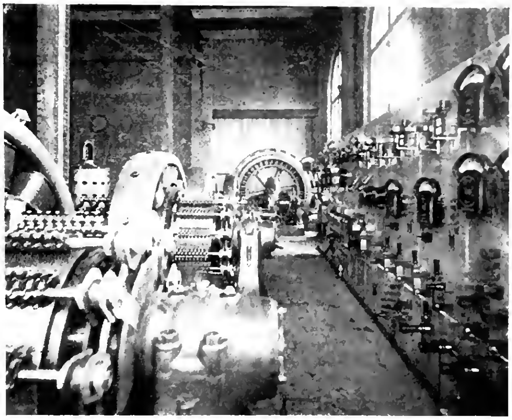


FIG. 6.—VIEW OF TURBINE ROOM, SWITCHBOARD, ETC.

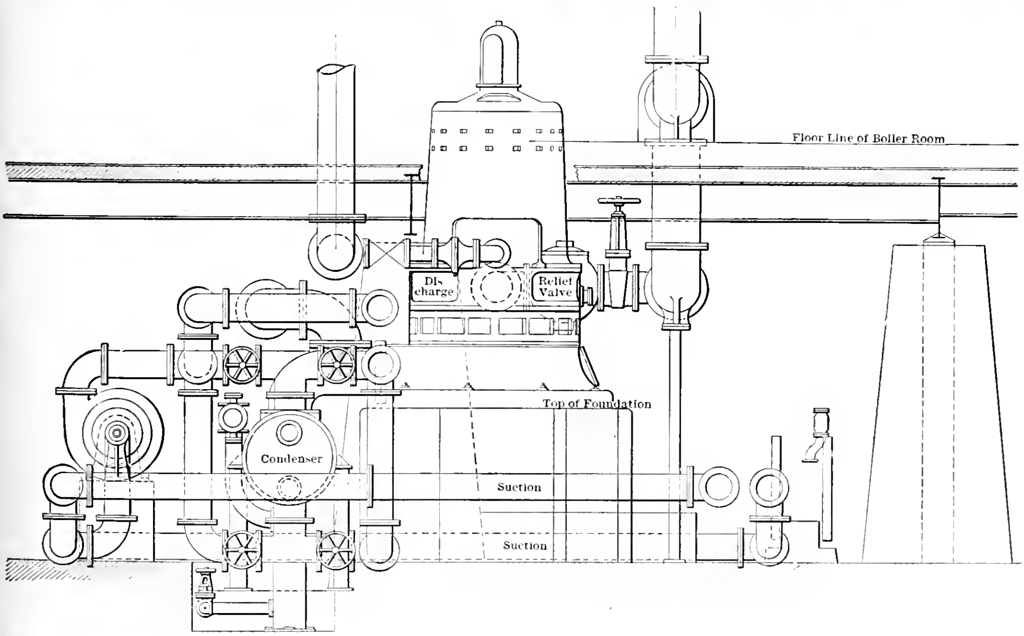


FIG. 7.—ELEVATION OF ONE OF THE STEAM TURBINE UNITS.

RECONSTRUCTION OF THE ZANESVILLE (OHIO) RAILWAY, LIGHT & POWER COMPANY'S PROPERTY.

and Chicago, undertook the reorganization of the properties now merged in the Zanesville Railway, Light & Power Company, in September, 1902, their contract providing for, not only the reorganization of the securities of these properties, but also for their complete physical and operating reconstruction. Kleybolte & Company, in turn, contracted with H. M. Byllesby & Company, of Chicago, for all the engineering work connected with the rebuilding of the property, the designing of the new power house and its contents, and H. M. Byllesby & Company, in connection with Messrs. Kleybolte & Company, also had charge of the reorganization of the operation of the properties.

Under the reorganization, all the former operating officials were retained; Hon. F. A. Durban, of Zanesville, being elected president; H. M. Byllesby, vice-president and engineer; W. A. Gibbs, general manager and assistant treasurer; W. D. Breed, of Messrs. Rudolph Kleybolte & Company, secretary and treasurer. Mr. Gibbs had been in charge of the properties under the former management for several years, and under the reorganization his powers and duties were largely increased and he had a prominent part in the reorganization of the operating conditions and in the reconstruction of the properties in connection with H. M. Byllesby & Company. Mr. Gibbs, together with E. C. Braun, one of the engineeers of H. M. Byllesby & Company, had charge on the spot of the reconstruction of the property.

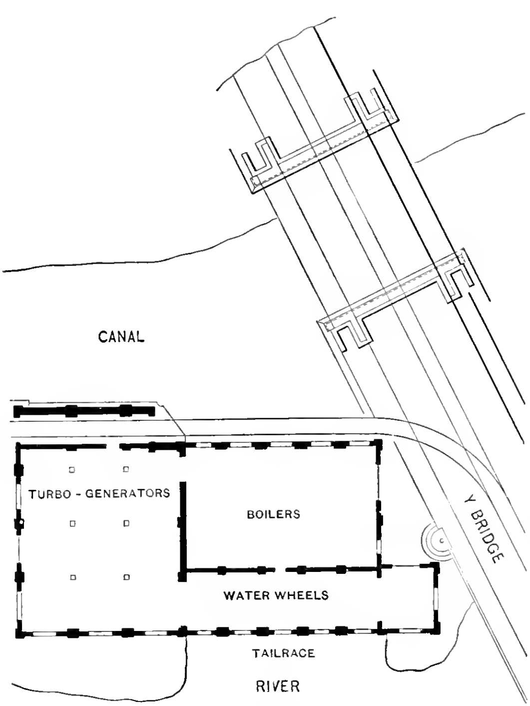


FIG. 8.—PLAN OF POWER HOUSE, ETC.

The street railway system, comprising some 14½ miles of track, was of 5-ft. 2-in. guage laid with rails ranging from 36 to 70 pounds per yard. Along with the reconstruction of the power house, the street railway system was reconstructed to bring it to standard gauge. This also called for a new rolling stock. The track as reconstructed now consists of 70-pound standard A. S. C. E. T rail in dirt streets and 70-pound Shanghai T in paved street. Eight of the 14½ miles of track is in paved street. Ties are 6 in. x 8 ft., laid two feet between centers. Atlas rail joints were used. The trolley is No. 0000 wire. The bonds and overhead material were furnished by the Ohio Brass Company. These cars are equipped with four 25-hp G. E. motors. Eighteen cars are operated during rush hours and ten upon ordinary schedule.

Niagara Beauty or Niagara Power.

At the hearing before the New York State Senate Committee on Miscellaneous Corporations at Albany on the bill to increase the water rights of the Niagara, Lockport & Ontario Power Company, Charles M. Dow, president of the Board of Commissioners of the State Reservation at Niagara, vigorously objected to the measure. Among other remarks, he said: "Owing to the greater declivity of the river bed on the Canadian side, as well as the wider expanse of the Horseshoe Fall, it is estimated that only one-fifth of the whole volume of the river passes over the American fall. Furthermore, owing to the difference in elevation of the Canadian and American river beds, the water has a tendency to gravitate toward the Canadian fall, and the American fall is the first to show the effect of any subtraction of water from the river above. As the general depth of the water on the fall is only about four feet, and as the elevation of the American fall is something like six or seven feet above that of the Canadian fall, it is apparent that the American fall might be made entirely dry while water still poured over the Canadian fall. That such a discrepancy would appear in the event of the diversion of a sufficient amount of water is not simply a theory; the fact was demonstrated in 1848, when the flow of the river was diminished by an ice blockade at the foot of Lake Erie, and on a lesser scale by more recent ice gorges.

"From the foregoing it will appear that the diversion of 20 per cent. of the water of Niagara River would be sufficient to render the American fall as dry as the once famous cataract of Lodore in England. Now, let us see what the State has already done to accomplish such a disastrous result: The reservation had hardly been created, for the express purpose of preserving the scenery of the falls, when the Legislature began, with singular inconsistency, to give away gratuitously the very water upon which the existence of the falls depends. Seven corporations were granted charters to take water from the Niagara River, between 1886 and 1894, besides another corporation which is taking water without authority, making eight American corporations which have either been authorized or are taking water without authority from the river. There are two Canadian corporations, for which the New York Legislature is not responsible, of course, but the effect of whose operations upon the flow of the falls must be reckoned with.

"Some of these corporations are limited in the amount of water which they can divert. More are unlimited. One limited American company alone is authorized to develop 200,000 hp, requiring 6 per cent. of the volume of the river. With a similar development by its corresponding company on the Canadian side, the flow of the river will be diminished about one-eighth—sufficient to dry up the American fall, according to one estimate. A similar development by all of the companies in existence would rob Niagara of one-third of its volume, and insure the obliteration of the American fall beyond a peradventure."

Evansville Municipal Telephone Company's Trouble.

There is trouble existing among the stockholders of the Evansville Municipal Telephone Company, which threatens to disrupt the organization and defeat the unique scheme of its chief promoters. Ten months ago the City Council of Evansville refused to renew the franchise of the Cumberland Telephone Company, and a movement was started by Mayor Covert and others to organize a municipal company to install a plant in the city and drive the Cumberland Company out of the city. Stock has been subscribed to the amount of $78,000 and a call was issued nine months ago for a payment of 30 per cent. of it. According to the plans and promises of the promoters, the stockholders were to receive an annual dividend of 7 per cent. and all other surplus was to go toward retiring the stock. It was figured that at the end of 20 years the city would own the plant.

Out of patience in waiting to see something done, stockholders representing 430 shares of stock held a meeting recently and demanded that the directors make a statement. There were many heated debates and the directors were charged with being negligent and with not having the municipal idea at heart. Those present insisted that something be done toward installing a plant and threatened the directors that unless they make a report a receiver will be asked for and the company's business closed out.

The Electric Power and Transmission System of Schaffhausen, Switzerland.—II.

(Concluded.)

STORAGE BATTERY.

The storage battery which is used for reserve power for the railway service is located in a separate building on the left side of the Rhine between the two power stations. The battery consists of 276 elements and has a capacity of 165 amp.-hours. The battery room is illuminated by four incandescent lamps. A repair shop is located in the same building.

OPERATING COMBINATIONS.

Under normal conditions the lighting circuits are fed by the two single-phase alternators in the lower station, and the power circuits (including the railway) are fed by the two alternators in the upper station. Should an accident occur the single-phase-polyphase reserve generator in the lower station can be operated in parallel on the lighting circuit. If, however, one of the power service generators in the upper station is disabled the reserve generator can be used for the power circuits. By the use of this reserve generator danger of service interruption is reduced to a minimum.

SINGLE-PHASE DISTRIBUTION.

Six cables leave the lower station carrying single-phase current for lighting and small power work. They are carried in wooden casings over the iron bridge to the shore. Four of these cables have a cross-section of 2 x 60 mm. and two are 2 x 20 mm. Each cable is double and concentric, one part being for the outgoing current and the other for the return.

One circuit, forming the core of the cable, consists of copper strand insulated and lead-covered. The other circuit consists of copper strand spun around the inner lead covering. This strand is also insulated and protected by a double cover of lead. To prevent injury in handling, the complete cable is covered with asphalted linen. The resistance between the inner and outer cables is 1,120 megohms and between outer cable and earth 1,140 megohms.

Both primary and secondary cables are laid in clay pits filled with fine sand. When primary and secondary cables are laid in one pit, additional safety is secured by laying the primary cable about 120 mm. lower than the secondary. This makes it possible to repair the low-tension cable without coming into contact with the high-tension cable. Wherever possible, branching of the high-tension cables takes place in the transformer stations. The high-tension cables consist of 7.511 km. 2 x 20 mm. concentric cables, 2.799 km. 2 x 40 mm. concentric cables and 5.645 km. 2 x 60 mm. concentric cables, making a total length of 15.955 km (9.6 miles).

The transformers, which reduce the 22,000-volt current to 120 volts, are set up in cylindrical iron houses. Two types are used for underground entrance of the primary cables and underground exit of the secondary cables. For underground primaries and overhead secondaries these houses are furnished with masts. Those for overhead work are outside the city limits.

Each of the four door houses has room for two 20-kw transformers. On one side of the interior there is an iron framework for carrying the transformers and a double-pole switch controlling the high-tension current going to the next transformer station. The second side carries two double-pole, high-tension switches operated from the third side to control the transformers. The fourth side has two marble panels, the upper one carrying two double-pole, low-tension switches for transformer control, and protective devices, and the lower panel a double-pole switch for the outgoing low-tension cables as well as safety contrivances.

The houses arranged for overhead work are, in addition to the above, equipped with lightning arresters.

Besides these transformer stations there is also one located at the center of the city. It is reached by ladder from the street surface through a shaft covered by wooden and iron covers. This room contains four transformers with switchboard and arrangements for ventilation and sewerage. There are in use 28 transformer stations using 33 transformers, taking 630 kw.

As the tension of the two-wire system is 120 volts and of the three-wire system 240 volts, all transformers have two secondary windings, which can be arranged in parallel for the former system and in series for the latter. All wires of the three-wire system are buried, but in general the two-wire system is an overhead one.

FIG. 5.—SECONDARY SIDE OF TRANSFORMER HOUSE.

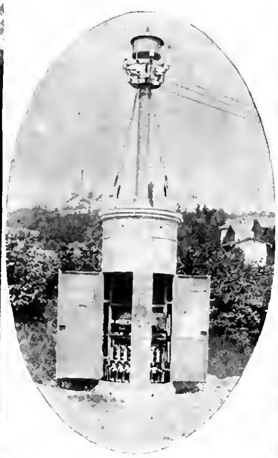


FIG. 6.—TRANSFORMER HOUSE.

FIG. 7.—HIGH-TENSION SIDE OF TRANSFORMER HOUSE.

The overhead wires are carried on double-covered insulators mounted on zinced iron supports attached to wooden poles 30 to 32 ft. high. These poles are covered with cast-iron caps and at exposed places are also furnished with lightning protection.

The length of the buried secondary network, consisting of 15 mm., 25 mm., 50 mm., 100 mm., 150 mm., and 200 mm. cables, is 16.327 km. (10 miles). The total length of the overhead secondary wires is 36 miles and weighs 9.2 tons. The total number of private consumers is 353.

All public arc lamps are separately shut in and out of circuit by water-tight switches. An automatic timing method is also being tried at present. The public incandescent lamps are all of 25 cp. There are in use 11,007 incandescent lamps and 88 arc lamps. There were also 22 motors on this circuit using in all over 39 hp. The total capacity of this system is 675,462 kw-hours.

POLYPHASE DISTRIBUTION.

Two triple 3 x 60 mm. cables laid in clay pits are led from the upper station to the lower one. At the latter station the cables branch, one being led to the three-phase motors running the railway generators and the other to a city distributing station. All of these cables are triple, have double lead covers and asphalted linen protection. The middle insulation resistance of each cable is 2,500 megohms per km.

From the main polyphase distributing station cables are led to ten sub-stations as well as a number of factories. Each station is furnished with a three-pole switch and other regulating and protective devices. Five of these polyphase stations also contain transformers and controlling apparatus.

Nine 1,900-volt, three-phase motors taking a total of 815 hp are used on this system, the largest being the two 150-hp motors used in connection with the railway generators. Another 150-hp motor is used in a worsted mill. The other motors are distributed among a dyeing establishment, nail factory and the Engestieg, Rheinalde and Breite pumping stations.

The low-tension polyphase motors on this system operate at 190 volts. At present there are 28 in use, totaling 318 hp. The largest motor used has a capacity of 30 hp. The total product of this system in 1901 was 1,144,721 kw-hours, and the maximum for one day 5,025 kw-hours.

SCHAFFHAUSEN CORD WORKS.

The power for operating the machinery in the Schaffhausen Cord Works is transmitted from the upper station through a 3 x 250 mm. high-tension cable. This cable divides into four parts at the factory switchboard. One of these three-phase branches gives but two phases to a 5-kw transformer which steps down the voltage to 240 for lighting the works. If necessary, the lighting circuit can be connected to the city lighting mains. This circuit feeds 230 16-cp incandescent lamps and three 14-amp. series arc lamps.

All the motors are operated at 390 volts. The motor equipment comprises six 50-hp motors and one 35-hp motor. All motors transmit power through belting.

SCHAFFHAUSEN WORSTED MILLS.

As has been stated before, the Schaffhausen Worsted Mills receive the power generated by two hydro-electric sets in the lower station. Current is transmitted by two overhead cables, each consisting of two cables each made up of 37 strands 32 mm. diameter. The overhead transmission in crossing the Rhine has a single span 100 m. long and enters the motor station of the worsted mills.

In this station the cables are led to double-pole switches, which

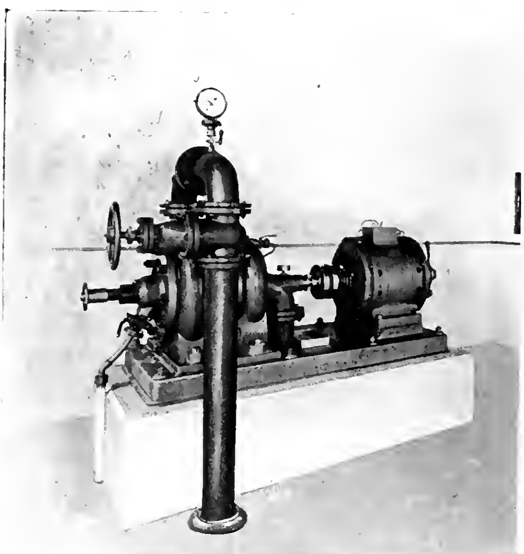


FIG. 8.—35-HP, THREE-PHASE MOTOR, BREITE PUMPING STATION.

are opened during lightning storms and outside of working hours. The cables also have lightning protection. They are led underground from these switches to the distributing switchboard, which contains the necessary instruments for controlling the branch circuits.

The motor station contains a 350-hp twin motor, which, through a rope drive, formerly operated the chief transmission system of the mills. This twin motor, which consists of two dynamos, is no longer used as a motor, but serves as a reserve generator operated by a steam engine in case the outside transmission system fails.

Every motor is operated at 650 volts and is furnished with a separate control panel including two-pole switch and ammeter. The present motor equipments of the mills include one 135-hp motor, five 60-hp motors and two 30-hp motors.

SCHEDULES.

The following charges are made to power users:

For all purposes, except lighting, 3.86 cents per kw-hour. The rebates are the same as those given below for lighting circuits; but there is a minimum annual charge of $9.65 (50 francs) per kw capacity of the individual station used by the consumer. The lowest

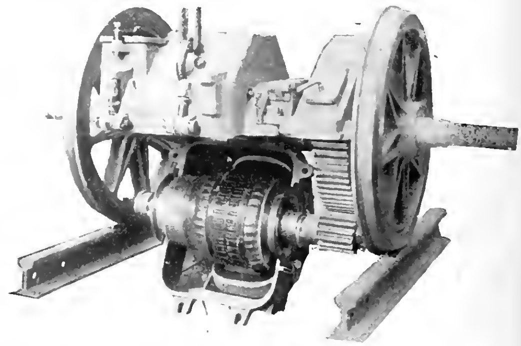


FIG. 9.—RAILWAY MOTOR.

price, namely, 3.86 cents, applies only from midnight to twilight. If the motors are used at night during lighting hours special terms are made.

Light consumers are charged 11.58 cents per kw-hour., and a minimum of $6.95 per annum.

In the following table the second column gives the rebate for using more than the amount specified in the first column opposite:

Dollars.	Rebate.
19.30	2 per cent.
48.25	4 " "
96.50	6 " "
193.00	8 " "
289.50	10 " "
482.50	15 " "
965.00	20 " "

Larger special discounts are given to consumers using more than $1,158 (6,000 francs) of power.

The minimum annual cost per horse-power using separate polyphase stations is $28.95 for low-tension motors and $24.13 for high-tension (2,000-volt) motors of 50-hp or greater capacity.

The single-phase circuits may be used continuously except for two to four-hour intervals, on Sundays and holidays. The polyphase system gives current every day except Sunday and holidays from 6 A.M. to 7 P.M. As the railway depends on this system consumers do not receive current outside of the hours named unless the conditions are favorable.

THE STREET RAILWAY SYSTEM OF SCHAFFHAUSEN.

The Schaffhausen-Neuhausen line begins at the southern end of the steam railroad station in Schaffhausen, passes to the Oberthor, crosses the government steam railroad below grade and ends in the center of Neuhausen in front of the Hotel Rheinfall. The second line (Breitelinie) runs between the railroad station and Marksmen's House. The third line connects the Emmersburg quarter and the railroad station.

All of the lines are single-track construction with turn-outs averaging 263 ft. in length. The distance between track centers is about 8 ft., leaving a clearance of 20 in. between cars passing each other. The minimum distance between outer rails and curb is 3.28 ft. The track is divided as follows on the Neuhausen and Breitelinie lines, respectively: Straight track, 53 per cent. and 66 per cent., curved track, 47 per cent. and 34 per cent.

The Neuhausen line climbs a 5.4 per cent. grade on the way to Oberthor and a 4.6 per cent. grade between the steam railroad crossing and Scheidegg. The Breitelinie route has a maximum grade of 8.1 per cent.

All of the lines run on the public highway, and as the railheads are flush with the street, wagon traffic suffers no interference. The rails are laid on a foundation made up of large stones covered by rubble.

The track joints are made by mitering in a way common in Germany, milling out a portion of the head of the rail each side of the joint and extending the top of the outer angle bar so that it fits into the milled section and carries part of the weight from the wheel. Edison-Brown plastic bonds are used throughout.

The car barn, which has a capacity of twelve cars, is constructed of brick with skylights and wood and cement roof. It has two pits and four trucks, and is lighted by four arc lamps and ten incandescent lamps. A smithy and repair shop adjoin the car barn. The repair shop contains two lathes, planing machine, boring machine and grindstone. All of the machines are operated through belting by a 2-hp Oerlikon motor.

The line voltage is 550 and the drop is not permitted to exceed 50 volts. Current is transmitted by buried cables from two motor-generator sets located in the lower power station. One of these sets is always held in reserve. The motors receive current either from the upper station or from the reserve generator in the lower station.

The twelve-pole motors of these sets are built for 150 hp at 490 r.p.m., using 2,000-volt, three-phase current at 50 cycles. Each motor is connected to the corresponding direct-current generator by a flexible coupling. Each dynamo generates 182 amp. direct current at 550 volts.

All the trolley poles are constructed of steel. The power wire is made of hard-drawn copper 8 mm. thick and is supported by 6 mm. steel span wires 20 ft. above the rails. Return is made to the power station through the rails. The lines are protected by lightning arresters mounted on poles, and an automatic arc extinguisher where the feeders leave the power station. Steel guard wires have been placed parallel to the power wire to prevent contact with falling telephone or telegraph wires. These additional wires are attached to a 6-mm. copper wire connected to the rails.

The rolling stock consists of nine single-truck motor cars, one sanding car and one repair car. The mechanical part of the motor cars was built by the Schweizerischen Industriegesellschaft, of Neuhausen. The motors can be inspected from the top by lifting a portion of the car floor.

Each car has two 24-hp motors made with a close-fitting steel frame. The laminated poles are screwed to the inside of the frame. The frame is divided into two parts and may be opened either from the top or bottom, making all parts easy of access. Current is taken through four collector brushes. These brushes are so placed that they may be quickly removed from above even when the motor is mounted for service.

The armature has 37 slots containing 36 wires triple-covered with silk and varnished. The four poles, which are connected in series, have 200 turns of wire each.

The motors are series-coupled when running slowly, and parallel-coupled at high speeds and heavy loads. For control there are four series, six parallel and six braking positions. One of the motors can be cut out of circuit by lifting a contact on the reversing handle without interfering with the running and braking of the car. All of the controller contact fingers are furnished with arc extinguishers. The total cost of the street railway system was $112,000 (561,060.4 francs), or $23,000 per mile. The total number of passengers during 1901 was 481,143, or 6.5 per trip. To carry this traffic required 131,541 kw-hours. Fares are paid according to the zone system, the first zone costing 2 cents and 1 cent for additional zones. The highest fare possible is 5 cents. Reduced-fare tickets are sold to school children and workmen. Passes are granted to employees of the railway.

The operation of the system (exclusive of power stations) requires the services of twenty-nine men, including a director, starter, cashier, two ticket agents, three shopmen, three trackmen, nine motormen and nine conductors.

Electrical Exposition at Warsaw.

An electrical exhibition will be held at Warsaw, Poland, this summer to which it may be to the advantage of American manufacturers to send exhibits, in view of the fact that it is believed locally that the current year has opened a period of great industrial activity, especially in the electrotechnical branch. Articles for exhibition will be admitted free of duty. It is hoped that the Russo-Japanese war may not distract public attention from the affair.

Proposed Experiments With X-rays and Radium.

By Edward P. Thompson.

Before the advent of Rontgen rays, Sir John Lubbock, F.R.S proved, by a long series of critical, varied and repeated experiments, that the invisible ultra-violet rays are perceived, in some manner or other, by the insignificant, yet highly interesting ant. For details of the apparatus and experiments see "Ants, Bees and Wasps," D. Appleton & Co., published in 1888. His experiments were based upon the dislike which ants, in their nests, have for light. Although they have no such feeling when out in search of food, yet if light is admitted to their nest they at once hurry about in search of dark corners, where they all congregate. If, for example, he uncovered one of the nests, and then placed an opaque substance over one portion, the ants invariably made the shaded portion their rendezvous. The ants likewise carried their pupæ and larvæ to the darkest portions of the nest. This characteristic was also a basis of operations.

His first experiments related to the ants' relative avoidance of visible light rays of different colors. In all these tests the violet and purple rays affected the ants much more strongly than the other colors employed. In a general sense the transmitted light of differently colored glasses appeared to act on ants in the same general order as it does on a photographic plate. Furthermore, they preferred the violet glass to the plain colorless glasses. In place of the latter solutions were tried, and tests involving equal temperatures were included, but the results remained the same. It is needless to say that Sir John Lubbock took every possible precaution and followed the strictest rules of scientific research.

Another series of experiments included ultra-violet rays, negatively. He had found that if the ants have to choose between the violet and other colored glasses, they always preferred one of the latter. Next he found that the effect of putting over the violet glass a layer either of sulphate of quinine or bisulphide of carbon (both of which are transparent to our eyes, but both of which cut off the ultra-violet rays), the effect was to make the violet glass seem to the ants as good a shelter as any of the other colors. Hence, this two-fold result is strong evidence that ants perceive ultra-violet rays.

He then tried more positive experiments with a saturated solution of chrome alum and chromium chloride, as these are very opaque to the visible light rays, but transmit the ultra-violet rays. The results were very striking. It made that portion of their nest so dark that he could see nothing. By an apparent expedient for watching their movements, he found that the ants avoided the ultra-violet rays. Different species of ants and different ants of the same species but of different nests behaved in a similar manner.

Whether the ants actually see some new color or light, or feel or hear it is not certainly known; but that ants constitute a detector of the invisible portion of the spectrum beyond the violet appears conclusive to Sir John Lubbock.

I have no longer the facilities for making X-ray experiments, nor do I know if others have tested their effect upon ants; but I propose to the Carnegie Institution at Washington or to others who are experimenting in the field of ether vibrations or limits of vision in animals, to determine if ants are affected by X-rays.

The electrical engineer is not so much concerned about the physiology of ants as is the naturalist, but he is anxious to add more facts for assisting in arriving at a more exact knowledge of the nature of X-rays. So far, it is known that this form of radiant energy causes certain salts to fluoresce; and that it affects the photographic plate. Consequently, it is like the short wave length from a luminous source. It is at the same time, invisible to man, and is thus like either the very short or very long wave length. It is like a long wave length in its power of penetrating substances which are opaque to light. As the same wave could not be both long and short at the same time, there is no reason why it could not be a mixture of long and short waves or else some energy without waves. Until ants are experimented upon, therefore, there is a void in this department of the science of radiant energy. A short wave, or energy of the spectrum beyond the violet, troubles ants. Will these insects immediately run away from Röntgen rays?

Investigations should also include the recently discovered etheric radiations. As nine years have elapsed since Prof. Röntgen made his remarkable discovery, and although all conceivable tests have been made upon radiant energy, may we not perhaps say, "Go to the ant thou sluggard, consider her ways and be wise?"

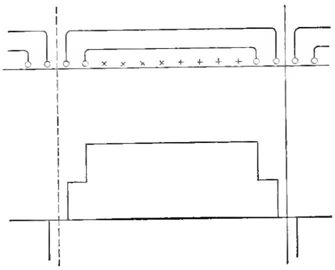
Calculation of the Equivalent Ampere-Turns of Windings for Single and Polyphase Currents.—II.

By C. F. Guilbert.

EQUIVALENT M.M.F. OF A SEPARATE PHASE WINDING.

CONSIDER first the common case of a polyphase winding where all sorts of the same phase are situated, for each pole, one following the other. It is evident that from the standpoint of the distribution of the inductive m.m.f. in the air-gap, the direction of current in the different conductors of each slot is only of interest; we can then group, by imaginary exterior connections, the conductors of different slots of the same phase in such a manner as to constitute a certain number of elementary coils per pole and per phase. In the present instance there are two cases depending upon the number of slots per pole and per phase.

Assume first the case of a winding of q phases with an even number, u, of slots per pole and per phase. Fig. 3 indicates that in this case we can form per pole and per phase $u/2$ elementary concentric coils of N/u turns, if N is the number of field conductors per pole and per phase. The m.m.f. distribution curve takes the form shown in Fig. 4. The angle between the axes of two neighboring slots being, for a bipolar machine, $\pi/q\,u$, the widest elementary coil will have the width



FIGS. 3 AND 4.

$$b = \frac{a}{\pi}\left(\frac{q\,u}{\pi} - 2\frac{\pi}{2\,q\,u}\right)$$

which gives for the quantity $\frac{b}{a}\frac{\pi}{2}$, $\frac{b\,\pi}{a\,2} = \frac{\pi}{2} - \frac{\pi}{2\,q\,u}$.

The m.m.f. of this coil is, therefore,

$$f_i' = \frac{4}{\pi^2}\cos\frac{\pi}{2\,q\,u}\,\frac{N}{u}\,I\,\sqrt{2}.$$

For the second coil we will have similarly for b and $\frac{b}{a}\frac{\pi}{2}$, the values

$$\frac{a}{\pi}\left(\pi - \frac{6\,\pi}{2\,q\,u}\right) \text{ and } \frac{\pi}{2} - \frac{3\,\pi}{2\,q\,u},$$

which lead, for this coil, to an equivalent m.m.f.,

$$f_i'' = \frac{4}{\pi^2}\cos\frac{3\,\pi}{2\,q\,u}\,\frac{N}{u}\,I\,\sqrt{2}$$

and so on. Finally, the equivalent m.m.f. per pole and phase is $\mathfrak{F}_i = f_i' + f_i'' + f_i''' + \ldots$

$$= \frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{2\,q}}{u\,\sin\frac{\pi}{2 q\,u}}\,N\,I\,\sqrt{2}.$$

To obtain the equivalent m.m.f. for q phases, it is merely necessary to multiply the above by q, which finally gives for the equivalent m.m.f. per pole of a width carrying current I,

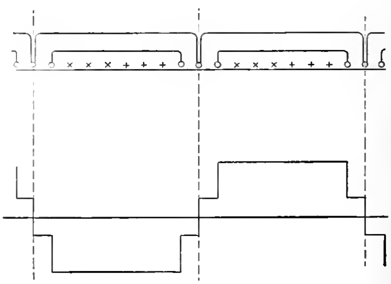
$$\mathfrak{F}_t = q\,\frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{2\,q}}{u\,\sin\frac{\pi}{2\,q u}}\,N\,I\,\sqrt{2}.$$

Suppose, now, that u is an odd number. With $u - 1$ slots we can first form per pole $\frac{u-1}{2}$ elementary coils of $\frac{N}{u}$ turns, and then divide the last slot into two parts so as to form with the slots not utilized a coil of only $\frac{N}{2\,u}$ turns per pole. Figs. 5 and 6 represent diagrammatically the case for a three-phase alternator with three slots per pole and per phase.

The coil of $\frac{N}{2\,u}$ turns will have a width b' equal to the step, so that the equivalent m.m.f. will be $f_i' = \frac{4}{\pi^2}\,\frac{N}{2\,u}\,I\,\sqrt{2}$. The widest coil with $\frac{N}{u}$ turns will have a width

$$b = \frac{a}{\pi}\left(\pi - 2\frac{\pi}{q\,u}\right)$$

since the angular distance between two slots referred to a bipolar



FIGS. 5 AND 6.

machine is $\frac{\pi}{2\,u}$. We then have $\frac{b}{a}\frac{\pi}{2} = \frac{\pi}{2} - \frac{2\,\pi}{2\,q\,u}$, and consequently the equivalent m.m.f. of this coil is

$$f_i'' = \frac{4}{\pi^2}\cos\frac{\pi}{q\,u}\,N\,I\,\sqrt{2}.$$

The narrowest coil, that of the order $\frac{u-1}{2}$ among the coils of $\frac{N}{u}$ turns, will, by analogy, have an equivalent m.m.f. equal to

$$\frac{4}{\pi^2}\cos\left(\frac{u-1}{2}\,\frac{\pi}{q\,u}\right)N\,I\,\sqrt{2}.$$

Summing up, as before, we have for a complete winding, per pole,

$$\mathfrak{F}_i' = q \frac{2}{\pi^2} \frac{\sin \frac{\pi}{2q}}{u \sin \frac{\pi}{2qu}} N I \sqrt{2},$$

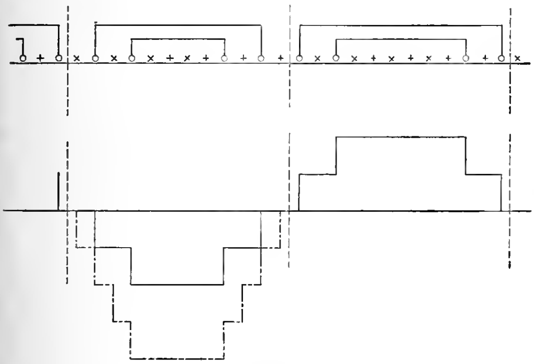
which is identical with the expression when u is an even number.

EQUIVALENT M.M.F. OF A SUPERPOSED PHASE WINDING.

We will now take up the case of superposed phase windings. This superposition can be regarded in two ways: First, that each slot contains only conductors of the same phase, in which case the slots of one phase are alternated with those of another phase; or that each slot contains an equal number of conductors of different phases. We will take up first windings with distinct slots.

Two cases are to be considered according as the number, u, of slots per pole and per phase are even or odd in number. Take first the case of an even number. As in the analogous case considered above, we can group the u slots of one phase and pole in two series of $\frac{u}{2}$ in such a manner as to constitute with a non-neighboring series and with the aid of imaginary connectors, one coil per pole formed of $\frac{u}{2}$ elementary coils placed concentrically (Fig. 7).

If we represent the m.m.f. due to a given current passing through



FIGS. 7 AND 8.

all the conductors of the phase considered, we obtain the distribution shown in Fig. 8. As will be seen, the m.m.f. of a phase is not the same for two neighboring poles. It is thus necessary in order to obtain the mean distribution of the m.m.f. per pole to take the arithmetical sum of the distribution curves under two neighboring poles and to divide the ordinates by 2, which is equivalent to using a double scale.

This summation having been made for the left side of the figure, it is easily seen that the result is as if there were per pole, in the phase considered, twice the number of slots, each of them being the seat of half the number of ampere-conductors. The value of the widths, b, of the elementary coils of a phase of a single pole are then, the angular distance between the two slots being $\frac{\pi}{2qu}$,

$$\frac{a}{\pi}\left(\pi - \frac{\pi}{qu}\right),\ \frac{o}{\pi}\left(\pi - \frac{\pi}{qu}\right)\ \cdots \cdots \frac{a}{\pi}\left(\pi - (2u-1)\frac{\pi}{qu}\right)$$

We then deduce for the successive values of the quantity $\frac{b}{a}\frac{\pi}{2}$.

$$\frac{\pi}{2} - \frac{\pi}{2qu},\quad \frac{\pi}{2} - \frac{3\pi}{2qu},\ \cdots \cdots\ \frac{\pi}{2} - (2u-1)\frac{\pi}{2qu}.$$

If we always designate by N the number of conductors per pole and per phase, the number of turns of each elementary coil will here be $\frac{N}{2u}$, and the equivalent m.m.f. per pole will have for the phase considered,

$$\mathfrak{F}_i = \frac{4}{\pi^2} \frac{N}{2u} I \sqrt{2} \times$$

$$\left[\cos\frac{\pi}{2qu} + \cos\frac{3\pi}{2qu} + \cdots \cos(2u-1)\frac{\pi}{2qu}\right]$$

This sum has for value in applying the method used previously,

$$\mathfrak{F}_i = \frac{2}{\pi^2} \frac{\cos\left[\frac{\pi}{2qu} + (u-1)\frac{\pi}{2qu}\right] \sin u \frac{\pi}{2qu}}{\sin\frac{\pi}{2qu}} \cdot \frac{N I \sqrt{2}}{u} =$$

$$= \frac{2}{\pi^2} \frac{\sin\frac{\pi}{q}}{2u \sin\frac{\pi}{2qu}} N I \sqrt{2}.$$

Finally, we will have for the equivalent m.m.f. corresponding to q phases,

$$\mathfrak{F}i = q \frac{2}{\pi^2} \frac{\sin\frac{\pi}{q}}{2u\sin\frac{\pi}{2qu}} N I \sqrt{2}.$$

It is not without interest to compare the preceding formula with that which we established above for the case of windings by distinct phases. It will be seen that the expression for $\mathfrak{F}_i$ differs only by the factors

$$\frac{\sin\frac{\pi}{2q}}{u\sin\frac{\pi}{2qu}} \text{ and } \frac{\sin\frac{\pi}{q}}{2u\sin\frac{\pi}{2qu}}.$$

These factors have the same value only when the number of phases is very great; that is to say, when the values $\frac{\pi}{q}$ and $\frac{\pi}{qu}$ are such that the sines can be replaced by arcs, when the expressions become equal to unity. In order to make a comparison with the normal values of q, suppose the number of slots is sufficiently large per pole and per phase that the sine can be replaced by the corresponding arc. We have then for the two factors,

$$\frac{\sin\frac{\pi}{2q}}{\frac{\pi}{2q}} \text{ and } \frac{\sin\frac{\pi}{q}}{\frac{\pi}{q}}, \text{ or } \frac{q}{\pi}\, 2\sin\frac{\pi}{2q} \text{ and } \frac{q}{\pi}\sin\frac{\pi}{q}.$$

If we consider in particular the case of a three-phase winding $q = 3$ and the values are, for a factor $\frac{3}{\pi}$, $2 \sin\frac{\pi}{6}$ and $\sin\frac{\pi}{3}$, or 1 and 0.866.

The employment of a superposed phase winding thus reduces the equivalent m.m.f. and consequently the field due to the corresponding winding, by 13 per cent. Superposed phase windings, which have been employed to obtain a distribution as close as possible to that of the sinusoid, thus lead in reality to a reduction of torque, and this is confirmed in practice.

On Turbo-Dynamos.—I.

BY PROF. DR. F. NIETHAMMER.

THE purpose of this paper is to outline the electrical and mechanical difficulties which arise in the design of turbo-dynamos (dynamo-electric generators directly connected to steam turbines) of 500 to 4,000 r.p.m. With all extra high-speed dynamos it is an easy problem to get a high-efficiency, a low-voltage drop, and, in the case of polyphase alternators, assure parallel running even with very variable loads consisting of synchronous motors or rotaries. The weight per kilowatt, the floor space per kilowatt (especially for types with vertical shaft), and the price per kilowatt may, without any difficulty, be kept pretty low, though by no means decreasing inversely proportional to the speed, since with high speeds the materials must be very carefully selected, while the shop work calls for special precision, involving increased labor cost.

The main difficulties in the design of turbo-dynamos are as follows:

(1) Satisfactory commutation to secure non-sparking in direct-current machines.

(2) Excessive heating, as the losses grow with the speed faster than the capability of radiating heat.

(3) High mechanical stress from centrifugal forces on rotating parts, their windings and insulation.

(4) Noiseless running.

It is certainly hazardous to guarantee the same degree of safety in service for turbo-dynamos as for the usual slow-speed, direct-connected dynamos. Any reduction of the speed of steam turbines to about half the value of present practice would be greatly welcomed by the electrical engineer, and the Curtis turbine seems to be a step in this direction. The difference in price would be trifling, as the materials would be cheaper and the wages lower for machines of larger size. A further trouble with these high speeds sometimes arises in three-phase plants of low periodicities. It is a well-known fact that turbo-alternators of 60 cycles can only be built for 3,600, 1,800, 1,200, 900, 600 and 500 r.p.m., and types of 25 periods only for 1,500, 750 and 500 r.p.m.; and in some cases the steam turbine has, therefore, necessitated quite abnormal periodicities. Turbo-alternators for less than 500 kw are rarely manufactured commercially, as they are impossible for small periodicities, neglecting the Laval turbine, since it works with a reduction gear.

In my opinion the rotating steam engine with rotating piston, instead of with reciprocating motion, is much more favorable for electrical work than the steam turbine. I have the following data on rotating steam engines of the Paschke system, which are built from 1 hp up to 10,000 hp and more:

5,000 hp, 250 to 420 r.p.m., as against 750 revolutions of the steam turbine: 4.3 kg. steam consumption for an indicated hp-hour. For 500 hp the speed is 250 to 610, against 1,500 to 2,500 for the steam turbine. It is, of course, necessary to gather further experience concerning this type in regular service.

There is an English patent, No. 6734 (1902) granted to Parsons, which tries to obviate the impossibility mentioned of building an alternator for 25 cycles directly connected to a steam turbine of 3,000 revolutions; but it is rather complicated and consists of two alternators, one of which has a rotating field directly connected to the steam turbine and outside of it an armature rotating with half the speed. This armature drives the field of the second alternator, the armature of which stands still.

(1) The difficulty of commutation for high-speed, direct-current machines is well known and has been discussed at much length. The fact is that some of the best-known electric concerns refuse to manufacture direct-connected, continuous-current turbo-dynamos. A more general use of steam turbines would thus lead to the exclusive adoption of a distribution system with polyphase central stations and sub-stations with rotaries. The excellent uniformity of speed of steam turbines would warrant in any case a very satisfactory service with rotaries even of 40 to 60 cycles.

Sparkless commutation is bound by the fundamental condition that the reactance voltage[1]

$$e_r = 4\, n\, L\, I$$

(where n = periodicity of commutation, L = coefficient of self-induction in henries, I = current in an armature circuit) shall be smaller than 2 to 3 volts at any load, or that the reactance voltage be continuously neutralized by a counter e.m.f. induced by an exterior field (field of commutation), either entirely or at least up to 2 or 3 volts. The high speeds naturally lead to a high value of

$$n = \frac{\textit{velocity of commutator}}{\textit{2 times thickness of a brush}}$$

and on account of the low voltage usually to a high value of the current, I, per armature circuit. Actual calculations on turbo-dyna-

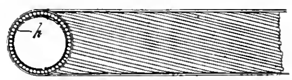


FIG. 1.—PARSONS TWISTED TUBULAR CONDUCTORS.

mos of the best feasible design show reactance voltages of 5 to 15 volts. Without the help of an auxiliary commutation field, e_a, a sparkless commutation seems, therefore, to be next to impossible. A direct reduction of the reactance voltage can only be achieved by decreasing the coefficient of self-induction and the current, I, in an armature circuit. The first condition involves very narrow armature cores, large diameters and extremely high circumferential velocities; the second condition may be satisfied by splitting the type into several machines with proportionally reduced output, all on one shaft and connected in parallel. Somewhat less efficient is the method

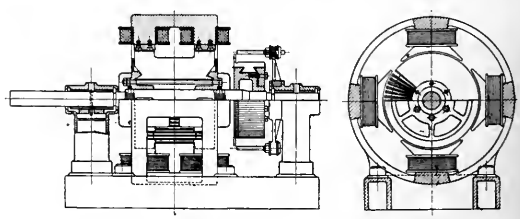


FIG. 2.—SCHÜTTDORFER METHOD OF BUILDING UP ARMATURE CORE.

of using one machine with several separate commutators. A low coefficient of self-induction is equivalent to a high resistance of the self-induced magnetic field round the short-circuited armature coils. Parsons proposes in his English patent, No. 5374, specially shaped, twisted tubular conductors on a smooth armature core (Fig. 1), to increase the magnetic resistance. For the same purpose the Schüttdorfer Maschinenfabrik builds up the armature core of iron sheets split in a radial direction not vertical to the shaft (Fig. 2).

The arrangement for neutralizing the reactance voltage, e_r, by an auxiliary counter e.m.f., e_a, are the following:

(a) *Automatic brush shifting.*

α corresponding to the variable current (Thury, Parsons),

β corresponding to the potential difference between the back (trailing) corner of the brushes and the commutator segments, (Fig. 3, Siemens Bros. English patent, No. 3777, 1903); in both cases the shifting is by a relay and an auxiliary motor.

(b) *Variable stray fields.*—Near the short-circuited armature

[1] Many of the points I can only mention here are more fully treated in the author's work, *Elektrische Machinen, Apparate und Anlagen (Enke).*

coils between the pole tips, small auxiliary poles without winding are arranged, which divert a certain stray field from the main poles to the short-circuited coils. This stray field strength is varied according to the load by shifting these auxiliary poles in a radial or circumferential direction.

(c) *Auxiliary distributed field windings* shifted against the usual field winding by about half a pole pitch and excited by the main current (Ryan, Déri). This arrangement compensates also the armature reaction and allows the voltage to be reduced down to zero without sparking. Fig. 4 shows the cut of a direct-current turbo-dynamo with Déri winding built by the Austrian Union Company (330 kw, 650 volts, 3,000 revolutions; armature diameter = 520 mm., commutator diameter = 300 mm., air gap = 5 mm.). The compensating winding is imbedded into slots; opposite to the short-circuited arma-

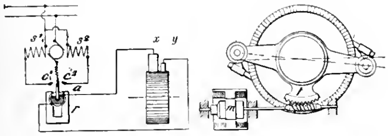


FIG. 3.—SIEMENS BRUSH AND SEGMENT ARRANGEMENT.

ture coils a specially broad commutation tooth directs the necessary commutation field on said coils.

(d) *Auxiliary poles excited by the main current* opposite to the short-circuited armature coils, either as a single-pole (Sautter, Harlé & Cie, Paris) or a two-pole (Siemens & Halske) arrangement.

(e) *Auxiliary Armature Windings.*—Between the main armature winding and the commutator a commutation winding is arranged which is either shifted towards the pole tips (Sayers) or induced by a special small field frame excited by the main current (Seidener); in each case the induced e.m.f. must act against the reactance voltage.

(f) *Spark-extinguishing blow-out devices,* acting either by compressed air (Thury) or by condensers switched between the commutator segments (Thury, German patent, No. 142,562).

(g) *Replacement of the commutator type* by the *unipolar* or *homopolar* machine, in which direct current is produced without any commutation. The main trouble is the fact that all existing unipolar types generate only very low voltages (50 volts and less) and that large eddy currents often occur. By using the most recent materials of exceptionally high mechanical resistivity, like nickel-steel, more satisfactory results may be expected.

(2) The *temperature rise, T,* in degrees Centigrade of a body

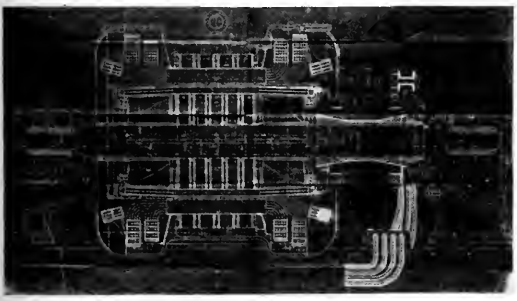


FIG. 4.—DIRECT-CURRENT TURBO-DYNAMO.

rotating at v meters per second and in which W watts are transformed into heat is approximately either

$$T = k \frac{W}{S\ (1 + 0.1\ v)}$$

or

$$T = k' \frac{W}{S\ (1 + 0.3 \sqrt{v})}$$

where S = radiating surface in square centimeters and k and k' are constant.

If the speed of a given type is increased from v to $m\,v$, the voltage rises from e to e_1 volts. If the main current, I, remains the same for both speeds, the copper losses, W_c do not vary for both cases, but the iron losses, $W_h + W_e$ (hysteresis + eddy currents) grow to the value

$$m\,W_h + m^2 W_e.$$

The ratio of the temperature rise T_m (with $m\,v$) to T (with v) is, therefore, using the $\sqrt{v}$ formula, the best for wide variations of speed:

$$T_m : T = \frac{W_c + m\ W_h + m^2 W_e}{1 + 0.3\ \sqrt{m}\ \sqrt{v}} : \frac{W_c + W_h + W_e}{1 + 0.3\ \sqrt{v}}$$

This equation proves that with increasing values of m, that is with increasing speed or circumferential velocity, the temperature rise grows more and more and for a fixed maximum value of T_m there exists a certain speed, $m\,v$, for which W_c must be zero. That means for said high speed, $m\,v$, the machine cannot radiate any copper

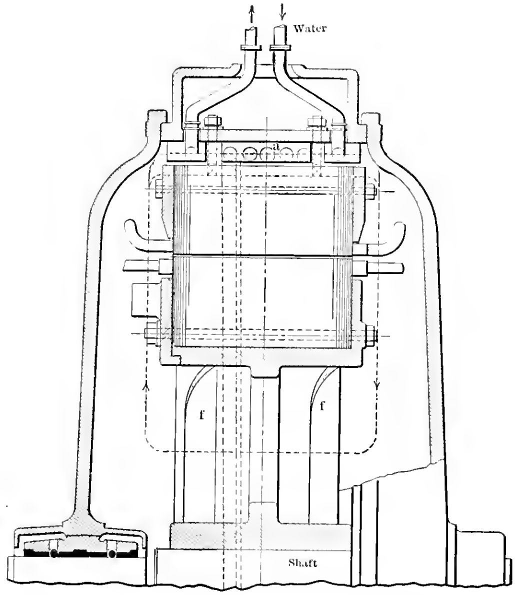


FIG. 5.—GENERATOR FRAME, WITH WATER-COOLING COILS.

losses, or the iron losses heat it to the very limit. In this case the dynamo delivers no useful work at all.

For high speeds especially nothing like an approximate proportionality between output and speed exists, which may be directly seen from the simple expression

$$T = \frac{k_1 + k_2 v + k_3 v^2}{S\ (1 + 0.3\ \sqrt{v})}$$

in which the total losses, W, are replaced by the sum of the copper losses, k_1, the hysteresis, $k_2 v$, and the eddy current, $k_3 v^2$, k_1, k_2 and k_3 being constants. Even in good design of low and moderate speed dynamos, $k_2 v + k_3 v^2$ is equal or larger than k_1, so much the more for high-speed machines, even of the very best design, the iron losses prove to be larger than the copper losses; that means, $k_1 + k_2 v + k_3 v^2$ grows faster with v than the denominator, $S\ (1 + 0.3\ \sqrt{v})$.

To keep the temperature rise sufficiently low, the iron section of turbo-dynamos in the induced parts must, therefore, be chosen as large as possible, and even especially thin iron sheets may be recommended in certain cases. In direct-current generators the radial iron depth is, however, very limited, as the outside diameter has to be small with regard to the high circumferential speed, and the inside diameter is fixed by the dimensions of the shaft. In the usual alternator design with rotating field, any radial iron depth is possible, but there are several drawbacks. The air-gaps diameters being pretty small, the magnetic paths in the induced part become very unequal and the outside strips of the deep sheets grow more and more useless. Besides, the reduction of the iron losses is not proportional to the radial depth, but only about to the square root of it. The result of this reasoning is that the iron sections can usually only be made large enough by increasing the length of the machine. The capability of radiating heat, which decreases with growing speeds, must be artificially ameliorated by a great number of air ducts, in many cases ducts of 15 to 20 mm. breadth on an armature length of only 20 to 50 mm. The output coefficient $k = \frac{kw}{d^2 l\, n}$ (where d = air-gap diameter, l = axial length, n = r.p.m.) must be smaller than with slow-speed types in order to provide for sufficient radiating surface. Wing-shaped blades or even entire fans must often be attached to the rotating parts, diminishing somewhat the efficiency. A very rational means to reduce the dimensions, and especially also the high circumferential speeds, is in the use of water-cooling coils, *a*, wound into the generator frame (Fig. 5), while the air circulates round all the active parts moved by screw-shaped blades, *f*. In a more radical design (German patent, 96,532, by Schuckert) the cooling coils pass directly through the sheet iron of the induced parts.

A disagreeable addition of heating is very often experienced in high-speed generators by unforeseen eddy currents in the armature conductors, in hubs, flanges, bolts and pole shoes.

(3) High speeds necessitate also high circumferential velocities, v_p, of the journals in the bearings, viz., v_p = 10 to 15 meters per second, against 2 to 5 meters in usual designs. For a journal of the dimensions $d_r \times l_p$, the temperature rise is

$$T_p = C \cdot \frac{d_p\ l_p\ v_p^{\ 3/2}}{\pi\ d_p\ l_p} = k^1\, v_p^{\ 3/2}$$

T_p grows with the 3/2 power of v_p. This is the reason why most bearings of turbo-dynamos need artificial lubrication by oil under pressure or circulating water. All high-speed shafts must run absolutely true; the rotating field or armature must be carefully balanced, all the singular parts separately and totally, without and with windings. To avoid dangerous magnetic pulls, even in so-called compensated types (Ryan, Deri) the air-gap must be pretty large and the air-gap induction of moderate size.

Measurement of Internal Resistance of a Battery by Ohm's Method.

By J. L. Dickson.

An interesting method of measuring the internal resistance of a closed-circuit battery is given below.

In Fig. 1, let G represent a galvanometer, R a variable resistance, K a switch for breaking the circuit, C a commutator for reversing the current by means of the plug P, and B a battery, the internal resistance of which is to be measured.

The apparatus is to be connected up in series as shown in the

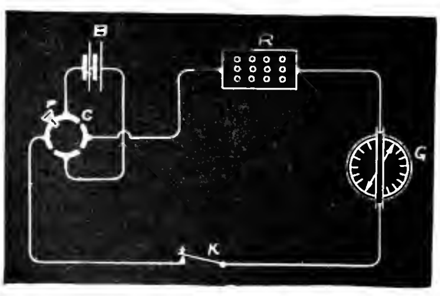


FIG. 1.—DIAGRAM OF CIRCUITS.

diagram, using short, heavy lead wires of negligible resistance for the connections. The plane of the galvanometer coils should be carefully set in the magnetic meridian, and the resistance of the galvanometer, if not known, determined by the Wheatstone bridge method.

The resistance R is then so adjusted as to give an angle of deflection of about 40° on the galvanometer G. This deflection is to be recorded, then the current reversed through the galvanometer by means of the commutator C, and the deflection again noted. In reading the angle of deflection of the galvanometer both ends of the needle are to be read; the current is then reversed and both ends again read, and the average of all four readings taken as the angle of deflection. Enough more of the resistance R is then inserted to

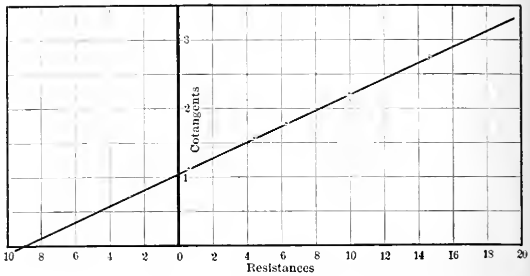


FIG. 2.—CURVES SHOWING RELATION BETWEEN RESISTANCES AND COTANGENTS.

reduce the deflections by about 5° and the readings again taken as above. This is to be continued until the deflections are reduced to 20° or less.

Let us assume that during a certain test the following readings were obtained:

Resistance, Galvanom.	Resistance, Circuit.	Total Resistance.	Angle of Deflection. Position 1.	Position 2.	Position 3.	Position 4.	True Deflec.	Cotan. Deflec.
Ohm.	Ohm.	Ohm.	Deg.	Deg.	Deg.	Deg.		
.65	0.0	.65	40	39	43	43	41	1.15
.65	3.7	4.35	32	31	32	34	32	1.60
.65	5.7	6.35	29	28	30	31	29	1.80
.65	9.4	10.05	24	25	24	24	24	2.24
.65	13.9	14.55	20	19	20	19	20	2.74
.65	20.9	21.55	15	16	16	15	15	3.73

From the above readings let us plot a curve, using known resistance in circuit (adjustable resistance plus galvanometer resistance) as abscissæ and the reciprocals of the tangents of the angle of deflection as ordinates. The origin should represent zero values of both quantities.

The curve is found to be a straight line and shows that the resistances and cotangents of the angle of deflection bear a certain relation to one another; that is, as the resistances increase, so do the cotangents of the angles. This curve is continued as shown until it cuts the axis of abscissas, and the intercept on this axis represents the internal resistance of the battery, which in this case is found to be 8.9 ohms.

The interception of the straight line on the horizontal axis gives the internal resistance, because the external resistances were plotted on the other side of the zero point. Therefore, if this line is continued, it passes back of the zero, which is on the internal resistance side of the horizontal axis.

This method assumes a constant e.m.f. for the battery, and is not suitable for cells which polarize.

Electricity in Syria.

A recent United States consular report received at Washington from Syria says: "Recently the Beirut Gas Works, which has a ninety-nine year exclusive franchise from the Ottoman Government and first option on use of electricity, was purchased by Ibrahim Sabbag, a wealthy and enterprising Syrian, who is an honorary dragoman of this consulate. Mr. Sabbag is interested in securing the co-operation of American experts, being hopeful of extending the use of gas and eventually of electricity throughout Turkey in Asia. American electric fans have recently been admitted to Beirut, where quite a few have been sold during the past year. It is believed that electric street railways will be authorized by the Central Government before long, along with electric light, telephones, etc."

Standardizing of Subway Manhole Construction.

By HUGH C. BAKER, JR.

ENGINEERS who have had experience in the construction of subways for telephone or electric light cables, especially in suburban districts, will readily appreciate the value of a system of manhole construction whereby all manholes can be built exactly the same in size and shape, with interchangeable concrete wall and top blocks which are placed together by ordinary laborers practically without supervision.

Such a system has now been designed and patented, and was used last year experimentally by the New York Telephone Company.

In Fig. 1 is shown a sectional elevation of a concrete block manhole which is believed to have points of sufficient merit to make it a standard. The walls of the manhole are built up of separate horizontal layers or rings of concrete blocks of two different sizes and shapes—eight blocks to a ring, laid on a six-inch foundation of concrete. The four end wall blocks, exactly similar in size and shape, are adapted to be reversed or turned end for end in each separate layer so that all joints are broken, or staggered, as shown by the sectional elevation.

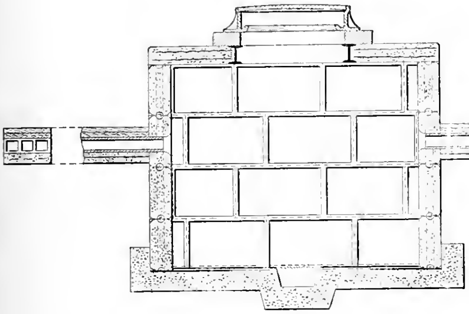


FIG. 1.—SECTIONAL ELEVATION OF MANHOLE.

The blocks can be made any suitable height. In moulding, grooves are formed in the flat surfaces of the blocks (Figs. 1 and 4) preferably semi-circular in cross-section, as shown in Fig. 5. When the walls of the manhole are constructed, these grooves, coming together, form continuous open spaces, extending from top to bottom of the manhole, which are filled with liquid cementing material, forming mortar dowels between each block horizontally and vertically, as shown by Fig. 1. These dowels not only tend to lock the blocks in position, but will prevent water from passing through the joints.

FIG. 2.—GENERAL VIEW OF BLOCK MANHOLE.

The roof of the manhole is formed by sliding into position six flat concrete slabs, each about 5 inches thick, reinforced with expanded metal, or steel rods, and with beveled edges. The slabs bear on the flanges of the steel beams and on the walls. On completion, all exposed joints in the walls and roof are pointed with mortar, and the inside of the manhole is finished with a white cement wash to increase the light. The manhole illustrated, if properly constructed, should be absolutely impervious to water or gas.

The advantages of the block concrete manhole, compared to any previous method of construction, including monolithic concrete and brick construction, are that the blocks can be made in one place under proper supervision, in the winter time if necessary, shipped to the work, and laid up without skilled labor; and that there is very little, if any, waste of material. The duct entrance is made by breaking away portions of the blocks and filling in the opening around the ducts with concrete, using a small inside mould and outside boards to confine the free concrete to the shape of the walls.

Last year the New York Telephone Company constructed a large amount of subway in its suburban territory adjacent to New York City. More than one hundred sets of the concrete tops, about the same as illustrated in Figs. 1 and 3, were used on the ordinary brick manholes with satisfactory results, and a number of the concrete block manholes were constructed, the blocks being without grooves and rectangular in cross section.

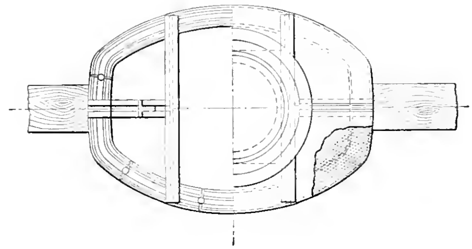


FIG. 3.—PLAN OF MANHOLE.

Fig. 2 illustrates one of the standard block manholes actually built in Rye, N. Y., where a railway bridge crossing was made with creosoted wooden conduit. All of the blocks were made in a large barn in Rye and shipped by wagon or rail to the different places where they were to be used. Over 1,200 blocks were made in the barn and only nine were broken in handling.

Portland cement concrete was used mixed in the proportion of 1-2-4, using three-quarter-inch machine-crushed trap-rock from the Connecticut quarries. The blocks were made in separate wooden molds and about five hours after mixing were placed in the open air to set from three to five days, before shipping. The average cost of the block manholes constructed was found to be less than the cost of brick manholes of the same size and shape, and it was found that a block manhole could be constructed in about one-third of the time required to build a brick manhole. A concrete block manhole can be constructed, the iron cover set, the excavation filled in and the street opened for traffic in five hours by three men, under favorable conditions, whereas it usually takes a mason and helper with from three to four laborers one and one-half days to build a brick manhole of the same size.

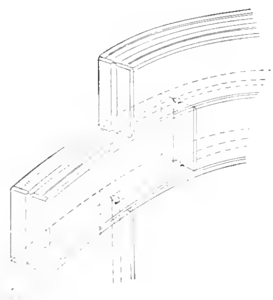


FIG. 4.—PART OF WALL SHOWING GROOVES.

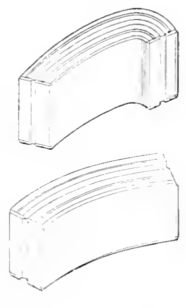


FIG. 4A.—WALL BLOCK SHOWING GROOVES.

The concrete blocks used last year were unnecessarily large and heavy, and time was lost in moulding in separate moulds. A new form of mould has been designed, by means of which the required number of blocks for an entire manhole can be made in a small space in one operation, thereby greatly reducing the cost of manufacture.

The use of the block manholes in city streets is not always practicable, because of the presence of pipes and other obstructions. Under such conditions it is necessary to design each separate manhole to conform to the space available; and although a monolithic concrete manhole might be built instead of brick, it is less expensive to use brick, because of the high cost of building suitable interior moulds which are required in the construction of the monolithic concrete manholes.

For suburban work or the construction of long line subways on country roads, the concrete block manhole is without doubt the most economical and most suitable form of construction yet devised, and it is believed that a large number will be used in the immediate future.

A manhole has been designed built up of semi-hollow blocks which will probably be experimented with this year. The blocks when placed in the walls form vertical spaces through the walls similar to the construction of some of the concrete buildings which are now being erected in the Southern and Western States. It is not believed that the hollow blocks will be as universally suitable as the solid grooved blocks for manhole construction, however, because of the difficulty in making water-tight and gas-tight joints. The only object in using hollow, or semi-hollow, blocks would be to reduce the weight and the amount of concrete required.

Early References to the Mariner's Compass.

The following are the passages referred to by Brother Potamian in his introductory notice to the letter of Petrus Peregrinus on the magnet, which we printed last week:

Abbot Neckam (1157-1217) in his *De Naturis Rerum,* writes:

The sailors, moreover, as they sail over the sea, when in cloudy weather they can no longer profit by the light of the sun, or when the world is wrapped up in the darkness of the shades of night and they are ignorant to what point their ship's course is directed, these mariners touch the lodestone with a needle, which (the needle) is whirled round in a circle until when its motion ceases, its point looks direct to the north. (*Cuspis ipsius septentrionalem plagam respiciat.*)

In his *De Utensilibus,* we read:

Among other stores of a ship there must be a needle mounted on a support (*habeat etiam acum jaculo superpositam*) which will oscillate and turn until the point looks to the north, and the sailors will thus know how to direct their course when the pole star is concealed through the troubled state of the atmosphere."[1]

Alexander Neckam was born at St. Albans in 1157, joined the Augustinian Order and taught in the University of Paris from 1180 to 1187, after which he returned to England to take charge of a College of his Order at Dunstable. He was elected Abbot of Cirencester in 1213 and died at Kemsey, near Worcester, in 1217.

Guyot de Provins' satirical poem, written about 1208, contains the following passage:

The mariners employ an art which cannot deceive,
By the property of the lodestone.
An ugly stone and brown,
To which iron joints itself willingly
They have; they attend to where it points
After they have applied a needle to it:
And they lay the latter on a straw
And put it simply in the water
Where the straw makes it float.
Then the point turns direct
To the star with such certainty
That no man will ever doubt it.
Nor will it ever go wrong.
When the sea is dark and hazy,
That one sees neither star nor moon,
Then they put a light by the needle
And have no fear of losing their way.
The point turns towards the star;
And the mariners are taught
To follow the right way.
It is an art which cannot fail.

Provins, from which Guyot took his surname, was a small town in the vicinity of Paris.

Cardinal Jacques de Vitry, in his *Historia Orientalis,* Cap 89, writes:

"An iron needle, after having been in contact with the lodestone, turns towards the north star, so that it is very necessary for those who navigate the seas."

Jacques de Vitry was born at Argenteuil, near Paris, joined the fourth crusade, became Bishop of Ptolemais, and died in Rome in 1244. He wrote his "Description of Palestine," which forms the first book of his *Historia Orientalis,* in the East, between 1215 and 1220.

Albertus Magnus (1200-1280) in his *De Mineralibus,* Lib. II., Tract. 3, Cap. 6, writes:

"It is the end of the lodestone which makes the iron that touched it turn to the north (*ad zoron*) and which is of use to mariners; but the other end of the needle turns towards the south (*ad aphron*)."

This illustrious Bavarian schoolman joined the Dominican Order in his youth, lectured to great audiences in Cologne, became Bishop of Ratisbonne in 1260, and died in 1280. Thomas Aquinas, the greatest of schoolmen, was among his pupils.

In the Spanish code of laws, begun in 1256, during the reign of Alfonso el Sabio, and known as *Las Siete Partidas,* we read:

"Just as mariners are guided during the night by the needle, which replaces for them the shores and pole star alike, by showing them the course to pursue both in fair weather and foul, so those who are called upon to advise the King must always be guided by a spirit of justice."

Brunetto Latini, in his *Trésor de toutes Choses,* 1260, writes:

"The sailors navigate the seas guided by the two stars called the tramontanes, and each of the two parts of the lodestone directs the end of the needle to the star to which that part itself turns." (The reverse is the case).

Brunetto Latini (1230-1294) was a man of great eminence in the thirteenth century; Dante was among his pupils at Florence. For political reasons, he removed to Paris, where he wrote his *Trésor* and also his *Tesoretto.* He visited Roger Bacon at Oxford about 1260.

In his treatise *De Contemplatione,* begun in 1272, Raymond Lully writes:

"As the needle, after having touched the lodestone, turns to the north, so the mariners' needle (*acus nautica*) directs them over the sea."

Lully was born at Palma in the Island of Majorca in 1236; he joined the Third Order of St. Francis, dying in 1315.

Ristoro d'Arezzo, in his *Libro della Composizione del Mundo,* written in 1282, has the following:

"Besides this, there is the needle which guides the mariner, and which is itself directed by the star called the tramontane."

The following metrical translation of a poem by Guido Guinicelli, an Italian priest, 1276, we take from Bauer's "Principal Facts Relating to the Earth's Magnetism," 1902:

In what strange regions 'neath the polar star
May the great hills of massy lodestone rise,
Virtue imparting to the ambient air
To draw the stubborn iron; while afar
From that same stone, the hidden virtue flies
To turn the quivering needle to the Bear
In splendor blazing in the Northern skies.

The above extracts show that the directive property of the magnetic needle was well known in England, France, Germany, Spain and Italy in the thirteenth century. In the passage from Neckam, the *acum jaculo superpositam* has been construed by some to mean a form of pivoted needle, while in the letter of Peregrinus, 1269, which will appear in our next issue, the double pivoted form is clearly described. In this connection it will be interesting to note that the Dent Brothers, of London, have adopted in some of their ships' compasses this very mode of suspension on account of the damping effect which it exercises on the swing of the magnet.

[1] The Chronicles and Memoirs of Great Britain and Ireland during the Middle Ages, by Thomas Wright (1863).

High-Tension Work.

The March meeting of the American Institute of Electrical Engineers will be devoted to a discussion of subjects relating to high-tension work, which will be introduced by a number of papers serving as a framework for the discussion, to which all members are invited to contribute. Below are given abstracts of these papers:

THE RELATIVE FIRE RISK OF OIL AND AIR-BLAST TRANSFORMERS.

In opening the author, Mr. E. W. Rice, Jr., says that two types of transformers have been extensively used in electrical installations up to date, distinguished by the method of insulation and cooling employed. The "oil transformer" relies upon oil as the cooling and insulating fluid. The "air-blast transformer" contains insulation material mainly of cloth, paper and wood impregnated with oil or varnish, and is cooled by the circulation of a blast of air. In both types the insulating material is of an inflammable nature and under certain abnormal conditions may take fire with more or less serious consequences.

The electrical engineer must, therefore, consider carefully not only the relative but the actual fire hazard which exists, and by proper and common-sense methods minimize such danger. Both types can be made entirely safe by correct methods of design and installation.

It will be admitted that in general that type which contains the greater quantity of inflammable material will occasion the greater fire hazard. The inflammable material in an air-blast transformer of say 1,000-kw capacity will amount to about 800 pounds, in an oil-cooled transformer of the same capacity the amount will be about 7,300 pounds. While this comparison cannot be taken as a measure of the relative fire risk, it is an indication to be considered, especially in view of the fluidity, the low temperature of ignition, and high calorific value of oil.

While the quantity of inflammable material in an air-blast transformer is, as stated, relatively small, it has an extended surface exposed to a large volume of air, and, therefore, if a fire starts from internal causes, such as short-circuit or extreme overload, is capable of rapid combustion. This combustion could be checked by shutting off the flow of air to a transformer by means of a diaphragm automatically closed by the melting of a fusible link, the fusible link so located as to be melted by the first contact with flame; a method similar to that employed for closing fire doors in buildings.

An oil-transformer properly cooled is probably not particularly subject to ignition of the oil from internal burn-outs or arcs. It is well known that oil is an excellent medium for the smothering of alternating arcs, and this principle is utilized in connection with oil switches.

The vapor above the oil may, however, be ignited by electrical discharges. Even in this case, while the quantity of combustible material is enormous, the surface exposed is relatively small. The principal fire hazard in an oil transformer is due to the large mass of inflammable liquid material which, under certain conditions, may become totally consumed. It becomes a special hazard in the case of fire from sources eternal to itself.

Considerations of fire cost, economy of space, simplicity, operating costs, etc., have resulted in placing transformers in the same room with switchboards and other apparatus, such as synchronous converters, motor-generators, etc. Under such conditions it would seem that the air-blast transformer constituted the lesser fire risk than the oil transformer, and would, therefore, be generally employed if the fire risk were the only consideration. The air-blast type, however, is limited in practice to pressures of about 30,000 to 35,000, as the static discharge which occurs at much higher pressures would in time break down the insulation. It is, therefore, necessary to employ oil insulation on the higher pressures now common.

The fire risk can be practically eliminated by placing such transformers in a room or rooms separated by suitable fire walls from the other part of the plant. This plan has already been proposed and introduced. An entirely separate building, subdivided again into suitable rooms, may be employed where the maximum of safety is demanded. Much may be done to limit the risk, even when the transformers are placed in the same room with other apparatus, by proper systems of piping for drainage of the oil away from the building, by placing the transformers in a depressed area of concrete arranged for rapid drainage, etc. Of course, any of the methods commonly employed for preventing, limiting or extinguishing oil fires may be properly employed.

THE USE OF GROUP SWITCHES IN LARGE POWER PLANTS.

Mr. L. B. Stillwell, in a paper with the above title, considers the group-switch system with particular reference to the plant of that system installed at the Manhattan power station in New York. In this plant two complete sets of main bus-bars are used. Switches are provided by means of which each of these sets may be divided into two independent sets of bus-bars to each of which four alternators and four groups of feeders may be connected. Eight group switches are provided, through each of which current is supplied to a set of auxiliary bus-bars, to which in turn the individual feeders are connected through their respective switches. One of the eight feeder groups is used to supply power to auxiliaries in the power house. The other seven groups supply power, respectively, to the seven sub-stations which receive power from this central source. All switches in the high-pressure alternating-current circuits are of the motor-operated oil type.

The arguments in favor of the group switch as used in the plant of the Manhattan Railway Company are as follows:

1. It affords an additional means of opening a feeder switch that fails to open its circuit, when operated for that purpose. The advantages of the group switch in respect to this function to-day appear materially less than they did five years ago, for the reason that the power-operated oil switch within the period named has demonstrated a high degree of reliability. However, it cannot be assumed that the feeder switch is invariably reliable, and, therefore, judgment of the weight of the argument in favor of the group switch, based upon its use as a reserve for the feeder switch, becomes a question of judgment of the chances of failure of the feeder switch on the one hand and the seriousness of total interruption of power supply on the other.

2. It affords means of reducing aggregate load upon the power house in case of necessity, more rapidly and otherwise less objectionably than the usual method of cutting off individual feeders. It will sometimes happen in the operation of a power plant that it becomes necessary suddenly to shut down one of the generating units. If the load carried at the time be such that the shutting down of the generator implies reduction of the external load, this can be accomplished most conveniently by operating one or two group switches.

3. Where duplicate main bus-bars are used it facilitates transfer of load from one set to the other, in case it becomes necessary suddenly in operation to make such transfer. As bus-bars and connections are now installed in our best plants, this necessity does not arise frequently; nevertheless, it is liable to occur, and obviously half a dozen group switches may be used to affect the transfer in much less time than would be required were five or six times that number of individual feeder switches used.

4. The grouping of the external feeder circuits in group units bearing a simple fixed relation to the generator units establishes a symmetry and proportion most useful to the operator, particularly in times of emergency. In the case of the plant under consideration, at times of full load, the power passing through each group switch is substantially equal to the output of one generating unit. This relation of course does not exist under partial loads, but under such loads it is not difficult usually to keep in service generating capacity exceeding the load by a margin sufficient to make it possible to shut down one generator without cutting off feeders; and in cases where this margin of capacity is not kept in service it is, nevertheless, a more speedy and certain operation to cut off the necessary number of groups of feeders than it would be to cut off a proportionate number of individual feeders.

The arguments against the group switch are as follows:

1. It introduces additional apparatus and, therefore, in itself increases the risk of interruption due to failure in switch insulation, etc. The successful operation of many plants, particularly in America, has been interfered with by the introduction of too much switch gear and too many safety devices, automatic and other; these additions in themselves being responsible in some cases for more trouble than they prevent; and it is to be noted that the group switch implies the auxiliary bus-bar. Here again it is impossible to dogmatize, for as the result of additional experience, the judgment of to-day may be reversed five years from now. Mr. Stillwell considers that if the group switch and the auxiliary bus-bars be reasonably well insulated and installed, the interruptions originating in this additional apparatus should be almost negligible in the case of such a plant as that to which his remarks refer.

2. The group switch and its bus-bars imply, of course, an increase of cost of the plant. In case of the Manhattan plant this increase is about 10 per cent. of the cost of the switch gear and measuring apparatus, and about four-tenths of 1 per cent. of the cost of the plant. To put it another way, the cost of the group switches and bus-bars for the plant approximates $20,000, and the annual cost, assuming this to be 10 per cent. of the investment costs is $2,000, which is about two-tenths of 1 per cent. of the annual cost of operating the entire plant, including sub-stations.

In the plants in which the feeder unit equals or exceeds the dynamo unit of power, the group switch, of course, disappears. In this case, however, it may still be advisable to use two feeder switches in series in order to avoid the necessity of shutting down the entire plant in case of the failure of a single feeder switch.

Obviously, also, there is no reason for attempting to use group switches in cases where the total number of feeders is small. For plants comparable in magnitude to the plant of the Manhattan Railway Company, using a very considerable number of feeders, the group switch is important and its use generally advisable.

OIL SWITCHES FOR HIGH PRESSURES.

Mr. E. M. Hewlett, in a paper with the above title, compares the oil-break switch with the air-break switch. The following points are given as the main ones for consideration:

1. *Abnormal Rise in Pressure.*—Owing to the fact that in oil switches the circuit is opened at the zero point of the wave, the rise of pressure found in the air-break switch is not experienced. This point is of particular importance in high-pressure, long-distance lines, and in cables carrying considerable energy.

2. *Capacity.*—Experience has proved that oil switches may be designed to break circuits of practically unlimited capacity.

3. *Length of Arc.*—Owing to the smothering action of the oil on the arc the length of arc under oil is only a fraction of its length in air.

4. *Insulation.*—The insulating qualities of the oil decrease the distance required to prevent leakage and arcing.

5. *Size of Switch.*—Owing to the fact that the arc length is materially decreased and the value of the oil as an insulation reduces the creeping surface, an oil switch can be made very much more compact than an air switch.

6. *Remote Control.*—The design of the oil switch lends itself readily to operation by control from a distance.

7. *Arc Confined.*—The fact that the arc is ruptured under the oil within the switch has two advantages. First, switches can be placed close together without danger of short-circuit; second, in case of emergency, confusion is avoided as there is no visible arc to disconcert the attendant.

8. *Station Arrangement.*—The flexibility of the oil switch places no limitations on the station arrangement, permitting the circuits and busses to be arranged in the most advantageous manner.

9. *Isolation of Phases.*—The possibility of complete isolation of the phases in a reasonable space is easily secured by the use of oil switches.

TERMINALS AND BUSHINGS FOR HIGH-PRESSURE TRANSFORMERS.

Mr. Walter S. Moody, in a paper, considers the subjects of cables, straps, connectors, etc., for both high and low-tension side, designed both for terminal connections and for changes in the ratio of transformation, together with their insulation. In transformers for moderate pressure and having but two high and low-pressure terminals, the problem of terminals is a simple one; with higher pressures and numerous changes in the ratio, however, the design of these parts of the transformer often becomes a most difficult problem upon the proper solution of which depends, to no small extent, the reliability of the transformer.

It is much better to have the high and low-pressure terminals at opposite ends of the structure, for it is almost impossible to keep safe distances between the terminal and connecting coil leads, when all are at one end. In a shell-type structure, having its coils in vertical position, this requires one set of coil terminals to be at the bottom of the case, but to bring these safely to the top is not as difficult as to separate high and low-pressure conductors that are at the same end of the windings.

In an oil-immersed transformer the insulation of coil terminals presents little difficulty, as it is simply necessary to have all leads rigidly spaced a safe distance from each other and from the coils, and covered with sufficient water-proof insulation to prevent any moisture penetrating the coil around the terminals before the oil is put in.

In air-blast transformers, however, the case is different; here all terminals must be covered with an insulation integral with that on the coil itself, to a distance from the coil that provides sufficient surface insulation, even when the lead is well covered with dust and dirt.

Often the dielectric strength of a transformer is materially lowered by allowing the coil terminals or taps to project beyond the sides of the coils, thus shortening the distance between the primary and secondary. "Spreading" the exposed ends of the windings removes this difficulty, except when the terminal comes from a point well within the coil, but introduces a more serious defect, lack of rigidity to withstand the strains of short-circuits. Usually the problem can be solved by so winding coils as to have only outside terminals and locating such coils as have taps on the outside of the coil structure.

The best location for main terminals naturally varies with the type of transformer and its pressure; for the air-blast type, the air chamber forms a convenient and natural location for the low-pressure wiring, and the terminals of these are, therefore, usually located in the base of such transformers and made accessible by doors in the side of the base. For pressures not exceeding 25,000 volts, the high-pressure wiring can also be placed in the air chamber, without making the air chamber of excessive cross-section, so that all transformer terminals are in the base and exposed wiring is avoided. Heavy rubber-insulated cable is to be avoided in such construction, however, for should the rubber take fire from short-circuit or other causes a draft of air will carry the fire along the duct and into the transformers with great rapidity.

In oil-filled transformers the terminals are, of necessity, located at or near the top of the case. Often for convenience in external wiring projecting pockets are provided through which terminal leads may leave the case in a downward direction. With such construction, it is necessary to have a solid section in the cable, just above the oil line, and to have this section uninsulated or covered with an insulation impervious to oil, otherwise the cable and insulation will act as a syphon and discharge oil.

Below 40,000 volts the insulation of high-pressure terminals offers no special difficulty; porcelain or glass bushings can readily be obtained that are safe for this pressure, even if the conductor has no insulating covering. For higher pressures, the problem is more difficult, if no insulation is used on conductor, the bushings become expensive and so large that there is scarcely room on top of a moderate size transformer for as many terminals as are often required.

Some of the more common forms of bushings that have been used are wooden tubes, hard-rubber tubes, glass and porcelain tubes, both single and concentric, and numerous forms of molded porcelain bushings.

Wooden tubes of the necessary size cannot be thoroughly dried and filled. Hard rubber is so apt to contain impurities that it is unsatisfactory; moreover, it deteriorates rapidly if ozone is generated near it. Glass is fragile and must be protected with other semi insulators. Porcelain, or any smooth tube, must be very long if it have sufficient leakage surface to be safe when dirty, and even the best shapes of corrugated bushings are large and expensive when capable of withstanding a test of from 75,000 to 160,000 volts. All things considered, the following practice is quite satisfactory for test pressures not exceeding 160,000:

Insulate the lead with varnished wrappings that will safely withstand for one minute about half of the test pressure to be applied, bringing out this lead through a porcelain bushing having the same strength as the insulation of the lead, and sufficient surface to prevent leakage at this pressure when dirty; in other words, let the insulation of the leads be sufficient for the working pressure, and the porcelain be of such strength as to give the factor of safety desired. This combination forms a far safer insulation than a bare conductor and a larger bushing, which would stand the same puncture test as the combination, from the well-known fact that oxidized linseed oil is an insulation that will momentarily stand several times as much as it will for any considerable length of time, while porcelain, glass, etc., have no such time factor.

In leads requiring a test of 100,000 volts or more, and insulated in this manner, an additional difficulty is met in the induced charge on the outer surface of the insulation; at this pressure the surface is covered with a heavy brush discharge that so reduces the surface resistance to leakage that 100,000 volts will travel along several feet. It is usually impracticable to make the insulated lead long enough to withstand the pressure under these conditions, but the discharge may be broken up, so that it will not appreciably reduce the surface resistance, by bell-shaped pieces of rubber, porcelain or other insulation slipped over the lead before all the varnished wrappings are put on, and having its small end so shaped as to allow of its being burned in the outer wrappings.

In transformers designed for Y-connection and grounded neutral, some transformer builders, in order to save expense on high-pressure bushings, have grounded one terminal on the case and insulated only; such leads as are to be connected to the line; this prevents operation with △ connections, but otherwise seems unobjectionable. In similar manner, the use of three-phase transformers with the interconnecting between the phases made within the case, reduces the expense and possibility of trouble with bushings.

Eighty thousand volts is the highest pressure that is now practicable for transmission work, but transformers and insulators must be tested, consequently there is some demand for transformers working up to 200,000 volts. The insulation of the terminals of such transformers is the most formidable part of their design. As yet there is no satisfactory solution of the problem except to use oil-filled tubes as terminals. A terminal that has withstood 375,000 volts without any indication of weakness is constructed as follows:

The tube was the shape of two truncated cones, bases together; about 12 in. in diameter at the center and 4 in. at either end; it was built up of thin wooden rings, telescoped a short distance into each other and held together by the conductor, which, for mechanical purposes was made quite heavy, and which was located in the axis of the cones and supported by washers at either end of the tube; between each section of the tube were collars of insulating material, some three inches larger in diameter, than the tube which served the purpose of greatly increasing the leakage surface. After the sections were drawn tightly together by nuts at each end of the conductor, the whole structure was repeatedly dipped in varnish and dried, thus sealing all joints. The terminal was mounted with the lower end several inches under the oil in the transformer and with its largest diameter on a level with the cover; the lower end of the tube was tightly sealed, making the tube perfectly oil-tight.

At present we are passing through a period of development in line construction. Each engineer of a new transmission system of considerable length desires to use as high pressure as possible with a line construction of reasonable cost, but few are sure whether 50, 60, 70 or 80,000 volts is the safe maximum for their conditions. It is common, therefore, for the manufacturers to be asked to make transformers that can be operated at several voltages on the high-pressure side. The result, whether accomplished with series-multiple connection, changing from △ to Y, or simply by taps, usually requires so many terminals that it becomes quite impracticable to place all the necessary leads outside of the case, even were it desirable to do so; consequently, accessible terminals inside the case must be provided. Again, at these and lower pressures, also, it is usually desirable to provide for limited range of adjustment in the ratio, say, by 2 per cent., with a total of 10 per cent.; such changes are usually too small to be made except by means of taps on the high-pressure windings.

Except to transformers of very large capacity, there would be no room safely to insulate so numerous terminals above the surface of the oil; the practice is, therefore, to locate such terminals just under the oil and make them as accessible as possible, either by the removal of the transformer top or through an auxiliary cover on the top of the case. It is better that each of these terminals be separately supported by glass or porcelain insulators, for a single support, such as a slab of marble, is almost sure to collect sufficient semi-conducting material to cause trouble sooner or later. Such terminals being, at the best, rather inaccessible there is danger that a wrong or imperfect connection will be made when changes are desired; the following method of mounting transformers in the tank greatly simplifies the problem of getting at such terminals, especially when transformers are installed under a crane. Instead of supporting the transformer proper on the base of the case as usual, it is hung from a strong cover; the interior terminals are placed in about the usual position, but are supported by the bolts carrying the transformer. To get at these terminals it is then simply necessary to raise the cover with the transformer, until the terminals are on a level with the top of the case; connections may then be made with convenience and safety and the transformer returned to its position in the tank.

Usually low-pressure terminals present no special difficulties; when transformers are connected in multiple and deliver 500 amp. or more, special caution should be taken that all joints are soldered or that terminals are of such construction as to have extremely low contact resistances. Taper plugs and receptacles are perhaps the most reliable form of contact for the purpose.

Current in excess of 500 amp. should never be brought out through separate openings in the case, otherwise there will be local heating around the terminal and needless reactance introduced into the circuit. Currents over 2,500 amp. should be brought out by means of intermixed bus-bars for the same reason.

The Ward Leonard Oerlikon Locomotive.

We publish herewith three interesting photographs showing the Ward Leonard Oerlikon locomotive in actual operation. The practical tests of this locomotive began the first week in February, the tests being made in the presence of a Swiss government committee appointed for the purpose of investigating the locomotive. The entire control of the locomotive in starting, accelerating, varying the speed, braking electrically, stopping and reversing was accomplished in the most satisfactory manner by a single controlling hand wheel, which controls the small current required for exciting the field of the generator. The experiments were conducted with a single-phase current of 13,000 volts. As a result of these satisfactory trials the Oerlikon Company arranged to extend its private experimental line

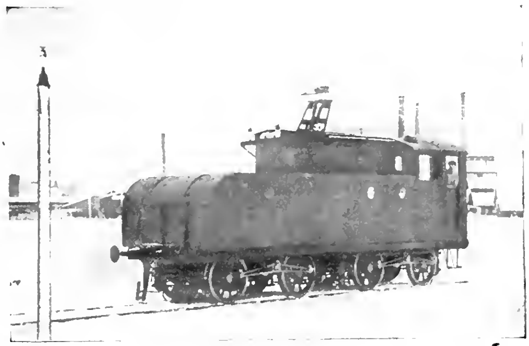


FIG. 1.—GENERAL VIEW OF LOCOMOTIVE.

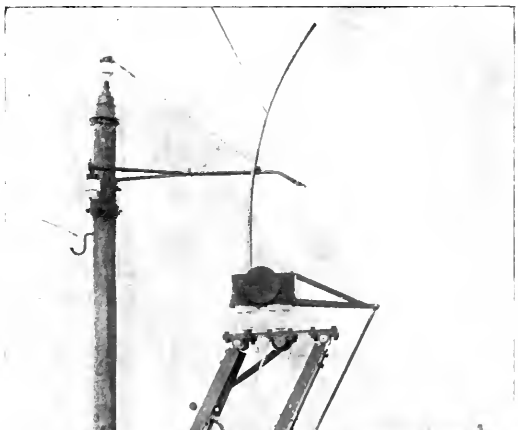


FIG. 2.—CURRENT-COLLECTING DEVICE ON TOP OF CAB.

to the Seebach station, which is one terminus of the State Railway to be equipped with the Ward Leonard system by the Oerlikon Company in connection with the State Railway authorities.

Mr. Leonard has called our attention to a typographical error which occurred in his article published in our issue of February 27. Mr. Leonard had stated that the horse-power of modern steam locomotives had reached 1,750 hp and that two of such locomotives were often used upon a single train, showing that modern practice demands upwards of 3,000 hp upon a single train. This figure of 1,750 hp was by error printed "175 hp." Mr. Leonard believes that the immediate future will see single freight trains operated by upwards of 5,000 hp, and claims that his system presents unique advantages for such heavy service because of the simplicity and perfection of the multiple control of several locomotives, which will divide, under all conditions, the total tractive effort demanded by such a train.

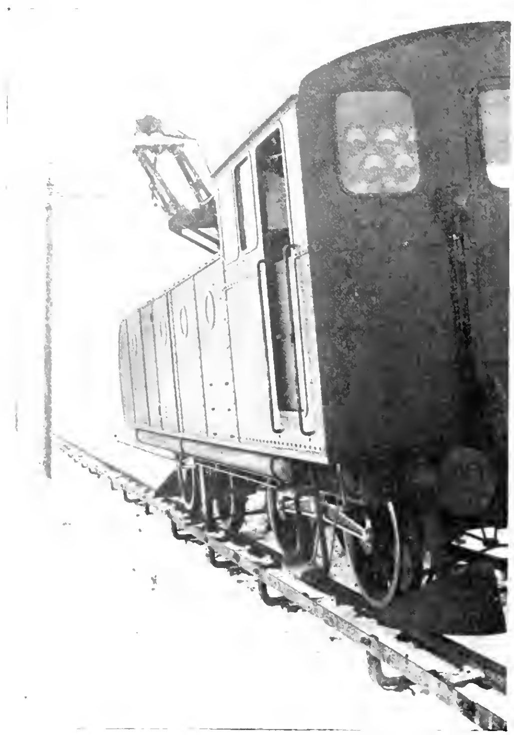


FIG. 3.—SIDE VIEW OF LOCOMOTIVE.

The Rivalry of Electricity and Steam.

The overlapping of the merits and claims of electric and steam traction have been noted for some time past, but they occupy more and more attention as the time goes by, and their struggles remind one of the early warfare waged on electric lighting by the advocates of gas. Within the past week the subject has been discussed by two leading organs of technical opinion, the *Railroad Gazette* and the *Street Railway Journal,* each authoritative in its own field. Both recognize the problems and difficulties of the situation, involved not only in a change of motive power, but in a necessary readjustment of conditions in many other respects. The *Street Railway Journal* regards the conditions as a deadlock, and says: "The flank movement executed by the railroads in securing important links in the electric railway network is a very adroit one, and will certainly block the union of interurban lines for through business in numerous instances. As a matter of public policy this attack must be in some way met, but it is rather difficult to settle on a course of action which will be both effective and unobjectionable. The general interests of the community are served by an increase in the facilities for transportation, and the fact that such an increase will injure somebody's previous monopoly of them is not a thing that should be considered any more than the introduction of improved machinery should be hindered, because it destroys the monopoly secured by an earlier patent. But whatever steps are taken to prevent the crippling of the development of interurban roads must be taken cautiously and without prejudice or malice." It also remarks: "We believe it is within bounds to say that upon the whole the electric roads operated by steam railroad companies are among the very best of the interurban class. Their managers bring to the work of construction and operation the best precedents of railroad practice, too often neglected by the independent roads, and the general results are worthy of high commendation. But for the full development of the usefulness of electric traction, so far as the public is concerned, and for the maintenance of earning capacity it is highly desirable that interurban lines, now generally run in a very heterogeneous fashion, should work in harmony and deal with through traffic of the less important kind at least. What is the use of having great electric railway networks, covering scores of hundreds of miles, if they cannot be fully utilized for want of proper management? The managers of interurban lines are rapidly finding out that through cars are a paying part of the equipment, and that it pays to use connections instead of disregarding them. Now, these connected systems, when properly operated, give to the public much better service than is generally given by the steam lines which cover more or less thoroughly the same territory, and are, therefore, competitors in the proper sense of the term. What shall be done about through connections in case the steam system acquires, by hook or by crook, one of the essential links in the electric interurban network?"

Turning to the *Railroad Gazette,* we find there a significant editorial discussion of the purchase of the trolley network at New Haven, Conn., by the New York, New Haven & Hartford Railroad Company, and, considering it under two aspects, physical and local, of President Mellen's policy in this move, it says: "He is prompted, no doubt, immediately by the threatened electric parallels of which two links are already built and two projected. There is nothing, it is true, to prevent absolutely such an extensive line from "looping" a city like New Haven in its advance toward New York City. But the physical obstacle is considerable, a cross-country line is bare of local business, and the tapping of important cities is vital to its success as both an immediate and remote competition. There are other questions which such a large purchase by a steam railroad corporation raises. For example, what is the policy of a steam company as the owner of both the steam and trolley competitors? Will the steam or the electric rivalry give way? The answer in terms of corporative common sense as well as of public interest is ready at hand. The electric traffic must be favored and the steam service reduced, the loss by the latter being of relatively small import so long as the receipts of both go to the same corporative pocket. To a second query the answer is more obscure. In the wholesale purchase of urban systems to block long-distance parallels, what will be the policy of legislatures toward long-distance lines with reference to the right of urban entry —either independently or over the purchased system under control of hostile interests? Hitherto, in general, the entrance of outside lines on unified urban street railway systems has had to be obtained by special contract and concessions, and even when there are general railroad statutes on the subject they are apt to be evaded in spirit and practice by the urban monopoly, whether steam or electric. Will such a policy give us a new and more drastic direction of law-making on interchanges of electric traffic? That it will at least promote some acute legislative controversy seems pretty certain.

"In more general phases still the New Haven precedent has large meanings. Experience has shown clearly at the west that direct interurban competition by the old steam companies with electric lines has been futile. But here is a new proposition: For competition by operation has been substituted the new method of competition by purchase, using the word "competition" here in its broadest sense to include prospective rivalry. The method, should it ever become generally accepted, introduces us to an entirely new set of theorems bearing on the relations of steam and trolley. Beyond lie even larger potentialities, such as bringing nearer the period when, with the great steam railroads operated with electric locomotives, and owning large urban street railway systems, the electric car, for purposes of local traffic, may duplicate service on the city street and the electrified steam line. It is not very remote, and the Fair Haven & Westville sale is one of the striking events that nods towards it."

One of the Groups in the Power Plant of the World's Fair.

BY THOMAS M. MOORE, CHIEF DEPT. MACHINERY.

The accompanying plan shows the arrangement of machinery in one of the sections of the Exhibitors' Power Plant of the St. Louis World's Fair. By reference to the installation plan for Machinery Hall, which accompanies this, and by reference to Block No. 36 thereon, it will be discovered what relation this particular block holds when compared with the total, for it must be borne in mind that the entire western half of Machinery Hall—that is, all the blocks from No. 36 to No. 53, inclusive—are devoted to prime-movers and accessories and the power plant of the Exposition.

The elements to be found in Block No. 36 are as follows: The principal unit, located in the center of the space, is a 5,000-hp Allis-Chalmers engine of the same type as the engines to be found in the Manhattan Elevated Railway power station in New York City. It is a compound condensing engine with a horizontal high-pressure cylinder (44 x 60-in.), and a vertical low-pressure cylinder (94 x 60-in.). Directly connected to it is a Bullock 3,500-kw, 6,600-volt, 25-cycle alternator. The normal revolutions are 75 per minute, and the current generated will be availed of for general lighting and power purposes.

The smaller engine is an A. L. Ide & Sons compound, with cylinders 13 and 26 in. in diameter x 18 in. stroke. Directly connected to this engine is a 200-kw, 250-volt, direct-current Bullock generator. About one-fourth of this energy is availed of for the excitation of the large Bullock alternator, and the remainder—about 150 kw—is passed through a balancer set and delivers multivoltage to motors driving machine tools exhibited in Machinery Hall, and operated by the Bullock multivoltage system.

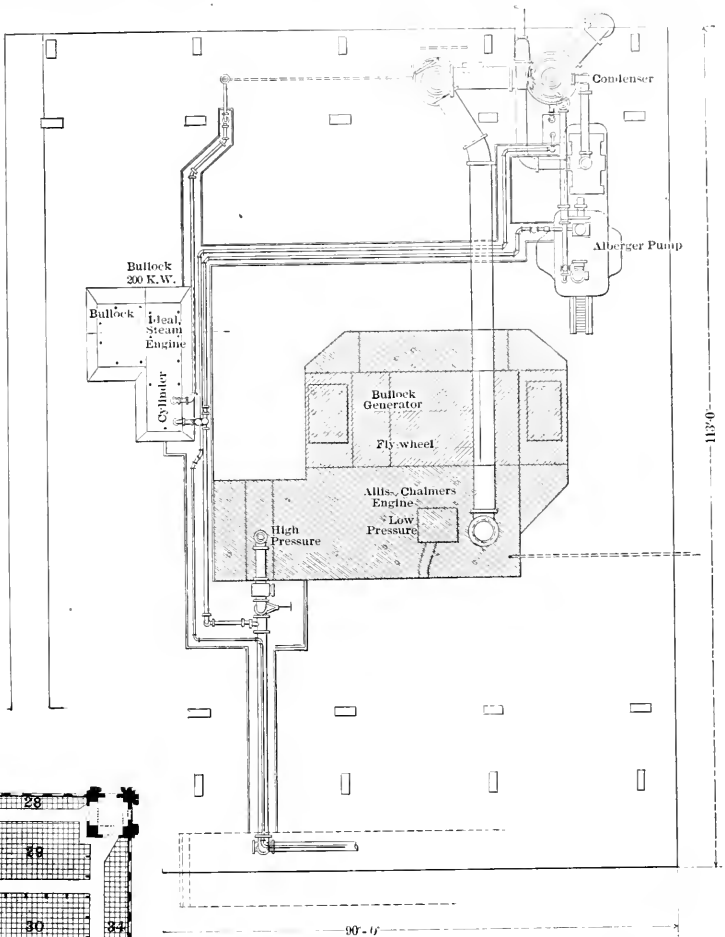


FIG. 2.—PLAN OF POWER EXHIBIT AT ST. LOUIS FAIR.

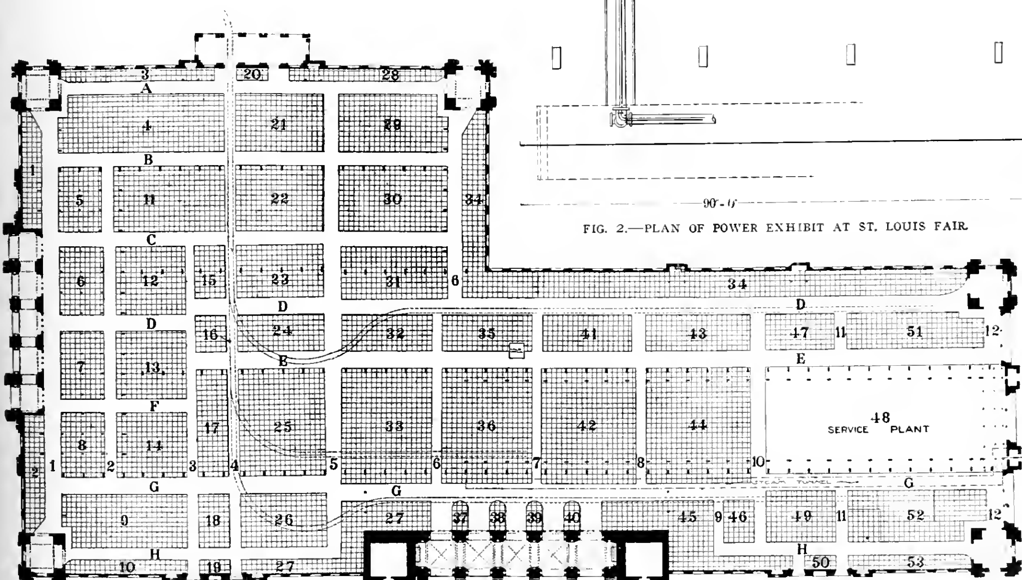


FIG. I.—INSTALLATION PLAN MACHINERY HALL, ST. LOUIS FAIR.

The steam for these engines is generated in the Steam, Gas and Fuels Building, located about 100 feet west of Machinery Hall, and the group of boilers furnishing this steam is approximately 750 feet distant from the engine installation. The steam is delivered at 150 pounds pressure at the throttles.

The condensation of the exhaust steam is taken care of by exhibits from the Alberger Condenser Company, of New York. The apparatus consists of a 36-in. barometric tube type condenser with air cooler and tail pipe complete and a combination vertical Corliss engine-driven vacuum-pump and a rotary circulating-pump. The condenser cone is elevated 55 feet above floor level. The steam traps, steam separators, oil separator and exhaust heads are exhibited by the Steam Appliance Company of Milwaukee, Wis. The pumps exhibited by the Morris Machine Works, of Baldwinsville, N. Y., and the Deming Company, of Salem, O., take care of, respectively, the return water and the freeing of the oil separator.

The total installation is rapidly approaching completion, and if nothing now unforeseen prevents the plant will be ready for operation by or about the first of April. The erection of the machinery has been effected by the 60-ton traveling crane, with a 5-ton auxiliary, built and exhibited by the Shaw Electric Crane Company, of Muskegon, Mich. The heaviest piece in this installation weighs 83 tons and this was handled with the utmost ease by the Shaw crane.

New Telephone Patents.

THE REPEATER AGAIN.

Still another repeater has come to light, this time described in a patent issued to S. P. Levenberg, of New York City. This is shown in section in Fig. 1. It will be noted that the microphone part is not in the usual position with reference to the diaphragm of the receiving part, but is located with its electrodes in a plane perpendicular to that of the diaphragm. The diaphragm is not rigidly secured, but lies upon the top of a hard rubber annulus. Projecting from this annulus in a downward direction, at opposite extremities of a diameter, are two lugs of sheet metal. The left-hand one, as shown in the cut, is secured to the frame of the instrument by screws passing through its lower end, while the right-hand one is secured directly to the movable electrode of the transmitting button. The diaphragm is, of course, capable of taking two sorts of motion—a vibration confined to itself and a swinging motion about the hinging lug.

It is the idea of the inventor that this latter motion will produce an effect upon the transmitter far in excess of anything which could be produced by direct action of the diaphragm. However, the bulk

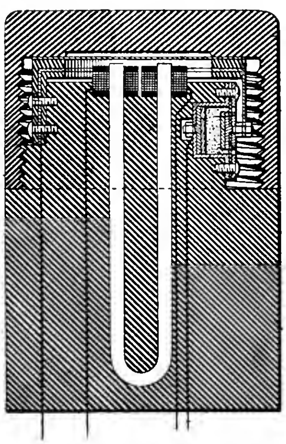


FIG. 1.—LEVENBERG TELEPHONE REPEATER.

of the moving parts will surely introduce a sluggishness of action quite fatal to the quality of the repeated tone.

NEW RELAYS.

Mr. H. P. Claussen, of Chicago, has produced a new relay for telephone signal work which embodies most novel means for preventing sticking of the armature due to incipient welding of the contact to its anvil. Considerable trouble is at times experienced from this cause, especially where a condenser of a high capacity line or apparatus is in the controlled circuit. The new relay in question is of the double-bobbin type, much in appearance like an ordinary telegraph relay of which the plane of the coils has been turned parallel to that of the direction of armature swing. The usual adjustable screw stop and adjustable contact screw of this telegraph relay are provided, supported from a frame to which the bobbins are secured. Upon the rear of the armature is secured a slip spring riveted near the middle of the armature. One end of this is engaged by an adjustable screw and secondly the metal crown would apparently be almost as good spring carries the contact anvil, which is placed on the side of the spring nearest the armature and opposite an aperture in this latter. Thus, when the armature comes up for contact, the contact screw passes clear through it without resistance, and, striking the contact anvil, forces the spring away from the armature. When the current ceases the armature begins its backward travel and strikes a hammer blow upon the contact spring sufficient to break any weld which may have occurred.

Another new relay is one patented by M. C. Rorty, of Boston. This is a single-core relay with a return pole piece lying above the coil and serving as a hinge and support for an angular armature, after a well-known design. A novel feature is, however, the polarization of the relay by the mounting of a permanent magnet of U form with one pole clamped to the yoke end of the core of the bobbin, while the other pole confronts its free end. The design is such that a dust-proof cap of standard construction may be readily used, as may be seen from a glance at Fig. 2, which shows side views of both Mr. Claussen's and Mr. Rorty's relays. Of the two patents, that of the first-mentioned of these gentlemen has been assigned to the American

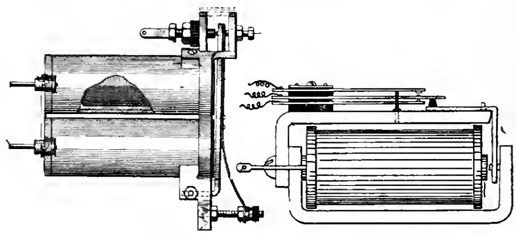


FIG. 2.—CLAUSSEN AND RORTY RELAYS.

Electric Telephone Company, while that of the latter is assigned to the American Telephone & Telegraph Company.

SOME NEW CIRCUIT ARRANGEMENTS.

Two patents for new circuit arrangements have been issued, the one to F. R. McBerty, of Evanston, Ill., relating to message-counting devices, and the second to E. H. Smythe, of Freeport, Ill., covering new connecting cord and trunk circuits. Both patents are assigned to the Western Electric Company.

It is Mr. McBerty's idea to so control the push-button type of message counter that it will be impossible for an operator to register a message before the called party has answered. It will be recalled that the type of counter in question is usually wired in parallel with the subscriber's cut-off relay, but is insensitive to the currents received in normal connection. To operate it a high current from an excessive source of potential must be thrown upon it by a push key under control of the operator. In the present case an electrically-controlled latch restrains this key until the controlling magnet is energized by the response of the called subscriber as indicated by his removing his receiver from the hook. From this time on a call may be registered, the latch being held from the key during the remainder of the connection.

Mr. Smythe's circuit includes extra switching devices in both trunk and connecting cord circuits, arranged to remove all grounds from the trunk line or along side of a through connection, and thus avoid the disturbing effects of two widely separated grounds. The control of the new switching devices is, in the case of the trunk, associated with the hook switch of the called subscriber through the agency of his supervisory relay, while in the case of connecting cords differentiation between subscribers' and trunk lines is made by the removal of the ground connection from the jack sleeves of the latter class of line.

PARTY LINE SWITCHING APPARATUS.

Two switching devices for party lines are the respective subjects of patents, one of these latter being issued to C. H. Prött, of Germany, and the other to Messrs. T. W. Gleason and R. Hamilton, of Boston, Mass.

The system of the former gives the primary control of the line to a main station, which is to receive the central office signals and transmit them to the desired station through a manual switching commutator. As soon as a connection is completed, an electromagnetic lock at each station prevents interference from those stations not involved in it. Each sub-station has a manually-operated commutator for calling the central office or selecting any of the other line stations, the same lock-out conditions existing as for an incoming call.

The second system employs electrically-operated automatic switches working on the step-by-step principle. These are controlled for all stations from any one, by circuit-making and breaking devices, which, through resulting current impulses on the line, rotate selective commutators at each station. Complete lock-out and automatic return of the selective commutators is provided, all the functions being carried out over two line wires, which also serve as the talking circuit.

Recent Electrochemical Developments.

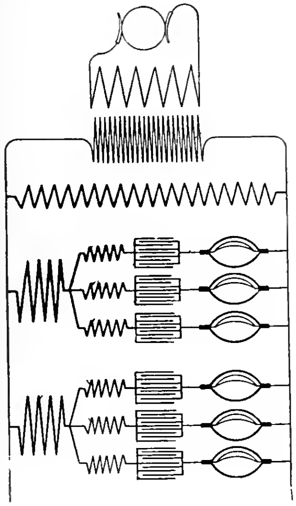
ELECTRIC MANUFACTURE OF IRON ALLOYS.

For the electric furnace production of iron alloys, such as ferro-silicon or ferro-manganese, with the simultaneous production of alkaline oxides or alkaline earths, a patent was granted on March 8 to G. Gin, of Paris, France, who has in recent years been an active worker in the application of electrical methods to the metallurgy of iron and steel. His new process may be best explained by its application to the production of ferro-silicon and baryta.

The process consists of two steps. In the first step, which does not necessarily require an electric furnace, since a high temperature is not required, he subjects a mixture of broken quartz or non-clayey sand, barium sulphate and charcoal to a heating action to produce barium silicate. The barium silicate is then mixed with an oxide of iron or metallic iron and carbon and treated in a second operation in an electric furnace to produce ferro-silicon and barium oxide. The latter is collected in the form of a sublimate.

FIXATION OF NITROGEN FROM THE AIR.

In view of the enormous commercial consequences which a successful economical solution of the problem of the fixation of nitrogen from air would have especially in agricultural chemistry, the work undertaken by Bradley and Lovejoy at Niagara Falls has aroused great interest all over the world. Naturally other workers have entered the field. A patent granted to J. von Kowalski and I. Moscicki, of Freiburg, Switzerland, relates to the same problem. Their apparatus is shown in Fig. 1. The secondary of a transformer supplies



KOWALSKI AND MOSCICKI METHOD OF PRODUCING NITROGEN, ETC.

alternating current to mains across which are connected in parallel a main induction coil and a number of groups of induction coils, condensers and air-gaps, in a manner clearly seen from the illustration. Across the air-gap a series of sparks in the nature of an arc is produced, and the desired nitrogen compounds are obtained from the air.

The inventors give the following data taken from a plant for the production of nitric acid: The secondary circuit had an e.m.f. of 50,000 volts, producing spark arcs of about 24 cm. length in each gap. In each consumption branch the current was 0.05 amp. and the frequency about 6,000 cycles per second, while the frequency of the alternating current in the secondary circuit outside the consumption branches was 50 cycles per second. The apparatus required 33 hp, and with these were obtained 1,155 grams of nitric acid per hour from atmospheric air; that is, 35 grams of nitric acid per hp-hour. It was found that the frequency of the current in the consumption branch should have a minimum of 6,000 cycles per second and a maximum of 10,000 cycles per second.

To produce a frequency between these limits the induction coils and condensers shown in the illustration must be properly proportioned. By applying several condensers in parallel the inventors intend to get a sufficiently high frequency, while the inductance coil in series with each condenser prevents the frequency from overstepping the maximum limit. The inductance coil in series with each group of inductance coils and condensers is intended to maintain the original frequency of the alternating current in all parts of the secondary circuit outside the consumption branches, by preventing the propagation of the oscillatory currents by the condenser beyond its respective consumption branch. The main induction coil which is connected across the mains and which is in parallel with all the different groups of consumption branches is intended to eliminate the production of a wattless component in the secondary circuit in order to maintain a high efficiency.

The predetermination of the different inductance coils and condensers suggests the solution of a problem which is not electrochemical, but distinctly in the realm of alternating-current engineering. The ordinary methods of treating alternating-current phenomena, like Steinmetz's symbolic method, are, of course, not applicable to this case, because the fundamental supposition of their application is that there is a constant frequency all over the circuit. What the inventors disclose in their patent is a method of producing and maintaining a frequency between certain limits. There are, of course, analytical methods by which this problem can be treated with the aid of calculus, but a method of the same simplicity and beauty as Steinmetz's method for dealing with the phenomena in a circuit of constant frequency, has not yet been devised for describing the transformation of frequencies.

MISCELLANEOUS.

The porosity of carbon electrodes is one of the reasons which cause their quick disintegration. There is also experienced a creeping of the solution upwards with a resulting corrosion of the metallic connections. The latter disadvantage has even been experienced with artificial graphite electrodes which are otherwise much superior to, and much more porous than, ordinary carbon, and to overcome this disadvantage, the electrodes have often been impregnated with paraffin with good success. A patent granted to G. J. Atkins, of Tottenham, England, refers to a similar method, the special feature of which seems to be the use of an oxidisable oil, such as linseed oil or cottonseed oil. The disadvantages claimed are that the oil is gradually oxidized and forms an insoluble material which is not attacked by the electrolyte and does not melt when the electrode becomes warm.

The production of ozone from air—for the purpose of using the ozone afterwards for the sterilization of water—depends upon the production of silent discharges and the prevention of arcs. For this purpose solid dielectrics like glass are often resorted to, as for instance in the ozonizer of Siemens & Halske. The objectionable feature of this is that the glass may break, so that no ozone is formed and the water is not sterilized. In order to get along without solid dielectrics A. Vosmaer and A. Lebret, of Amsterdam, Holland, have studied the conditions under which silent discharges without arcs are produced in an air-gap. From a paper of van't Hoff of last year it appears that their system has been in successful use for some time in Holland. In a patent granted to them on March 8, they state that silent discharges depend upon a high voltage and a low current, and are best produced by connecting the air-gap in shunt with a condenser to the terminals of the secondary of a transformer, an induction coil being inserted between the secondary of the transformers and the condenser.

A patent granted to A. Müller, of New York City, refers to mechanical details of a battery stopper, for preventing the spilling of the battery liquid.

Fessenden Wireless Telegraph Patents.

Three new patents were issued March 8 to Prof. R. A. Fessenden. Of these one[1] is a subdivision of No. 753,863 and relates to wireless signalling as described in a previous article. The second patent[2] embodies specifically a radiator or resonator system as shown in Fig. 1, made in the form of a cone and having a large capacity. The cone may be made of sheet metal or formed of a network of wires. This horizontal metal cone serves to deflect the radiated waves and direct them along the surface of the earth. A horizontal conductor, the length of which is equal to the base of the cone, extends in the direction the waves are to be propagated and may include an inductance, as shown.

The third patent[3] relates to a method of transforming alternating currents into high-frequency oscillations by operating a generator with a steam turbine. The inventor points out in this particular specification that where a reciprocating steam engine is used to

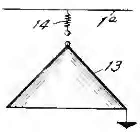


FIG. 1.—RADIATOR.

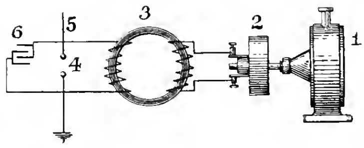


FIG. 2.—ALTERNATING-CURRENT GENERATOR CONNECTED TO STEAM TURBINE.

actuate a generator it is not possible to obtain a high peripheral speed of the moving coils of wire; that is to say, 3,000 or 4,000 r.p.m. are not nearly great enough and to obtain speeds of 25,000 or 30,000 r.p.m. a steam turbine must be employed.

By referring to Fig. 2 the steam turbine is represented connected to a revolving-pole alternating generator operating a transformer. The increased potential from the secondary charges the condensers, which finally disrupt an air-gap and so sets up oscillations in the radiator system, 5; thus a high peripheral velocity with small circumference of moving parts may be obtained.

The advantages of this improvement are illustrated by numerical statements. It is claimed that a fundamental and radically new effect is obtained by employing a prime-mover having a constant torque to operate a generator armature of small diameter, as for example, two feet—and a high peripheral speed—as for example, ten miles per minute. If the pole pieces have a width of one-twentieth of an inch a periodicity of 100,000 per second may be obtained. With a reciprocating engine giving 600,000 r.p.m. the diameter of the armature would have to be 260 ft. to give the same number of periods per second with the same width of pole pieces.

Many advantages of this new combination are pointed out by its designer, among the more important being that the torque is exceedingly uniform; a high peripheral velocity reduces the number of poles and hence eliminates largely disturbance from resonance; there will be a smaller change in periodicity when signals are sent and the generator will not be thrown out of resonance; a light and portable wireless telegraph set may be constructed and such a set will not give rise to vibrations to disturb the operation of the station.

Meeting of the Iowa Telephone Association.

The eighth annual meeting of the Iowa Telephone Association was called to order Tuesday afternoon, March 8, at Des Moines, by the vice-president, Mr. J. C. Sullivan. The meeting was adjourned until Tuesday evening. After the appointment of the committee on credentials at that session, the annual address of the president was given, his topic being "Combinations and their Necessity in the Telephone Business in Iowa." The subject of "Long-Distance Lines" was handled by P. C. Holdeogel, of Rockwell City.

At the session Wednesday morning "Farm Lines" were discussed in many details and phases. The subject seemed to be an interesting one to most of those present, as it evoked a great deal of discussion. Papers presented at this session were: "Jealousy Among Independent Telephone Men," by H. E. Ralston, of Maitland, Mo.; "Operating a Telephone Plant as a Side Line," J. C. Thorne; "Our Business Relations," Paul H. Patton, of Waterloo, and "Our Loyalty to the Principles of the Association," by H. A. Kinney, of Woodbine.

A special session was called for Wednesday afternoon to discuss the papers of D. M. Griswold, of Des Moines, on "Necessity of Uniformity in Toll Line Service and Rates," and by J. M. Plaister, of Ft. Dodge, "Shall We Establish a Clearing House?" The discussion brought out the fact long realized by many that there is urgent need for a clearing house or similar office, but the meeting was somewhat divided as to the scope of a plan and the details to be arranged.

On Wednesday evening about 200 of the members of the Association and their friends sat down to a dinner served at Our Circle Hall. Following the banquet, Mr. U. S. Alderman, acting as toastmaster, called on Governor A. B. Cummins for an address which was largely in the nature of a welcome. The Hon. Lafayette Young spoke on the subject, "A Long-Distance Hot Wire." Mr. Young was in a very happy vein, and thoroughly entertained his hearers. Mr. A. L. Urick, of the State Federation of Labor, spoke on the "Relation of Employer and Employee," and was listened to with great interest. Judge Nichols responded to the toast, "Service," with a very fine address.

At the last session which was held Thursday morning, E. H. Martin, of Webster City, had for his topic, "How Can We Promote Better Feeling Among Toll Operators, Inducing Harmony, Improving Our Service, and thus Reducing the Lost Call Record?" The following were elected officers for the ensuing year: J. C. Sullivan, of Creston, president; S. S. Lichty, of Vinton, vice-president; Charles C. Deering, of Des Moines, secretary and treasurer. Executive Committee—J. S. Bellamy, of Knoxville; J. C. Thorne, of Fairfield; P. C. Holdeogel, of Rockwell City, and W. S. Alderman, of Nevada.

Among those present, on behalf of supply concerns, and representing local telephone companies were: H. McCartney, J. C. Sullivan, Geo. E. Atkinson, Charles C. Deering, George N. Bandy, J. S. Bellamy, R. S. Redman, S. S. Lichty, J. C. Thorne, Paul H. Patton, J. M. Plaister, G. F. Bygel, M. I. Berger, G. O. Lundgren, S. A. Dinsmore, F. L. McGillen, W. B. Swaney, E. H. Martin, W. E. Doolittle, J. E. Keelyn, E. B. Overshiner, F. C. Musson, W. R. Hind, W. H. Trimm, A. J. Carter, Wm. Bowen, Fred Walthauer, H. A. Jones, W. S. Arnold, F. M. Boardman, N. G. Harvey, M. McNeill, P. J. Eubanks, H. P. Blackledge, W. R. Hauptman, W. O. Bryan, H. S. Durant, E. J. Pietzcher, W. J. Crawford, B. J. Carney, A. L. Plummer, C. C. Keister, A. T. Whittle, P. C. Holdoegel, J. H. Bradt, Claus Anderson, Francis Anderson, O. C. Cochran, O. A. Repass, H. A. Kinney, H. L. Bell, H. E. Ralston, F. H. Jones, J. W. Brown, H. U. Anderson, L. L. Bowlin, Senator Brooks, G. W. Greaves, J. A. Brown, Charles R. Kirk, Mr. Shipley, Mr. Brooksmith, H. H. Herr, F. E. Dupee, W. O. Wells, F. W. Lindquist, S. E. Weitzel, W. D. Dunsmore.

Telegraphy and Telephony in Germany.

According to the statistics of the German Federal Post Office and Telegraph Department for 1902 all branches show an increase, though the number of telegrams is somewhat reduced, the result of the extension of the telephone system. The number of federal telegraph offices was 22,292, against 21,150 in 1901; that of telephone offices, 16,292, against 15,200.

The total personnel of the federal post-office and telegraph service at the end of 1902 was 209,906 persons, being an increase of 7,319 persons, or 3.6 per cent. over 1901. Among this number were 85,267 full officials (82,861 in 1901), inclusive of 9,562 (8,963 in 1901) females. The number of post and telegraph offices owned by the Federal Government increased from 476 in 1901 to 490 in 1902. The number of telegrams was 41,118,729, against 41,125,033 in 1901, being a decrease of 6,304.

The telephone conversations, however, increased from 692,687,730 in 1901 to 757,648,580 in 1902, an increase of 75,000,000 per year, or over 200,000 per day.

[1] No. 753,863. Wireless Signalling. U. S. Letters Patent.
[2] No. 753,864. Signalling by Electromagnetic Waves. U. S. Patent.
[3] No. 754,058. Signalling by Electromagnetic Waves. U. S. Patent.

Single Phase Traction Meeting in Chicago.

The Chicago branch meetings of the A. I. E. E. of this year, in every case, have exceeded the seating capacity of the Western Society of Engineers' meeting room, which seats about 100. The meeting for the discussion of single-phase traction systems was, everything considered, the most successful meeting of the Institute ever held in Chicago, quantity and quality of attendance both being considered.

President Arnold presided at the meeting, and in response to a number of references by various speakers to the part he had taken in the pioneer work of bringing about a realization of the necessity for some single-phase alternating-current traction system, expressed his appreciation, and said that it was always a pleasure to see one's prophecies come true.

The discussion of the subject was opened by Mr. Clarence Renshaw, who took up the theory of both the single-phase series motor and the repulsion motor. In analyzing this question he said that the single-phase repulsion motor, while it did away with the necessity for a step-down transformer on the car (since the fields of the motor could be operated at a high voltage) the increased weight of the repulsion motor, with its high-voltage field windings, was enough more on a four-repulsion motor equipment than on a four-motor equipment of series single-phase motors to counteract any saving in weight due to the absence of a transformer on the car equipped with the repulsion motor.

The operation of a series single-phase motor on direct-current trolley lines, while quite possible, was not recommended by him as good engineering except where it was absolutely necessary. In most cases where an interurban car comes over city lines, he thought that the running of a second trolley wire was advisable, so that the interurban cars could operate with alternating current. If the series single-phase motor car was to be run from direct current it must be equipped with rheostatic control, and this wiped out all of the economies possible by the use of induction control for accelerating and slow-speed running.

Mr. W. A. Blanck presented a paper giving the comparative cost of a sixty-mile interurban railway electrical equipment with direct current supplied from sub-stations and with single-phase alternating current. Mr. Blanck's figures showed a difference of about $2,000 a mile in favor of the single-phase alternating-current system.

CURRENT NEWS AND NOTES.

CONTRABAND.—The Russian war regulations declares telegraph and telephone material as being on the contraband list.

THE METRIC SYSTEM IN GREAT BRITAIN.—The House of Lords has unanimously passed a bill making compulsory the metric system in Great Britain on April 5, 1906, or at such later date as may be directed by an Order in Council.

MONORAIL IN ENGLAND.—During the past week a model of the Behr monorail system, proposed for installation between Liverpool and Manchester, has been shown in London. It seems high time something was done to build that line, of which we have now heard so much.

WRECK OF CABLE STEAMER SCOTIA.—The good old *Scotia*, a cable steamer known to a great many of our readers, is, it is feared, a total wreck in the Pacific. A special dispatch from Washington, D. C., of March 12 says: "Wrecked within a short distance of a safe harbor, the crew of the cable ship *Scotia* was rescued by the naval garrison at Guam. The supplies carried by the ship, which were intended for the Commercial Pacific cable station at Guam, have been partly saved, but the ship is apparently a total loss. Lieutenant Raymond Stone, Acting Governor of Guam, sent a cablegram, dated yesterday, to the Navy Department, in which he said: 'Cable ship *Scotia* has been wrecked on Callahan Bank, coming in, March 11, northeast and north Spanish rock five hundred feet approximately. Leading marks intact; entrance buoy is partly sunk. Vessel is lying in dangerous position, but cargo can be recovered if wrecking vessels arrive while weather continues favorable. I am rendering assistance with all resources available. I am feeding and sheltering part of the crew on shore. *Scotia* suffered from want of provisions. Ship probably totally ruined. No wrecked people lost.'"

INSTITUTE NEW YORK MEETING.—The 185th meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West Fifty-fifth Street, New York, Friday, March 25, at 8.15 P.M. The following papers will be presented for discussion: 1. "The Relative Fire Risk of Oil and Air-Blast Transformers," by E. W. Rice, Jr., technical director of the General Electric Company, Schenectady, N. Y. 2. "Use of Group Switches in Large Power Plants," by L. B. Stillwell, electrical director of the Interborough Rapid Transit Railway Company. 3. "Oil Switches for High Pressures," by E. M. Hewlett, engineer of the General Electric Company, Schenectady, N. Y. 4. "Terminals and Bushings for High-Pressure Transformers," by Walter S. Moody, electrical engineer with General Electric Company, Schenectady, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Mr. Charles L. Edgar, president of the National Electric Light Association, was in New York several days this week looking after Association affairs. President Edgar was accompanied by Past-President James I. Ayer, whom he has been fortunate enough to induce to act as chairman of the entertainment committee of the twenty-seventh convention, to be held in Boston May 24-27. The entertainment committee, among its other duties, will have charge of assigning rooms at the Vendome, which is to be the headquarters of the Association, and particulars regarding rates, etc., will be issued very soon. As delegates sometimes prefer to stop at a smaller or quieter hotel than that selected for convention headquarters, arrangements will be made by which they also can secure through the committee such accommodations as they prefer. In fact, hotel arrangements promise to be more systematic and satisfactory than on previous occasions.

RAYING OUT WAR SCARS.—A special dispatch from London says: "London has a new scientific surgical sensation in the application of the Finsen rays—which are apparently allied to the Röntgen—for the removal of scars following wounds, whether inflicted in war or by the surgeon's knife. Lately quite a number of British subalterns have sought out the "light-curer" for the removal of face wounds received in South Africa. The custom is rapidly growing of surgeons sending their patients to have the scars left by operations removed. A "light-curer" gives the following description of the process: "Repeated applications of the Finsen light in a powerful form are given until the blood corpuscles are stimulated to such an extent that, by distension of the cells and other resultant processes, new tissue is formed and scars disappear."

STAFF FOR SIGNAL SERVICE.—The United States Civil Service Commission announces an examination April 6-7, 1904, to secure eligibles from which to make certification to fill vacancies in the position of assistant electrical engineer in the Signal Service at Large, Washington, D. C., at $1,400 per annum, and other similar vacancies as they may occur. The examination will consist of the subjects mentioned below, which will be weighted as follows: 1. Theoretical and practical questions in electrical engineering, 75. 2. Technical training and experience (rated on application), 25; total, 100. Two days will be required for this examination. Age limit, 20 years or over. Applicants for this position should have a good general knowledge of electrical science, and should be thoroughly familiar with telephone, telegraph and cable engineering. This examination is open to all citizens of the United States who comply with the requirements. Competitors will be rated without regard to any consideration other than the qualifications shown in their examination papers, and eligibles will be certified strictly in accordance with the civil service law and rules. Persons who desire to compete should at once apply either to the United States Civil Service Commission, Washington, D. C., for application Form 1312, which should be properly executed and filed with the Commission at Washington. Persons who are unable to file their formal applications and who notify the Commission of this fact, either by letter or telegram, with the request that they be permitted to take the examination, will be examined, subject to the subsequent filing of their applications, provided their requests are received at the Commission in sufficient time to ship examination papers.

Letters to the Editors.

The Theory of Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs:—I beg to thank you for having given space to my communication of January 2 and for the favorable comment in your editorial of January 16. I am entirely in accord with the views which you express in this editorial and I find of much interest the hypothesis in which you complete my modest contribution—necessarily very incomplete—by the consideration of a conducting atmospheric stratum forming a second and parallel surface at a height of about 50 miles. One may have doubts, it is true, on the manner in which such a stratum conducts, since it would probably follow laws of conduction different from those applying to metals; but the hypothesis is none the less interesting and it could be verified up to a certain point by a study of the law of distances. Properly speaking, the theory which I have sought to develop applies for distances much smaller than those at which the upper stratum intervenes, and it may be in error for greater distances. The quantity of energy received by an antenna would then first decrease according to the law of inverse squares of the distance, and next simply inversely with the distance. It is to be understood that I entirely agree with you on the subject of superficial currents, of which the earth is the seat and which establish the electrical junction between the lines of force ending normally at the earth, for each half wave. If we imagine a symmetrical antenna beneath the surface, supposed to be equivalent to a thin layer, superficial currents equal and of opposite signs would be produced in this layer and annul the preceding ones. This justifies us in saying that a system of an antenna and earth is equivalent, from the standpoint of action at a distance, to a system of the antenna and its image.

I have also read with much interest the letters which my communication has brought forth from Prof. Fessenden and Mr. Taylor. It is somewhat amusing to find that they are in complete contradiction with each other, which, however, was easy to predict. My position with respect to them is rendered more simple for the reason that I do not pretend to have made a great invention, but merely to have understood rationally, by the exercise of simple common sense, existing theories; and I do not think there is any need of inventing half waves as Prof. Fessenden has done, nor sliding waves as Mr. Taylor has done, for the simple reason that these waves have long been known from the work of Hertz.

As to the other remarks of Prof. Fessenden, I am entirely disposed to be in complete agreement with him when experiment has enabled me to appreciate the practical value of his new bolometric detector, which, up to the present, I have not had an opportunity to examine closely. In principle the employment of the bolometer would appear to offer an excellent solution to the problem of syntonic reception. I am not sure, however, that the gold coherers tested by Prof. Fessenden were of the same type as my own. I am happy to note that the theoretical ideas of Prof. Fessenden have many points of contact with my own.

With respect to the remarks of Mr. Taylor, I note with pleasure his emphatic affirmation that his theory is different from mine; and since he desires it I am entirely ready to give in detail my objection to the "erroneous ideas" which he reproaches me with having criticised without proper examination.

1. The form of the waves indicated by Mr. Taylor is incompatible with a propagation with the velocity of light, for the crest of the waves of Mr. Taylor are displaced tangentially to the lines of electric force, which is contrary to the principles of the propagation of electromagnetic waves, which are always propagated transversely. At all points of electromagnetic waves, according to the theorem of Poynting, the propagation of energy is directed according to a vector perpendicular at the same time to the lines of electric force and to the lines of magnetic force; whereas Mr. Taylor would have an energy vector tangential to the lines of electric force at the crest of the loops of the waves.

2. The distinction which Mr. Taylor makes between waves propagated in free ether and along a wire does not conform to established principles, and the citation which he makes from the work of Hertz cannot justify it. Hertz has, indeed, indicated a form of wave along wires analogous to that which Mr. Taylor cites (work of Hertz, German edition, Vol. II, page 167, Fig. 32B); but he was careful to point out that this form applies only to waves having a velocity less than that of light, and should be replaced by the form *C*, corresponding to a transmission purely transversal if the propagation of waves takes place with the velocity of light. Hertz was very much astonished that his experiment on propagation along conductors had given him only results contrary to the theory of Maxwell, and expressed the greatest doubt on the subject of the correctness of the form 32B. Since that epoch, however, numerous experimenters, notably M. Blondlot, in 1891, have shown that the experiments of Hertz were inexact on this point, and that the propagation along wires takes place with the velocity of light, thus contradicting the result found by Hertz. If, then, Mr. Taylor wishes to apply the theory of Hertz, it is necessary to adopt the form 32C and not the inexact 32C which he has chosen.

3. There is no identity between the case of propagation along a wire and the case of propagation along a plane surface. A wire necessarily produces a *concentration*, for it is surrounded with lines of electric force perpendicular to its surface and radiating all around it; and nothing similar is produced in the case of a plane surface. Besides, all the experiments with propagation along wires are made in reality with two conductors; or rather, two parallel wires are employed between which the field is concentrated, or a wire is stretched horizontally above the earth, in which case the earth itself serves as a second conductor, and the field is concentrated between the wire and the earth. Nothing resembling this occurs in the case of a vertical wire. One can easily conceive that in the case of two parallel conductors the energy remains concentrated between them and there is no loss from radiation since there passes simultaneously through the two wires current of opposite sign. On the contrary, in the case of a plane surface, there is nothing to prevent natural propagation and radiation. If the antenna produces effects at great distances it is precisely because it is alone and no parallel conductor intervenes to reduce its radiation. If one used two vertical antennæ, one alongside of and parallel to the other, and connected with opposite electrodes, according to the arrangement ordinarily employed in the study of propagation along wires (methods of Lecher, Blondlot, etc.), no effect occurs at a distance.

4. My theory does not prevent in any manner the admission that waves are guided by conductors, since on the contrary we know that they are guided at their lower portion by the ground. It may be that the curve of distribution to which calculation leads does not correspond exactly with reality, and that the energy remains more concentrated at the surface of the soil; experiments alone can establish this, but even if it is shown, this will not contradict the fact that the propagation is transversal by polarized hemispherical waves, as I have pointed out. It would simply prove that the distribution of the energy in these waves differs somewhat from that which the elementary theory developed indicates; or rather, that the energy is absorbed more quickly by the gaseous medii of the atmosphere, than in the immediate neighborhood of the soil. Moreover, there is no incompatibility between this general propagation by hemispherical waves and local deformation of waves produced by irregularities of the ground. The phenomena of diffraction are in no respect denied by the general conception of spherical waves.

5. As to the form of the lines of force, which seems so extraordinary to Mr. Taylor, it is much less so to my mind than that of lines of force studied by Hertz. (*Loco citato,* pages 156-157). If Mr. Taylor will read the explanations of Hertz, he will see how much more complicated in reality is the movement of these waves than I have assumed; he will also see that the waves of Hertz attain the same final form as that which I have indicated.

6. As concerns the velocity of propagation of waves, Mr. Taylor reproaches me with supposing that the velocity of light is only attained after a certain number of wave lengths from the source, which he says is in conflict with known laws, provided *disturbing factors in the way of reflections, interferences,* etc., are absent. To this my reply is that there *is* a phenomenon of wave reflection at the summit of the antenna, and that I have specified nothing concerning the number of wave lengths after which the velocity of propagation becomes equal to that of light. Moreover, this distance matters little so far as concerns the results; that is to say, as to the final hemispherical form taken by the waves and the general manner in which they become deformed after leaving the origin. I shall

be happy if these explanations serve to convince Mr. Taylor, or if they should be found of interest by your readers.

PARIS, FRANCE. A. BLONDEL.

Sale of Power by Municipal Plants.

To the Editors of Electrical World and Engineer

SIRS:—An article in the ELECTRICAL WORLD AND ENGINEER of February 20 on the new installation at the City of South Norwalk Electric Works, by A. E. Winchester, came to my notice recently and I wish to call attention to an erroneous statement with reference to rates. He says: "For a continuous consumption of say 50 hp, measured by the customers' meters, the rate would be 1.9 cent per horse-power-hour, corresponding to $4.95 per month of 26 10-hour days. There is no place known where power can be obtained so cheaply."

I take exception to the assertion that "there is no place where power can be obtained so cheaply," and think before the municipal central station superintendent makes an erroneous statement and attempts to mislead others by presuming that a municipal plant is the only one from which cheap power can be obtained, that he should make some effort to inform himself of rates in vogue in other cities and towns. The assertion may sound well in his own city, but to those of us who know better it is absurd. However, it is in the same strain of the rest of the misleading statements that emanate from the mouths of the municipal central station promotors or advocates.

The writer knows of cities and towns in his own neighborhood that sell current for less than 1.9 cents per horse-power-hour, and give 24 hours' service and furnish free lamp renewals. As one who is opposed to the confiscation of property, I believe with you that every misleading statement emanating from the agitators of municipal ownership, should be called to account.

ONEIDA, N. Y. C. W. KOINER.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Progress in Dynamo Design.—LOEWY.—The first part of an illustrated summary of the progress made in dynamo design in the year 1903. The author first discusses new designs of direct-current machines. Generators with compensated armature field and with devices for preventing sparking are of special interest. He describes at some length the compensated machine of Ziehl. The field magnet is designed and wound like the stator of a three-phase machine. The winding of phase *I* in Fig. 1 is in shunt to the armature when the machine is a dynamo, and across the supply mains when the machine runs as motor. It serves for generating the exciting field, *Me*. The other two phases of which one, for instance, *II*, is wound in a direction directly opposite to that ordinarily used in three-phase machines, are supplied with the armature current and serve for producing the field, *Mg*, which is of the same size, but of opposite direction, as the armature field, *Ma*, so that the latter is compensated. In Fig. 2 the drawing at the top shows the three windings, the next one gives in dark lines the field, *Mg*, which results from composition of the fields *II* and *III*. The drawing at the bottom shows the field, *Mg*, as it really is in practice, as well as the exciting field, *Me*, and the armature field, *Ma*, which is completely compensated for by the field, *Mg*. In using this method for the connections between an alternator and its exciter, the armature reaction is annihilated and the generator gives the same voltage at any load. Instead of giving the same ampere winding to *II* and *III*, it is possible to increase the ampere winding of one and diminish those of the other by the same amount, which may be accomplished by means of a regulating resistance connected in parallel to one phase. If the ampere windings of *III* are increased, the exciting field, *Me*, is strengthened, while by increasing the ampere windings of *II*, the exciting field, *Me*, is weakened. It is thus possible without regulating the current in winding *I*, which produces the exciting field, *Me*, to change the value of this field and thus to change the voltage of direct or alternating current or polyphase machines when loaded or to change the number of revolutions of direct-current motors and to change the phase difference of synchronous motors or three-phase to direct-current converters. In order to use more stator windings for the generation of the exciting field, it is possible to make use of two of the three windings for this purpose and to generate the opposing field with the third one only.—*Zeit. f. Elek.*, February 21.

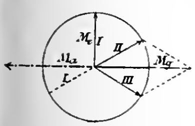


FIG. I.—PHASE DIAGRAM.

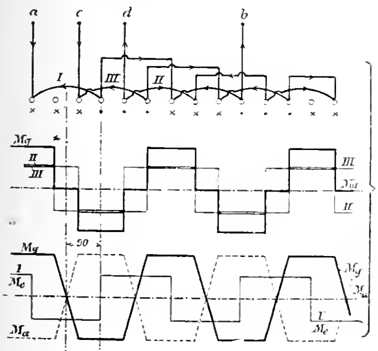


FIG. 2.—DIAGRAM OF WINDINGS DEVELOPED.

Direct-Current Machines.—SCHULZ.—An article on the progress made on the design of direct-current dynamos. While formerly the appearance of sparks at the commutator was often considered to represent the limit of load, the limit is now mostly found in the heating since it is possible to assure good commutation quite successfully. There is now a tendency to provide good ventilation in order to also counteract the heating. The author gives several formulas which have been proposed for the choice of the armature dimensions. Concerning the number of poles he says that more-pole machines are always preferable to machines with few poles and the latter should only be chosen if the calculated air-gap with the more pole arrangement would lead to mechanical difficulties. The price of the magnet yoke, the magnet coil copper and the armature copper is lower with a four-pole machine than with a two-pole machine, while the magnet cores and pole shoes are more expensive for the four-pole machine; but in the latter case the difference is insignificant. He then discusses the various formulas given for determining the commutation from the reactance voltage, but says that the reactance voltage alone should not be considered the only point upon which good commutation depends. There is also distortion of the field, and even with a good reactance voltage it may cause an impermissible brush displacement on account of field distortion. The use of sheet iron for the magnets or at least for the pole shoes has largely increased. This is probably due mainly to a better understanding of the importance of a correct pole shoe shape. The cost of manufacture is not very different, since sheet iron is cheaper than cast steel. The author concludes with some remarks on standardization.—*Elek. Anz.*, February 14.

REFERENCES.

Speed Regulation of Induction Motors with Commutator.—LATOUR.—While it is known that the use of a commutator with alternating-current machines enables one to operate them without phase difference at normal load with perfect commutation, and to start single-phase motors with a good torque, the author endeavors to show mathematically that it also enables one to change the speed of induction motors without influencing the efficiency. The author gives the theory for shunt and series polyphase motors and makes some brief remarks on single-phase motors.—*L'Eclairage Elec.*, February 27.

Single-Phase Commutator Motors.—BLONDEL.—In a continuation of his very long serial on the theory of single-phase commutator motors, the author begins to discuss analytically and with the aid of diagrams the theory of the repulsion motor with supplementary shunt excitation.—*L'Eclairage Elec.*, February 27.

Single-Phase Commutator Motors.—EICHBERG.—The first part of a complete illustrated translation of the long paper of Eichberg read before the Berlin Electrical Society and abstracted recently in the Digest.—Lond. *Elec. Eng.*, February 26.

LIGHTS AND LIGHTING.

Mercury Vapor Lamp.—BODENSTEIN.—A brief account of experiments with a mercury vapor lamp made of fused quartz (of Heræus). The lamp is built in form of an H and the arc plays through the nearly horizontal tube between the mercury surfaces in the two vertical arms. For connections iridium wires are used. A small tube at the side of, and communicating with, one vertical tube of the H lamp is filled with mercury and is electrically heated. The mercury evaporates and the vapor presses the liquid mercury through the nearly horizontal tube so far that it makes a short circuit with the mercury in the other vertical tube. An automatic device then disconnects the heating current. The mercury vapor in the side tube condenses again and sucks the liquid mercury back and the arc is lighted through the nearly horizontal tube. Concerning the energy consumption it is said that by a rough estimation the lamp gives for 2 amperes at 100 volts the same illumination as an arc between carbon switch 20 amperes and 50 volts, but is much more constant. In spite of its green color, the light is rich in ultra-violet rays and for this reason suitable for many special scientific investigations. At the beginning of the use of the lamp a strong smell of ozone was observed.—*Zeit. f. Elektrochemie*, February 19.

POWER.

Austrian Transmission Plant.—BOEMENDAL.—A detailed and profusely-illustrated description of the water power plant using rapids of the River Mur. There are four turbine-driven, 500-kw generators with a power factor of 0.85. The generating voltage is 1,500. For transmission the current is transformed up to 21,000 volts by means of three 650-kw sets of transformers. Single-phase transformers are used in order to secure the advantage of the delta connection, so that should one transformer get out of order the other two could keep up the supply, working in V form under an overload for which they are designed. Most careful attention has been given to the arrangement of the ovehead conductors. These consist of three copper wires, 38.7 sq. mm. (0.06 sq. in.), carried on porcelain insulators. The latter have a triple bell; they are fixed on their wood supports with the interposition of porcelain studs screwed in hardwood, fully impregnated with paraffin. The testing of the insulators has been carried out with great care, using a 120,000-volt pressure, the tests having been made, as far as practicable, by placing the insulators in service conditions and under a water spray. The three wires are mounted in a 3-ft. 3⅜-in. equilateral triangle. One insulator is at the top of the post, and the two others are on wood brackets. Every post is fitted with a lightning rod suitably connected to earth, and at about every 1,000 yards there are provided lightning arresters with magnetic blow-out devices. An incident is recorded which occurred when the line first started working. The first section of the line was first set alive as far as the nearest switch and the tension was gradually raised up to 24,000 volts, the section remaining under these conditions for thirty minutes. This was effected in the case of four consecutive sections with satisfactory results. When, however, the fifth section was connected up, and the pressure had risen to over 18,000 volts, a short-circuit was produced and the 21,000-volt fuse blew. As a matter of fact, this section bore the 18,000-volt pressure for an indefinite time; but on its being gradually raised by only 50 volts the short-circuit occurred. The cause of this, after rather lengthy investigations, was found to be the cracking of an insulator, producing thereby the short-circuit, although the crack did not go through the whole thickness of the porcelain. The experiments were further carried on, and a series of critical limits of pressure were tabulated; at these limits the very smallest defects in the porcelain insulators are of importance, and may lead to injurious results. The long-distance line has a length of 20 miles, and is divided into eight sections, in order to more easily detect any defects and to cut out any section without stopping the whole plant.—Lond. *Eng'ing*, February 26.

Electric Power in Workshops.—IRWIN.—A paper in abstract read before the Rugby Engineering Society, in which he describes the power supply of the Niclausse boiler works of Willans and Robinson. When these works were being planned, the question of the adoption of direct or alternating current came up. In some respects the alternating current could claim superiority for works of this kind. Since the load was principally made up of motors driving tools and machines at constant speed, induction motors would have been suitable. Other considerations, however, among them that of cost, decided in favor of the direct-current supply. The main supply is at 410 volts from three shunt-wound generators, two of which are 220-kw machines and one a 90-kw machine. Working in parallel with the generators and in conjunction with an automatic booster is a battery of 197 cells. The cells are able to give a discharge of 125 amp. for three hours. Instead of the ordinary three-wire system, with equal voltage on each side of the middle wire, a "balancer" is provided which has two windings and two commutators on the same armature core, and gives 308 volts on one side and about 102 volts on the other. As there is very little load on the 300-volt circuit, the function of the machine is not to balance so much as to give a supply at 100 volts, and it is referred to as a rotary transformer. The reason for this division is, in the first place, to supply 100-volt current for arc welding; secondly, to allow of single arc lamps being run where two lamps would not be necessary; thirdly, to allow, where required, of a large range of speed. Thus, by keeping the field of the motor across the 400-volt circuit and by putting the armature successfully across the 100, 300 and 400-volt circuit, the speed will vary in the ratio of one to three to four. Intermediate speeds can be obtained by field regulation if necessary. The main arc lighting is carried out from the 400-volt circuit, partly by enclosed and partly by open-type lamps. The enclosed lamps are run four in series, and the open-type lamps eight in series. All these lamps are provided with external automatic cut-outs and substitutional resistances. One of the problems to be solved was that of driving the rolling mill and the tube draw benches by means of a motor, without disturbing the arc lamps running off the same set of mains. The motor has a capacity of 275 hp and is compound-wound and drives, by means of ropes, an eight-inch diameter shaft to which the mill and draw benches are coupled. The rope pulley on the shaft is about 15 tons in weight and, therefore, acts as a fly-wheel governor.—Lond. *Elec.*, February 19.

Gas Engines in a Metallurgical Plant.—LANGTON.—An illustrated description of the power plant of the Montezuma Copper Company at Nacozari, Sonoro, Mexico. The power house contains eight gas engines each being connected to a 65-kw direct-current generator. The generators are run in parallel and the current is distributed at 250 volts to some 40 different motors, scattered about the works and ranging in size from 5 to 175 hp. Arc and incandescent lamps are operated from the same circuits as the motors. Producer gas is used and the methods of making the gas either from coal or wood (the latter being the most novel feature of the plant) are described in detail, and the analysis of the gas produced is given. The paper is concluded by some remarks on the use of gas engines in general, and it is pointed out that the most economical capacity of a gas engine is its absolute maximum capacity and in order to allow for variations which are inevitable even under the best conditions of commercial working, the maximum capacity should be discounted about 15 per cent. to get a figure that may be called maximum commercial capacity. This commercial maximum capacity should equal the peak of the load curve. With a very variable load, therefore, an engine capacity is required greatly in excess of the average power demand. This disadvantage counterbalances the advantage of the ease with which gas may be transmitted to scattered gas engines without loss. The author thinks that in most cases the balance of advantage is found to be on the side of a central power house generating electrical energy from gas engines together with electric distribution to motors.—*Electrochem. Ind.*, March.

Electric Haulage in Metal Mines.—CLARK.—A paper in which the author states that the use of electricity for mine haulage has materially cheapened the cost of production; from data compiled at various mines the cost per ton of hauling coal is 50 to 75 per cent. below mule haulage, according to the situation of the mine, the grade of slope and the distance hauled. The trolley system of haulage has not been extensively used in metal mines. It is particularly adapted to long "tunnel" systems through which is hauled the ore from a number of properties. The conditions of haulage in a metal mine are radically different from those found in coal mines in which a locomotive is required which is very low, but without restriction as to width. The ordinary adit driven to tap metalliferous veins has ample height for any locomotive now on the market, but is usually restricted as to width. Some notes are given on the draw-bar pull required and the influence of grades, and the haulage system of the United Gold Mines Company, of Victor, Colo., is described. It is the only electric mine haulage system in use in the Cripple Creek district. An 8-ton locomotive is used with a draw-bar pull of about 3,500 pounds and a speed of 15 miles per hour. The machine is equipped with a single high-speed motor placed in the center and on the top of the frame, and the motor shaft connects to the drivers by a chain of gearing. The brake is applied directly to the motor shaft. The trolley is hung in the center of the track and has caused no inconvenience. From a water power plant three-phase currents are transmitted a distance of 12 miles at a pressure of 13,000 volts, the frequency being 30 cycles. At the sub-station step-down transformers and rotary converters change the current to 550 volts direct current to the trolley.—*Eng. & Min. Jour.*, February 25.

REFERENCE.

A Swiss Hydroelectric Plant.—COLLISCHONN.—The first part of a profusely-illustrated description of the Kubel water power plant situated at the juncture of the rivers Sitter and Urnaesch. The present installment describes the hydroelectric plant, for which a basin is provided to store enough water so that even in summer time, should new water cease to come, the plant would be able to give for three weeks daily 20,000 hp-hours.—*Elek. Zeit.*, February 25.

TRACTION.

Electric Mountain Road.—HERZOG.—The first part of an illustrated description of the electric railroad from Freiburg to Anet in Switzerland. The length of the road is 32 km. While the third rail is used along the road, the overhead trolley wire is employed in the stations, to prevent accidents. A central station in Freiburg provides 8,000-volt, three-phase currents, which are transmitted to two sub-stations containing motor-generators for producing the 750-volt direct-current supply to the line. The capacity of each sub-station is sufficient to give the energy required by one train. Since the average power required by a train is 150 hp, each sub-station contains a motor-generator of this capacity, together with a storage battery of sufficient capacity to furnish the power required beyond the average.—*L'Eclairage Elec.*, February 27.

Electric Railway in the Isle of Man.—A description of this line which is largely a summer road and has recently been thoroughly reconstructed. A short description is first given of the original plant, which used both water and steam power for generating electricity. The chief work in the reorganization has been in centralizing the power supply. The new generating plant, consisting of 300-kw, 7,000-volt generators, has been installed with three sub-stations containing 150-kw rotaries.—*St. R'y Jour.*, March 5.

REFERENCES.

Alternating-Current Traction.—BELL.—A review of the demand for an alternating-current railway motor. He points out that polyphase motors are not satisfactory, principally because they require two trolley wires, and because they do not have sufficient torque at starting. The writer then discusses the two types of single-phase motors which have been placed on the market, one represented by the Westinghouse and the Finzi motor, the other the repulsion motor as built by the General Electric and other companies.—*St. R'y Jour.*, February 27.

Single-Phase Traction.—EICHBERG.—The first part of a paper read before the Vienna Electrical Society. The author discusses the various types of single-phase motors, giving the characteristic features of the Winter-Eichberg motor, the series motor, the repulsion motor and comparing their relative advantages.—*Zeit. f. Elek.* (Vienna), February 28.

Electric Mine Locomotives.—AFFELDER.—A fully illustrated article on traction, third rail and sprocket locomotives, their development and the conditions to which they are adapted. He thinks that the third-rail haulage system is not a competitor of the traction or trolley system, but rather one to be used when adverse grades make traction haulage impracticable. The third-rail locomotive will continue to become a decided competitor of rope haulage and as such will probably produce its best results.—*Mines and Minerals*, March.

Light Railway.—An illustrated description of the Barking-Becton light railway, which is 1.3 miles in length, the trolley system being used. Owing to the fact that the line carries very few passengers other than workmen employed at the Becton gas works, the load is a very variable one and the system of split shifts has been adopted. In passing over a river it was stipulated that some arrangements would be made whereby it was impossible to open the bridge whenever a car was within a hundred yards on either side. To comply with this requirement, certain interlocking devices were designed which are described. Electric power is used for opening the bridge.—Lond. *Elec.*, February 26.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Voltage Regulation in Alternating-Current Systems.—H. S. MEYER.—A continuation of his illustrated paper, the first part of which was abstracted in the Digest last week. The supply of incandescent lamps demands an almost perfect regulation, since changes—even if only of the order of 2 to 3 per cent.—will have serious consequences for the life and efficiency of the lamps, and, therefore, all ordinary generators, in order to supply satisfactorily a lighting system, need careful attendance at the switchboard. Concerning an induction motor load, he says that under full load and at standard speed the power factor should lie, with a well-designed polyphase induction motor, between 90 and 95 per cent., but when running partially loaded or with slow-speed motors or single-phase machines figures much below those mentioned must be expected, and it may be assumed that motors when used on a supply system will introduce lagging currents amounting to about 60 per cent. of the rated load current of the motor load. By combining separately the wattless and the energy current thus introduced with the corresponding currents of the rest of the load, the resultant power factor is obtained upon which the regulation of the generator depends. A diagram if given to show the influence which a large induction motor starting under heavy load will have on the generator regulation. The author points out that it is wrong and unfair to restrict the starting current of an induction motor to a certain percentage of its full-load current. Such restriction affects a 10-hp motor in the same way as a 1-hp motor, although the disturbances in the voltage regulation in the former case would be ten times as large. Furthermore it gives the advantage to the poorer motor, as this will have a larger full-load current, due to the lower apparent efficiency. The correct way is to either place a limit on the amount of current which may be taken at starting, or, still better, vary the restrictions for each size and grade of motor. The power factor of a synchronous motor can be made leading or lagging at will by varying the strength of the field excitation, so that the synchronous motor offers a simple method of compensating for the effects of inductive loads in other parts of a power system. If a synchronous motor is over-excited so as to take a resultant current 5, 10 or 15 per cent. greater than its normal load current, it is capable of compensating for a lagging current 32, 46 or 57 per cent. as great as its normal load current. The most efficient way of using such machines as "rotary condensers" is by loading the same with 71 per cent. of the rated output mechanically, and then raising the excitation until the resultant current is equal to the rated current. A leading component is then obtained of the same magnitude as the energy component. In spite of such advantages as may be obtained by controlling the power factor, a more general introduction of the synchronous motor for power work is greatly hampered by their inferiority in regard to starting torque. Too many synchronous motors on one system may also lead to trouble, as they are extremely sensitive to any fluctuations in the voltage or impressed frequency as may be caused by the prime-movers.—Lond. *Elec.*, February 26.

Frankfort.—An extract from the annual report of the Frankfort-on-Main municipal lighting and traction plant, which is particularly interesting from the fact that a 5,000-hp steam turbine has been in use since August, 1902. This turbine operates 17 hours a day and is guaranteed for 2,600 kw single-phase current. The main power station also contains four 552-kw turbines and four 1,033-kw turbines. The coal required per kw-hour during the year reported was 1.63 kg. and the cost of coal per kw-hour was 0.75 cent.—*St. R'y Jour.*, February 20.

REFERENCES.

Dangers of Electricity in Mining.—A very long serial with many illustrations. The direct danger of touching a conductor which carries current is enhanced by the particular conditions of mining and has already caused some accidents, on the other hand the more indirect dangers, due to fire and explosion, caused by electric sparks, etc., have caused so far very few accidents, mainly for the reason that in installing an electric plant in a dangerous mine, great and sometimes even exaggerated precautions are taken. The various possibilities of danger are discussed in detail and methods which have been devised for preventing them are described, together with a general account of the arrangements of electric plants in mines. The serial is to be concluded.—*Glückauf,* January 30; February 6, 13, 20, 27.

Electric Installation on Board Ship.—LEBLOND.—A continuation of his article on electric installations on board warships. In the present installment the author deals especially with the methods used in wiring and the insulation of the conductors.—*L'Ind. Elec.,* February 25.

Ignition of Gas Engines.—SOULIER.—An illustrated description of various types of magneto electric machines for producing the sparks for ignition of gas engines, especially in automobiles.—*L'Ind. Elec.,* February 10.

ELECTRO-PHYSICS AND MAGNETISM.

The Structure of the Atom.—J. J. THOMSON.—A paper in the first part of which the author discusses a mathematical problem suggested by the view that the atoms of the elements consist of a number of negatively electrified corpuscles enclosed in a sphere of uniform positive electrification. The problem discussed by him is the motion of a ring of a given number of negatively electrified particles placed inside a uniformly electrified sphere. The general equations are first developed and are then applied to the cares of two, three, four, five and six corpuscles and the mathematical conditions for the stability of a ring containing more than six corpuscles are developed. The author then applies his mathematical results to the hypothesis that an atom consists of a number of corpuscles moving about in the sphere of uniform electrification, and shows that if the corpuscles are constrained to move in one plane they will arrange themselves in a series of concentric rings, while when they can move about in all directions they will arrange themselves in a series of concentric shells. The author adds the extremely interesting proof that if we assume such a structure of the atom it will have properties analogous in many respects to those possessed by the atoms of the chemical elements and that in particular the properties of the atom will depend upon its atomic weight in a way very analogous to that expressed by the periodic law.—*Phys. Mag.,* March.

Electro-Capillarity.—CHRISTIANSEN.—An account of experiments in which the author studied some peculiar movements of mercury in

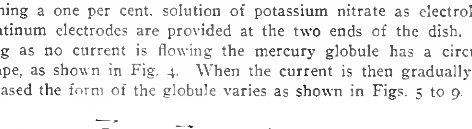
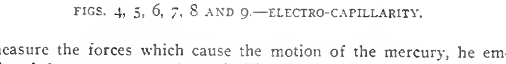


FIG. 3.—ELECTRO-CAPILLARITY.

an electrolyte, due to electro-capillarity. As seen in Fig. 3, a globule of mercury was placed in a watch glass at the bottom of a dish containing a one per cent. solution of potassium nitrate as electrolyte. Platinum electrodes are provided at the two ends of the dish. As long as no current is flowing the mercury globule has a circular shape, as shown in Fig. 4. When the current is then gradually increased the form of the globule varies as shown in Figs. 5 to 9. To



FIGS. 4, 5, 6, 7, 8 AND 9.—ELECTRO-CAPILLARITY.

measure the forces which cause the motion of the mercury, he employed the arrangement shown in Fig. 10, in which a tube is provided at the two ends with two wider tubes to contain the electrolyte. A mercury globule is placed in the middle of the tube. The tendency of the globule to move on account of the flow of the current is counteracted by placing the tube in an inclined position as shown in the figure. A thrd experiment was made with mercury drops, falling through an electrolyte. As long as there is no current the drops fall plumb, but when an electric current is passed through the electrolyte

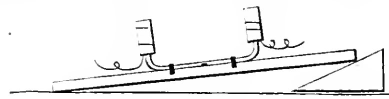


FIG. 10.—ELECTRO-CAPILLARITY.

the drops are deviated from their plumb course towards the negative pole. The deviation is approximately proportional to the current and also depends upon the electrolyte. The author explains these phenomena by the double-layer hypothesis.—Lond. *Elec. Rev.,* February 19.

Photographic Action of Radium Rays.—SKINNER.—Since a photographic plate by exposure to radium rays is affected in such a way that the plate develops similarly to its development after its exposure to light, the author has made experiments to find whether the actions are the same in both cases. His results seem to indicate that only slight differences occur in the early stages of development. For prolonged exposure he reaches the following conclusions: The density of the image produced on a plate by exposure to radium rays (β and α) increases to a critical value and then decreases, first rapidly and afterwards very slowly, until a time is reached when the image is totally reversed. Spark images are at first obliterated by radium rays which do not cause such a great density as that of the spark images obliterated. With prolonged exposure, radium rays reverse spark images.—*Phil. Mag.,* March.

REFERENCES.

Light and Electric Waves.—BRAUN.—An account of experiments in which he produced with ordinary light waves the effect produced by Hertz with a grating of parallel wires which is found to reflect electric waves vibrating in the plane parallel to the wires while it freely transmits those waves which vibrate at right angles to the wires. In his experiments he used wires disintegrated on a glass plate by means of a powerful electrostatic discharge.—*Sitzungsber. Akad. Wiss., Berlin,* January 21; abstracted in Lond. *Elec.,* February 19.

N-Rays.—BICHAT.—An account of experiments made to find an explanation for the apparent anomaly that N-rays, being a form of radiation, may be "conducted" by a wire. The conduction is a case of successive reflection. Light may be similarly conducted along a curved glass tube. The transmission is really due to the wire and not to the medium in which it is placed. In order that the conduction may take place, it is necessary that the material of the wire should itself transmit N-rays.—*Comptes Rendus,* February 8; abstracted in Lond. *Elec.,* February 26.

Magnetic Effect of Convection Currents.—GUTTON.—A description of a new method of proving the magnetic effect of convection. If a luminescent screen is placed on an earthed sheet of lead and an electrified ebonite rod is put underneath, then as long as the rod is at rest it exerts no influence; but if it is revolved about its own axis, the luminescence becomes temporarily greater. An unelectrified rod has no such action.—*Comptes Rendus,* February 8; abstracted in Lond. *Elec.,* February 26.

ELECTRO-CHEMISTRY AND BATTERIES.

Constitution of Salt Solutions.—ABEGG.—Hittorf has already shown long ago that cadmium chloride must contain in solution, besides the simple cadmium and chlorine ions, also complex ions formed by a combination of cadmium chloride with chlorine ions. From experiments made by Labendzinski, the present author concludes that such complex ions must be assumed to exist to a far greater extent than has been assumed to be the case, in acetates,sulphates and chlorides, and to a smaller extent in nitrates; the metals, the salts ofwhich were examined being zinc, cadmium, iron, cobalt, nickel, lead and copper. To the existence of such complex ions the author attributes the reason of the well-known disagreement between theory and practice in the case of Ostwald's law for the relation between conductivity and dilution.—*Zeit. f. Elektrochemie,* January 29; abstracted and commented upon in *Electrochem. Ind.,* March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct-Reading Ohmmeter.—SACK.—An illustrated description of a direct-reading ohmmeter of Siemens-Halske, which consists essentially of a milliammeter with revolving coil. With some storage cells and the unknown resistance to be tested it is connected in series. In order to get a suitable scale, that is, one with approximately uniform divisions, the pointer is arranged to be at open circuit beyond the scale and to enter the scale only when the tested resistance is smaller than the maximum ohms for which the instrument is calibrated. In order to prevent that when opening the circuit and pointer comes back with too high a speed to its zero point, arrangements are made so that when the tested resistance is disconnected, the instrument is at once connected to another resistance which corresponds to the maximum ohms for which the instrument is calibrated. The pointer goes to the beginning of the scale and the circuit may then be opened without danger. In order to make the reading independent of the voltage of the battery, a magnetic shunt is provided which by means of a screw can be pushed more or less over the poles of the magnet so as to vary the magnetic field strength at will.—*Elec. Rundschau*, February 15.

MISCELLANEOUS.

Electrical Engineering in Russia.—An account of the proceedings of the third Russian Electrical Congress which was held in St. Petersburg at New Year, more than 500 members being present. Kowalewski spoke on the utilization of the water powers. Nearly nothing has been done in this regard in Russia; while in Germany water falls are available to the extent of not more than 17,000 hp, in Russia up to about 15,000,000 hp are available. The congress adopted a resolution that the right of developing the power of rivers for electrical purposes belongs to the state, which may either develop the power itself or may sell the franchise to companies or private parties, which thereby obtain the right of expropriating the ground necessary for the plant. Lubenski discussed the application of electric traction on the Siberian Railway and thought that especially in Central Siberia for a length of 900 km. the use of electric traction would be profitable since in winter there are difficulties with steam traction. In the discussion which followed the economy of this project was questioned, since ice formation on the trolley wire might offer a great difficulty. Graftio spoke on the economical results of electric traction on railroads and the congress adopted a resolution in which the departments of commerce and finance were requested to have an investigation made of the utilization of the water falls of the Caucasus and near the Black Sea in order to electrify the railroads in the neighborhood. Kohan reported on the project of electric tramways in St. Petersburg. While no decision has yet been reached concerning the method of current supply to the cars, the general plan has been laid out of the road. The capacity has been calculated so that 264,000,000 passengers can travel per year. The length of the lines will be 315 km. A central station of 18,000 kw, with 6,000-volt, three-phase currents and eight sub-stations for 600-volt direct current have been projected, but it is not yet decided whether water power or steam engines or steam turbines shall be used. Popow spoke on wireless telegraphy. There are now in the far east of Russia 50 stations and it is possible to transmit messages from ships to the coast for the distance of 190 km.—*Elek. Zeit.*, February 18.

REFERENCES.

Engineering College.—A detailed illustrated description of the equipment of the Northampton Institute, its technical departments, the mechanical and electrical engineering and the applied physics departments and the various workshops and laboratories.—Lond. *Eng'ing*, February 19.

Austria.—An account of a meeting in which a union of the Austrian electric central stations was organized.—*Zeit. f. Elek.*, February 21.

Biographical.—An account, by Abegg, of the life and work of Savante Arrhenius, the founder of the electrolytic dissociation theory, with his portrait.—*Zeit. f. Elek.*, February 19.

Naval Wireless Telegraph School.

It is stated that the Navy Department is making preparations to transfer the wireless telegraph school for enlisted men from Newport, R. I., to the Navy Yard at New York.

New Books.

HIE EUROPA! HIE AMERIKA! By Julius H. West. Berlin: Siemenroth. 55 pages. Price, 1 mark.

The author of this book has endeavored to lay bare the reasons for America's economic superiority in the markets of the world. While much of his reasoning is not new, his book is very interesting because he discusses the subject from the standpoint of actual experience. Mr. West visited the United States on two occasions to study manufacturing methods. He himself spent several years in actual machine shop practice before becoming an editor of the *Elektrotechnische Zeitschrift*. His comparisons between European and American shop practice are very interesting. While in Europe the working man is not encouraged to make any improvements and is treated as an inferior, Mr. West found that in the United States every inducement is offered to the employee to make improvements resulting in lower cost of product. He earnestly recommends European manufacturers to change their present policy and follow the best American methods.

A Motor Driven Coin-Counting and Wrapping Machine.

BY EDWARD VAN WINKLE.

The accurate counting and the proper handling of a large number of coins is a heavy task and necessitates the employment of clerks and others for the purpose. Such persons, unless specially skilled in counting, often find it difficult to continue the work for any length of time without great fatigue, while errors are likely to arise because of miscount. A machine for this purpose is illustrated here-

FIG. 1.—MACHINE IN OPERATION.

with, which counts and wraps at the rate of seven coins a second or 420 coins (8 to 12 bundles) in one minute.

The immense saving of labor is at once realized by making a comparison to hand labor, which can as a maximum, provided no error in count occurs, count and wrap only one bundle per minute. This machine therefore will do the work of from eight to twelve men, without taking into consideration the loss in time if a miscount is found, with hand labor. The above speed is limited only by the examination of the coins by the operator, as they are fed into the machine from the table upon which they were first deposited. Experience has proven that 300 coins examined per minute is a safe and conservative limit which should be expected from the average operator.

It does not require any knowledge of machinery to run and operate the machine, as a small boy has proven to be as capable as any operator. The machine being entirely automatic, requires no attention.

By referring to the illustrations, Fig. 1 represents the machine in operation. Fig. 2 shows the machine in closed position with the coin conduit and box removed and table top swung around taking its position directly over the machine so as to protect it when not in use. A cover or hood may then be thrown over the machine to keep out the dust. Fig. 4 shows the product of the machine with the ends crimped like a cartridge, exposing the coin.

The coins are first deposited upon the table attached to the machine and then passed under the gauge by the operator, who rejects any mutilated or counterfeit pieces. They then drop into the conduit and are conducted by gravity to the machine, where they are each taken up separately regardless of thickness or diameter, advanced by the reciprocating push bar and assembled in a row ready to be wrapped. After the requisite number of coins are advanced, the registering of the final coin of the bundle sets in operation the wrapping mechanism, which is normally inoperative. The bunched coins are then transferred from the buncher to the wrapper by means of the holder, which then returns to its original position, ready to receive the coins of the subsequent bundle.

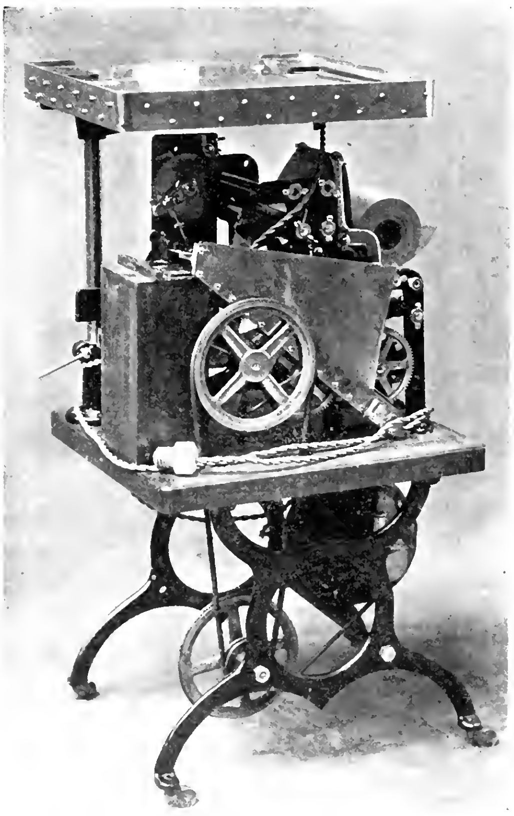


FIG. 2.—MACHINE IN CLOSED POSITION.

The bunch of coins while thus being transferred to the wrapping mechanism carries with it the end of the paper which has been fed in their path during the wrapping of the preceding bundle. Simultaneously, the lower coin roll is raised, forming a pocket with the two upper rolls into which the bunch of coins is carried, and the end of the paper is fed by friction between the three driving coin rolls and around the bundle of coins. The wrapper completely encircles the coins twice, giving strength and body for the crimp. The feeding of the paper around the bunch of coins tears the wrapper from the roll of paper by pulling the paper over a V-shaped knife, leaving its end, which serves for the final wrapping, cut with inwardly converging edges. The side edges of the wrapper are then turned inwardly by the crimpers, thereby drawing upon the converging edges in opposite directions and holding the final wrapping end of the wrapper closely and smoothly upon the rolled package without the aid of independent fastening, such as glue or paste.

The length of the package is determined by the thickness of the coin, which varies considerably. The crimp is always brought up tight to the coins by the crimpers, which are drawn together by means of a right and left-hand screw. When the crimp is complete the cartridge is thrown out of the machine into a box, which is detachable and may be filed away in a safe or vault, thus minimizing the labor in handling the coins. The package of coin when shot out of the machine is so securely wrapped that no one coin can be extracted without destroying the entire package, thus making it impossible to cheat the machine.

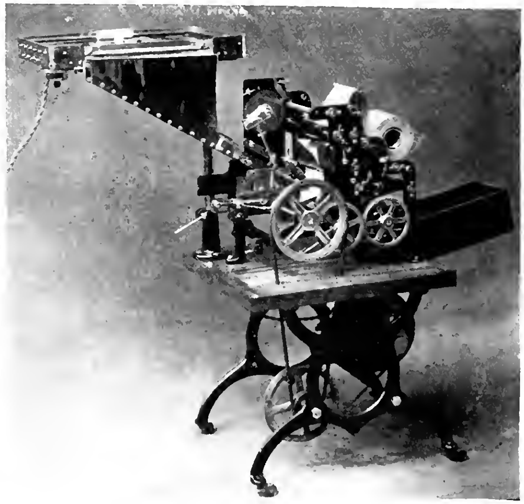


FIG. 3.—COIN-COUNTING AND WRAPPING MACHINE.

The machine is operated by an electric motor, and as it consumes but three-tenths of an ampere at 110 volts, it is easily attachable to any standard light socket by means of a connection plug. It is started and stopped by a turn of a button switch.

It will be noticed that the paper is fed into the machine from the under side of the roll, which is in plain view in Fig. 1. In this position the curl of the paper due to the roll helps the wrapping of the package and makes it possible to neatly crimp the ends, as shown in Fig. 4. If fed from above, as was the case when the machine came to attention for development, the crimper, in addition to its own work in crimping the ends of the package, had to overcome the curl of the paper, and the crimped ends were therefore an impossibility. Simple changes like the above made this machine possible.

It may be interesting to look into the history of this coin-counting and wrapping machine and its development. The writer while exhibiting of these machines at Washington, had a long talk with the Patent Examiner, who said that he could not account for the fact that the counting and wrapping of coins by machinery had not been patented before, unless the fact that inventors as a rule did not have any money to count, and consequently their minds did not run that way. As the inventor of this machine had been connected with a "penny-in-the-slot" machine company and was dependent for his living upon returns from several of these vending machines, his revenue was all in coin and he came to dislike the sight of it. He had three nail kegs in his room in which he deposited his daily collections, and perchance if he wanted to pay some bills by check, he and his family would have to stay up all night counting and wrapping these coins so that he could deposit the same in the bank.

His wife suggested in jest one evening, while his family were industriously wrapping coin in order to swell his bank account sufficiently to pay his rent, that he "invent a way to count coins by machine and thus save this distasteful hand labor." He gave considerable thought to the idea, and developed at first a crude device which he patented and afterwards found out could not be made to work. His idea was to give rotating motion to the coins by means of a loose belt, forming a pocket instead of the three rolls as now used. He had planned to shear off the paper with sharp knives and glue the paper around the coins and fold the ends, as now accomplished by hand wrapping. His original patent called for a printing device which printed on each package the face value of the coins with each wrapping. The ideas were found to be impractical, as the knife blades would dull, and if the machine was allowed to stand the

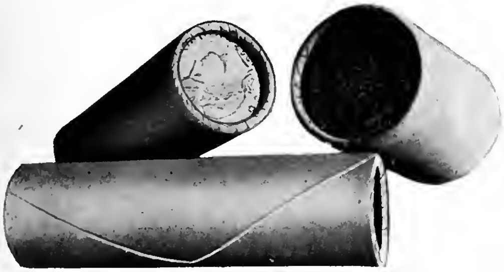


FIG. 4.—PACKAGES OF COINS.

glue would become hard and the ink dry. The loose belt would throw the coins on the floor and was found most unreliable; the idea was therefore abandoned.

With the coin exposed at each end of the package it is not necessary to print the value of the coin on the wrapper. However, when required, the printing can be done before the paper is put into the machine. Each wrapper, in length, is equal to twice the circumference of the coin which it wraps and the printing is spaced, a distance equal to half the length of the wrapper, from one end of the roll of paper to the other; thus it matters not where the wrapper is cut off the roll, as only one printing is visible on the package.

The length of the longest wrapper is 7¾ inches and is 2⅜ inches wide. This size is used to wrap twenty-five cent pieces. The length of the shortest wrapper is 4⅛ inches long and is 2⅞ inches wide and used for fifty ten-cent pieces. The economy of paper is only realized when one tries to wrap the coins by hand in a wrapper automatically cut off by the machine.

Westinghouse and the British Trade Union.

The British Westinghouse & Electric Manufacturing Company, Limited, whose colossal works at Trafford Park, near Manchester, are now in full swing, and give employment to more than 6,000 hands, have agreed to the insertion of the "fair wages" clause in their municipal contracts and are joining the British Employers' Federation, thereby undertaking to abide by the working terms mutually agreed upon by the Federation and the trade unions. Thus, once and for all, American terms of employment, which were aimed at when the company was first organized, have gone by the board.

H. S. Loud, the general manager of the Westinghouse works, according to advices received here, states that the "fair contracts" clause of the Manchester Corporation has been the main factor in bringing about the decision. The company tendered recently for a substantial contract, which was duly secured, with the tramways department of that city and at a certain stage of the negotiations the question of signing the clause came up. Practically it was a question whether the company would accept the clause or run the risk of losing a valuable contract.

The concession which the British Westinghouse people have made is the outcome of prolonged negotiations. In Pittsburg it is the custom to pay time and one-half for all overtime, and this was what the British company began to do at Trafford Park. But the British trade union rule is time and a quarter for the first two hours of overtime, time and a half for the second two hours and double time for the third two hours. The company tried to show the trade unions that the Yankee method was the more advantageous, but the unions were unconvinced and the company yielded the point.

Another dispute between the company and the unions was in reference to the working hours of the night shift, but this has been amicably settled and now that the company has accepted the terms of the "fair wages" clause the last bone of contention is buried.

Electric Power in Gold Dredging.

BY C. WESTON CLARK.

The first gold dredgers in California were operated by steam, but expensive operating made them successful only when rich ground could be worked. With cheap electric power, dredging land averaging less than 10 cents a cubic yard is made profitable. The gold-carrying soil varies from 10 to 50 ft. in depth, being a gravel deposit left in old river channels.

The two types of electric dredges which have been used secure the soil by either lifting it through centrifugal pumps or by an endless chain of buckets. The latter system seems to be the most favorable. A boat is built in a pit where it is to be operated, and the necessary machinery placed aboard. The pit is then filled with water to a depth of from 25 to 40 ft. The boats are fed by a cable about 500 ft. long, which runs from the shore to the boat. Generally these cables are arranged for three-phase, 60-cycle current standard low voltage, but one or two of the boats are fed by a 4,000-volt, four-wire cable, which is carried directly to the boat and the ore transformers placed on the boat. The lower voltage cables are rubber insulated and triple-braid water-proof. The 4,000-volt cables are leaded and armored. The transformers are sometimes placed on the boat and sometimes on a pole near the boat. Usually the latter arrangement.

The dredger digs its own channel ahead of it, depositing the soil

FIG. 1.—DREDGE "HEAD ON."

which has been worked behind it. The soil is elevated into a grizzly or similar screening device where the rocks are washed from the soil, the rocks being delivered to the carrier that deposits them out of the way behind the dredger. The soil is then washed through shakers and riffles, leaving the gold deposited on saving tables to be taken up with quicksilver, and the worked-over soil is run out at the stern of the boat. The General Electric Company, Schenectady, N. Y., has developed electric equipments for such machinery of all kinds, and the electrically-operated dredges recently equipped by that company are splendid examples of successful engineering enterprise.

A typical outfit recently sold to the Western Engineering & Construction Company for the Central Gold Dredging Company, of Oroville, consists of the following induction motors: One 50-hp motor, with controller and resistance for driving the bucket line; one 15-hp motor, with controller and resistance for operating the winches (this apparatus is for working the head lines and changing the direction of the boat to suit the work); one 40-hp motor, direct-connected to a centrifugal pump (this pump furnishes water for washing the soil); one 15-hp motor to drive the stacker or conveying belt which disposes of the stones; one 15-hp motor for operating the shaking screens; one 30-hp motor for operating the sand pump (this motor is worked occasionally when the sand accumulates too thickly at the back of the boat, and delivers it out on the rock pile through a long pipe); one 3-hp motor for operating a deck and bilge pump, used for general washing purposes. The buckets each carry 3 cubic feet of earth. A similar equipment of the chain bucket type is furnished the Butte Gold Dredging Company. This has 85 buckets to the chain, each bucket having a capacity of 5 cubic feet, and being oper-

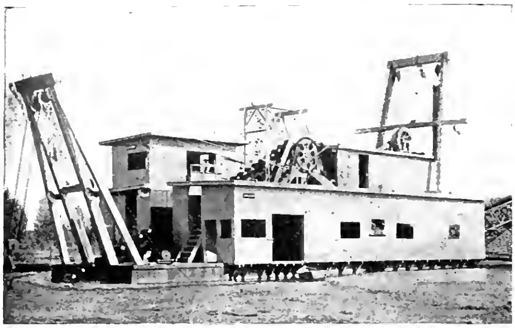


FIG. 2.—DREDGE WORKING SAND PILE.

ated at a normal speed of 22 buckets per minute. The dredge will dig from 50,000 to 75,000 cubic yards of material per month. There are some dredges using a 3½-cubic-foot bucket which will not exceed 50,000 cubic yards per month. The standard dredge, however, uses the 5-foot bucket. This dredge has a hull about 36 by 90 feet on the water line, with a draft of 5 feet. It is fitted with two spuds —one wood, 50 feet long, weighing about 10 tons; one steel, 50 feet long, weighing about 17 tons. The swing permits of a cut about 90 feet in width. The bucket line can be run continuously on any point of the controller from the third notch to full speed. The stacker is 30 inches wide and about 90 feet long.

A number of other successful installations equipped by the General Electric Company on these lines could be mentioned. Among them are plants for the Yuba Consolidated Dredging Company, the Folsom Development Company, the Boston & Oroville Gold Dredging Company, the Oroville Gold Dredging & Exploration Company, the El Oro Gold Dredging Company, and the Ashburton Mining Company. There are now about 40 dredgers working in California with more to come.

FIG. 3.—BUCKET LINE.

Portable Voltage and Series Transformers.

The ordinary equipment for making electrical measurements affords chances for error which care cannot always overcome. It is frequently impossible to have at command instruments of all the capacities required to give the best results. Readings should be taken well within the range of the instruments, upon the portion of the scale where the divisions are large and open and errors in observation not likely to occur. Even when instruments of all the desired ranges are at hand, it is still often difficult to obtain absolute accuracy and uniformity of results, owing to the variations in the different instruments which make it impossible to check up the results obtained.

In checking and testing electrical instruments with the use of the ordinary appliances, the standards often present the same difficulties and make it impossible to certify absolutely to the accuracy of the results obtained. In fact, the greater number of the errors and discrepancies in tests can be traced directly to lack of legibility of standards and to variations in the different instruments.

Manifestly, the ideal instrument either for taking measurements or for making comparisons with other measuring devices is one which will combine a great degree of legibility with a capacity for all ranges in which readings are to be taken, and any means by which these

FIG. 1.—PORTABLE TRANSFORMER.

characteristics can be imparted to the instruments now in service is of practical value.

The best method for accomplishing the desired result is by the use of transformers which will adapt the voltage or current to be measured to the capacity of the instrument to be used, adopting a ratio which will permit readings to be taken from the most legible portions of the scale. By this means any difficulty in readings is obviated, uniform accuracy at all capacities is assured, and a single voltmeter, ammeter and wattmeter will fulfil all the requirements of the most exacting service.

Portable series and voltage transformers made by the Westinghouse Electric & Manufacturing Company and shown in the accompanying illustrations are especially designed for this work. They are carefully made, the ample insulation and generous amount of iron and copper used reducing to a minimum the error of transformation. They are designed to give accurate ratios at the load which will normally be imposed on the secondary, by the ordinary type of portable instruments, the output of the voltage transformer being about .15 amp. and the maximum voltage across the secondary of the series transformer being about three volts.

The series transformer is made in two types. In one, Fig. 1, designed for primary currents up to 100 amp., the ratio is changed by plugs, somewhat as in the Wheatstone bridge. In the other type, which is designed for larger capacities, there is a circular opening through the transformer, and the conductor is passed through this opening, forming the primary. In this type the ratio is changed by the number of turns made by the conductor; passing it through the aperture once gives a ratio of 400 to 5, twice a ratio of 200 to 5, and four times a ratio of 100 to 5.

The voltage transformers are furnished in various capacities up to 750 volts primary, the standard secondary voltage at the maximum primary voltage being 150 volts. The terminals on the primary are arranged so that a number of primary voltages may be obtained, although they are not usually required in a great range of capacities, as is the case with series transformers.

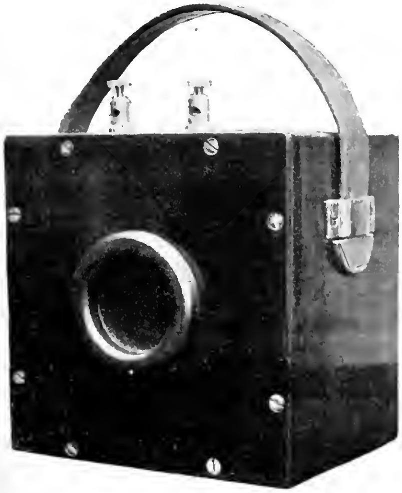
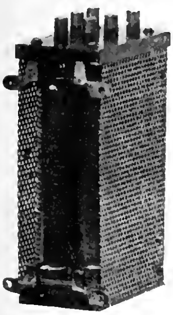


FIG. 2.—PORTABLE TRANSFORMER.

These transformers are mounted in finely finished mahogany cases with carrying handles. The terminals of the voltage transformers and the plug contacts of the series transformers are protected by a cover, which, for convenience in use, is made removable.

Quadruplex "Leak Boxes."



"LEAK" BOX.

The Ward Leonard Electric Company, of Bronxville, N. Y., is building a large number of quad. leak boxes for the Postal Telegraph Cable Company, which have the following features: The resistance consists of five Postal units (6½ in. long by 1⅛ in. in diameter) which can be readily taken out and new ones of different resistance inserted, if desired. The resistance wire is of a special alloy, which has a practically zero temperature coefficient. The resistance wire and the joint between it and the large lead wire are thoroughly covered by enamel, which hermetically seals them from the atmospheric conditions of moisture, etc.

The Postal Telegraph Cable Company has found that resistance lamps and cotton-covered insulator coils of resistance are not electrically perfect nor are they permanent, for the reason that, in the case of the lamp resistances the filament deteriorates and that even when new the resistance is variable with the temperature of the filament, due to the passage of current. In the case of the cotton-covered wires, more than one layer is necessary to obtain the proper resistance in a limited space, which leads to the result that upon the passage of current the inner layers are at a high temperature, heat from which cannot be readily dissipated, etc., and the insulation of the inner layers becomes charred and burned off. Mr. Francis W. Jones, head of the engineering department of the Postal Telegraph Cable Company, has suggested the design of these boxes and has paid particular attention to the special type terminals, which consist of nuts and washers, with the necessary lock nuts, etc., so arranged that not more than one nut can be moved at one time and when once locked can never become unlocked of itself.

Big British Westinghouse Contract.

The British Westinghouse Electric & Manufacturing Company, Limited, has recently secured the most important contract ever awarded in Great Britain for the installation of a light and power system for dock use. The value of the contract is in the neighborhood of $350,000. The Midland Railway, which operates one of the principal steam roads on the other side, is expending some $18,000,000 in the construction of docks at Heysham Harbor, Morecambe Bay, Lancashire, which will be used in connection with the company's Irish steamship service.

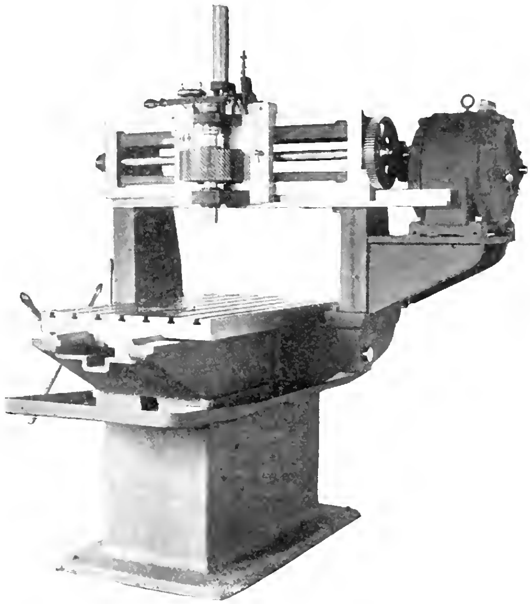
The initial equipment of the power plant will be somewhat over 1,000 hp. There will be three 350-hp Westinghouse gas engines direct-connected to Westinghouse generators of 250-kw capacity each. The gas engines will operate on Mond producer gas. There will be 500 kw more generating equipment added to the plant shortly. The cranes will be 28 in number. There will be one of 100-tons capacity, ten of 5-tons capacity, five of 2-tons capacity and twelve platform cranes.

Another interesting contract obtained by the British Westinghouse interests calls for the motor equipment for 200 additional cars for the Manchester Corporation electric traction system. Each car will have two motors of 35 hp each.

Motor Driven Profiler.

The machine illustrated herewith was built for finishing the bevel edges of irregular-shaped retort doors, and shows how readily the electric drive can be adapted to this class of tool. The spindle is driven by spiral gear and pinion from a spliced shaft and the wide face of the spindle gear permits the up and down adjustment.

The cross slide is moved by vertical rack pinion shaft contained in the right-hand upright and connected with a pilot wheel at the side of the bed. The large table is also moved by pilot wheel, the two wheels being located close together, so that all necessary movements in following an outline are controlled from one point, from which the cut can be seen at all times. The movements of the machine are by hand as is necessary in following the outline of the model.



MOTOR-DRIVEN PROFILER.

The spindle runs in bronze cap boxes and the slide is balanced and fitted with micrometer lock notch stop and screw gauge stop. The table feeds 46 in., clear height 6 to 13 in., clear width 25 in. The weight is 4,500 pounds. The maker is the Garvin Machine Company, New York.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The market was very dull throughout the week, and the volume of business done was exceedingly small—in fact, the smallest for almost ten years. Business from commission houses was entirely lacking and the professional operations were quite insignificant. Toward the end of the week there was a little improvement in point of activity, but it was almost entirely at the expense of prices. The week was entirely devoid of any striking incidents in connection with the share list. The Steel shares were quiet and firm, and the traction group was irregular. Some weakness developed toward the close of the week in Metropolitan Street Railway, the closing price—106⅞—being 7⅛ points below that of the previous week. Brooklyn Rapid Transit lost ⅜, closing at 39½. The electric group also suffered losses, General Electric closing at 159½, being a net loss of 1½, and Westinghouse at 157, a loss of 8 points. Western Union was the exception, making a net gain of ½ point, the closing price being 88½. The curb market was somewhat irregular and reactionary, in sympathy with the Stock Exchange, and the volume of business was small. Electric Boat preferred made a net gain of 2 points, closing at 54, ex-dividend 2 per cent. Following are the closing quotations of March 15:

NEW YORK.

	Mar. 8	Mar. 15		Mar. 8	Mar. 15
American Tel. & Cable	85	84	General Electric	160	162¼
American Tel. & Tel.	121	121	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	113½	107⅛
Brooklyn Rapid Transit	40¼	41¼	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	185	180	N. Y. & N. J. Tel.	..	..
Electric Boat	23	22	Marconi Tel.	..	..
Electric Boat pfd.	53	52	Western Union Tel.	88	88½
Electric Lead Reduction	½	½	Westinghouse com.	157	159
Electric Vehicle	7½	7½	Westinghouse pfd.	180	175
Electric Vehicle pfd.	10	10			

BOSTON.

	Mar. 8	Mar. 15		Mar. 8	Mar. 15
American Tel. & Tel	121	122	Western Tel. & Tel. pfd.	79	78
Cumberland Telephone	114¾	115	Mexican Telephone	1¼	1½
Edison Elec. Illum.	*235	234	New England Telephone	118	118
General Electric	161	162	Mass. Elec. Ry.	18	18
Western Tel. & Tel.	8⅛	8½	Mass. Elec. Ry. pfd.	73	71½

PHILADELPHIA.

	Mar. 8	Mar. 15		Mar. 8	Mar. 15
American Railways	43	42½	Phila. Traction	97¼	..
Elec. Storage Battery	52	52	Phila. Electric	5¾	5⅞
Elec. Storage Battery pfd.	52	52	Phila. Rapid Trans.	14	13½
Elec. Co. of America.	7¾	7⅞			

CHICAGO.

	Mar. 8	Mar. 15		Mar. 8	Mar. 15
Central Union Tel.	..	..	National Carbon pfd.	98	97½
Chicago Edison	..	..	Metropolitan Elev. com.	15¼	14
Chicago City Ry.	156	156	Union Traction	4½	5
Chicago Tel. Co.	..	..	Union Traction pfd.	30⅛	30
National Carbon	25¾	25			

*Asked

WESTERN UNION FIGURES.—The Western Union Telegraph Company reports for the quarter ended March 31, 1904 (partly estimated):

	1904. (Estimated.)	1903. (Actual.)	1902. (Actual.)	1901. (Actual.)
Net revenue	$1,750,000	$1,842,269	$1,592,218	$1,504,226
Bond interest	286,300	286,300	254,770	239,040
Balance	$1,463,700	$1,555,969	$1,337,448	$1,265,186
Dividends	1,217,017	1,217,014	1,217,008	1,217,001
Surplus	$246,683	$338,955	$120,440	$48,185
Previous surplus	14,360,346	12,176,386	10,209,866	8,964,710
Total surplus	$14,607,029	$12,515,341	$10,330,306	$9,012,895

The above partly estimated statement gives the approximate figures for the nine months of the fiscal year (July 1 to March 31) as compared with the actual figures of the three preceding years:

	1904.	1903.	1902.	1901.
Net revenue	$6,007,256	$6,206,773	$5,399,852	$4,922,812
Bond interest	858,900	791,400	737,810	717,120
Balance	$5,238,356	$5,415,373	$4,662,042	$4,205,692
Dividends	3,651,051	3,651,035	3,651,022	3,651,002
Surplus	$1,587,305	$1,764,338	$1,011,020	$554,690
Previous surplus	13,010,724	10,751,003	9,319,286	8,458,205
Total surplus	$14,607,029	$12,515,341	$10,330,306	$9,012,895

BROOKLYN RAPID TRANSIT.—The statement of Brooklyn Rapid Transit for the calendar year 1903 showed a surplus after charges of $1,138,225, compared with a surplus of $964,878 for the fiscal year ending June 30, showing an increase of $173,347, or 17.9 per cent. The surplus for the calendar year is equal to 2.5 per cent. on the $45,000,000 stock. The following table compares operations of the calendar year and the fiscal year 1903:

	Cal. year.	Fiscal year.	Increase.	Per cent. inc.
Gross	$14,025,825	$13,280,321	$745,504	5.6
Expenses	8,392,607	7,931,079	461,528	5.8
Net	$5,633,217	$5,349,242	$283,975	5.3
Other income	207,512	277,493	*69,981	*2.5
Total net	$5,840,739	$5,626,735	$214,004	3.8
Charges and taxes	4,702,513	4,661,857	40,656	0.8
Surplus	$1,138,225	$964,878	$173,347	17.9

*Decrease.

The increase in gross for the six months is proportionately less than the increase during the last fiscal year, which was 6.15 per cent. The operating ratio is 60 per cent. of gross earnings, compared with less than 50 per cent. for Manhattan and Metropolitan.

FAIR HAVEN TROLLEY DEAL.—The basis of the merger of the Fair Haven & Westville Trolley Company with the New York, New Haven & Hartford is understood to be the exchange of 50-year 3½ per cent. debentures for the Fair Haven & Westville stock, the latter being taken at a valuation of $50 for each share of par value of $25. The shareholders of the Fair Haven & Westville thus get 7 per cent. on the debentures in place of the present 5 per cent. dividend on stock. The merger will call for the issue of about $9,600,000 of New Haven debentures to take up the outstanding trolley stock or stock to be created April 1. By the merger the New Haven obtains about one-fifth of the whole trolley mileage in the State of Connecticut. This trolley road is the second largest single system in the State of Connecticut, and for a time was considered as a probable nucleus of an electric system between New York and Boston, paralleling most of the New Haven. Its purchase now by the New Haven will prevent any such scheme. Following the acquisition of the Fair Haven & Westville comes the report that the New Haven is negotiating to buy the Connecticut Railway and Lighting Company's lines in Connecticut, owned by the United Gas Improvement Company of Philadelphia.

NEW WESTERN ELECTRIC FACTORY.—Note has been made from time to time of the large new Western Electric factory in the suburbs of Chicago. It is said that one of the principal objects of the Western Electric Company in establishing a large factory and warerooms in the suburban district is to provide space for a large supply department sufficient to supply all the Bell telephone companies of the United States with material at the lowest price and to carry on hand large stocks of the standard goods, thereby obviating the necessity of the various companies carrying a larger stock of supplies than that actually needed. This massive storehouse and purchasing agency will be in charge of a competent person, who will do the buying for all the Bell telephone companies of the country. At present it is estimated that the several companies of the country have invested in unused supplies at least $10,000,000; under the new arrangement this can be reduced from 50 to 75 per cent. By purchasing in large quantities and distributing as wanted considerable money could be saved. This plan will, it is asserted, be put into operation as soon as the buildings are completed.

FEDERAL TELEPHONE.—The appended statement shows comparative earnings of eight of the subsidiary companies of the independent Federal Telephone Company for the months of January, 1903, and 1904. The companies included in the statement are the Cuyahoga, Findlay, Fostoria, Youngstown, Zanesville, Lancaster, Massillon and Stark County:

	1904.	1903.
Gross	$46,559.89	$44,594.44
Net	21,730.35	19,772.09
Surplus	8,590.75	7,722.23

ELECTRICITY FOR MEXICAN STEAM ROAD.—Mexico City advices state that the Mexican Railway has applied to the Secretary of Public Communications for the necessary permission to establish electric traction on the section of its road known as Las Cumbres de Maltrata, where the heavy grade requires two locomotive to haul an ordinary passenger train. The current will be generated at a large fall on the Atoyac River. The government authorities have commissioned Armando Santa Cruz to examine this waterfall and report as to the electric power it can produce.

DIVIDENDS.—The Otis Elevator directors have declared the regular quarterly dividend of 1½ per cent. on the preferred stock and a dividend of 2 per cent. on the common. The directors of the Safety Car Heating & Lighting Company have declared the regular quarterly dividend of 2 per cent. and an extra dividend of 1 per cent., payable April 1. The directors of the United Traction & Electric Company of New Jersey have declared the regular quarterly dividend of 1¼ per cent., payable April 1. Books close March 15 and reopen April 2. Westinghouse Air Brake directors have declared the regular quarterly dividend of 2½ per cent. and 2½ per cent. extra, payable April 11. The previous extra dividends were 3½ per cent. The regular quarterly 1 per cent. dividend on International Steam Pump common is payable April 1.

J. A. FAY & EGAN.—The annual report of the J. A. Fay & Egan Company shows net earnings of $324,000, with a surplus of $172,000, for the year after all dividends and charges. These figures represent the largest year's business in the history of the company. Fred. T. Egan has been elected a director of the J. A. Fay & Egan Company in place of Albert N. Spencer, who retires as director and second vice-president. The following were elected officers of the company: Thomas P. Egan, president; S. P. Egan, vice-president; W. M. Green, secretary; A. A. Faber, treasurer; Joseph Rawson, F. H. Simpson, Rudolph Klybolte, L. G. Robinson, J. E. Bruce, W. H. Doane and Fred. T. Egan additional directors.

NEW "SOO" COMPANY.—It is stated officially that the Consolidated Lake Superior reorganizers contemplate making C. D. Warren, president of the Traders' Bank and of the Metropolitan Traction Company, both of Toronto, president of the reorganized Consolidated Lake Superior Company. T. J. Drummond is slated for the vice-presidency. The New York banks have already consented to the change in the personnel of the Canadian Improvement Company, and it is stated that all of the Philadelphia banks have promised to sign.

MISSOURI & KANSAS TELEPHONE COMPANY.—The Missouri & Kansas Telephone Company (an American Bell licensee), reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.	1900.
Gross	$1,303,795	$1,228,436	$1,056,638	$863,235
Expenses	1,039,717	956,993	814,790	665,132

SAFETY CAR HEATING & LIGHTING.—The statement of the Safety Car Heating & Lighting Company for the year ending December 31, 1903, shows as follows: Net profits, $870,419, against $626,182 in 1902; paid out in dividends, $639,445, against $491,084; surplus, $230,974, against $135,098.

BELL TELEPHONE STOCKHOLDERS.—The number of stockholders of the American Telephone and Telegraph Company is now in excess of 16,500. Through the last increase in the company's outstanding stock, amounting to about $21,000,000, the number of stockholders was increased by about 3,000 names.

TROLLEY BONDS.—It is stated from Toledo that the Lake Erie, Bowling Green & Napoleon Electric Railway Company has issued and sold $1,000,000 5 per cent. thirty-year gold bonds, the money to be used to extend the present line to Fort Trenton and Napoleon.

Commercial Intelligence.

THE WEEK IN TRADE.—The conditions in trade throughout the country are much improved, due largely to the more favorable weather. Spring trade is "looking up" everywhere, and life is taking the place of the inactivity and dullness that prevailed generally through the effect of the prolonged cold weather. In the iron trade there is increased activity, and the prices of crude material are stiffer. The transportation situation is much improved, and the railway gross earnings for February promise to make a better showing than was anticipated. From many cities come complaints of collections notwithstanding the easy market and low prices for money. Reports from the South indicate an enormous acreage in cotton, and the reports of trade in most all lines are full of encouragement. Figures of iron production and stocks show that notwithstanding a large increase in the output, supplies on hand are smaller than during the winter. Finished products are also more active, and increased business is reported. From all parts of the country come details of much activity in agricultural implements. The copper market was inactive and extremely dull and transactions were very few. The prices quoted on the Mutual Exchange are 12½ to 12¾c. for Lake, 12⅜ to 12⅝ for electrolytic and casting stock. The London market was of the same character as that in New York. The business failures for the week ending March 10, as reported by Bradstreet's, numbered 200, an increase of five over the week previous, while those in the corresponding week last year numbered 176.

POWER TRANSMISSION IN IDAHO.—The Moscow Electric Light & Power Company, Moscow, Idaho, have made arrangements with the Lewiston Water Power Company to furnish them with 1,000 hp for distribution in the territory north of the Clearwater River. This power will be generated by a large water-power plant to be installed at the mouth of the Grand Ronde River and will be taken to Moscow, Genesee and other towns at a pressure of over 20,000 volts on a three-phase circuit. The current will be furnished twenty-four hours in the day. It is expected that power can be delivered in Moscow and Genesee by July 1, as construction work will begin by April 1 on the lines from Lewiston, and power will be supplied from the present plant of the Lewiston Company at Asotin until the large plant at the Grand Ronde can be installed. Engineers and surveyors have been at work on the plans since last fall and a plant will be installed that will cost nearly $1,000,000. Twenty-five thousand hp can be developed at the proposed plant, so there will be plenty of power to supply all that will be needed for some time to come. It is reported that a contract has been made with the large Word Flouring Mills at Genesee for power to run their mills and elevator twenty-four hours per day and also with the city for lighting the streets and pumping the water for the new waterworks plant to be installed this summer. Mr. M. J. Shields, president, and Mr. E. S. Aldrich, manager of the Moscow Electric Light & Power Company, state that they have been negotiating with Mr. Libby, of the Lewiston Company, for nearly a year, and have every assurance that the current can be delivered in Moscow by not later than August 1 of the present year. They also state that they will be able to save the city of Moscow at least 25 per cent. in pumping the city water, which will amount to a large sum when the new sewer system is put into operation as it will require at least double the water to be pumped that is being pumped now. The present steam plant will, of course, be held as a reserve power, but it is not expected that it will ever be needed as current has been on the lines of the present plant ten miles from Lewiston all the time for eighteen months and only one interruption of ten minutes has occurred.

ALLIS-CHALMERS DATA.—A great deal of interest is naturally being taken in the electrical field, in the advent of the Allis-Chalmers Company into it, not only as builders of reciprocating engines and other heavy mine and mill machinery, but of steam turbines, hydraulic turbines, gas engines and electrical apparatus. The acquisition of the Bullock Electric Manufacturing Company has also again attracted attention, as putting the company in line for immediate work of all kinds, including street railway motors. The capital stock issue of the Allis-Chalmers Company is $36,250,000 and of the Bullock Company $3,600,000, making a combined capital of $39,850,000. The total number of employees of the combined companies amounts to over 8,700 men. At the present time Allis-Chalmers are constructing for the Manhattan Elevated Railway system of New York about 100,000 hp in reciprocating engines having a capacity of from 3,000 hp normal to 12,000 hp maximum output. A duplicate of this important station is also being constructed for the Subway, New York.

ELECTRICAL EXPORTS.—The United States Department of Commerce and Labor has issued the figures in detail of January export trade. The total export of electrical machinery for the month was $455,091, as compared with $556,315 last year, while the total for the seven months was $2,892,251, as compared with $3,668,432 last year. The smaller demand was chiefly in England, where the amount was $875,431, or hardly one-half what was taken in 1903. The exports of electrical instruments of all kinds were $375,044 for the month, as compared with $239,234 in 1903. For the seven months the total was $3,177,106, as compared with $2,496,368 last year. The two items added together show $6,069,357, as compared with $6,164,800, so that on the whole the electrical export trade has been fully maintained despite the growth of American factories abroad.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, has recently greatly increased its manufacturing output in order to meet the heavy demands for the new telephone apparatus it is putting on the market. It has equipped its factory with considerable new machinery, including a number of large drill presses and full automatic Brown & Sharpe screw machines. The International Company has a full complement of special tools for manufacturing every distinct part of multiple switchboard central energy systems and generator-call exchange systems, including its improved self-restoring drop switchboard. Several recent heavy contracts are reported.

ILLINOIS TELEPHONE TUNNEL.—It is stated that President A. G. Wheeler of the Illinois Tunnel Company, which recently took over the assets of the Illinois Telegraph & Telephone Company, announces that bids for about 2,000 steel freight cars, to be operated in the tunnels underneath the downtown streets of Chicago, will be asked about March 15. Tentative operations are now being carried on in the tunnels where about twenty cars are already in service. Many of the large buildings and wholesale houses lying along the route of the tunnels are having connections cut into their basements. They will be ready to receive and deliver goods and supplies to and from railroad terminals and freight depots by July. President Wheeler also announces that since the preliminary work of the big tunnel company has been completed, the telephone plan will be pushed more vigorously. The company now has in the neighborhood of 5,600 automatic telephones in operation in the business district. Practically all business blocks have been wired for the new service and Mr. Wheeler expects that the present number of subscribers will have been doubled by July 1.

BELL TELEPHONE.—Boston advices say: "President Fish, of the American Telephone and Telegraph Company, during his recent Western trip, found the general business conditions of the Far West to be extremely satisfactory. There is no sign there of the distrust that is such a disturbing element in the East. The conditions of the Middle West are also favorable and the people confident. In Mr. Fish's opinion, the optimistic views of the West, which are justified by the situation there, will have a great influence in bringing about the restoration of normal financial conditions at a much earlier date than would be the case if the West shared to a greater extent the present somewhat unreasonable feeling of depression that seems to characterize the East. Mr. Fish reports the telephone situation as everywhere encouraging. About a quarter of a million new subscribers were added to the Bell system during the year 1903, and the growth still continues. The development on the Pacific coast is extremely satisfactory, the number of telephone subscribers there being enormously greater in proportion to the population than in any other part of the country."

SOME BUFFALO FORGE COMPANY ORDERS.—The Buffalo Forge Company, 39-41 Cortlandt Street, has secured a contract from the American Coke and Gas Company, of Pittsburg, for a small lighting equipment for one of its Ohio plants. The Buffalo vertical engine will be direct connected to a Westinghouse generator. Blackall & Baldwin, Taylor Building, New York City, have also placed an order for a small lighting set for use in William Crafts & Company's plant at Newark, N. J. The generator will be of Crocker-Wheeler manufacture. A small ventilating outfit has been ordered for the Hotel York, Thirty-sixth Street and Sixth Avenue. The motors will be of General Electric build.

EQUIPMENT FOR NEW GORHAM PREMISES.—The Gorham Manufacturing Company's new premises, at Thirty-sixth Street and Fifth Avenue, New York, are to be installed with several electrically operated pumps, fans, etc., in connection with the heating and ventilating system. There will be two 1½-in. Buffalo centrifugal pumps and two 5-in. x 8-in. triplex pumps of same build, direct connected to Crocker-Wheeler motors. The steel plate fans will be five in number, varying from 7½ ft. to 4 ft. The Buffalo Forge Company also secured the contract for these outfits, which will be driven by Crocker-Wheeler motors.

G. M. GEST, the expert subway contractor, of New York and Cincinnati, has been awarded the contract for the construction of a heavy 40-duct conduit system by the Public Service Corporation of New Jersey. This system will run into thousands of dollars in cost and is a main trunk feeder line running through Hoboken and Jersey City. Work is to be begun on the 15th of March and a large force of men is to be employed to push the work rapidly. Mr. Gest has also closed with the B. M. & J. F. Shanley Co., of Jersey City, a contract for laying its conduits in Harrison, N. J., and Kearney, N. J.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Northern Illinois Lighting & Traction Company at Ottawa, Ill., for the installation of a battery of "Chloride" accumulators having a capacity of 160 kw-hours. This battery is to be used for current regulation. Contracts have also been closed for residential lighting and power plants for H. B. King, Prides Crossing, Mass., and Dr. C. E. Parker, Princeton, Mass., and with Frederick L. Milliken at Milton, Mass., for an isolated lighting plant.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., successor to the Christensen Engineering Company, manufacturer of air brake and electrical machinery, has just moved its executive offices and engineering department to its new building located at the works. The building is constructed of cement blocks 2 ft. long by 1 ft. high and is 200 ft. long x 66½ ft. wide. Extensions and improvements are also being made in the company's shops to supply the necessary facilities for handling its constantly increasing business.

LIGHTING EQUIPMENT FOR MEXICAN SUGAR PLANT.—The Reeves Engine Company, of Trenton, N. J., New York offices, Singer Building, has taken an order for a vertical cross compound engine for direct connection to a Crocker-Wheeler generator to be installed for the purpose of lighting the Panuco Sugar Company's plant at Tampico, State of Vera Cruz, Mexico. A 400-hp Reeves vertical cross compound engine, for direct connection to a centrifugal pump, has been ordered for a large rice plant near Houston, Tex.

WESTINGHOUSE EQUIPMENT FOR BRITISH STEEL WORKS.—The British Westinghouse Electric & Manufacturing Company, Limited, has been awarded the contract for the electrification of the extensive steel works operated by the Carnforth Iron & Steel Company, Limited. The Carnforth plant is being remodeled on American lines, Julian Kennedy, Sahlin & Co., Limited, London, of which Julian Kennedy, the well-known American metallurgical expert is one of the principals, having undertaken the work.

EQUIPMENT FOR NEW JERSEY NEWSPAPER PLANT.—The printing plant of the *Freie Zeitung*, at Newark, N. J., is to be electrically operated throughout. In the meantime, an order has been given for a lighting equipment. MacKenzie, Quarrier & Ferguson, 114 Liberty Street, acting on behalf of the Harrisburg, Pa., Foundry and Machine Works, secured the order for the engine, which will be direct connected to a Westinghouse generator.

PHILLIPS' CANADIAN FACTORY.—The Eugene F. Phillips Electrical Works, Limited, Montreal, Canada, intend adding to their factory plant the coming season one building 275 by 60 ft., one story high, and another building 180 by 60, three stories. The plant will be erected in the town of St. Louis. Nothing has been decided on yet as regards power. Mr. Geo. H. Olney, 2d, is the resident secretary and treasurer.

MEXICAN MINES.—The American-Mexico Mining and Development Company, which owns large mining interests in the vicinity of Torreon, Mexico, is to install a $50,000 electric plant at its Velardena Camp, for the purpose of lighting and operating the mines. Dr. W. S. Phillips, of Chicago, Ill., is president of the company. Dr. A. T. Grove, also of Chicago, is secretary-treasurer.

ALBERGER CONDENSERS FOR TESTING.—The Alberger Condenser Company, White Building, Liberty Street, New York, has secured a contract for two large high vacuum condensing equipments with two-stage vacuum pumps for installation in the turbine testing rooms of the Westinghouse Machine Company. They will be utilized to test turbines varying from 4,000 kw to 5,500 kw capacity.

AMERICAN TELEPHONE ORDERS.—Among switchboard shipments recently reported by the American Electric Telephone Company, of Chicago, are the following: Kenton, Ohio, one 100-line express; Adrian, Mich., one 100-line express; Three Lakes, Wis., one 25-line express; Muscatine, Iowa, two 100-line express; Frankford, S. Dak., one 100-line express.

INTERBOROUGH PACKAGE EXPRESS.—The question of operation of a package express on Interborough lines has been receiving consideration from Interborough interests. The question of a contract with the United Express Company has not, however, been brought formally before directors of the Interborough Rapid Transit Company.

PLANT FOR MEXICAN PLANTATION.—The Mexican Tropical Planters' Company, which possesses a large property known as the Columbia plantation, located on the Coatzaconlcos River, Isthmus of Tehuantepec, is about to be in the market for a large electric lighting plant. Mr. Louis Kunz is the general manager.

CONTRACT FOR MONCLOVA.—The contract has been let for the lighting and power plant for the city of Monclova, State of Coahnila, Mexico. Victor M. Braschi & Bro., of Mexico City, will undertake the work. The plant will entail an expenditure of about $100,000 gold.

PLANT FOR CUBAN SAW MILLS.—The Mackay Engineering Company, Singer Building, Broadway and Liberty Street, New York, has taken a contract for a complete electric plant to be used for lighting and operating large saw mills at Santiago de Cuba.

APPARATUS WANTED.—The Weston West Virginia Electric Light, Power & Water Company is in the market for a 300-hp steam turbine direct-connected to two 100-kw direct-current generators, 125 volts. Mr. J. S. Mitchell should be addressed on the subject.

CHICAGO TELEPHONE COMPANY shows for February a gain of 1,724 Bell instruments, making the total of subscribers in the system 104,368.

THE WATERBURY BATTERY COMPANY, of Waterbury, Conn., have increased their capital stock from $10,000 to $50,000.

General News.

THE TELEPHONE.

HANFORD, CAL.—The Independent Telephone Company has been incorporated with a capital stock of $25,000 to build a line from Lemoore to Hanford, a distance of ten miles. The incorporators are: H. L. McCubbin, P. Carrasco, and J. Mills.

WASHINGTON, D. C.—In the District appropriation bill which is now before the House, there is a paragraph relating to telephone service in the District. An amendment thereto has been offered by Mr. Bartlett, providing that none of the money appropriated shall be paid except at the following rates: $50 per annum for the use of a telephone on a single wire; $40 for each telephone where there are two in a wire; $30 where there are three; and $25 each where there are four or more on the same wire.

SEYMOUR, IND.—The Seymour Home Telephone Company is installing a 500-line board of the new lamp signal type manufactured by the Sterling Electric Company, of Lafayette, Ind.

SELMA, IND.—The Selma Co-operative Telephone Company has decided to purchase property for a new exchange. It will install a new switchboard and otherwise improve its plant and service.

MONROE CITY, IND.—The Wabash Home Telephone Company, operating an exchange and system in this city, has increased its capital stock $25,000. The corporation will make extensive improvements in the exchange and extend its lines during the present year.

ETHEL, IND.—The Morning Star Telephone Company has incorporated for the purpose of installing an exchange and telephone system in this city, Crawford and adjoining counties. The capital stock is $5000. The incorporators are: Joseph R. Allen, of Ethel; W. H. Williams and William J. Truly, of Traswell.

WARREN, IND.—The Warren Telephone Company's plant has been sold to George Griffith and Frank Canaday, who will organize a new company. The plant has been in operation for five years and includes a number of country lines. The new management will take charge April 1, when a general system of improvement will be begun.

SALAMONIA, IND.—The Salamonia Telephone Company has filed articles of incorporation with the Secretary of State. The company proposes to install an exchange and erect and operate telephone lines in this city and throughout Jay County. The capital stock is $5200. H. E. Barting, J. J. Kidder, John W. Crull and others are the incorporators.

NEW PALESTINE, IND.—The New Palestine Telephone Company, which operates a telephone system in the southern part of Hancock County, has planned to extend its lines into the northern part of Shelby County. A new metallic circuit will be put in, also a new switchboard in the exchange. The company has increased its charges from $1.20 to $2.

TERRE HAUTE, IND.—An important meeting was held in this city on March 2 by the representatives of independent telephone exchanges in eastern Illinois and western Indiana, representing a total of 14,000 telephones. The purpose of the meeting was to arrange a uniform long distance rate. Plans were made and a secretary employed to give his entire time to the unifying of distance and applying the schedule of rates thereto.

SCHLESWIG, IA.—The Schleswig Telephone Company will build 30 miles of new line.

CAMBRIDGE, IA.—The Cambridge Independent Telephone Company will extend its system during the coming season.

VAN WERT, IA.—The Van Wert Rural Telephone Company has elected officers as follows: President, F. L. Hall; vice-president, J. F. Hockler; secretary, H. O. Tuttle; treasurer, F. O. Stearns.

LAKE CHARLES, LA.—Application has been made to the City Council by W. C. Easterling and W. C. Pfeiffer, representing Pennsylvania capitalists, for a franchise for installing a telephone system here.

GRAND HAVEN, MICH.—The Michigan Telephone Company is extending its lines from this city into the townships of Grand Haven, Robinson and Olive, and will expend several thousand dollars in extension work.

DETROIT, MICH.—The receiver of the Michigan Telephone Company will, about March 15, turn over the property of the concern to President W. A. Jackson, of the Michigan State Telephone Company, its successor.

NEW YORK MILLS, MINN.—A telephone company is being organized in this place.

GRANITE FALLS, MINN.—A farmers' telephone company has been organized at Stony Run.

TORDENSKJOLD, MINN.—A farmers' telephone company is projected here. Mr. E. E. Olson is interested.

VERNON, MINN.—The Farmers' Interurban Telephone Company has been incorporated with a capital stock of $50,000. The directors are B. C. Roe, A. S. Berge and others.

MONTROSE, MINN.—The Montrose Farmers' Telephone Company, of Montrose, Wright County, has been incorporated with a capital stock of $10,000, the incorporators being: C. A. Stolyman, A. C. Strey, E. W. Swanson, F. E. Belden, C. P. Stapleton, J. P. Thornquist, Louis F. Miller, F. G. Miller and C. F. Denvon, Montrose.

HARRISONVILLE, MO.—The Cass County Telephone Company has been incorporated with a capital stock of $50,000. The directors are R. W. and D. Adams.

ST. LOUIS, MO.—The Bell Telephone Company announces that beginning March 1, in the unlimited residence service, the direct line which has been $72 a year was reduced to $60, and the duplex line (two telephones on one line) was reduced from $48 to $42 a year. The charges for these services were at one time $80 and $60 a year. No other rates are changed. The Kinloch Telephone Company has recently made a $36 rate for its unlimited service, two-party residence telephones. Its one-party line, unlimited service rate remains $48. The Kinloch Company is rapidly extending its long-distance service and expects to connect with the system of the United States Telephone Company in Ohio before the opening of the World's Fair. Its lines are now within seventeen miles of the Ohio State line. When they reach Ohio and join those of the United States Telephone Company, they will be connected with 80,000 telephones east of Indiana. The company then will be able to reach Philadelphia and Buffalo and nearly all principal points in the interior of New York and Pennsylvania. In less than one month the lines will be connected with one of the telephone companies in Kansas City, and through its wires, with all important points in Kansas. These wires also reach St. Joseph and North Missouri. The line to Joplin is nearing completion. This line will give connections in Oklahoma, Indian Territory and Texas.

BARTLEY, NEB.—A new telephone company has been formed here.

KENESAW, NEB.—Mr. S. A. Westing is interested in a proposed telephone exchange in this place, which is to be organized with a capital stock of $10,000.

ALBANY, N. Y.—The Conesville & Gilboa Telephone Company, of New York, has been incorporated with a capital stock of $1000. The incorporators are: J. W. Gaylord, B. C. Wright and Elmer Baker.

TREADWELL, N. Y.—The Treadwell Telephone Company has been incorporated with a capital stock of $3000. The incorporators are: Robert Ballantine, Duane D. Wheat, of Treadwell, and U. R. Ogden, of Leonta.

NEW YORK, N. Y.—The New York Telephone Company will install a new exchange at 22 Cortlandt Street, to be called "Liberty." The new exchange will relieve the Cortlandt exchange of several hundred subscribers. Other down-town exchanges will also be relieved in a similar manner.

UTICA, N. Y.—At the recent annual meeting of the boards of directors of the Central New York Telephone & Telegraph Company and the Empire State Telephone Company, officers were elected as follows: For the Central New York Company—President, U. N. Bethell, New York City; vice-president; Joseph Rudd, Jr., Utica; secretary and treasurer, Francis G. Wood, Utica; chairman of the board of trustees, Charles F. Cutler, New York City. For the Empire State Company—President, U. N. Bethell; secretary and treasurer, Francis G. Wood; chairman of the board, Charles F. Cutler. No vice-president was elected.

COLUMBUS, N. C.—The Columbus Telephone Company is completing the installation of metallic circuits, thus affording long distance connections through the Bell Company with many outside points.

CHAGRIN FALLS, OHIO.—The exchange of the Chagrin Falls Telephone Company was destroyed by fire recently.

ADAMSVILLE, OHIO.—The Adamsville Telephone Company has been incorporated with a capital stock of $1000.

BRITTAIN, OHIO.—The Springfield Township Rural Telephone Company has been organized with a capital stock of $10,000. The incorporation papers are to be applied for at once.

COLUMBUS, OHIO.—The Waldo Home Telephone Company, of Waldo, has been incorporated with a capital stock of $25,000. The company will build systems in Marion, Union, Delaware and Morrow counties. The incorporators are: William Klingel, M. Lewis, A. Oborn, W. D. Kraemer and Sam Schwaderer.

TIFFIN, OHIO.—The Home Telephone Company, which recently increased its capital stock from $60,000 to $125,000, has changed its name to Tiffin Home Telephone Company. New officers have been elected as follows: President, F. B. Myers; vice-president, K. F. Briggs; treasurer, James J. Kintz; secretary and superintendent, Edwin R. Strohm.

SHIPPENSBURG, PA.—The subscribers of the United Telephone Company in this city are objecting to the discontinuance of free service to Carlisle and Wainsboro after April 1. The company proposes to charge tolls for conversations between the points named.

PORT BOLIVAR, TEX.—Messrs. Tuggle and Kitchen, of this place, are constructing a telephone line from here to High Island.

BELTON, TEX.—The Moody Telephone Company, of this place, has been granted a franchise to extend its lines through portions of the country.

SAN MARCOS, TEX.—The franchise of the Southwestern Telegraph & Telephone Company in this place has been declared forfeited by the City Council.

EL PASO, TEX.—Sam Byrne and S. Nicholls, of De Soto, Mo., are investigating the independent telephone situation here with the view of acquiring the uncompleted plant of the local system, which was started by Mrs. Brett. If the consent of the city authorities can be obtained, the system will probably be rehabilitated and completed.

CHRISTIANA, WIS.—The Christiana Farmers' Telephone Company has been incorporated, the directors being P. O. Nelson, S. Haight and others.

SILVER CITY, N. MEX.—It is announced that the Grant County Telephone Company, of this place, will build a long distance telephone line to the different mining camps situated in the Burro Mountains. This company now has an extensive telephone system, extending to all the leading mining camps and towns in the southwestern part of New Mexico.

TORONTO, ONT.—The Stark Telephone, Light & Power Company has applied to the city of Toronto for the privileges of establishing a telephone, light and power service within the city limits, and to obtain the right to lay down conduits, wires and cables, and where necessary to erect poles and string wires. The company promises to give a telephone service at $6 per year, and one cent per outgoing call for telephones in private houses, with a limit of $15 per annum. The rate for business telephones is to be $6 per annum and one cent per call, with a limit of $35 per annum. The company also promises reduced rates for light and power. It has already secured over 4000 telephone subscribers, and will proceed at once to install its system.

Electric Light and Power.

SAN DIEGO, CAL.—The City Council has granted Charles E. Sumner, of Cleveland, O., an electric light and gas franchise. Mr. Sumner is supposed to be backed by H. E. Huntington, of Los Angeles.

RIVERSIDE, CAL.—The City Trustees are considering a proposition to establish a municipal electric light plant. The Tracy Engineering Company, San Francisco, has submitted a definite proposition to the trustees.

EUREKA, CAL.—The Eureka Lighting Company, it is stated, will at once begin the development of its water power on Trinity River, for the purpose of generating electric power. The plans contemplate the expenditure of nearly $500,000.

WHEATLAND, CAL.—The power line which the Bay Counties Power Company is building from the power house at Nimshew is nearly completed and will reach Colgate in the near future. The necessary equipment for the proposed extension has already arrived.

SAN FRANCISCO, CAL.—An additional generating equipment of 400-kw., in two units, will be installed in the isolated electric plant in the basement of the Rialto Building. The 500-hp boiler plant will be supplied through the California Engineering and Construction Company, the contract calling for three Franklin boilers of the Heine water-tube type. A new seven-story hotel to be erected on Market Street, adjoining the Palace, will be supplied with electric light and power from this plant, as well as the Rialto Building annex.

SAN FRANCISCO, CAL.—The Big Creek Power Company, of Santa Cruz, Cal., C. E. Lilly manager, has closed a contract for an additional Westinghouse alternating-current generator of moderate capacity. The Power Company contemplates the erection of an additional generating station at Chittenden from which it can supply light and power to Watsonville, Gilroy and Hollister. If satisfactory terms can be obtained for fuel, a large steam plant will be installed and fuel oil will be piped in from the Watsonville Oil Company's wells. The present plant is operated by water power and is inadequate to supply the demand.

SAN FRANCISCO, CAL.—The Watsonville Light & Power Company, which has been incorporated by C. W. Waller, A. W. Linforth, F. M. Ray, J. C. Love and J. H. Foote, with a capital stock of $250,000, is controlled by John Martin and other representatives of the California Gas & Electric Corporation. The latter company, which owns numerous lighting plants in Northern California, has only one as far south as Fresno, but the new acquisition may result in extending the system southward along the coast. The Watsonville Light & Power Company will absorb in Watsonville two gas companies and the Watsonville Electric Light Company's steam plant, installed by F. M. Smith.

COLORADO SPRINGS, COL.—The Colorado Electric Power Company is made the defendant in a foreclosure suit brought by the Union Trust Company, of Pittsburg, as trustee. The suit is to recover $2000 and interest, which with other claims brings the total up to $226,700.

WASHINGTON, D. C.—Bids will be received March 22 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the Navy Yards, Portsmouth, N. H., and Boston, Mass., a quantity of steel-plate fans, blowers, electric motors, arc lamps, rubber and lead-covered wire and cable, conduit and fittings, electrical supplies, iron pipe, pipe fittings, valves, etc.; also April 5 at the Navy Yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of electric blowers, motor generator set, conduit and fittings, electrical supplies, iron wire, galvanized sheet steel, wrought iron pipe, rivets and asbestos cement, Portland cement, etc. H. T. B. Harris, Paymaster-General, U. S. N.

COVINGTON, GA.—C. C. Brooks, of Covington, writes that it is proposed to develop the water power of Alcova River at a cost of $100,000. The company is not yet organized.

BLUE RIDGE, GA.—E. B. Garwood, manager Blue Ridge Electric Light & Power Company, writes that it is proposed to construct a larger plant for lighting and power, to be operated by water.

BELLEVILLE, ILL.—A mortgage for $350,000, to cover an issue of bonds to that amount, was filed in the St. Clair County Recorder's office in this city, March 1, by the East St. Louis Trust & Savings Bank, trustees for the Muskogee Electric & Gas Company of Indian Territory. The East St. Louis Trust & Savings Bank probably will float the bonds.

ALTON, ILL.—A movement is on foot in North and Upper Alton to secure a joint lighting plant of their own, and thus be independent of the Alton Light & Traction Company, which is now furnishing current to both towns at what is considered an exorbitant price. The idea is to locate the power house midway between the two towns, which are only a few miles apart, and to secure a plant sufficiently large to fill the needs of both places. The town of Grafton has just made a lighting contract for ten years whereby the village secures an all-night service every night in the year for about $30 per light.

MONTICELLO, IND.—The Tippecanoe Power Company has purchased from Bradner & Smith what is known as the Tioga Paper Mill site at Tippecanoe Falls, near Monticello, Ind. The 100 acres adjacent to the falls is being cleared of timber to make locations for factories. The plan of the company is to develop 5000 horse-power from the falls. Two dams will be built. Theophilus King, banker, Boston, Mass., is at the head of the company.

LONDON, KY.—The London Electric Light Company has been chartered, with R. M. Jackson president.

BALTIMORE, MD.—A bill has been introduced in the House at Annapolis providing for the municipal ownership of an electric lighting plant in this city. The question whether the plant shall be established, and the debt therefor contracted, will be submitted to the voters at the general election in 1905.

BROWNING, MO.—Carl Thudium, of Brookfield, is interested in the construction of an electric light plant.

ST. JAMES, MO.—Chas. W. Orendorf and J. W. Scott, of St. Louis, have secured a franchise from the City Council for an electric light plant, also right of way through the town and depot facilities for an electric road to be constructed from Jefferson City to a point on the Mississippi River opposite Chester, Ill.

COLUMBIA, MO.—The citizens have voted to issue $100,000 bonds for the purchase by the city of the water works and electric light plants owned by the Columbia Water & Light Company. The plant will be purchased for $67,000, will be improved and a system of deep wells installed.

ST. LOUIS, MO.—A municipal plant for lighting that portion of the city south of Keokuk Street is being planned by the city officials. The introduction of an ordinance providing for the plant hinges upon the amount of money demanded by the police board. Should the amount required for the police not be excessive, it is thought that the city can afford the $140,000 which will be needed to erect an electric lighting plant. The location of the plant has already been selected. It is intended to place it on the river front, between Elwood and Kraus streets. The territory whch it is intended to light is now divided between the Carondolet Gas Company and the Welsbach Lighting Company. The first company receives $54,000 annually and the latter $5000.

WEBSTER, N. H.—Horace J. Davis, of Contoocook, general manager of the Blackwater Power Company, writes that it is proposed to develop the power of Blackwater River at Webster.

WEEHAWKEN, N. J.—The Committee on Lighting has been directed to have plans prepared for an electric light plant for the township, to be installed in the new pumping station at a cost of about $5000.

NIAGARA FALLS, N. Y.—It is stated that the Toronto & Niagara Falls Power Company has decided to use steel towers for its transmission line between Niagara Falls, Ont., and Toronto. The towers will be 8 or 10 feet square at the base and about 50 feet high, and will be placed at intervals of 400 feet.

NEWBURGH, N. Y.—Mr. T. E. Hayes, of Middletown, has been appointed receiver for the Neversink Light & Power Company, which has a plant at Rose's Point, near Cuddebackville. The appointment of a receiver is the result of the action brought by Mr. Hayes to recover on a promissory note upon which judgment was taken and sequestration proceedings instituted. The Neversink Light & Power Company began business about a year ago and has furnished power to Port Jervis for street lighting, also for the electric railway operated by the Port Jervis Gas, Electric Light & Power Company.

FAYETTEVILLE, N. C.—The Cape Fear Electric Power Company is laying the foundations for a sub-station in Fayetteville for the transmission of power from the river to the town, to be utilized in mills and other industries.

ASHEVILLE, N. C.—The Biltmore estate, near Asheville, has been furnished power for the first time over the transmission lines of the W. T. Weaver Power Company's plant. The power, however, does not come from this company's plant, which will not be ready to furnish the same until April 1, when the Biltmore estate will take 250 horse-power and the Asheville Electric Company will take 600 horse-power.

GLACE BAY, N. S.—Glace Bay about two years ago installed an electric light system which is owned and operated by the town. The people have been given a good electric service, cheap light, and on the operation last year the town cleared the sum of $1,800 over and above operating expenses.

BRIDGEWATER, N. S.—The town of Bridgewater earned last year, through its electric light plant, which is municipally owned and operated, over $1,700 above expenses, and the saving thus enabled the town to have its streets lighted, water for fire protection and good sewerage without cost to the town.

CLEVELAND, OHIO.—The contract of the city with the Cleveland Electric Illuminating Company fixes a price of $75 per arc per year.

BELLEFONTAINE, OHIO.—The Board of Public Service has received plans for the municipal electric light plant, which, it is estimated, will cost $10,000.

YORK, PA.—The floods during the first week of the month caused damage to the power plant at York Haven to the extent of about $5000.

CHAMBERSBURG, PA.—The Shippensburg Electric Light, Heat & Power Company has been amalgamated with the Shippensburg Gas & Electric Compand. The new combination has a capital of $45,000.

YORK, PA.—The directors of the recently chartered Deer Creek Water & Power Company have effected an organization by the election of the following named officers: President, James H. Gable, of York; vice-president, J. Benson Gable; secretary, J. N. Wilson; treasurer, Charles F. Ramsey; superintendent of construction, J. K. Green, of York. The company proposes to construct a dam and power plant on Deer Creek, one mile from Stewartstown, for the purpose of furnishing water power and electric light to Stewartstown and vicinity.

SHERBROOKE, QUE.—The City Council has accepted the offer of the Heat, Light & Power Company for its plant, for $233,000, but before the contract is made with the company the question will be submitted to the property holders for their approval.

CARTHAGE, TENN.—Dr. Drake is interested in the construction of an electric light plant.

FARMERSVILLE, TEX.—The Farmersville Mill & Light Company has been organized, with a capital of $50,000. H. L. Carver and E. W. Stewart are interested.

TOOELE, UTAH.—The Clark Electric Company, of Tooele, is considering the installation of an electric light plant near Richfield.

EMPORIA, VA.—The Greenesville Water Power Company has been incorporated at Emporia, Va., with a capital of $10,000 to $50,000. W. Samuel Goodwyn is president of the concern.

BELLINGHAM, WASH.—The Likens-Wyatt Power Company has been granted a franchise to establish and operate a power plant in this city.

WAUPACA, WIS.—The Waupaca Electric Light & Power Company has increased its capital stock from $75,000 to $125,000.

OMRO, WIS.—The Omro Electric Light Company has been incorporated with a capital of $10,000.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The directors of the Birmingham Railway, Light & Power Company have issued a call for a meeting of the stock-holders, to consider the proposition of negotiating a loan of $1,000,000 for improving the system. The company proposes to double the capacity of the electric power plant and the gas plant, and to make extensions and improvements on its street railway system.

STONINGTON, CONN.—The contract for the building of the Groton & Stonington Street Railway has been awarded to the John B. Macafee Company, of Philadelphia. The contract includes the power station complete.

HARTFORD, CONN.—The Hartford Street Railway Company has applied to the municipal authorities for approval of its plans to extend its lines within the city limits. The company has also under contemplation the extension of its suburban lines.

BRIDGEPORT, CONN.—The Connecticut Railway & Lighting Company is enlarging its power station for the Bridgeport division of its system. The plant has been extended and an 800-kw generator, directly connected with a 1200-hp engine, is now being installed. It will be at least two months before the new generator will be ready for use. The plant will then have a capacity of 3600 horse-power, and will supply power, not only for the local lines, but for the Milford and Westport branches.

MATTOON, ILL.—The promoters of the Mattoon-Charleston Electric Railway will in all probability construct a line between this city and Champaign, as a continuatinn of the former line.

ROCK ISLAND, ILL.—The Tri-City Railway Company is perfecting plans for concentrating all its power generating plant into one large station on the site of the present plant in First Avenue, Rock Island, from which it will be able to furnish current for the operation of all its lines in the three cities. At the present time the Rock Island plant only furnishes sufficient power for the operation of the cars on the Illinois side of the river, and it has been found necessary to obtain power from the People's Power Company for the operation of the lines in Davenport. The improvements will involve a large investment of capital.

WARSAW, IND.—The City Council has granted a franchise to the Goshen, Warsaw & Winona Electric Railway. Cleveland capitalists, headed by J. B. Hanna, are behind the project, and there is no doubt about the immediate building of the road.

WABASH, IND.—The contract for all the material to be used in the completion of the Wabash & Rochester Electric Railway has been awarded to a New York firm. The contract includes rails and overhead work, power house machinery and cars. The work of grading for the road began March 1.

FT. WAYNE, IND.—The Ft. Wayne, Logansport, Lafayette & Lima Traction Company has filed amended articles of association with the Secretary of State, changing its name to the Ft. Wayne & Wabash Valley Traction Company. The articles also provide for the extension of the system to Goshen, Elkhart, Mishawaka, South Bend, Ligonier and other places. The directors of the newly-formed company are: H. C. Paul, J. L. Jones, Randall Morgan, Bayard Henry, S. B. Fleming, James Murdock and G. F. McCulloch.

DUBUQUE, IA.—At the recent annual meeting of the stockholders of the Union Electric Company, held in this city, a plan of procedure was mapped out for the improvements which are to be made to the property. All the tracks, both inside and outside the city limits, will be relaid and the roadbed placed in first-class condition, and a new power house will be built and improvements made in Nutwood Park. The new power house will be of such capacity and facilities that ample power will be furnished for the operation of the street railway system and the electric light plant, and the entire system will be as modern as it is possible to make it.

WORCESTER, MASS.—Claims against the Worcester & Southbridge Street Railway Company were filed recently with Charles M. Thayer, one of the receivers. A greater portion of the claims will be settled on a 50 per cent. basis through a syndicate, which plans to operate the road. Several persons, however, have refused to settle on that basis.

MIDDLEBORO, MASS.—John T. Burnett, of Southboro, and John L. Hall, of Boston, have been appointed receivers of the Middleboro, Wareham & Buzzard's Bay Street Railway Company. The appointment was the result of a suit brought by the American Electrical Works, one of the company's creditors. The receivers have been authorized to operate the road.

OWOSSO, MICH.—The Owosso & Corunna Traction Company has sold its line to a Pennsylvania syndicate that controls a number of lines around Allentown, Pa., and also has control of the public lighting franchise in the city of Flint. The new company has secured an extension of franchise rights in Owosso and Corunna, and will also extend the road to Durand.

BENTON HARBOR, MICH.—The Kalamazoo & Lake Michigan Railroad Company will have 66 miles of interurban road, from Kalamazoo to Benton Harbor, Mich., constructed this year by the Western Engineering & Construction Company, Chicago. G. A. Mullins is general manager, and Eric Wolff is chief engineer and general superintendent. Contracts are now being let. The road will have five sub-stations. Two direct-connected 1000-kw units will be installed in the power house.

KANSAS CITY, MO.—The Fifteenth Street line of the Metropolitan Street Railway Company is to be extended to Centropolis.

RENO, NEV.—It is officially stated that the new electric railway between Reno and East Reno is an assured fact, and that work is to begin immediately. J. B. O'Sullivan, president, states that the material for constructing the line has been shipped.

RALEIGH, N. C.—The Raleigh Electric Street Railway is considering a proposition to build a 28-mile line to Durham.

JAMAICA, N. Y.—The New York & Long Island Traction Company has filed in the Queens County Clerk's office its franchise granted by the Board of Aldermen, permitting it to lay about 25 miles of track in the town of Jamaica over three routes extending in an easterly and westerly direction.

NEW YORK, N. Y.—William G. McAdoo, president of the New York & New Jersey Railroad Company, which is building the tunnel recently completed, from Jersey City to New York, has sent to the Rapid Transit Commission an application for permission to extend the New York spur of that tunnel up to Sixth Avenue and Thirty-third Street. According to the plan he proposes, the tunnel will continue from West Tenth and Greenwich Streets, where its terminal originally was projected, in a northeasterly direction under West Tenth Street to Sixth Avenue, and then straight up the avenue to Herald Square.

NIAGARA FALLS, N. Y.—The International Railway Company's new power house in North Tonawanda has been completed and is now in operation. The power plant supplies energy for the Buffalo & Niagara Falls line from La Salle to the Buffalo city line; the Buffalo & Lockport Railway from the Buffalo city line to Lockport, and the Buffalo & Kenmore line from the Buffalo city line to Gratwick. The equipment is of the General Electric Company, and consists of three 350-kw rotaries. There is also a 1200-ampere-hour battery which was installed by the Electric Storage Battery Company. The International Company's new power house in Lockport is also in operation. This plant takes care of the Lockport-Olcott line; the local street railway and the Gulf branch. It also supplies power for the Buffalo-Lockport line from Lockport to North Tonawanda. In this plant are installed two 350-kw rotaries and an 1800-ampere-hour battery.

NEW YORK, N. Y.—Borough President Littleton, of Brooklyn, made public his plans for the proposed municipal elevated railroad to connect the terminals of the Brooklyn and Williamsburg bridges on both sides of the river. The suggested road is to be built, owned, and operated by the city. Mr. Littleton's plan provides for the construction of an elevated road through Centre and Delancey Streets, in Manhattan, connecting the termini of the two bridges, with stations at the terminal of the Brooklyn Bridge, Centre and Worth Streets, Centre and Howard Streets, Delancey Street and the Bowery, Delancey and Allen Streets, and the terminal of the Williamsburg Bridge. The proposed railway would cross the Williamsburg Bridge to South Fifth Street, Williamsburg, up this street to Union Avenue, and to Broadway to Throop Avenue to Willoughby Avenue, through Fort Greene Park by a tunnel under the hill to Willoughby Street, to Fulton, to Washington, to the Brooklyn terminal of the Brooklyn Bridge. The proposed road would be partly a four-track and partly a two-track structure, and there would be eight stations on the line in Brooklyn. Mr. Littleton and Commissioner of Public Works John C. Brackenridge estimate that the proposed railroad would cost about $10,000,000. They figure that with a three-cent fare it would pay 3½ per cent. on the bonds and leave a net profit of nearly a quarter of a million dollars each year.

MONESSEN, PA.—The Webster, Monessen, Belle Vernon & Fayette City Street Railway will extend its line to Fayette City.

HARRISBURG, PA.—A charter has been granted at the State Department to the Wayne Electric Street Railway Company, capital $6000, to build a one-mile line at Wayne.

CHAMBERSBURG, PA.—The Chambersburg & Gettysburg Electric Railway Company has secured an option on a property in this town which is to be used as a site for a power house.

ELWOOD CITY, PA.—A franchise has been granted to the Elwood City Electric Street Railway Company. This railway will connect with the Newcastle and Beaver Falls lines at Whitedale, three miles west of this place.

LANCASTER, PA.—A charter has been granted to the Strasburg & Georgetown Street Passenger Railway Company, capital $6000, to build a one-mile line from Strasburg turnpike along the Georgetown public road. This is to be part of the system to connect this city and Philadelphia. Albert H. Swing, of Coatesville, is president.

WEST CHESTER, PA.—It is reported that a plan is being considered for the merging of the interests of the West Chester Street Railway Company with those of Wilmington capitalists who have franchises in that city, and to the Delaware line, the combined company to construct and operate an electric railway between Wilmington and Lenape.

LANCASTER, PA.—A conference has been held between representatives of the Lancaster & Quarryville Trolley Company and the Conestoga Traction Company regarding a connection with the Strasburg line at Elliott's Corner. The new line will follow the Big Spring and Beaver Valley pike from Repton to Elliott's Mill. The route is now being surveyed.

MONTREAL, QUE.—Dr. Payette, of this place; J. E. E. Dickson, of Westmount, and H. Fontier, of Montreal, are applying for a charter to build an electric railways through the counties of Hochelaga, Jacques Cartier, Laval, Two Mountains, Argentine and Terrebonne.

PROVIDENCE, R. I.—An act to incorporate the Worcester & Providence Street Railway Company was introduced in the House of Representatives and referred to the Committee on Corporations. The act authorizes the issuing of $1,000,000 of capital stock and the issue of bonds for a like amount; also authorizes the company to acquire land by condemnation and to lease and buy other railroads.

OGDEN, UTAH.—The Ogden Rapid Transit Company has been granted a franchise to operate a street railway system through some of the most important streets of the city.

NORFOLK, VA.—Mr. R. I. Mason, receiver for the Hampton Roads Electric Railway, will, it is reported, apply for permission to issue $150,000 of receiver's certificates to complete the road.

WALLA WALLA, WASH.—James Galloway has asked the City Council for a franchise for an electric street railway, claiming that he represents eastern parties in the enterprise. The Council has previously been troubled with unreliable promoters and has required that Galloway make a deposit of $2000 as evidence of good faith.

MANITOWOC, WIS.—The Fond du Lac & Northeastern Electric Railway Company has made application for a franchise to enter this city.

NEW INDUSTRIAL COMPANIES.

THE RICE & BALDWIN ELECTRIC COMPANY, of Hartford, Conn., has increased its capital stock from $10,000 to $20,000.

THE TROY TELEGRAPH CONSTRUCTION COMPANY, New York, has been incorporated; capital, $10,000. Directors: Thomas L. Hughes, L. B. Grant and Ashley T. Cole, New York.

THE THIRD RAIL SAFETY SIGNAL COMPANY, New York, has been incorporated; capital, $25,000. Directors: G. F. Balentine and A. P. Nevin, New York, and Otto Ernst, Larchmont.

THE ADAMS INCANDESCENT LIGHT COMPANY, New York, has been incorporated; capital, $200,000. Directors: Thomas Adams, Jr., Bay Shore; L. R. Adams, New York, and G. J. Adams, Brooklyn.

THE RITER-CONLEY MANUFACTURING COMPANY, Pittsburg, has secured the contract for the building of a large steel stack for the power house of the Manila Electric Railroad & Lighting Corporation, Manila, P. I.

THE ACKERMAN-BOLAND TELEPHONE COMPANY has been incorporated in Chicago with a capital stock of $6000, to manufacture electrical apparatus. The incorporators are Charles Ackerman, J. F. Boland and J. W. Liggett.

THE VORTEX ELECTRICAL FAN COMPANY has been formed at Augusta, Me., to manufacture electrical devices. Its capital stock is $225,000, of which $50 has been paid in. Mr. Howard F. Butler, of Boston, Mass., is president and treasurer.

THE DITTRICK & JORDAN ELECTRIC COMPANY, Cleveland, Ohio, has been incorporated with $12,000 capital stock, by A. R. Dittrick, J. Jordan, W. E. Davis, F. A. Little and A. D. Dittrick. They will do electric railway repair work.

THE COOLEY ELECTRIC PROCESS COMPANY has been incorporated at Augusta, Me., to manufacture electrical machinery and appliances. The capital stock is $50,000. The officers of the company are: President, John F. Cooley, Boston, Mass.; treasurer, Robert Cushing, Brookline, Mass.

THE SHEDD ELECTRIC COMPANY, of Elizabeth, N. J., has filed articles of incorporation, the capital stock being $250,000. The company will conduct a general electrical supply business. The incorporators are: W. H. Peck, J. F. Symes, C. A. Matthews, H. C. Henshaw and H. R. Palmer, all of New York City.

OBITUARY.

MR. JOHN B. O'HARA, associate editor of the *Street Railway Journal*, died at the residence of his brother-in-law, J. G. Hickey, in Rochester, March 13. Mr. O'Hara joined the editorial department of the paper just two years ago. He was born in Rochester on December 10, 1865. After graduating from the public schools he became connected with the *Rochester Herald* and was afterwards appointed associate city editor of the *Post-Express*. Fifteen years ago he went to Chicago to join the editorial staff of the *Western Electrician* and became editor in chief of that paper. This position he occupied for a number of years with marked success. Later he was offered a proprietary interest and business management, with editorial control, of *Modern Machinery*, a monthly paper published in Chicago. He was soon obliged to resign this position on account of failing health, and to take a long vacation. Partially recovering and being of a disposition which would never permit unnecessary idleness, Mr. O'Hara joined the Publication Department of the Westinghouse Companies with headquarters in New York, but after a few months' connection with this company was offered and accepted the position on the editorial staff of the *Street Railway Journal*. Ten years ago Mr. O'Hara was married to Miss Margaret Hickey. After her recent death he attended the body to Rochester where the interment took place, but serious illness followed so soon in his own case that he was unable to attend the funeral in that city. His death occurred just four weeks after that of his wife, and was caused by valvular heart trouble. He is survived by an only son aged eight years, his father and two sisters. Mr. O'Hara possessed the high esteem and respect of all with whom he was acquainted, and especially of his immediate associates who had an exceptional opportunity of learning and appreciating his high character and admirable qualities of mind and heart. He was an associate member of the American Institute of Electrical Engineers.

LEGAL.

JEFFERSON CITY, MO.—The Supreme Court in banc has decided that the charter of Kansas City did not give the city authority to pass an ordinance regulating telephone charges in that city. J. W. Garner, of Kansas City, instituted mandamus proceedings in the Supreme Court against the Missouri & Kansas Telephone Company to compel the company to reduce its rates to the scale fixed by the city ordiance. The writ is denied by the Supreme Court.

VALIDITY OF FRANCHISE.—The Supreme Court of Louisiana has held that the franchise granted in New Orleans to the Consumers' Electric Company is valid. Its syllabus of decision says: "City Ordinance No. 1694, granting to the Consumers' Electric Company the privilege of using the streets and public places for laying of conduits, etc., falls within the scope of section 86 of the city charter as amended, and said ordinance, having been passed in accordance with the requirements of said section, is valid. The furnishing of electric light and energy to private consumers is not a public duty or function, or a utility to become public on terms, within the meaning of section 87 of the city charter as amended."

PERSONAL.

B. H. WARREN.

MR. B. H. WARREN.—The recent election of Mr. B. H. Warren to the presidency of the Allis-Chalmers Company, as noted in our columns last week, renders very timely the publication of a portrait and some biographical data about this well-known engineer and man of affairs. Mr. Warren graduated in the engineer corps at the United States Naval Academy in 1874, and was in active service in the United States Navy at sea and on shore until 1878, when he resigned from the service to find larger opportunities for his energies. From 1878 until 1890 he was with the Hancock Inspirator Company, Boston, Mass., as mechanical engineer, manager of the London office four years and as superintendent six years. From 1890 to 1895 Mr. Warren was manager of the hoisting machinery and pulley block department at the Yale & Towne Manufacturing Company, Stamford, Conn. He went thence, when the business of that department was sold, to the Pratt & Whitney Company, Hartford, Conn., serving temporarily as assistant secretary and treasurer. Mr. Warren was next, from 1896 to 1902, with the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., as assistant general manager, in charge of manufacturing, for ten months, then as second vice-president, in charge of both the manufacturing and the commercial branches of the business. This is a remarkably wide experience, and a most felicitous preparation also for the duties incumbent upon the president of such a concern as the Allis Chalmers, making apparatus for all the four powers—steam, gas, water and electricity. Mr. Warren assumes his new responsibilities this week, and thus will have a very active part in the successive developments which are raising the Allis-Chalmers Company into an industrial organization of the first magnitude, his marked improvements in methods of manufacture, in works management, in broad plans for increasing output and decreasing expenses, as well as multiplying efficiency, all now having a wider platform for their display than ever before. Mr. Warren, by the way, is a Bostonian. He has also a lovely country-place in Virginia. He is a member and an ex-vice-president of the American Society of Mechanical Engineers; a member of the Society of Naval Architects and Marine Engineers; and a member of the Society of Naval Engineers. He is a member of the University Club, of New York, and of the Engineers' Club. After he has completed his inspection of the Allis-Chalmers Company's works at Scranton, Cincinnati, Chicago and Milwaukee, his offices will be established in the Empire Building, 71 Broadway, New York. It is two years since Mr. Warren severed his Westinghouse connections.

MR. W. STANLEY, JR.—It is understood that Mr. Stanley will not carry out plans recently announced of acting as consulting electrical engineer to the Allis-Chalmers Company, but will confine himself, at least for the present, to experimental work.

MR. ASA M. MATTICE has resigned as chief engineer of the Westinghouse Machine Company and consulting engineer of the Westinghouse Electric & Manufacturing Company, to accept the position of chief engineer of the Allis-Chalmers Company.

MR. H. B. KIRKLAND.—The many friends of Mr. H. B. Kirkland, general sales manager of the American Circular Loom Company, will be pleased to know that he has almost fully recovered from his recent severe illness and is in receipt of many congratulations.

MR. JOHN F. KELLY, of the John F. Kelly Engineering Company, has resigned from the position recently assumed by him as chief electrical engineer of the Allis-Chalmers Company, finding that the responsibility and work involved from his connection with both concerns was more than he could well carry.

MR. CARLOS G. PALACIOS, the chief engineer of the electrical end of the Caracas Gas & Electric Light Company, who has been here for the past month on behalf of his company and also for the La Guayra Electric Light Company, will sail March 19 for Venezuela. Mr. Palacios was the first introducer of American electrical machinery into Venezuela. While in New York he placed through the export commission house of Kates & Bok some $75,000 of orders for various equipment, details of which were noted in our issue of February 13. Mr. Palacios expects to cause the sending here of a number of requisitions, shortly after his return home, for machinery to be installed in various Venezuelan plants owned by capitalists for whom he acts in an advisory capacity.

MR. OSCAR T. CROSBY.—Owing to a prolonged absence in Europe, Dr. M. I. Pupin has not arrived early enough to deliver this month, as already announced, his lecture on the Physics of Wireless Telegraphy, before the New York Electrical Society. The officers of the society have, however, very great pleasure in informing the members that in response to an invitation addressed to him by a number of his friends, members of the society and of the American Institute of Electrical Engineers, Mr. Oscar T. Crosby, E. E., the distinguished engineer and explorer, has kindly consented to deliver a lecture entitled "Things Seen in Turkestan and Thibet," at the lecture room of the American Institute, 19 West 44th Street, Wednesday, March 23, at 8 P.M. Due notice will be issued. Mr. Crosby has returned recently from the mysterious mountain plateau of Central Asia, and his adventures constitute a most fascinating and instructive story. The lecture will be illustrated by some 30 lantern slides, and the officers of the society congratulate their fellow members on this delightful and unexpected supplement to the winter programme, already so notable for its successes. It is a ladies' night.

CARL SCHWARTZ.

MR. CARL SCHWARTZ has been appointed on the staff of the New York Central R. R. electrical engineering department as assistant engineer, and will be connected with the design and erection of the electrical part of the traction power stations. Mr. Schwartz after graduation from the Royal Technical College in Hanover, Germany, entered the Allegemeine Elektricitats Gesellschaft as designing engineer and later was appointed by the Siemens & Halske Company chief engineer of its light and power department in St. Petersburg, Russia, where he designed and erected a number of important low and high-tension power stations and power distributing systems. Mr. Schwartz was with Siemens & Halske for about seven years, and latterly was their general representative for the South of Russia and director of a concern for light and power utilization which he organized with a capital of 4,000,000 rubles, and which controlled stations of 6000 and 1500 horse-power, three-phase. Coming to the United States, Mr. Schwartz visited the works of all important manufacturing companies and the more prominent central stations in order to familiarize himself with the conditions in this country. Concluding to stay in the United States, he accepted a position with the Commonwealth Electric Company in Chicago, where he had charge of the design of the electrical part of the New Fisk Street Station laid out for 14 Curtis steam turbines of 5000 kw each, and into which he introduced a number of new features in high-tension power station design. He was also in charge of the erection of several new substations for 1000-kw rotary converter-units, and a high-tension distributing system of his own design.

MR. S. J. CONDIT, JR., of Boston, was a visitor in New York City last week, on important business.

W. E. BAKER & COMPANY, electrical and mechanical engineers, have moved their offices from 170 Broadway to 27 William Street, New York.

DR. LEE DE FOREST, of the American De Forest Wireless Telegraph Company, is to lecture before the Franklin Institute on March 31 on wireless telegraphy.

MR. F. P. FISH, president of the American Bell Telephone Company, recently arrived in San Francisco on a visit, and was entertained extensively by prominent citizens.

MR. E. A. WAKEMAN, formerly with the Batavia, N. Y., Consolidated Gas & Electric Company, has become superintendent of the Glens Falls, N. Y., Gas & Electric Company.

MR. ROBERT McCULLOCH, a veteran street railway manager, has returned to an old "stamping ground," having just been elected second vice-president of the St. Louis Transit system.

MR. G. E. BENNETT, formerly assistant manager of the Chicago office of the Nernst Lamp Company, has been appointed district sales manager of that company, with offices at 17 West Mohawk Street, Buffalo, N. Y.

MR. C. L. EDGAR, president of the National Electric Light Association, was at headquarters in New York City last week, busily engaged making preparations for the Boston convention next May. A large and interesting programme is already promised.

MR. CLARENCE J. MESSER, of the United Telpherage Company, of Boston, will deliver a lecture on telpherage or the modern electric art of transporting material aerially on a wire track, etc., before the Franklin Institute, Philadelphia, on April 14.

MR. JAMES I. AYER, general manager of the Simplex electric heating department, was a visitor to New York last week, and had a variety of most interesting data as to new heating problems and successful work, with which he has been dealing quite recently.

MR. CORNELIUS C. VERMEULE, consulting engineer, 203 Broadway, New York, has gone to Cuba in connection with the construction of the extensive lighting and traction system in and around Cienfuegos. He expects to be back by the end of the month.

MR. CHARLES RICOU, electrical engineer, etc., connected with the central station at Hanoi, Tonkin, French China, and consulting engineer of the Tramways Company, will be glad to receive catalogues of electrical apparatus bearing upon various applications.

MR. W. S. DORAN, at one time associated with the Worthington interests and who now is prominently identified with the sales department of the British Westinghouse Electric & Manufacturing Company, Limited, sailed for Europe March 1, after a short visit to this side.

MR. W. D. RAY has severed his connection with the Westinghouse Traction Brake Company as representative for the Central States, and has now entered the steam specialty field. He will represent several well-known manufacturers in the sale of high grade specialties, with offices at 312 Electric Building, Cleveland, O.

MR. HERBERT LAWS WEBB, of whom we published an illustrated biographical sketch in our issue of February 20, has taken offices in London as a telephone engineer, etc., at 35 Old Queen Street, Westminster. He will be glad to receive there catalogues from American manufacturers of telephone and telephonic appliances.

MR. JAMES STEWART, under whose supervision the colossal works at Trafford Park, near Manchester, of the British Westinghouse Electric & Manufacturing Company, Limited, were constructed and who latterly built in record time a number of large power houses for which the company secured the contracts, is to locate permanently in New York. He will open offices very shortly and will engage in general contracting work.

MR. C. O. MAILLOUX, of New York City, lectured before the engineering students of Delaware College, Newark, Del., Thursday and Friday, March 3 and 4. His general subject for all the talks was "Central Station Practice." This had been arranged by the Department of Mechanical and Electrical Engineering for the purpose of bringing the class room work more closely in touch with engineering practice. Mr. Mailloux has lectured before Lehigh, Cornell, Harvard and other universities, where the value of his suggestive talks to the students has been highly appreciated.

GEN. FRANCIS V. GREENE, general manager of the Ontario Power Company, spoke before the Niagara Club, at Niagara Falls, on March 4, on "The Future of the Niagara Frontier." He pointed out very forcibly that the improvement of the Erie Canal would mean a remarkable development of that section and the restoration of the Empire State to the supremacy in the industrial world He said that cheap power, generated at the Falls, cheap raw material and railroad and lake transportation, would bring about the establishment on the Niagara frontier of large industries in steel and iron electrochemical products, milling and various textile lines.

MR. J. G. WHITE, head of the engineering firm of J. G. White & Company, of New York, gave a dinner at the University Club last week to Secretary of War Taft, formerly governor of the Philippines. Mr. White is now building 40 miles of trolley road in Manila, and Mr. Taft is anxious also to interest American capital in steam railroad enterprises in the Islands. A distinguished party met Mr. Taft, including Mr. Elihu Root, late Secretary of War; and members of the leading banking houses of New York and the Eastern States. Mr. Oscar T. Crosby, who has recently returned from a journey through Thibet, was one of the speakers.

MR. EDWIN REYNOLDS.—Milwaukee newspapers state that Mr. Edwin Reynolds, consulting engineer of the Allis-Chalmers Company, was unanimously tendered the position of chief engineer of the committee of awards of the Louisiana Purchase Exposition at St. Louis. He declined the honor. His final decision was given to a special committee of machinery exhibitors who went to Milwaukee from St. Louis last week for the express purpose of urging him to accept the plaoe, one of the most honorable and important positions connected with the expositibn. In declining the honor, Mr. Reynolds informed the committee, as he had done before by letter, telegraph and telephone, that he did not feel that he could undertake the responsibility at this time, largely on account of his advancing years and the time it would require during the entire exposition. Out of a total of thirty-three votes by the largest machinery exhibitors in the world, who will have extensive exhibits at St. Louis, Mr. Reynolds received thirty votes on the first ballot for the position of chief engineer of the committee of awards. Later he received the unanimous vote of the exhibitors. A salary of $10,000 was voted to go with the position. Then the exhibitors started to induce him to accept. From the beginning he told the committee that he did not feel that he could undertake the work, because if he did he would not neglect it, and would only sign certificates after becoming personally convinced of the justice of the awards, and he did not now feel equal to the undertaking.

Trade Notes.

EXHAUST HEADS.—The Burt Manufacturing Company, Akron, Ohio, has sold the Jones & Laughlin Steel Company a 30-inch exhaust head for its plant at Pittsburg, Pa.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agents for Zenith lamps, is sending out a handsome descriptive catalogue of these lamps, to all who failed to receive one on the first distribution.

KELLER, PIKE & COMPANY, of Philadelphia, electrical contractors and engineers, have opened an office in Baltimore, at 211 North Calvert Street. This office will be in charge of Mr. John S. Dobler, of Baltimore, whose training, experience and connections especially fit him for this position.

THE DALE COMPANY, New York City, is very busily engaged putting on the market its new Dale wireless cluster, for multiple or series work. It makes up in very compact and handsome form and is cheap and durable. Mr. John Dale is already happy over a rushing business in all the forms of this new specialty.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., has just placed upon the market two new subscribers-station protectors for the protection of telephones, one consisting of heat coil and carbons and one of heat coils only. They are reported to be very efficient protectors and recommend themselves to the trade on account of merits and low cost.

THE CALCULAGRAPH COMPANY has issued a 16-page pamphlet speaking of the changes in appliances for calculating time. The story begins with the sand glass, talks about the establishment of clocks and their peculiarities, and winds up, of course, with a description of the Calculagraph as a time keeper and a calculator. The catalogue is printed in two colors on a good quality of paper and contains copies of testimonial letters from various users.

TESTING PLATE FOR ENGINES.—One of the most interesting features of the new plant now being erected by the B. F. Sturtevant Company at Hyde Park, Mass., is an elaborate testing plate for its engines. With an output of a thousand engines or more per year, this is the essential climax of a careful system of manufacture and testing. The plate, or more properly the plates, will be supported upon a series of heavy parallel walls between which steam and exhaust pipes are carried so that at almost any point in the entire area of the floor, measuring about 30x60 feet, steam and exhaust connections may be made to any engine. Testing facilities will be provided, and a transfer crane overhead will make it very simple to locate or remove the engines. The same crane will transport them to the packing department, and thence load them directly upon cars which traverse the end of the building.

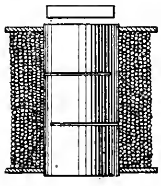
Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 8, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

753,839. TROLLEY WIRE FINDER; William Barnhurst, Dallas, Tex. App. filed June 1, 1903. A pulley pivoted under the trolley wheel and carrying a guiding fork, is rotated by a cord to throw the fork into operative position.

753,866. BRUSH HOLDER FOR ELECTRICAL MACHINES; William H. Foot, Wilkinsburg, Pa. App. filed June 24, 1903. A number of individually actuated brushes of such construction that their position on the rocker arm may be easily and quickly reversed when it is desired to reverse the direction of rotation of the armature.



753,879.—Electromagnet.

753,872. ELECTRIC PRINTING MACHINE; George S. Gallagher, New York, N. Y. App. filed April 29, 1903. Details of construction of a telegraph printer.

753,875. ELECTRICAL MANUFACTURE OF IRON ALLOYS; Gustave Gin, Paris, France. App. filed July 7, 1902. (See page 569.)

753,879. ELECTROMAGNET; Willis D. Gregory, Pittsburg, Pa. App. filed April 9, 1903. The fixed core of the magnet is structurally interrupted in one or more planes transverse to the direction of the magnetic lines, with the object of producing an electromagnet which will quickly discharge itself.

753,881. ELECTRIC SNAP SWITCH; Gerald W. Hart, West Hartford, Conn. App. filed April 18, 1903. Details.

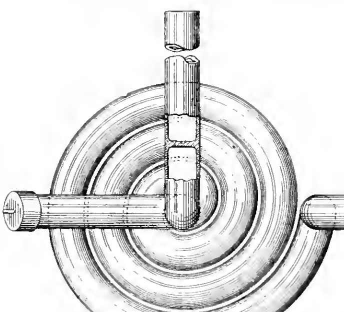
753,916. SHUNT RESISTANCE; Geo. W. Richmond, Pittsburg, Pa. App. filed July 10, 1903. A ribbon resistance set on edge and supported by blocks having slits into which the ribbon fits.

753,935. INCANDESCENT ELECTRIC LAMP; Herbert M. Taylor, Hamilton, Canada. App. filed Sept. 2, 1902. The lamp has an internal conical reflector around which the filament passes, for the purpose of diffusing the light.

753,944. TRANSFORMER CASE; Wm. L. Waters, Milwaukee, Wis. App. filed March 5, 1903. Tubular passages are formed in the casing to permit of a circulation of air for cooling purposes.

753,999. CONTROLLING VALVE; Asa H. Mosher, Westfield, N. J. App. filed Feb. 25, 1903. Details.

754,005. FIRE ALARM OR TEMPERATURE ANNUNCIATOR; John A. Olson, Minneapolis, Minn. App. filed Aug. 3, 1903. An index moving over a dial closes different alarm circuits at different positions on the dial.



754,079.—Spiral Vacuum Tube for Therapeutic Purposes.

754,018. ELECTRIC SAD-IRON; Geo. J. Schneider, Detroit, Mich. App. filed Aug. 11, 1903. The end of the flexible conductor leading to the binding posts of the iron is supported by passing through an opening in the handle just before it reaches the binding post.

754,030. ALARM ATTACHMENT FOR LINOTYPE MACHINES; Geo. L. Venable, New Brunswick, N. J. App. filed April 11, 1903. An electric alarm indicating to the operator when the molten metal in the pot reaches a certain level.

754,075. GAS BURNER; Wm. Kohn, Brooklyn, N. Y. App. filed July 6, 1903. Details.

754,079. SPIRAL VACUUM TUBE FOR THERAPEUTIC PURPOSES; Robert Machlett, New York, N. Y. App. filed Jan. 26, 1904. A flat spiral with the electrode fixed in the outer and inner ends respectively, designed to bring the rays near to the surface of the body and to distribute them over a large surface.

754,081. BATTERY-STOPPER; Albert Muller, New York, N. Y. App. filed Oct. 24, 1903. (See page 569.)

754,111. JUNCTION BOX FOR ELECTRIC WIRES IN BUILDINGS; Boyd W. Allen, Boston, Mass. App. filed Dec. 12, 1903. The bottom of the box is a thick body of insulating material in which the nipple for the fixture is embedded, thus avoiding the use of nails or screws passing behind the box.

754,114. PROCESS OF PREPARING ELECTRODES; George Jones Atkins, Tottenham, England. App. filed Oct. 6, 1903. (See page 569.)

754,123. INSULATOR PIN; James H. Bullard, Springfield, Mass. App. filed Oct. 26, 1903. A metal pin comprising a series of longitudinal webs joined together and forming grooves for a plastic material, to aid in holding the insulator in place.

754,124. ELECTRIC MOTOR; David P. Burdon, Jacksonville, Fla. App. filed July 13, 1903. An oscillating motor having a switch for shifting the current from pole to pole.

754,133. SYSTEM OF ALTERNATING-CURRENT DISTRIBUTION; Edwin R. Gill, New York, N. Y. App. filed Sept. 5, 1900. As a means for producing auxiliary current-waves out of phase with an original single-phase current in a main circuit, an auxiliary circuit having a self-induction approximately equal to that of the main circuit, a condenser and means for alternately charging the condenser from the main circuit during rise of potential in the circuit, and discharging the condenser into the auxiliary circuit, whereby the main and auxiliary circuits are made to carry perodic currents of different phases and common periodicity.

754,147. APPARATUS FOR ELECTRICAL PRODUCTION OF NITROGEN OR OTHER COMPOUNDS; Josef Von Kowalski and Ignaz Moscicki, Freiburg, Switzerland. (See page 569.)

754,152. SIGNALING APPARATUS; Otto Luddeckens, Breslau, Germany. App. filed Feb. 21, 1903. A signal for mines in which the engine room receives the signals passing between the pit bottom and the mouth and the engineer is able to prepare in advance for signals coming direct to him from the mouth of the mine.

754,208. ELECTRIC SIGNAL; Joseph E. Feller, Brooklyn, N. Y. App. filed April 24, 1902. Relates to the construction of instruments in which the person signalled may indicate to the person signalling if the signal is properly received.

754,235. EXTENSION FIXTURE FOR INCANDESCENT ELECTRIC LAMPS; Conrad H. Titel, Meriden, Conn. App. filed May 6, 1903. A spring drum and ratchet arrangement for taking up and letting out the conductor and the mechanical support for the fixture.

754,261. OZONIZER; Alexander Vosmaer, Nieuwersluis, Amsterdam, and Adriaan Lebret, Utrecht, Netherlands. App. filed Sept. 11, 1902. (See page 569.)

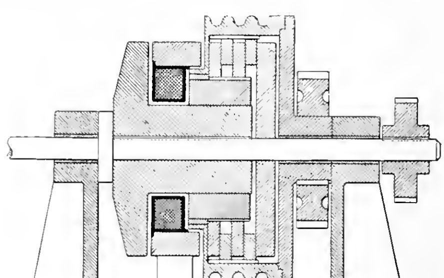
754,291. MAGNETIC CLUTCH; Arthur C. Eastwood, Cleveland, O. App. filed Jan. 26, 1904. Interleaved metal plates are caused to frictionally engage by a magnet placed to act upon them.

754,294. HORSE BLANKET; Ida J. Foglesong, St. Paul, Minn. App. filed Sept. 17, 1903. Electric heating wires are threaded through the blanket for the purpose of sweating the animal.

754,359. APPARATUS FOR STOPPING RAILWAY TRAINS FROM THE LINE AND FOR SIGNALING PURPOSES; Bernardus A. J. Van Der Hegge-Zijnen, Hanover, Germany. App. filed May 26, 1902. An arm is projected from the roadway to strike an air-brake valve of the train to set the brakes. The contact between the parts closes a circuit to notify an operator at a station of the event.

754,362. RAILWAY SIGNALING SYSTEM; Henry Bezer, Westfield, N. J. App. filed Oct. 16, 1901. Various features of a block system in which the rails of the track are the only conductors from one end of the block to another.

754,363. RAILWAY SIGNALING SYSTEM; Henry Bezer, Westfield, N. J. App. filed Oct. 16, 1901. A modification of the preceding patent.



754,291.—Magnetic Clutch.

754,378. ELECTRIC SWITCH; Norman Marshall, Newton, Mass. App. filed June 27, 1903. Improved devices for transmitting movement from the spindle to the catch which holds the spring until it has been fully put under tension.

754,379. ELECTRIC SWITCH; Norman Marshall, Newton, Mass. App. filed Oct. 6, 1903. Details.

754,380. ELECTRIC SWITCH; Norman Marshall, Newton, Mass. App. filed Oct. 6, 1903. Details.

754,391. BURGLAR ALARM; Freeman C. Robinson and James E. Green, Council Bluffs, Iowa. App. filed Nov. 26, 1901. A pair of contacts are attached to the bolt of a safe and while the bolt is in its locked position, rest upon a plate of insulating material, but as soon as the bolt is withdrawn, they drop onto a metal surface, closing an alarm circuit.

754,397. ELECTRIC CLOCK; Geo. S. Tiffany, Brooklyn, N. Y. App. filed Nov. 30, 1901. Details.

754,402. FAULT LOCATOR FOR ELECTRIC CABLES; Daniel E. Wiseman, Spokane, Wash. App. filed Aug. 3, 1903. A Wheatstone bridge in which the scale of resistance is read directly in units of length.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, MARCH 26, 1904. No. 13.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, MARCH 26, 1904.

CONTENTS.

DREAMS THAT COME TRUE.

It is worth pointing out at this juncture, when the Union Engineering Building has become a certainty, that the idea has haunted the minds of engineers and scientists for at least a quarter century past. At the very outset of the American Institute of Electrical Engineers in 1884, the project was taken up, and as that body was then enjoying the hospitality of the Civil Engineers, it was under the roof of the Civils that it was more frequently discussed than anywhere else. There were in fact committees on the plan in those early days, but after all was said and done, the thing fell through, although everybody admitted its desirability. The times were not ripe, nor had the growing needs of the various national bodies given a real urgency to their search for a way of solving the difficulties. The project has now attained finality in a very desirable shape, and those who have watched its fate, with waning and waxing hopes and fears for two decades past, can once more rest assured and be reaffirmed in the conviction that a great idea never dies, but should be persisted in and advocated until its merits win out.

PETER THE PILGRIM

Following the excellent introductory notes of Brother Potamian in the two preceding issues, we print elsewhere in this issue a translation in full, specially made for our columns, of the epistle of Petrus Peregrinus. The Latin text used is that of Gasser, A.D. 1558, a copy of which rare work is in the Wheeler collection of the Library of the American Institute of Electrical Engineers. The letter of Pierre de Maricourt, commonly called Petrus Peregrinus (from having made a pilgrimage to the Holy Land), is the first great landmark in the domain of magnetical philosophy, and is rich in magnetic thought and suggestiveness. True, there have been writers from Thales and Lucretius down to Neckam and Roger Bacon, who wrote about the lodestone; but none of them stopped to investigate seriously its known properties or discover new ones, still less to devise means of applying them to the welfare of mankind. The credit of having done this and done it on an extensive scale, belongs unquestionably to Peregrinus, the Gallic friend of Friar Bacon, and at the same time the great magnetical man of the Middle Ages. His letter on the magnet, written in camp amid the din of war and the exigencies of his engineering duties, shows him to have been uncommonly gifted for original work and for delving deeply in the arcana of nature. In his researches he brought to light a great body of facts about the lodestone, tested them in numerous ways, co-ordinated them, and described them in due sequence in his famous "Epistola ad Sigerum," A.D. 1269.

If Peregrinus was a hard thinker and persistent worker, he was also a resourceful man in turning his discoveries to practical account. It may be held that Neckam knew of the pivoted needle before him; but if, after construing the Abbot's *acum jaculo superpositam* to mean that the support was the pointed end of an ordinary dart, we turn to the second part of the "Epistola," we will find in Chapter II a detailed account of the sharply pivoted needle of Peregrinus and an unequivocal statement of its use at all times in navigation. His magnetic motor is a startling conception for so early a period as the thirteenth century. We cannot but admire the ingenuity of the contrivance even if we do smile at the naiveté of the enthusiastic inventor, who flattered himself with the delusion that he had really contrived a perpetual motion wheel—little suspecting that he was realizing in himself his own words: "I have seen many persons vainly busy themselves and even become exhausted with much labor in their endeavors to invent such a wheel."

Singularly enough, it was this selfsame harmless wheel that stirred up to the full the wrath of Gilbert when, forgetful of all Christian precepts, he used such unparliamentary language as "May the gods damn all such sham, distorted works which do but muddle the minds of students." Nevertheless, the writer of this invective was greatly indebted to Peregrinus, whose terminology he adopts and whose "terella" experiments he repeats. It is true that Gilbert refers five times in his "De Magnete," A. D. 1600, to this letter of A.D. 1269, but all that his gratitude inspired him to write of it is that it is "a pretty erudite work for its time." In reading this half-hearted admission, we must bear in mind that the philosopher of Colchester was as sparing in meting out praise as he was liberal in his censures and forcible in his denunciations.

Two works of comparatively recent date have it that Peregrinus, while emphasizing the attractive virtue of the lodestone, nowhere mentioned magnetic repulsion. This must be a *lapsus calami* and nothing more, for in Chapter VI we read: "Know then that this is the law: The north pole of the lodestone attracts the south pole of another, while the south pole of the one attracts the north of the other. Should you proceed otherwise and bring the north pole of one near the north pole of another, the one you hold in your hand will seem to put the floating one to flight. If the south pole of one is brought near the south pole of another, the same will happen." The law of repulsion is as explicitly stated here as it is clearly demonstrated.

As Others See Us.

We have often discussed American engineering education in these columns—so often that we should hesitate to bring it again before our readers were it not for the paper read last month before the Institution of Electrical Engineers, which gives a transatlantic view of our virtues and shortcomings too valuable to be lightly passed over. The author, Dr. R. M. Walmsley, spent three months last year in investigating our engineering schools of various types, and succeeded in gathering an amount of practical information which we have not seen equalled in any similar investigation. And we may congratulate ourselves that the conclusions were of a flattering nature as a whole, especially in comparison with British conditions. Not only is the character of the engineering instruction upon the whole higher here than abroad, but the discrepancy in the number of students is something startling to the last degree. Dr. Walmsley found in sixteen of our prominent institutions 1,371 students in engineering courses who had been more than three years in attendance, while the latest available report in Great Britain showed but 56 students in the corresponding class. This difference does not so much indicate lack of facilities as difference in aims. Among first year and second year students, the comparison is upon more even terms, the truth being that with some distinguished exceptions the British technological schools are substantially what we would know here as trade schools, from which the pupils frequently pass into their technical pursuits without waiting to complete the course. This difference is emphasized by the undoubted fact that the average student material here and in Canada is drawn from a relatively better class than in England. As Dr. Walmsley remarks, the engineering professions there have to come into severe competition for personnel with the Army and Navy, the Indian and other public services.

He might have added that engineering is generally considered as too deucedly near to trade to attract on the whole a high grade of student material. The early efforts at scientific education in technical schools even in this reputedly democratic country suffered not a little from the same source. It would not have been quite a polite thing to say at the time, but twenty-five years ago engineering did not have its present standing among the professions, and the old classical colleges unquestionably got the pick of the student material. These social differences reach even further. We have had in this country a great many men in high commercial and technical positions who have risen from the ranks, and we are justly proud of them; but it is undeniable that the activities of our country for the past fifty years have been in greater proportion directed by college-bred men than in any other country in the world, with the possible exception of Germany. The result is that those who now direct our activities are in more than usual close sympathy with education, technical and other, and appreciate the advantage of drawing into their service young men with the best possible training. Hence, the conditions noted by Dr. Walmsley in regard to the demand for technically-trained men in American manufacture. The moral can in no wise be better pointed out than by mentioning that Charles William Eliot narrowly escaped becoming the manager of a cotton mill the year before he was elected president of Harvard College. We do not wish to be considered discouraging, but we do not see how technical education in England can be put firmly upon its feet until certain points of view are very considerably modified. When the well-to-do and well-born young Englishman heads for the engineering profession as freely as he heads for the Army or the Church, things will begin to go differently.

Dr. Walmsley, in way of criticism, puts a keen analytic finger on the very points which we have often recognized as weak spots in our technical education. His many conversations with American manufacturers brought out as the most general criticism "that in many cases the training is too superficial and too apt to overload the student with a large and confused assortment of facts instead of training him in principles, this being in a large measure due to attempts to deal in too much detail with a crowd of subjects, especially in the last year of the course." And with respect to one egregious fad in recent education, Dr. Walmsley remarks: "It is a matter for serious consideration whether the excessive amount of time given to manual work in the manual training schools has not been dearly purchased at the expense of starving the time which should have been given to mental training." We wish that some of our strenuous and solemn-visaged educators who spell themselves in large capitals and have so little sense of humor as to take themselves seriously, would cut out these two quotations and paste both into their hats. As things are at present, the higher technical institutions are busy for no inconsiderable part of the course in stopping the gaps left by kindergarten foolishness of various sorts in the primary and secondary schools. They admit students at eighteen or nineteen years of age and then spend the better part of two years in teaching them the elementary English, mathematics and modern languages that have been neglected in the secondary schools, to make room for nail-driving, music, painting and emasculated physiology. It is vast credit to the technical schools that in a four-years' course they can turn off the material they do in spite of inefficient preparation. Our English friends in trying to build up a system of technical education will at least have less foolishness to contend with at the start. The thing most needed over there, however, is the sympathetic assistance of the great universities. So long as they hold aloof from directly encouraging technical students, the tremendous weight of their centuries of social influence will stand against improvement.

The Telephone Repeater.

To one who might undertake to study the course of invention by reference to Patent Office records, the telephone repeater, from its numerous entries, would appear to be at least holding its own in the rapid progress of telephonic development. As a matter of fact, all the work of inventors in this branch during the past twenty years or more has thus far brought forth absolutely no practical result. This condition appears to indicate that in this perhaps more than in any other department of invention, the inventor is prone to apply for a patent without having first determined by practical trial if his apparatus will really in actual work over long-distance lines perform the functions for which it is devised; and in the present case this is the more inexcusable from the fact that opportunities for such a trial are nowadays within easy reach, and involving small expense either in apparatus or test. A successful telephone repeater is the great need in telephony, and its inventor would be abundantly rewarded materially, which undoubtedly accounts for the scores of patents that have been issued on "telephone repeaters"; yet of all these we do not know of one that has been put to public test on a circuit of sufficient length to demonstrate its capabilities. The uniformly negative results thus far may, however, be ascribed, not to any undue lack of inventive skill, but to the enormous difficulties in the way of renewing the energy of voice currents without affecting their speaking characteristics; that is to say, the difficulty of strengthening in absolutely equal proportion each element of a current varying enormously in frequency and in amplitude. The introduction into a circuit of repeating apparatus is in itself apt to destroy the speaking characteristics of the current to be repeated, even before it undergoes any supposed process of reinforcement. The futility of effort thus far indicates that the telephone repeater, if it is ever realized, will be based upon some radical discovery, perhaps second only to the discovery of the telephone itself. In the meantime, the record of past failure indicates that effort will be wasted in endeavors to realize a telephonic repeater through mere mechanical combinations of parts and without reference to the fundamental physical principles governing the generation and transmission of the telephonic current.

THEORIES OF WIRELESS TELEGRAPHY.

Our correspondence columns last week contained an interesting letter from Prof. A. Blondel on the subject of wireless telegraph theory. A few years ago, in fact as recently as 1900, a great diversity of opinion existed as to the nature of the waves employed in wireless telegraphy, and as to their mode of propagation. Now, however, there is very little difference of opinion outstanding, and the latest stones in the structure of the theory have been laid by the papers of M. Blondel. The gist of the whole theory lies in the recognition that the wireless telegraph waves are essentially the same as the waves produced and studied by Hertz, except that a sheet of conducting material, namely, the surface of earth or sea, occupies the midplane of the system, and that one-half of the system, i. e., that beneath the conducting plane, is abolished. The semi-system then remaining above the conducting sheet travels just as though the sheet were not there, so long as the sheet remains in the midplane. As soon as it bends out of the midplane, as by the curvature of the earth in the telegraph case, the pure Hertzian system becomes modified by the presence of the sheet, to the extent of bending over, or conforming to, or being guided by the sheet, and the waves, therefore, depart from their original rectilinear path. Add the secondary effects of attenuation at the surface of the earth due to imperfect conductivity, the tearing of gaps or rents in the wave by the presence of local conductors on the earth, such as structural steel buildings, lightning conductors, or receiving antennæ, as well as the possible influence of conducting strata high in the atmosphere, and the Hertzian wave theory applies at once to the wireless telegraph case. The views that have been expressed by Messrs. Blondel, Fessenden and ourselves are all in essentially complete accord.

Perhaps the easiest picture to form, in the mind's eye, of a wireless sheet wave is to consider a net, like an enormous seine or fishing net, invisible to the eye, emitted from the sending antenna and running out from it at the speed of light in all directions, spreading as it runs. If the cord of which the net is made is barbed, so as to mark the direction of weaving, the positive side of the wave will differ from the negative in the directions of these barbs. After a few wave lengths from the origin, the net will occupy the form of an inverted hemisphere. At the ground the horizontal lines, or the warp, will represent magnetic flux lines; while the vertical lines, or the woof, will represent electric lines. The net propagates itself everywhere, at light speed, in a direction perpendicular to the surface. It tries to get away from itself sideways. Every cord in the net extends elastically from the tension due to moving sideways. The net is constantly increasing in dimensions, and in the length of each cord as it advances. But no cord moves at any time in the direction of its own length. That is, the pull along any cord in one direction is exactly balanced by the pull in the opposite direction, so there can be no resultant force, or component of force, along any cord, tending to move it longways. All the pull which gives rise to movement makes each cord travel sideways, or perpendicularly to its length and to the net.

There is this curious analogy between the electromagnetic net and a material net moving over the ground. If the ground were absolutely smooth and perfectly frictionless, a vertical fishing net carried over the ground so that the lower edge just touched would not be bent from the vertical by the contact. This would correspond, in the case of the electromagnetic net, to a perfectly conducting surface. There would be no bending in at contact with the ground. But if the net were dragged over a rough surface it would be bent, at the lower edge, out of the vertical plane by the friction. This corresponds to imperfect conductivity in the electric case; the net becomes frictionally bent back at the surface, to a greater or less extent, and the wave at the ground, moving always perpendicular to its own surface, runs into the ground, thereby dragging part of the net after it and bringing about extra attenuation of the fibres.

Moreover, if the material net were carried over posts or obstructions at a sufficiently rapid rate, rents would be torn in the bottom of the net, and at the gaps the edges of the net would be bent back by the contact, or out of the perpendicular plane. So in the electric net, a brick wall is no obstruction, but a metal rod or a lightning conductor takes the part of a post in the material case, and tears a gash out of the net. The edges of the net at the gash are, however, bent back as they tear, and as the net moves on the edges take a lateral or sideways motion, in addition to the regular advancing motion, tending to draw the edges of the rent together, and seal up the gash, at the same time drawing upon the net as a whole to do this, and executing the repair with some general attenuation. The electric net, being bent at the gash out of the regular shape, can mend itself automatically by taking a component of force and motion that would correspond to longways propagation in the uninjured net. Assuming that we have a clearly defined working theory of the nature of wireless telegraph waves, we need convenient means of experimental exploration in the air and open field in order to make rapid progress in our knowledge of the subject. What we want is a measuring instrument so sensitive that when connected in the middle of an exploring rod observations can be collected in many different directions and at many different elevations.

Incandescent Lamp Patent Infringement Suits.

The Edison Electric Light Company, now a part of the General Electric Company, has instituted suit against 15 manufacturers of incandescent lamps and ten supply dealers, for infringement of two patents relating to means for exhausting lamps, and one patent on a detail relating to leading-in wires. The two first-mentioned patents are that of Malignani on the method of chemically completing the exhaustion of lamp bulbs and an improvement thereon patented by Mr. John W. Howell. The third is an Edison patent, which provides for sealing in glass, the junction between the platinum and copper leading wires, these wires being welded and the glass then squeezed around them from a piece of tubing. It is claimed that by this method of sealing the junction in glass any danger of the wire working up and down and causing air leaks is obviated. The date of the Malignani patent is April 16, 1895, the number being 537,693; the Howell patent, No. 726,293, is dated April 28, 1903; and the Edison patent No. 444,-530, is dated January 13, 1891.

Use of Electricity in Mines.

The growing use of electricity in mines in England led the British Home Secretary to appoint a Departmental Committee to consider and report on the subject; and the report has recently been published. The committee state the following as the general principles which they consider should govern the employment of electricity in mines:

1. The electric plant should always be treated as a source of potential danger.

2. The plant, in the first instance, should be of thoroughly good quality, and so designed as to insure immunity from danger by shock or fire; and periodical tests should be made to see that this state of efficiency is being maintained.

3. All electrical apparatus should be under the charge of competent persons.

4. All electrical apparatus which may be used when there is a possibility of danger arising from the presence of gas should be so enclosed as to prevent such gas being fired by sparking of the apparatus; when any machine is working every precaution should be taken to detect the existence of danger, and on the presence of gas being noticed, such machines should be immediately stopped.

In regard to (1) and (2) they point out that under the peculiar conditions existing in mines, no absolutely safe voltage limit can be stated. Under the circumstances they have decided, on grounds that have been already recognized in Germany, that with the adoption of all reasonable safeguards a fairly high pressure has advantages, even from the point of view of safety, over a uniformly low pressure. With this end in view, the voltage to be used in-bye is to be the medium standard adopted by the Board of Trade, namely, 650 volts. The main thing is that electricity at any voltage should be recognized as possessing very great elements of danger and treated accordingly. That all electrical apparatus should be under the charge of competent persons will meet with general approval. By far the greater proportion of accidents arising from the firing of shots have been caused by disregard of this rule. As to the working of coal cutters in places subject to firedamp, the committee consider, largely as a result of experiments made, that it is necessary to enclose the entire motor in a flame-tight cover. One important result of these experiments was to demonstrate the possibility of overcoming the heating of the parts due to ironclad construction by ventilating the machine through the armature bearings on the same principle as a Davy lamp.

The committee have adopted the view that all permitted explosives should be fired by electricity, and that the armored covering of all protected cables should be earthed. The first of these ordinances says the British *Colliery Guardian*, will be generally approved, a similar rule having been adopted in Lancashire for some years. Accidents that have occurred with electrically-fired shots have, in almost every case, been caused, not by the electricity but by carelessness or insubordination, and where the system has been efficiently carried out, the result has been a great reduction in the number of miss-shots and a general saving all around. With regard to the second point, there are no doubt many experts who do not approve of the earthing of the armoring of a cable, but as the question is not one of cost and both systems have their advantages, such a dispensation, for the sake of uniformity, should not be objected to.

In concluding their report, the committee suggest that the rules they have drafted should be introduced immediately. A very important reservation from the colliery owners' point of view is that giving the inspectors discretion to revise existing installations. Other provisions are those enabling an inspector to dispense with any rules in any case in which the special circumstances appear to him to render such exemption necessary, and providing for arbitration, as in the enforcement of special rules where any difference of opinion may arise between an inspector and an owner as to any requirement under the same section.

Finsen Light Treatment.

United States Consul Frazier, of Copenhagen, Denmark, reports that in the Finsen Medical Light Institute, now a State sanitarium, 1,367 cases had been treated up to May, 1903, by the Finsen rays. Of these most were lupus vulgaris and in about 1,000 cases the best results had been attained, so that "in most cases one may count definitely upon a cure," to use the official language.

Seventy-five American doctors went to Copenhagen last year expressly to visit the Institute from all sections of the United States. Many of them purchased "Finsen lamps" with a view to establishing institutes for the treatment of skin diseases by the Finsen method. There were eight patients at the time of the report from various parts of the United States. Most of them assert that they were under treatment for years in the United States and employed eminent specialists in various centers of population at home, but that they were unable to secure a satisfactory diagnosis of their affliction; that the various specialists consulted did not agree; and that after years of discouragement and suffering, having heard of the Finsen light treatment they went abroad. Of the eight American patients it appears that all but one had their cases diagnosed satisfactorily at once upon reaching the Institute and have been given hope of final recovery. The doctors at the Institute are extremely conservative and never promise to effect a cure; but the records show that in a majority of cases where sufferers have been encouraged by being admitted as patients cures have been effected. In the one case of the American patients where the physicians have not yet determined whether they can give relief, it appears the patient is suffering from a rather deep-seated cancer, and the Finsen rays do not cure any but the more superficial cancers.

This report does not pretend to discuss the Finsen treatment in detail. It consists of the application to the diseased part of electric arc light, concentrated by a series of lenses and filtered through distilled water, which process of filtration removes the heat rays, but preserves the violet, ultra-violet and blue rays, the chemical and bacterial effects of which are such as to destroy the disease germs of lupus vulgaris and various other skin diseases, curing the diseases apparently for all time.

There are large Finsen institutes in various centers, notably in London, Paris and Berlin, but it is natural that all look to Dr. Finsen and his able assistants at Copenhagen for leadership.

St. Louis Headquarters N. E. L. A.

Mr. James I. Ayer, the progressive and efficient chairman of the Committee on Relations with Kindred Organizations of the National Electric Light Association, announces that arrangements have been made by which the Association will have permanent headquarters at the St. Louis World's Fair, consisting of a railed enclosure furnished with chairs, a convenient desk, stationery, etc., for the use of its members. The office will be in a section used also for an Edison Historical Exhibition, the headquarters of the Association of Edison Illuminating Companies and the headquarters of the American Institute of Electrical Engineers. Members will undoubtedly find this agreeable for a meeting point and a convenience in many ways while at the Exposition. A register will be provided and it is desired that all members visiting the headquarters register their name, local address and probable duration of visit. It is believed that this register will be of much value to visiting members, as well as an indication of the usefulness of a headquarters at an important Exposition.

On Turbo-Dynamos.--II.

(Concluded.)

BY PROF. DR. F. NIETHAMMER.

I HAVE arranged a collection of the formulas for calculating the mechanical strains grst on all important parts of a rotating direct-current armature running with speeds up to 80 to 100 meters per second, which should never be exceeded for economical reasons:

(*a*) The active sheet-iron ring, which is not split in all turbo-dynamos, has to resist a maximum tensile stress from centrifugal forces of $\sigma_e = 0.8 \times 0.082\, v_s^2$ kg. per sq. cm. (v_s = circumferential velocity in meters at the root of the teeth). For $v_s = 80$ meters per second, which is sometimes used, we find $\sigma_e = 400$ kg. per cm².

(*b*) The roots of the teeth are acted upon by a radial tensile strain,

$$\sigma_e{}^1 = \frac{\dfrac{w_t}{g}\dfrac{v^2}{r} + \dfrac{w_w}{g}\dfrac{v^2}{r}}{b_t \,.\, l} \text{ kg. per sq. cm.}$$

w_t = weight of one armature tooth in kg., w_w = weight of the copper of one slot between flanges, $g = 9.81$; v = approx. outside velocity of armature in meters per second, $2r$ = armature diameter in meters, b_t = breadth of a tooth at root in cm., l = axial length of a tooth in cm. The centrifugal force of the windings is supposed to be transmitted to the teeth by wooden or mostly by metallic wedges. For an armature like Fig. 4, with $v = 100$ meters, $\sigma_e{}^1$ comes out 200 kg. per cm².

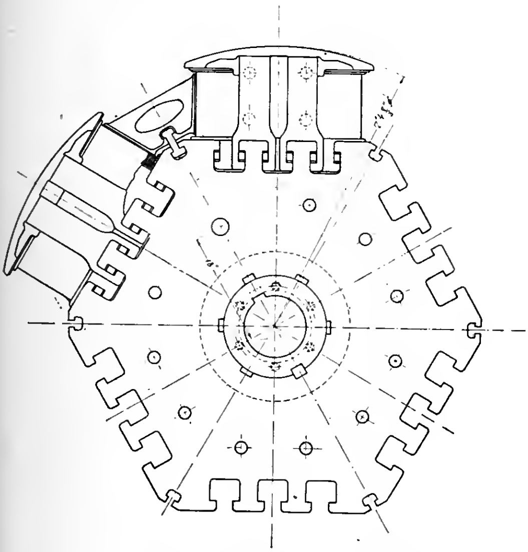


FIG. 6.—UNION COMPANY'S ARMATURE WINDING.

(*c*) The wedges which serve to help the windings of the slots in place are bent by a specific load of bending stress,

$$\sigma_b = 0.8\, \frac{\dfrac{v^2}{r\,g}\, w_w\, b_s}{l\, s^2} \text{ kg. per sq. cm.}$$

b_s = breadth of slot at top (equal to breadth of wedge); s = thickness of wedge; l = length of wedge, all in cm. For a wedge of 5 mm. thickness we find $\sigma_b = 500$ kg. per cm²., which is quite inadmissible for wood.

(*d*) The end connections, which are usually built up as a barrel winding, are usually protected by a seamless (nickel) steel ring (Fig. 4) or specially good bending wire in several layers. This solid or wire ring has to bear a tensile stress of

$$\sigma_e{}'' = 0.082\, v^2 + \frac{w_e}{g}\frac{v^2}{r}\frac{1}{2\pi\, l_r\, s_r} \text{ kg. per sq. cm.}$$

w_e = copper weight of the end connections of one side in kg.; $l_r \times s_r$ = section of ring in sq. cm. For the above example (Fig. 4), with $v = 100$ m. we get $\sigma_e{}'' = 800 + 2{,}000 = 2{,}800$ kg. per cm.², a very high strain. The ring or binding wire ought to be drawn on the winding with a tension equal to $\sigma_e{}''$ in the erecting shop to avoid loosening when running full speed; usually this is not possible in a perfect way.

(*c*) The commutators have to run with speeds up to 50 meters per second. The high centrifugal forces are absorbed by insulated shrinking rings (Fig. 4) put quite close together, or the commutator is composed of a series of very short commutators of usual design. The bending strain of the commutator segments is, in the case of shrinking rings, *a* cm. apart from each other:

$$\sigma_b{}'' = \frac{w_s}{g}\frac{vk^2}{rk}\frac{a}{{}^5/_6\, s\, h^2} = \frac{8\ 9}{1000\, g}\frac{vk^2}{rk}\frac{a^2}{1.3\, h} \text{ kg. per sq. cm.}$$

w_s = weight of one commutator segment in kg. so far as it lies between two shrinking rings; $g = 9.81$; vk = circumferential speed of commutator in meters per second; $2rk$ = commutator diameter in meters; s = mean thickness of a commutator segment in cm.; h = height of commutator segment in cm. For $vk = 50$ m. per second; $rk = 0.15$ m.; $a = 25$ cm.; $s = 0.75$ cm.; $h = 4$ cm., one finds:

$$\sigma_b{}'' = 1{,}500 \text{ kg. per cm}^2.$$

This value is excessively high for copper.

The shrinking rings on the commutators have to withstand the whose centrifugal force of the commutator segments and of their own weight. Their section is determined in the same way as in case *d*. Put G_c = entire commutator copper weight in kg.; l_s = entire axial length of all shrinking rings, together in cm.; s_s = radial height of same in cm.; v = speed of the shrinking rings in meters, then the tensile strain in the rings is

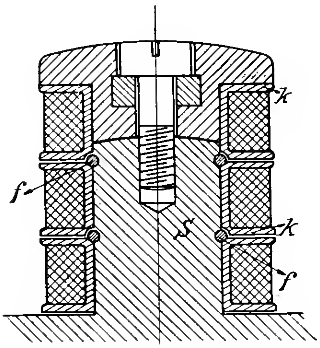


FIG. 7.—SUBDIVIDED COILS.

$$\sigma_e{}'' = 0.082\, v^2 + \frac{G_c}{rk}\frac{0.8}{2\pi\, l_s\, s_s} \text{ kg. per sq. cm.}$$

The rings have to be shrunk on the commutator with a tension at rest equal to $\sigma_e{}''$ to avoid a loose commutator at full speed. In the above example one finds

$$\sigma_e{}'' = 300 + 500 = 800 \text{ kg. per cm}^2.$$

For all the cases mentioned the remark holds good that mostly the strains only depend on the circumferential speed v and not on the diameter of the rotating part.

For three-phases, the rotating field type is nearly universally adopted. The material for the field wheels of high speed consists either of best cast steel or of solid forged iron or of piled thin iron sheets of 0.5 to 3 mm. thickness. The most important part, the field winding, may be (*a*) A *copper strip winding*, the strips *on edge* wound on definite poles; the overhanging parts of the coils must be specially fastened by clamps and angles (Fig. 6, German patent No. 141,295, of the Union Company).

(*b*) A *wire winding* on definite poles, which as a whole is least to be recommended. The coils ought to be subdivided and protected by heavy flanges or spool boxes (Fig. 7); the centrifugal force of each bobbin may be directly transmitted to the pole or pole piece by rings, *f*. (German patent, 134,755). Parsons threads the wires (Fig. 8) through many holes, *c*, in plates riveted or screwed to the

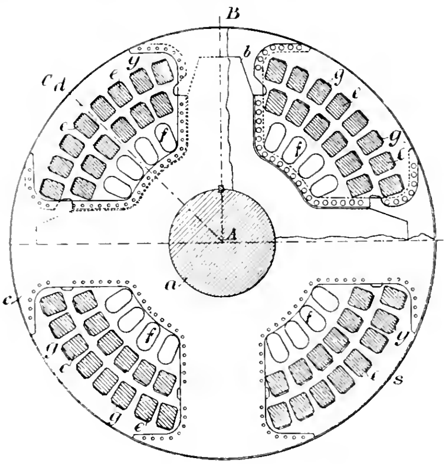


FIG. 8.—PARSONS WINDING.

field star (English patent, 5,907, year 1902), the end connections being fastened by a closed ring.

(*c*) A *definite pole winding distributed in slots* (Fig. 9, German patent, 143,119, of the Westinghouse Company) to divide the effect of the centrifugal forces on the coils; Brown, Boveri & Cie have been using this scheme for some time (German patent, 138,253).

(*d*) *A usual direct-current drum winding* (barrel wave winding), split and connected in such a way that the exciting current may be brought to the winding by two slip rings.

(*e*) A *ring winding* (Fig. 10[2] of the Maschinenfabrik Oerlikon), 1,500 revolutions; exterior field diameter = 860 mm., iron length between flanges = 850 mm.

In every case the exciter voltage has to be kept low, and the section of the exciter winding large, as the number of poles is very small in all turbo-alternators, even of high periodicity, and as it is desirable to have no considerable potential difference between two consecutive turns. The high mechanical pressures on the rotating winding, of 200 kg. per sq. cm. and more, may cause break-downs and leakage currents between adjoining turns, if one does not take special care; the surface of the copper must be absolutely smooth and the insulation layer sufficiently thick and resisting. Ordinarily the exciter voltage is only about 20 to 50 volts.

For some time turbo-alternators were built with rotating armatures and outside field frames (Parsons), the armature slots being perfectly closed and the end connections protected by a closed steel ring. A rotating field winding is, however, much safer to be manufactured than a rotating high-voltage winding and, therefore, the rotating armature has been generally given up. The inductor type of alternator seems to be very tempting for high-speed purposes, as all windings, the induced and inducing ones, are standing still and only

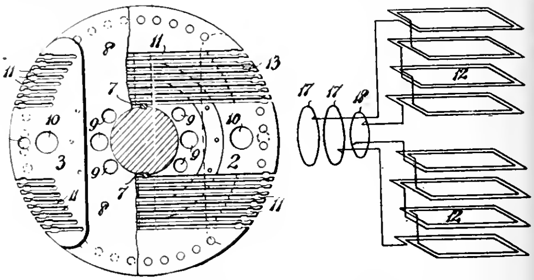


FIG. 9.—WESTINGHOUSE WINDING.

a simple steel wheel is rotating. In this type, however, the stray field losses and the iron losses, especially the eddy currents, are very considerable; the iron losses may even cause excessive heating.

Pole and pole shoes may form one piece with the yoke and hub (Figs. 8 to 10), which is perhaps the safest design. With definite poles usually either pole and pole pieces have together to be attached to the yoke by screws, dove-tails or wedges (Figs. 11 to 14 and Fig. 6), or the pole shoes are fixed in the same way on the pole projections, these being one piece, with the yoke (Figs. 15 to 17). In Fig. 18 (patent of the General Electric Company) sheet-iron bundles are

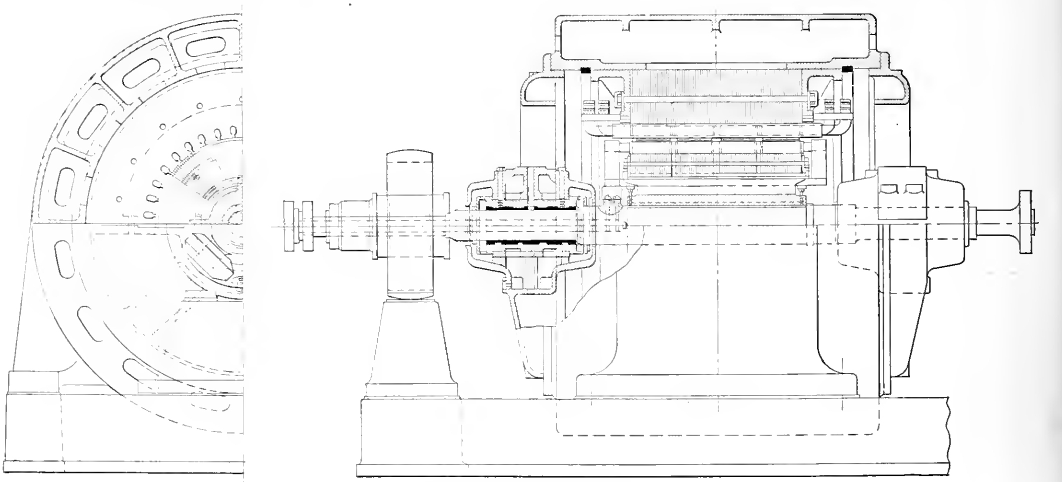


FIG. 10.—OERLIKON RING WINDING.

which for $2p$ poles has to be divided into $2p$ coils connected up alternately in opposite sense. The winding must be composed of very high bars. Fig. 10 represents a case for 1,200 kilovoltamperes and

mortised in the hub by a wedge; the same design is also used for pole pieces.

To get an idea as to the strains in the various devices for attaching pole and pole pieces of high-speed fields, I take the following example from actual practice:

[2] Taken from Strecker; German translation of S. P. Thompson's "Dynamo-electric Machinery."

Four-pole, three-phase, $u = 1{,}500$ revolutions; circumferential speed = 100 meters per second; dimensions, according to Fig. 11; $a = 25$ cm., $b = 4$ cm., $c' = 3$ cm., $h = 30$ cm., axial pole length $l = 30$ cm.; the pole shoes are supposed not to overhang the poles in the axial direction, but on both sides by 5 cm.; copper strips on edge 0.5×5 cm. section, 50 turns per pole; rectangular pole shape.

	Weight	Centrifugal force in kilos
	in Kilos.	
One pole piece	27	45,000
One pole	180	180,000
One coil.	150	150,000

The various means for fixing poles and pole shoes have been chosen as strong as possible with regard to the existing pole section. Fig. 11 diameter d of bolt = 8″; tensile stress

$$= \frac{375{,}000}{20^2 \dfrac{\pi}{4}} = 1{,}200 \text{ kg. per sq. cm.}$$

In Fig. 12 d can hardly be more than 6″, which means a still higher strain. Though these stresses are materially above the usual maximum in screw bolts, of 500 kg. per cm². in most cases, there still will not be sufficient space for the big nuts or screw heads inside the yoke. The tensile strain on two pieces of 3″ screws of Fig. 15 is

$$\frac{195{,}000}{2 \times 1.5^2 \dfrac{\pi}{4}} = 2{,}000 \text{ kg. per cm}^2;$$

in Fig. 16 with $\delta = 6''$,

$$\frac{195{,}000}{15^2 \dfrac{\pi}{4}} = 1{,}100 \text{ kg. per. cm}^2.$$

Only the very best material can effectively withstand these stresses.

The dove-tails of Fig. 13 show with $a = b = 7$ cm. a specific bending stress of

$$\frac{375{,}000 \,.\, a}{2 \times 2 \times \frac{1}{6}\, l\, b^2} = 2{,}700 \text{ kg. per cm}^2.$$

By choosing the angle of the dove-tail equal to 60° instead of 45, the value may be brought down somewhat. The section $c \times l$ (Fig. 13) has to bear a stretching strain of over 1,000 kg. per cm². if $c = 100$ cm. The shearing or transverse strain in the dove-tails is

$$\frac{375{,}000}{2 \,.\, b\, l} = 900 \text{ kg. per cm}^2.,$$

which must be combined in the well-known manner with the bending strain.

By replacing one dove-tail by two (Fig. 14) with $a = b = 3$ cm., the strain just calculated becomes 3,200, 2,100, 1,800 kg. per cm²., and for the pole piece (Fig. 17) with a double dove-tail, 1,600, 1,100, 500 kg. per cm². The specific surface pressures in the dove-tail reach values as high as 1,000 kg. per cm². In the design (Fig. 18) with mortised bundles of 2 x 15 mm. thickness the wedge, F, with a section = 20 x 40 mm. has to withstand bending strains =

$$\frac{375{,}000 \times 1.5}{10 \times 8 \times \frac{1}{6} \times 4 \times 2^2} = 2{,}500 \text{ kg. per sq. cm.}$$

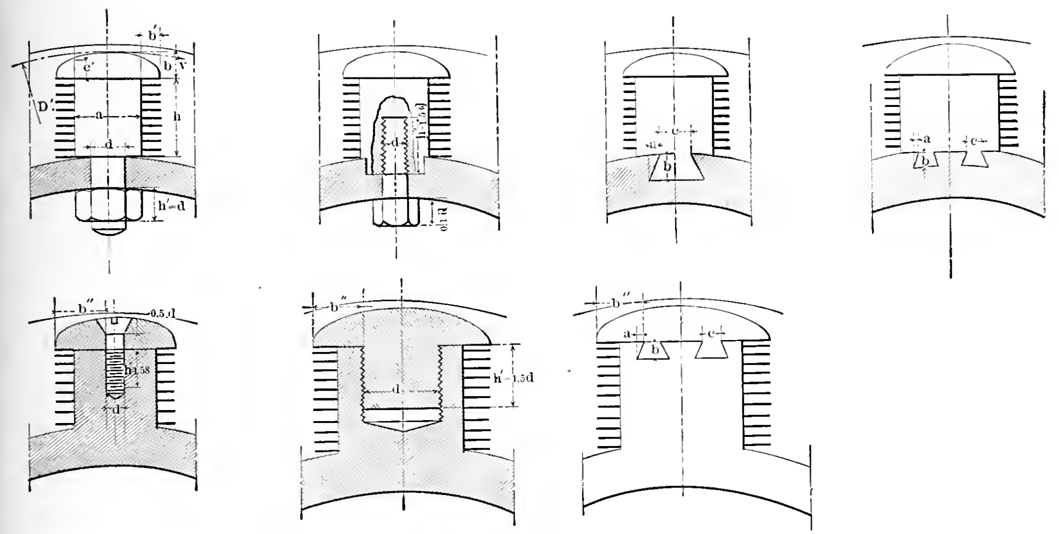
Similar calculations hold good for the design (Fig. 6). Of further importance are the bending pressures in the overhanging parts of pole pieces (Figs. 11 to 14) in the section c':

$$\frac{150{,}000\; b'}{2 \times 2 \times \frac{1}{6}\, l \,.\, c'^2} = 4{,}000 \text{ kg. per sq. cm.}$$

In Figs. 15 to 17 these strains are still higher as b' is to be replaced by the larger value, b'' and 2 in the denominator by 1.5 or 1.

These examples may be sufficient to give an idea of the excessive strains which exist in high-speed field bodies.

4. Finally a few words about noiseless running. It is generally known that all extra high-speed machines have a certain tendency to produce a penetrating, shrill or droning noise, which renders every conversation impossible, and which may be heard over a great distance. The cause is the very rapid air movement, especially the whirls and sudden variations of the section of the streaming air by projecting and overhanging windings or other parts of the generator. Bars insufficiently fixed in the slots or laminated teeth not well



FIGS. 11 TO 17.—VARIOUS METHODS OF COMBINING POLES AND POLE SHOES.

pressed together may magnify the noise considerably. The best remedy consists in designing an absolutely smooth drum or rotating

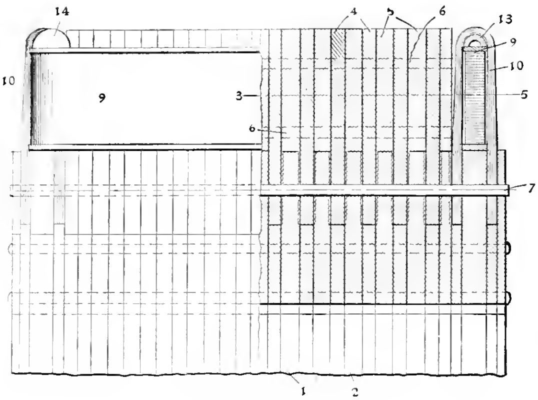


FIG. 18.—GENERAL ELECTRIC METHOD OF COMBINING POLES AND POLE SHOES.

part which can easily be done for the types of Figs. 9 and 10. Definite pole types have to be very often to be entirely closed by cylindrical

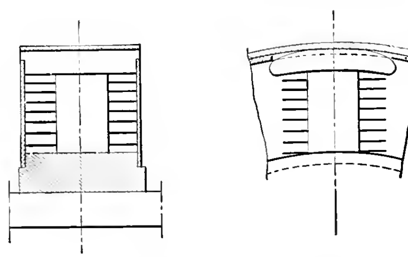


FIG. 19.—COMBINING POLES AND POLE SHOES.

and plain sheets (Figs. 8, 9 and 10), in which suitable air ducts and air holes have to be provided. All windings must be safely fixed by wedges and the teeth must be strengthened by solid end pieces.

New Telephone Company at Indianapolis.

The Indianapolis Telephone Company is the name of a new telephone company organized by the stockholders of the New Telephone Company with a purpose to lease and operate the exchanges and property of the New Telephone Company for a term of 20 years. The company will be incorporated and capitalized at $1,200,000.

The plans for the organization of the Indianapolis Telephone Company and the taking over, leasing and operating of the property of the New Telephone Company are very similar to those under which the Indianapolis Traction & Terminal and the Indiana Union Traction Companies were organized. The dividends on the stock and the interest on the bonds of the New Telephone Company, amounting in the aggregate to $64,000 annually, are guaranteed by the Indianapolis Telephone Company during the entire time of the lease.

The net income of the New Telephone Company last year was $110,000 and there are only 67 stockholders. These figures were given out by the officials for the first time this month. Under the new arrangements the net income will be increased at least $24,000 annually. The Indianapolis Telephone Company will realize $200,000 from stock, the greater part of which will be expended in making extensions so as to accommodate 3,000 more subscribers, 2,000 of whom already have their applications on file. The officers of the New Telephone Company have been elected to fill similar positions in the Indianapolis Telephone Company, viz.: S. P. Sheerin, president; Louis Holwegg, vice-president, and H. B. Sales, secretary and treasurer.

The Letter of Peregrinus on the Magnet, 1269.

THE following translation of this famous letter, to which we made a lengthy reference in our issue of March 11, is from the pen of Brother Arnold, M. Sc., Professor in Manhattan College, New York City. It was addressed by the author from the trenches at Nocera, Southern Italy, in August, 1269, to Sigerus de Foucaucourt, a countryman of his to whom he sought to explain the principle of his magnetic motor.

CHAPTER I.—PURPOSE OF THIS WORK.

DEAREST OF FRIENDS:—At your earnest request, I will now make known to you, in an unpolished narrative, the undoubted though hidden virtue of the lodestone, concerning which philosophers up to the present time give us no information, because it is characteristic of good things to be hidden in darkness until they are brought to light by application to public utility. Out of affection for you, I will write in a simple style about things entirely unknown to the ordinary individual. Nevertheless I will speak only of the manifest properties of the lodestone, because this tract will form part of a work on the construction of philosophical instruments. The disclosing of the hidden properties of this stone is like the art of the sculptor by which he brings figures and seals into existence. Although I may call the matters about which you inquire evident and of inestimable value, they are considered by common folk to be illusions and mere creations of the imagination. But the things that are hidden from the multitude will become clear to astrologers and students of nature and will constitute their delight as they will also be of great help to those that are old and more learned.

CHAPTER II.—QUALIFICATIONS OF THE EXPERIMENTER.

You must know, my dear friend, that whoever wishes to experiment, should be acquainted with the nature of things and should not be ignorant of the motion of the celestial bodies. He must also be skilful in manipulation in order that, by means of this stone, he may produce these marvelous effects. Through his own industry he can, to some extent indeed, correct the errors that a mathematician would inevitably make if he were lacking in dexterity. Besides, in such occult experimentation, great skill is required, for very frequently without it the desired result cannot be obtained, because there are many things in the domain of reason which demand this manual dexterity.

CHAPTER III.—CHARACTERISTICS OF A GOOD LODESTONE.

The lodestone selected must be distinguished by four marks—its color, homogeneity, weight and strength. Its color should be ironlike, pale, slightly bluish or indigo, just as polished iron becomes when exposed to the corroding atmosphere. I have never yet seen a stone of such description which did not produce wonderful effects. Such stones are found most frequently in northern countries, as is attested by sailors who frequent places on the northern seas, notably in Normandy, Flanders and Picardy. This stone should also be of homogeneous material; one having reddish spots and small holes in it should not be chosen; yet a lodestone is hardly ever found entirely free from such blemishes. On account of uniformity in its composition and the compactness of its innermost parts, such a stone is heavy and therefore more valuable. Its strength is known by its vigorous attraction for a large mass of iron; further on I will explain the nature of this attraction. If you chance to see a stone with all these characteristics, secure it if you can.

CHAPTER IV.—HOW TO DISTINGUISH THE PARTS OF A LODESTONE.

I wish to inform you that this stone bears in itself the likeness of the heavens, as I will now clearly demonstrate. There are in the heavens two points more important than all others, because on them, as on pivots, the celestial sphere revolves: these points are called one the arctic or north pole, the other the antarctic or south pole. Similarly you must fully realize that in this stone there are two points styled respectively the north pole and the south pole. If you are very careful, you can discover these two points in a general way. One method for doing so is the following: With an instrument with which crystals and other stones are rounded let a lodestone be made into a globe and then polished. A needle or an elongated piece of iron is then placed on top of the lodestone and a line is drawn in the direction of the needle or iron, thus dividing the stone into two equal parts. The needle is next placed on another part of the stone and a second median line drawn. If desired, this operation may be performed on many different parts, and undoubtedly all these lines will meet in two points just as all meridian or azimuth circles meet in the two opposite poles of the globe. One of these is the north pole, the other the south pole. A proof of this will be found in subsequent chapters of this tract.

A second method for determining these important points is this: Note the place on the above-mentioned spherical lodestone where the point of the needle clings most frequently and most strongly; for this will be one of the poles as discovered by the previous method. In order to determine this point exactly, break off a small piece of the needle or iron so as to obtain a fragment about the length of two fingernails; then put it on the spot which was found to be the pole by the former operation. If the fragment stands perpendicular to the stone, then that is, unquestionably, the pole sought; if not, then move the iron fragment about until it becomes so; mark this point carefully; on the opposite end another point may be found in a similar manner. If all this has been done rightly, and if the stone is homogeneous throughout and a choice specimen, these two points will be diametrically opposite, like the poles of a sphere.

CHAPTER V.—HOW TO DISCOVER THE POLES OF A LODESTONE AND HOW TO TELL WHICH IS NORTH AND WHICH SOUTH.

The poles of a lodestone having been located in a general way, you will determine which is north and which south in the following manner: Take a wooden vessel rounded like a platter or dish, and in it place the stone in such a way that the two poles will be equidistant from the edge of the vessel; then place the dish in another and larger vessel full of water, so that the stone in the first-mentioned dish may be like a sailor in a boat. The second vessel should be of considerable size so that the first may resemble a ship floating in a river or on the sea. I insist upon the larger size of the second vessel in order that the natural tendency of the lodestone may not be impeded by contact of one vessel against the sides of the other. When the stone has been thus placed, it will turn the dish round until the north pole lies in the direction of the north pole of the heavens, and the south pole of the stone points to the south pole of the heavens. Even if the stone be moved a thousand times away from its position, it will return thereto a thousand times as by natural instinct. Since the north and the south parts of the heavens are known, these same points will then be easily recognized in the stone because each part of the lodestone will turn to the corresponding one of the heavens.

CHAPTER VI.—HOW ONE LODESTONE ATTRACTS ANOTHER.

When you have discovered the north and the south pole in your lodestone, mark them both carefully, so that by means of these indentations they may be distinguished whenever necessary. Should you wish to see how one lodestone attracts another, then, with two lodestones selected and prepared as mentioned in the preceding chapter, proceed as follows: Place one in its dish that it may float about as a sailor in a skiff, and let its poles which have already been determined be equidistant from the horizon, i. e., from the edge of the vessel. Taking the other stone in your hand, approach its north pole to the south pole of the lodestone floating in the vessel; the latter will follow the stone in your hand as if longing to cling to it. If, conversely, you bring the south end of the lodestone in your hand towards the north end of the floating lodestone, the same phenomenon will occur; namely, the floating lodestone will follow the one in your hand. Know then that this is the law: the north pole of one lodestone attracts the south pole of another, while the south pole attracts the north. Should you proceed otherwise and bring the north pole of one near the north pole of another, the one you hold in your hand will seem to put the floating one to flight. If the south pole of one is brought near the south pole of another, the same will happen. This is because the north pole of one seeks the south pole of the other, and therefore repels the north pole. A proof of this is that finally the north pole becomes united with the south pole. Likewise if the south pole is stretched out towards the south pole of the floating lodestone, you will observe the latter to be repelled, which does not occur, as said before, when the north pole is extended towards the south. Hence the silliness of certain persons is manifest, who claim that just as scammony attracts jaundice on account of a similarity between them, so one lodestone attracts another even more strongly than it does iron, a fact which they suppose to be false although really true as shown by experiment.

CHAPTER VII.—HOW IRON TOUCHED BY A LODESTONE TURNS TOWARDS THE POLES OF THE WORLD.

It is well known to all who have made the experiment, that when an elongated piece of iron has touched a lodestone and is then fastened to a light block of wood or to a straw and made float on water, one end will turn to the star which has been called the Sailor's star because it is near the pole; the truth is, however, that it does not point to the star but to the pole itself. A proof of this will be furnished in a following chapter. The other end of the iron will point in an opposite direction. But as to which end of the iron will turn towards the north and which to the south, you will observe that that part of the iron which has touched the south pole of the lodestone will point to the north and conversely, that part which had been in contact with the north pole will turn to the south. Though this appears marvelous to the uninitiated, yet it is known with certainty to those who have tried the experiment.

CHAPTER VIII.—HOW A LODESTONE ATTRACTS IRON.

If you wish the stone, according to its natural desire, to attract iron, proceed as follows: Mark the north end of the iron and towards this end approach the south pole of the stone, when it will be found to follow the latter. Or, on the contrary, to the south part of the iron present the north pole of the stone and the latter will attract it without any difficulty. Should you, however, do the opposite, namely, if you bring the north end of the stone towards the north pole of the iron, you will notice the iron turn round until its south pole unites with the north end of the lodestone. The same thing will occur when the south end of the lodestone is brought near the south pole of the iron. Should force be exerted at either pole, so that when the south pole of the iron which had been touched by the north end of the stone is made touch the south end of the stone, or else that part which had been in contact with the south pole is made touch the south pole of the stone, then the virtue in the iron will be easily altered in such a manner that what was before the south end will now become the north and conversely. The cause is that the last impression acts, confounds, or counteracts and alters the force of the original movement.

CHAPTER IX.—WHY THE NORTH POLE OF ONE LODESTONE ATTRACTS THE SOUTH POLE OF ANOTHER AND VICE VERSA.

As already stated, the north pole of one lodestone attracts the south pole of another and conversely; in this case the virtue of the stronger becomes active, whilst that of the weaker becomes obedient or passive. I consider the following to be the cause of this phenomenon: the active agent requires a passive subject, not merely to be joined to it, but also to be united with it, so that the two make but one by nature. In the case of this wonderful lodestone this may be shown in the following manner: Take a lodestone which you may call *A D*, in which *A* is the north pole and *D* the south; cut this stone into two parts, so that you may have two distinct stones; place the stone having the pole *A* so that it may float on water and you will observe that *A* turns towards the north as before; the breaking did not destroy the properties of the parts of the stone, since it is homogeneous; hence it follows that the part of the stone at the point of fracture, which may be marked *B*, must be a south pole; this broken part of which we are now speaking may be called *A B*. The other, which contains *D*, should then be placed so as to float on water, when you will see D point towards the south because it is a south pole; but the other end at the point of fracture, lettered *C*, will be a north pole: this stone may now be named *C D*. If we consider the first stone as the active agent, then the second, or *C D*, will be the passive subject. You will also notice that the ends of the two stones which before their separation were together, after breaking will become one a north pole and the other a south pole. If now these same broken portions are brought near each other, one will attract the other, so that they will again be joined at the points *B* and *C*, where the fracture occurred. Thus, by natural instinct, one single stone will be formed as before. This may be demonstrated fully by cementing the parts together, when the same effects will be produced as before the stone was broken. As you will perceive from this experiment the active agent desires to become one with the passive subject because of the similarity that exists between them. Hence, *C* being a north pole must be brought close to *B* so that the agent and its subject may form one and the same straight line in the order *A B*, *C D* and *B* and *C* being at the same point. In this union, the identity of the extreme parts is retained and preserved just as they were at first; for *A* is the north pole in the entire line as it was in the divided one; so also *D* is the south pole, as it was in the divided passive subject, but *B* and *C* have been made effectually into one. In the same way it happens that if *A* be joined to *D* so as to make the two lines one, in virtue of this union due to attraction in the order *C D A B*, then *A* and *D* will constitute but one point, the identity of the extreme parts will remain unchanged just as they were before being brought together, for *C* is a north pole and *B* a south.

as during their separation. If you proceed in a different fashion, this identity or similarity of parts will not be preserved; for you will perceive that if *C*, a north pole, be joined to *A*, a north pole, contrary to the demonstrated truth, and from these two lines a single one, *B A C D*, is formed, as *D* was a south pole before the parts were united, it is then necessary that the other extremity should be a north pole, and as *B* is a south pole, the identity of the parts of the former similarity is destroyed. If you make *B* the south pole as it was before they united, then *D* must become north though it was south in the original stone; in this way neither the identity nor similarity of parts is preserved. It is becoming that when the two are united into one, they should bear the same likeness as the agent, otherwise nature would be called upon to do what is impossible. The same incongruity would occur if you were to join *B* with *D* so as to make the line *A B C D*, as is plain to any person who reflects a moment. Nature therefore aims at being and also at acting in the best manner possible; it selects the former motion and order rather than the second because the identity is better preserved. From all this it is evident why the north pole attracts the south and conversely, as also why the south pole does not attract the south pole and the north pole does not attract the north.

CHAPTER X.—AN INQUIRY INTO THE CAUSE OF THE NATURAL VIRTUE OF THE LODESTONE.

Certain persons who were but poor investigators of nature held the opinion that the force with which a lodestone draws iron, is found in the mineral veins themselves from which the stone is obtained; whence they claim that the iron turns towards the poles of the earth, only because of the numerous iron mines found there. But such persons are ignorant of the fact that in many different parts of the globe the lodestone is found; from which it would follow that it should turn in different directions according to the locality; but this is contrary to experience. Secondly, these individuals do not seem to know that the places under the poles are uninhabitable because there one-half the year is day and the other half night. Hence it is most silly to imagine that the lodestone should come to us from such places. Since the lodestone points to the south as well as to the north, it is evident from the foregoing chapters that we must conclude that not only from the north pole but also from the south pole rather than from the veins of the mines virtue flows into the poles of the lodestone. This follows from the consideration that wherever a man may be, he finds the stone pointing to the heavens in accordance with the position of the meridian; but all meridians meet at the poles of the world; hence it is manifest that from the poles of the world, the poles of the lodestone receive their virtue. Another necessary consequence of this is that the needle does not point to the pole star, since the meridians do not intersect in that star but in the poles of the earth. In every region, the pole star is always found outside the meridian except twice in each complete revolution of the heavens. From all these considerations, it is clear that the poles of the lodestone derive their virtue from the poles of the heavens. As regards the other parts of the stone, the right conclusion is, that they obtain their virtue from the other parts of the heavens, so that we may infer that not only the poles of the stone receive their virtue and influence from the poles of the world, but also likewise the other parts, or the entire stone from the entire heavens. You may test this in the following manner: A round lodestone on which the poles are marked is placed on two sharp styles as pivots having one pivot under each pole so that the lodestone may easily revolve on these pivots. Having done this, make sure that it is equally balanced and that it turns smoothly on the pivots. Repeat this several times at different hours of the day and always with the utmost care. Then place the stone with its axis in the meridian, the poles resting on the pivots. Let it be moved after the manner of bracelets so that the elevation and depression of the poles may equal the elevation and depression of the poles of the heavens of the place in which you are experimenting. If now the stone be moved according to the motion of the heavens, you will be delighted in having discovered such a wonderful secret; but if not, ascribe the failure to your own lack of skill rather than to a defect in nature. Moreover, in this position I consider the strength of the lodestone to be best preserved. When it is placed differently, i. e., not in the meridian, I think its virtue is weakened or obscured rather than maintained. With such an instrument you will need no timepiece, for by it you can know the ascendant at any hour you please, as well as all other dispositions of the heavens which are sought for by astrologers.

PART II.

CHAPTER I.—THE CONSTRUCTION OF AN INSTRUMENT FOR MEASURING THE AZIMUTH OF THE SUN, THE MOON OR ANY STAR ON THE HORIZON.

Having fully examined all the properties of the lodestone and the phenomena connected therewith, let us now come to those instruments which depend for their operation on the knowledge of those facts. Take a rounded lodestone and after determining its poles in the manner already mentioned, file its two sides so that it becomes elongated at its poles and occupies less space. The lodestone prepared in this wise is then enclosed within two capsules after the fashion of a mirror. Let these capsules be so joined together that they cannot be separated and that water cannot enter; they should be made of light wood and fastened with cement suited to the purpose. Having done this, place them in a large vessel of water on the edges of which the two parts of the world, i. e., the north and south points, have been found and marked. These points may be united by a thread stretched across from north to south. Then float the capsules and place a smooth strip of wood over them in the manner of a diameter. Move the strip until it is equally distant from the meridian-line previously determined and marked by a thread, or

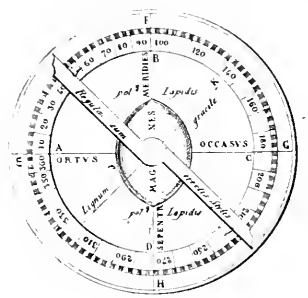


FIG. 1.—AZIMUTH COMPASS OF PEREGRINUS.

else until it coincides therewith. Then mark a line on the capsules according to the position of the strip and this will indicate forever the meridian of that place. Let this line be divided at its middle by another cutting it at right angles which will give the east and west line; thus the four cardinal points will be determined and indicated on the edge of the capsules. Each quarter is to be subdivided into 90 parts, making 360 in the circumference of the capsules. Engrave these divisions on them as usually done on the back of an astrolabe. On the top or edge of the capsules thus marked, place a thin ruler like the pointer on the back of the astrolabe; instead of the sights attach two perpendicular pins, one at each end. If, therefore, you desire to take the azimuth of the sun, place the capsules in water and let them move freely until they come to rest in their proper position. Hold them firmly in one hand, while with the other you move the ruler until the shadow of the pins falls along the length of the ruler; then the end of the ruler which is towards the sun will indicate the azimuth of the sun. Should it be windy, let the capsules be covered with a suitable vessel until they have taken their position north and south. The same method, namely, by sighting, may be followed at night for determining the azimuth of the moon and stars; move the ruler until the ends of the pins are in the same line with the moon or star; the end of the ruler will then indicate the azimuth just as in the case of the sun. By means of the azimuth may then be determined the hour of the day, the ascendant, and all those other things usually determined by the astrolabe. A form of the instrument is shown in the following figure. (See Fig. 1.)

CHAPTER II.—THE CONSTRUCTION OF A BETTER INSTRUMENT FOR THE SAME PURPOSE.

In this chapter I will describe the construction of a better and more efficient instrument. Select a vessel of wood, brass or any solid material you like, circular in shape, moderate in size, shallow but of sufficient width, with a cover of some transparent substance, such as glass or crystal; it would be even better to have both the vessel and the cover transparent. At the center of this vessel fasten a thin axis of brass or silver, having its extremities in the cover above and the vessel below. At the middle of this axis, let there be two apertures at right angles to each other; through one of them pass an iron stylus or needle, through the other a silver or brass needle crossing the iron one at right angles. Divide the cover first into four parts and subdivide these into 90 parts, as was mentioned in describing the former instrument. Mark the parts north, south, east, and west. Add thereto a ruler of transparent material with pins at each end. After this bring either the north or the south pole of a lodestone near the cover so that the needle may be attracted and receive its virtue from the lodestone. Then turn the vessel until the needle stands in the north and south line already marked on the instrument: after which turn the ruler towards the sun if day-time, and towards the moon and stars at night, as described in the preced-

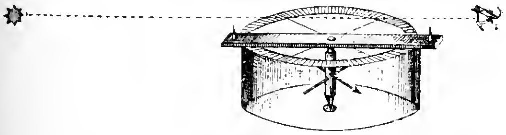


FIG. 2.—PIVOTED COMPASS OF PEREGRINUS.

ing chapter. By means of this instrument you can direct your course towards cities and islands and any other place wherever you may wish to go by land or sea, provided the latitude and longitude of the places are known to you. How iron remains suspended in air by virtue of the lodestone, I will explain in my book on the action of mirrors. Such, then, is the description of an instrument depending on the above-mentioned stone as depicted below. (See Fig. 2.)

CHAPTER III.—THE ART OF MAKING A WHEEL OF PERPETUAL MOTION.

In this chapter I will make known to you the construction of a wheel which in a remarkable manner moves continuously. I have seen many persons vainly busy themselves and even becoming exhausted with much labor in their endeavors to invent such a wheel.

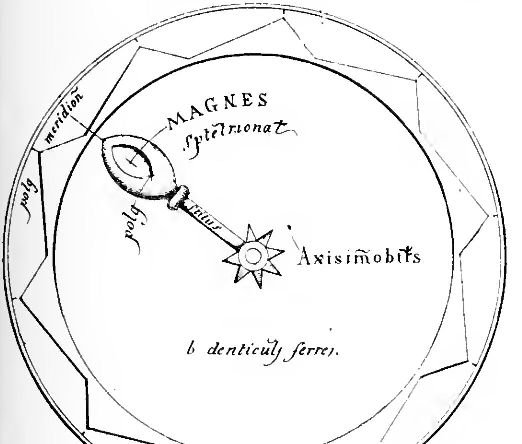


FIG. 3.—THE CONTINUOUSLY-MOVING WHEEL, OR MAGNETIC MOTOR, OF PEREGRINUS.

But these invariably failed to notice that by means of the virtue or power of this stone all difficulty can be overcome. For the construction of such a wheel, take a silver capsule like that of a concave mirror, and worked on the outside with fine carving and perforations, not only for the sake of beauty but also the purpose of diminishing its weight. You should manage also that the eye of the unskilled may not perceive what is cunningly placed inside. Within let there be iron nails or teeth of equal weight fastened to the periphery of the wheel in a slanting direction, close to one another so that their distance apart may not be more than the thickness of a bean or a pea; the wheel itself must be of uniform weight throughout. Fasten the middle of the axis about which the wheel revolves so that the said axis may always remain immovable. Add thereto a silver bar and at its extremity affix a lodestone placed between two capsules and prepared in the following way: When it has been rounded and its poles marked as said before, let it be shaped like an egg; leaving the poles untouched, file down the intervening parts so that thus flattened and occupying less space, it may not touch the sides of the capsules when the wheel revolves. Thus prepared, let it be affixed to the silver rod just as a precious stone is placed in a ring; let the north pole be then turned towards the teeth or cogs of the wheel somewhat slantingly so that the virtue of the stone may not flow diametrically into the iron teeth but at a certain angle; consequently when one of the teeth comes near the north pole and owing to the impetus of the wheel passes it, it then approaches the south pole from which it is rather driven away than attracted, as is evident from the law given in a preceding chapter. Therefore such a tooth would be constantly attracted and constantly repelled. In order that the wheel may do its work more speedily, place within the box a small rounded weight made of brass or silver of such a size that it may be caught between each pair of teeth; consequently as the movement of the wheel is continuous in one direction, so the fall of the weight will be continuous in the other. Being caught between the teeth of a wheel which is continuously revolving, it seeks the center of the earth in virtue of its own weight, thereby aiding the motion of the teeth and preventing them from coming to rest in a direct line with the lodestone. Let the places between the teeth be suitably hollowed out so that they may easily catch the body in its fall, as shown in the diagram below. (See Fig. 3.)

Farewell: finished in camp at the siege of Lucera on the eighth day of August, Anno Domini MCCLXIX.*

Telegrams and Cables in War.

The following reply, inspired by the Foreign Office, to Japan's rejoinder to the Russian protest against the violation of Corean neutrality, has been issued in St. Petersburg and is apparently intended to be accepted as official:

Japan's argument that she was justified in landing troops in Corea before the declaration of war because she had Corea's permission, and also that these troops arrived in Corea after "the existence of a state of war," is without value, as Corea in January promulgated her neutrality to the Powers, which received it warmly, Great Britain even officially conveying expressions of gratitude to the Corean Government. Therefore, no state of war gave the Japanese the right to violate her neutrality by landing troops in her territory. Even the consent of Corea, though extorted by the Japanese, is without force, from the fact that the dispatch of troops was not only before the war, but before the breaking off of diplomatic relations, as clearly established and indeed acknowledged by the Japanese themselves.

Japan's contention in defence of the attack on the Russian ships at Chemulpo, that the port was not neutral on February 9, is false, again because Corea had proclaimed her neutrality. Japan's denial of malicious interference with the transmission of Russian telegrams over the Danish cable cannot be sustained. A telegram to Baron de Rosen (then Russian minister to Japan), at Tokio, sent from St. Petersburg February 4, was not delivered till the morning of February 7. That delay did not occur on the Siberian line, as was shown by the fact that a reply to a telegram from Viceroy Alexieff sent at the same time was received the same day. Therefore, it is conclusive that the De Rosen telegram was held by the Japanese and not delivered for two days.

Communication with M. Pavloff (then Russian minister to Corea) by the Corean telegraph ceased in the middle of January. As the Coreans were enjoying friendly relations with Russia, there is good ground for believing that the interruption was due to the Japanese. Thereafter M. Pavloff used a mail steamer or a special warship to communicate with Port Arthur. The minister of Russia at Seoul February 8, therefore, knew nothing of the diplomatic rupture.

Japan pleads that the charge against her seizure of Russian merchantmen before the declaration of war cannot lie after the establishment of prize courts. Their seizure before the declaration of war being piracy is not defensible by the establishment of prize courts, which cannot exist before a declaration of war. The steamer *Russia* was seized in the waters of southern Corea even before M. Kurino had presented his note here.

The reply concludes: "Our information regarding Japan's announcement that in future Corea would be under her administration came from M. Pavloff and also from the representative of a friendly power at Seoul. Japan's denial, consequently, is fruitless, as also is

*This farewell sentence is in most MSS., but is not in Gasser's printed edition of the letter, 1558.

the attempt to refute our statement that the Russian minister and consul at Seoul were told to leave. We had conclusive proof in St. Petersburg on February 10 that the French minister at Seoul had officially notified our representatives that the Japanese Government had intimated that they should leave, and that the Japanese had occupied territory in Corea. M. Pavloff was unable to notify our consul at Fusan, his telegram being refused at the telegraph office."

A Metrical Detector for Electric Waves.

By L. Heathcote Walter, M. A.

THE want of a satisfactory metrical detector of electrical oscillations has so often been pointed out that a description of the new oscillation galvanometer, which I have designed in conjunction with Prof. J. A. Ewing, F.R.S., will probably be of interest.

This instrument differs from any of the detectors hitherto invented, in that the oscillations directly and visibly indicate their presence by a mechanical movement proportional to their intensity, as a galvanometer responds to a continuous current, and in that such

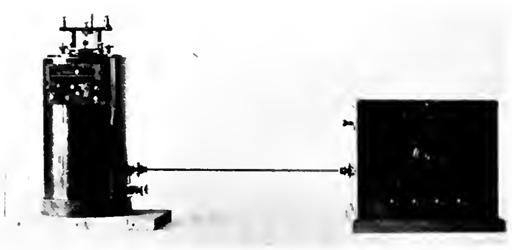


FIG. 1.—WAVE DETECTOR COMPLETE.

quantitative readings can be directly obtained over a practically unlimited range without any alteration to the aerial wires or other conducting masses used to pick up the waves.

Prof. Fessenden some time ago pointed out the impossibility of obtaining a direct mechanical movement from the oscillations, owing to their extremely high frequency. By using an extraneous source (a rotating field) to supply the energy, and making use of the novel property which I discovered—that by passing such oscillations along a magnetic wire, itself subjected to a rotating magnetic field, the hysteresis is enormously *increased,* the effect of the oscillations being to permit more of this externally supplied energy to be utilized—this difficulty is overcome, the same effect being obtained, and to a vastly increased extent, as if the direct electro-dynamic effects of the oscillations were made use of. The instrument depends, as before stated, upon the increase of hysteresis (in the sense of work done per reversal) produced in a bobbin of steel wire, placed in a rotating field,

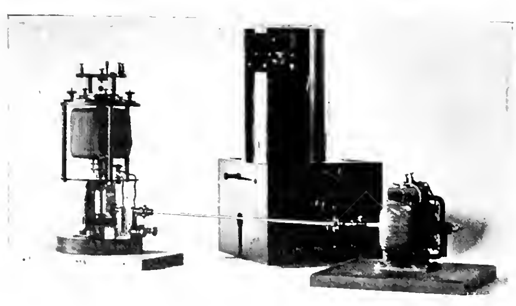


FIG. 2.—DETECTOR WITH COVERS REMOVED.

when oscillations are passed through the wire itself, such oscillations producing an oscillatory circular magnetism superimposed on the varying longitudinal magnetization. The principle and the preliminary experiments leading up to the design of the present instrument are described in a paper by Dr. Ewing and myself on "A New Method of Detecting Electrical Oscillations," read before the Royal Society, London, England, on February 11, 1904.

Briefly, the instrument is an adaptation of the Ewing hysteresis tester, in this case the specimen being held fast and the magnetic field revolving, being driven by an electric motor. The bobbin, which is supported on pivots in jewels, is prevented from following the field by means of a controlling spring. The winding on the bobbin is made as nearly non-inductive as possible by being double-wound, and consists of a number of turns of very fine insulated steel wire, the plane of the turns being at right angles to the axis of the bobbin. The bobbin is immersed in petroleum or thicker mineral oil, according to the amount of damping required, the oil also serving to steady the deflection and to improve the insulation. The instrument has to be considered from two standpoints, the requirements of which are somewhat different. Thus for physical measurements and metrical purposes generally, the instrument is provided with a permanent magnet system for the field, and readings are taken by spot and scale, a mirror being fixed on the bobbin axis. When the apparatus is working there is a steady deflection due to the normal hysteresis, and the spot can be set with the zero at any part of the scale. On oscillations arriving, the bobbin gives a throw in the same direction as that due to the normal hysteresis (same direction as the field), returning to the normal position as soon as the oscillations cease.

The sensibility of the instrument can be made anything desired, firstly, by suitable proportions being given to the bobbin and the wire winding. Thus for measurements near a spark coil, a very small bobbin and short length of wire of larger diameter and lower resistance will suffice, and such wire can be more highly insulated. For other purposes where a low resistance may be desirable, the instrument can be equipped with a bobbin provided with a copper primary of low resistance, either on the bobbin itself or as a fixture external to it, through which the oscillations are to pass, acting inductively on the magnetic winding, which in such a case must be inductively wound and closed on itself; several modifications of such windings are shown in the specification of United States Patent No. 741,570, so that it is unnecessary to describe them. An instrument provided with a bobbin of the highest sensibility can, however, be

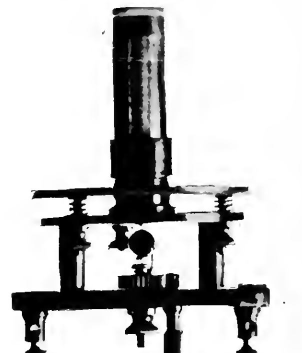


FIG. 3.—VIEW OF THE BOBBIN IN ITS CELL.

used for such measurements if a shunt circuit is employed, and in such a case a sensibility of the order of an average coherer is attainable.

For a receiver for wireless telegraphy, the requirements are somewhat different; sensitiveness (within limits) and rapidity of action being the dominating requirements. Any type of recording apparatus can be actuated by means of the bobbin, a syphon recording attachment having been so employed with good results. That is, however, merely a case of mechanical adaptation, such a possibility being self-evident. The oscillations used for this purpose are also of much greater wave length, necessitating, in the case of simple direct excitation connection (for the best results) the use of a more considerable length of wire on the bobbin. When using a transformer or a shunt connection the conditions are different. I hope shortly to be able to publish the results of experiments in this connection. The figures show one type of the instrument in which an electromagnet furnishes the revolving field. In Fig. 1 the complete instrument is seen. In Fig. 2 the outer covers are removed, to show the magnet system and the interior of the motor box. Fig. 3 shows the bobbin in its cell.

Calculation of the Equivalent Ampere-Turns of Windings for Single and Polyphase Currents.—III.

(Concluded.)

BY C. F. GUILBERT.

NEXT let us examine the case when u is an odd number. As is shown in Figs. 9 and 10, the law of distribution of the m.m.f. is then the same for all the poles. It is to be seen that as in the analogous case of separate phase windings, the coil having a width equal to the pole step a, should be considered for each pole as having half the number of turns as the others; that is to say, $\frac{N}{2u}$ instead of $\frac{N}{u}$. The peripheral widths, b, of the successive and concentric coils are thus:

$$a, \quad \frac{a}{\pi}\left(\pi - 2\frac{2\pi}{qu}\right), \quad \frac{a}{\pi}\left(\pi - 2\frac{4\pi}{qu}\right), \quad \ldots \frac{a}{\pi}\left(\pi - 2(u-1)\frac{\pi}{qu}\right)$$

which correspond for the quantity, $\frac{b}{a}\frac{\pi}{2}$, to the values

$$\frac{\pi}{2}, \quad \frac{\pi}{2} - \frac{2\pi}{qu}, \quad \frac{\pi}{2} - 2\frac{2\pi}{qu}, \ldots \frac{\pi}{2} - \frac{u-1}{2}\frac{2\pi}{qu}$$

The total m.m.f. per pole of the phase considered is then, taking account of the remark made with respect to the first coil.

$$\mathfrak{F}_t' = \frac{4}{\pi^2}\frac{NI\sqrt{2}}{2u}\left[1 + 2\left(\cos\frac{2\pi}{qu} + \cos 2\frac{2\pi}{qu} + \ldots + \cos\frac{u-1}{2}\frac{2\pi}{qu}\right)\right]$$

This expression is analogous to that which has already been obtained above for the case of separate phases; the number of turns is the same and the only difference consists in that the ratio of the progression of the arcs is double: that is to say, $\frac{2\pi}{qu}$ instead of $\frac{\pi}{qu}$. The desired result may then be obtained simply by replacing in the expression found above, q by $\frac{q}{2}$, in such a manner as to double the ratio. The expression for $\mathfrak{F}$ is then, for q phases,

$$\mathfrak{F}_t' = q\frac{2}{\pi^2}\frac{\sin\frac{\pi}{q}}{u\sin\frac{\pi}{qu}}$$

Unlike in the case of separate phase windings, the formula for calculating the equivalent m.m.f. is different for an even and odd number of slots per pole and per phase. This, however, is the only divergence.

As has been done in the case when u is even, it is interesting to compare this formula with that which corresponds to the case where the phases are not superposed. The two formulas differ only by the two quantities:

$$\frac{\sin\frac{\pi}{2q}}{u\sin\frac{\pi}{2qu}} \quad \text{and} \quad \frac{\sin\frac{\pi}{q}}{u\sin\frac{\pi}{qu}},$$

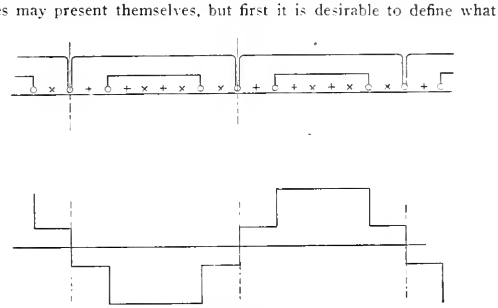
which reduce for large values of u to

$$\frac{2q}{\pi}\sin\frac{\pi}{2q} \quad \text{and} \quad \frac{q}{\pi}\sin\frac{\pi}{q}.$$

For the case of three-phase windings the values of these quantities are, for the factor $\frac{3}{\pi}$, 1 and 0.866, which leads to a difference identical to that corresponding to the case where u is even.

M.M.F. OF SUPERPOSED PHASE WINDING WITH COMMON SLOTS.

We finally come to the case where each slot contains the conductors of the two phases in equal number. As previously, several cases may present themselves, but first it is desirable to define what

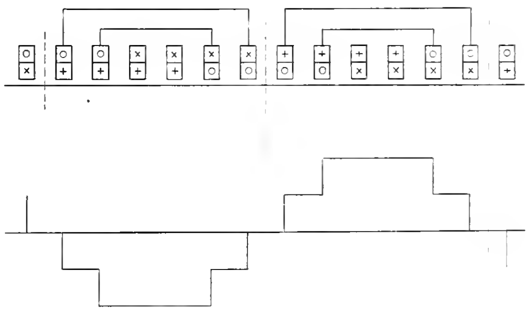


FIGS. 9 AND 10.

should be understood by u in order to obtain formulas comparable to those already established.

We will designate this time by $2u$, the number of slots per pole containing conductors of the same phase, so that the actual distance of two slots referred to the case of a bipolar machine will remain $\frac{\pi}{qu}$, u thus representing here the half number of slots corresponding per pole to a single phase. It is evident that since the number of slots, $2u$ per pole per phase, is always even whether u is odd or even, we can always form per pole a certain number of coils having the same number of turns. Thus one formula can be established for all values of u.

Take, for example, the case where u is even. It will be seen by Figs. 11 and 12 that we can form for each pole identical coils, giving rise consequently to the same law of distribution for all the poles.



FIGS. 11 AND 12.

The widths b of elementary coils have for value.

$$\frac{a}{\pi}\left(\pi - \frac{\pi}{q u}\right),\ \frac{a}{\pi}\left(\pi - 3\,\frac{\pi}{q u}\right)\ \ldots\ldots\ \frac{a}{\pi}\left(\pi - (2u-1)\,\frac{\pi}{q u}\right)$$

Applying the formula giving the m.m.f. of a single coil, bearing in mind that the number of turns for each elementary coil is here $\frac{N}{2u}$, if N is always the number of conductors per pole per phase, we will have in making summation for all the coils of the same phase,

$$\mathfrak{F}_i = \frac{4}{\pi^2}\,\frac{NI\sqrt{2}}{2u}\left[\cos\frac{\pi}{2qu} + \cos\frac{3\pi}{2qu} + \ldots\ \cos(2u-1)\frac{\pi}{2qu}\right]$$

This expression is identical with that obtained for the case of superposed windings having the same number of slots per pole, but where each slot contains only the conductors of a single phase. The expression for the equivalent m.m.f. of the entire windings will then again be

$$\mathfrak{F}_i = q\,\frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{q}}{2u\sin\frac{\pi}{2qu}}\,NI\sqrt{2}.$$

This formula thus applies to all cases where the phases are superposed except for an odd number of slots per pole. In this latter case alone the distribution of the instantaneous m.m.f. is not the same at two neighboring poles.

In what precedes we have taken for granted that each pole comprises an entire number of slots; or in other words, that the total number of slots is a multiple of the number of poles. This is true only for looped or series-parallel windings having a number of circuits in parallel equal to or a multiple of the number of poles. Consequently, the formulas are not rigorously exact in the case of alternators and asynchronous motors as usually wound. However, since an exact calculation would lead to expressions too complicated for practical use, the two general formulas deduced can be adapted for separate phase windings and superposed windings by leaving aside the case of an odd number of slots per pole and per phase. It suffices for this purpose to transform them by introducing the total number of slots of the machine, $u_1 = 2pqu$, $2p$ being the number of poles and b the total number of conductors per phase, $N_1 + 2pN$. The expression for the equivalent m.m.f. of windings by distinct phases thus becomes

$$\mathfrak{F}_i = q\,\frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{2q}}{2qpu\sin\frac{p\pi}{2qpu}}\,2qpNI\sqrt{2}$$

$$= \frac{1}{\pi^2}\,q^2\,\frac{\sin\frac{\pi}{2q}}{u_1\sin\frac{p\pi}{u_1}}\,N_1 I\sqrt{2}$$

and that for the equivalent m.m.f. of the superposed phase winding becomes

$$\mathfrak{F}_i = q\,\frac{2}{\pi^2}\,\frac{\sin\frac{\pi}{q}}{2qpu\sin\frac{p\pi}{2qpu}}\,qpNI\sqrt{2}$$

$$= \frac{2}{n^2}\,q^2\,\frac{\sin\frac{\pi}{q}}{u_1\sin\frac{q\pi}{u_1}}\,N_1 I\sqrt{2}.$$

The formulas which give the equivalent ampere-turns per pole of a polyphase winding traversed by alternating currents with an effective value, I, can be combined in a single formula,

$$\mathfrak{F}_i = \frac{q}{2}\,KNI\sqrt{2}.$$

in assuming with Prof. Blondel that $K = \left(\frac{2}{\pi}\right)^2 k$,

where k can take the following values:

$$k = \frac{\sin\frac{\pi}{2q}}{u\sin\frac{\pi}{2qu}}.\quad \text{Separate phase winding;}$$

$$k = \frac{\sin\frac{\pi}{q}}{2u\sin\frac{\pi}{2qu}}\quad \text{Superposed phase winding, } u \text{ even;}$$

$$k = \frac{\sin\frac{\pi}{q}}{u\sin\frac{\pi}{2qu}}.\quad \text{Superposed phase winding, } u \text{ odd;}$$

It is only to be remarked that the factors k are none other than the reduction factors of the induced e.m.f. permitting account to be taken of the distribution of the conductors of the same phase in several slots per pole.

Together with the exact formulas preceding we can finally employ the following approximate formula in the case where the number of slots corresponding to each pole is not a whole number:

$$\mathfrak{F}_i = \frac{q}{2}\left(\frac{2}{\pi}\right)^2 k\,N_1 I\sqrt{2},$$

when k can have the values

$$k = \frac{q\sin\frac{\pi}{2q}}{u_1\sin\frac{p\pi}{u_1}}.\quad \text{Separate phase winding;}$$

$$k = \frac{q\sin\frac{\pi}{q}}{2u_1\sin\frac{p\pi}{u_1}}.\quad \text{Superposed phase winding.}$$

These formulas naturally contain the preceding except that corresponding to the case where u is odd and the winding is of the superposed phase type. They are very convenient for application in all cases and may be found of much service in the calculation of alternators and asynchronous motors.

The Telephone Substation.—I.

By ARTHUR V. ABBOTT, C. E.

INDUCTION COILS AND SUB-STATION CIRCUITS.

THE earliest telephone line was simplicity itself. As illustrated in Fig. 1, it consisted of two magneto-telephones, each of which acted as transmitter and receiver alternately, united by a pair of wires, or even one wire could be dispensed with, and the "ground" employed as a return, as shown by the dotted line. But such a cir-

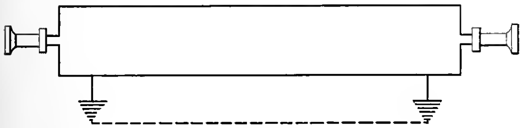


FIG. 1.—EARLIEST TELEPHONE CIRCUIT.

cuit could be employed only over short distances, because the impulses of the magneto telephone are too feeble to be intelligible over long lines. The invention of the battery telephone, which acted as an electric valve to allow power from a source independent of the transmitter to be available, rendered it practical to talk over much longer lines; but with this improvement simplicity had to be sacrificed. It was necessary to provide a separate receiver and transmitter at each station, and introduce a battery as a source of electricity, something as shown in Fig. 2. Consider such a circuit in the light of the transmitter operating as an electric valve. The effect on the receivers will be approximately proportional to the *changes* in the currents that traverse the circuit, and not at all to the actual volume of electricity. These pulsations are produced solely by such variations in the total opposition offered to the flow of electricity from the battery, as are due to the increase and decrease in the resistance of the microphonic contact in the transmitter set up by the changes in pressure on its diaphragm caused by the sound waves that impinge thereon. A circuit of this kind may be divided into four parts, each of which presents its own individual barrier to the passage of electricity: First, there is the opposition due to the receiver. The ohmic resistance of the receiver may vary from 50 to 100 ohms; but as its coils are wound upon an iron core, its reactance is large, and, at the high frequency of telephonic currents, its impedance is considerable. Second, there is the opposition offered by the line wire, which will vary with its length, material and size. Assuming the line to be essentially straight, and of average length, say, about a mile, its opposition will be chiefly due to ohmic resistance, because its inductance is inappreciable, only a few millihenrys and the entire impedance of this portion of the circuit will not exceed, say, 100 ohms. Third, there is the opposition of the battery that is entirely non-inductive, and, even in the case of high resistance cells, will not

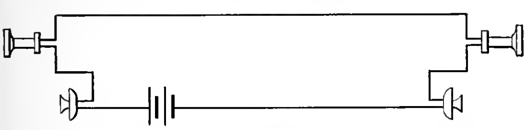


FIG. 2.—CIRCUIT WITH BATTERY TRANSMITTER WITHOUT INDUCTION COIL.

exceed a dozen ohms. Finally, there is the variable, though non-inductive, resistance of two transmitters, either of which may, from time to time, change from a fraction of an ohm to several hundred ohms, though it is rare to find transmitter resistance of more than 25 or 30 ohms.

So a telephone line connected as shown in Fig. 2 will offer an impedance of a thousand ohms or more, though its ohmic resistance would rarely rise above two hundred. Now, to make a favorable assumption, suppose the transmitter to be endowed with an ability to produce a maximum variation of 50 ohms; it would then be able to change the total impedance of the circuit about 5 per cent., and, therefore, its power of producing pulsations in the line current will be correspondingly small. To enable a transmitter to produce a greater effect, the circuit must be so planned that the change in the transmitter resistance will be a much greater proportion of the total circuit impedence. This Mr. Edison accomplished in 1878 by the aid of a *transformer,* or, in telephonic language, an induction coil. Mr. Edison's arrangement, and one which still survives unchanged in local battery installations, is shown in Fig. 3. Two receivers (*RR*) are united by a line, at each sub-station a transformer (*C*) is introduced. This transformer consists of an iron core upon which there are two windings, one of coarse wire, having relatively few turns, and of low resistance, while the other is of fine wire, much higher resistance and many more turns. The fine wire is placed in series with the line and receivers, while the coarse wire forms a local circuit, having a transmitter and battery in series with it. Fifteen years ago the theory and use of the transformer was but little known and practised, the spark coils of Ruhmkorff and others being about the only application of the principles of induction. While Prof. Gray had previously employed an induction coil in telegraphic work, Edison's application of it to the battery transmitter must be regarded as one of the great inventions of telephony.

The induction coil performs four entirely separate and distinct functions: First, it provides a local circuit for each transmitter, that by proper design can be made of so low an impedance that the variations in the resistance of the microphonic contact shall form a very large percentage of the total electrical opposition of the circuit. Second, it removes both transmitters from the line circuit, thus decreasing its resistance. Moreover, as the transmitter is of variable resistance, its direct presence in the talking circuit is exceedingly

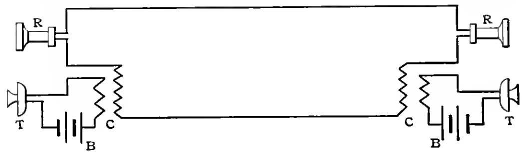


FIG. 3.—CIRCUIT WITH INDUCTION COIL.

objectionable. Third, the analogy of the transmitter to the electric valve leads to the belief that all the impulses it produces are positive quantities, or, so to speak, the transmitter injects jets of electricity into the line. Its action may be illustrated by Fig. 4, in which *AB* is the line of no current, *CD* the current line when the transmitter is at rest, and *EF* a representation of positive impulses superimposed upon the line *AB*. Even under the most favorable conditions, the impulses produced by the transmitter are small in comparison with electrical quantities that are met with under other circumstances. A few measurements upon transmitter currents have been made, the most recent of which are the experiments by Prof. Cross at the Massachusetts Institute of Technology. The various vowel sounds were pronounced in as uniform a tone as possible in front of various transmitters and the result on line current measured by a dynamometer. These tests are summarized in Table No. 1:

TABLE I.

LINE CURRENTS FROM VARIOUS TRANSMITTERS WITH DIFFERENT VOWEL SOUNDS.

Kind of Transmitter.	Vowel Sounds and Currents in Milliamperes.			
	a	o	u	i
Hunning	.737	.787	.503	.213
Fitch	.450	.548	.442	.264
Blake	.123	.144	.114	....
Edison	.088	.123	.144	.072
Magneto	.123	.260	.238	.103

Subsequently, other tests were made with a solid back, to test the effect upon the line current of varying pitch of the voice an octave. These results are shown in Table No. 2:

TABLE II.

RELATION OF LINE CURRENT TO PITCH OF SOUND.

Vibrations per second.	Vowel Sounds and Current in Milliamperes.				
	a	e	i	o	u
128	.300	.270	.250	.350	.200
236	.670	.620	.420	.680	.540

Fourth, the addition of the transformer changes radically the form of the impulses, because a pulsating current impressed upon the primary gives rise to a wave in the secondary which is an alternating one, and is more efficient in exciting the diaphragm of the receiver. This is illustrated in Fig. 5, in which *AB* is the line of no current, corresponding to *AB* of Fig. 4, while *CD* represents the current wave in the secondary, corresponding to *EF* in the primary. Fifth, it is well known that one of the most valuable properties of the transformer is its ability to vary the current and pressure relations of its primary and secondary circuits. This variation is nearly in proportion to the ratio of the number of turns in the primary to the number of turns in the secondary. Thus, if there are P turns in the

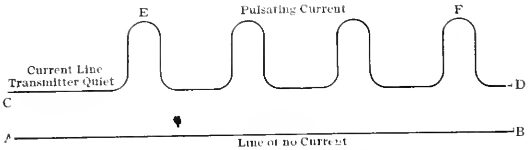


FIG. 4.—DIAGRAM OF CURRENT IN A TRANSMITTER CIRCUIT.

primary and P' turns in the secondary, the ratio is $\frac{P'}{P}$. If V volts be applied to the primary producing in the secondary a current of C am-

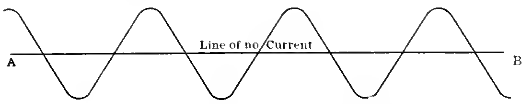


FIG. 5.—CURRENT IN SECONDARY OF INDUCTION COIL.

peres, the volts at the terminal of the secondary will be $\frac{V P'}{P}$ and the current will be $\frac{C P}{P'}$. Now, line losses in any transmission system are proportional to the square of the current which is employed, while the energy transmitted is proportional to the product of the pressure

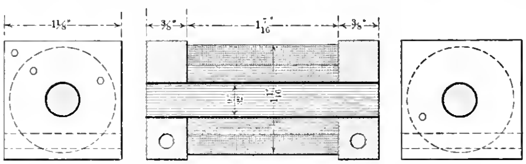


FIG. 6.—INDUCTION COIL FOR BLAKE TRANSMITTER, LOCAL BATTERY.

SPECIFICATIONS FOR FIG. 6.

Core: Bundle of No. 24 soft iron wire.
- Diameter of core, $^9/_{32}$ in.
- Length of core, 2¾ in.
- Winding space, $1^7/_{16}$ in.
- Paper insulation around core, $^1/_{32}$ in. thick.
- End blocks ⅜ in. thick, 1⅛ in. square.

Winding: Inside winding.
- Resistance, .6 ohms.
- 290 turns No. 22 single silk covered wire, wound from end to end of core.
- Two layers of common paper insulation around it.
- Outside winding.
- Resistance, 250 ohms.
- 3000 turns No. 36 single silk covered wire wound from end to end of core.

and the current. Consequently, by reducing the current and increasing the pressure, the same amount of energy may be transmitted, accompanied by much less loss. Owing to arcing at the michrophonic contacts it is impossible to operate a transmitter excepting at low voltages; but the induction coil affords the ability to transform the low pressure and relatively large current of the local circuit into high pressure and correspondingly small current in the secondary circuit.

Enough has been said to indicate the importance of the induction coil, and, therefore, the desirability of obtaining such a design as

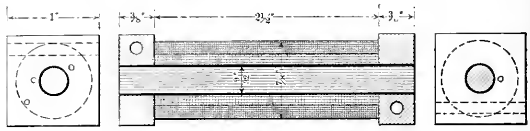


FIG. 7.—INDUCTION COIL FOR SOLID-BACK TRANSMITTER, LOCAL BATTERY.

SPECIFICATIONS FOR FIG. 7.

Core: Bundle of No. 24 soft iron wire.
- Diameter of core, $^9/_{32}$ in.
- Length of core, 3¼ in.
- Winding space, 2½ in.
- Paper insulation around core $^1/_{32}$ in. thick.
- End blocks ⅜ in. thick, 1 in. square.

Winding: Inside winding.
- Resistance, 1.76 ohms.
- 400 turns No. 26 single silk covered wire wound from end to end of core.
- Two layers common paper insulation around it.
- Outside winding.
- Resistance, 21 ohms.
- 1600 turns No. 28 single cotton covered wire wound from end to end of core.

will secure a maximum of the advantages thus outlined. Unfortunately, records of experiments made to determine the best proportions for induction coils are few and difficult to secure. A valuable set of experiments upon a number of coils made by the Swiss Telephone Department is reported by Sir William H. Preece. The results of these experiments are summarized in Table No. 3:

The tests referred to in Table No. 3 were made by taking the induction coil of a Blake transmitter as a standard and comparing therewith, over various lengths of lines, the coils designated in the first column of the table. Unfortunately, the electrical properties of the standard coil were not recorded.

The Iowa Electrical Association Convention.

The fourth annual convention of the Iowa Electrical Association will be held at Des Moines on April 13 and 14, 1904, at the Savery House. The programme as announced so far is as follows: "Uniform Accounting," by Austin Burt; "Electric Motors," by George W. Carson; "Combustion of Iowa Fuel," by Prof. George W. Bissell; "Incandescent Lamp Tests," by Prof. Spinney; "Station Steam Piping," by Mr. Gartlain; "Nernst Lamp Experiences," by Mr. G. C. Gardner; "Series Street Lighting," by Mr. Harrison; "Multiple Street Lighting," by Mr. Lee; "Storage Batteries," by Mr. Reavy; "Demonstrated Talk on Station Accounting," by Mr. Robert Ferris; "Question Box," by W. J. Greene.

TABLE III.—INDUCTION COIL TESTS SWISS TELEPHONE DEPARTMENT.

	Primary Coil.			Secondary Coil.			Length of Line in Miles and Relative Results.									
							.31		38		49		53		67	
Designation of coil.	Number of turns.	Size of wire B. & S. gauge.	Resistance.	Number of turns.	Size of wire B. & S. gauge.	Resistance.	Volume.	Clearness.	Volume.	Clearness.	Volume.	Clearness.	Volume.	Clearness.	Volume.	Clearness.
1	61	24	.25	1956	35	100	.3	.9	.9	1.0	.3	.7	.7	.8	.2	.9
2	62	24	.25	3191	35	180	.7	.9	1.0	1.1	.9	1.0	1.0	1.3	.7	1.0
3	62	24	.25	4080	35	250	.9	.9	1.0	1.3	.9	1.0	.9	1.3	.6	1.0
4	116	24	.50	3952	35	250	1.5	1.3	1.7	1.5	1.3	1.5	1.3	1.5	1.2	1.5
5	230	24	1.00	3865	35	250	1.3	1.0	1.3	1.2	1.1	1.3	1.3	1.5	1.0	1.3
6	232	24	1.20	4420	35	300	1.5	.9	1.6	.9	1.7	1.3	1.7	1.6	1.5	1.5
7	295	24	1.50	4278	35	300	1.3	.9	1.5	.9	1.1	1.1	1.5	1.4	1.6	1.3
8	368	24	2.00	4735	35	350	1.3	1.0	1.5	.9	1.1	1.0	1.5	1.4	1.6	1.2
9	368	21	1.17	4735	29	130.2	1.7	1.0	1.6	.9	1.7	1.4	1.6	1.6	1.7	1.3
10	1350	24	10.00	3950	35	400	1	.3	.3	.5	.3	.3	.3	.4	.3	.1

Methods of Signaling and Operating in Telephone Exchanges—VI.

By Kempster B. Miller and Charles S. Winston.

(Concluded.)

WESTERN ELECTRIC SYSTEM C. MODERN BELL SYSTEM.

In the previous article descriptions were given and illustrated of the two Western Electric toll systems, designating them as A and B. In one two wires are used in toll trunk circuits, in toll systems. In the other three wires are used in the toll trunk circuits. As neither of these systems, A or B, was considered entirely satisfactory by the American Bell Telephone Company, particularly on the ground of not being rapid enough in operation, the engineers of this company set to work to design a system capable of more rapid service, and which would have the advantages of both systems, A and B, with as few as possible of their disadvantages. As a result, about two years ago there was put in operation a new system, which has apparently proved more satisfactory than any of the systems yet tried by the Bell Companies, although it has one disadvantage in the extreme complexity of some of its circuits.

In this system, which we will call "System C," the cord circuits at the toll board are of such a nature that they can be used without change for making connections between two toll stations or between one toll and one local station. The system has advantages in that it affords greater ease of operation and, further, in that the cord circuit is not encumbered by a repeating coil and a repeating coil key. Toll trunk circuits are furnished, appearing as jacks in the toll sections and as plugs and lamps at the toll switching positions on the local switchboard. In addition to this recording toll trunk circuits are provided, which end at the recording operator's positions in lamps and jacks, and appear as multiple jacks only in each section of the local multiple switchboard. Locking relays and lamps controlled by them are used in both the toll line and cord circuits in place of line and clearing-out drops. At each subscriber's operator's position at the multiple switchboard, there is furnished one or more pairs of "tone test" cords adapted to throw a special tone busy test on to any line. With one of these cords which is intended to be connected with the jacks of the local common battery subscribers, is associated a white lamp, and with the other, which is used to connect with the jacks of the recording toll trunks, a red lamp.

The method of operation of this system in establishing a local to toll connection is as follows, reference being made to Fig. 12. A local subscriber desiring to talk over a long distance line will signal his local operator and ask for "toll" or "long distance." The operator will then insert the answering plug of a pair of tone test cords into the multiple jack of the calling line. She will then withdraw the answering plug of the regular pair of cords which she inserted into the answering jack of the calling subscriber's line in response to his call. The white lamp in the tone test cord circuit will remain unlighted as the subscriber with whose line the jack is connected has his receiver off its hook. With the second plug of the tone test circuit the operator will then test the multiple jacks of the recording toll trunk lines, and upon finding one that is not in use, will insert the plug into it. The second (red lamp) in the tone test circuit will also remain unlighted, but a lamp at the recording operator's position associated with the recording trunk circuit will light, and the recording operator having plugged into this jack will find out from the calling subscriber what toll connection is desired and also the number of his own line. From this information the recording operator will make out a ticket.

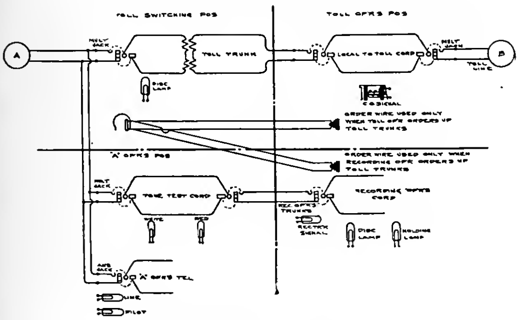


FIG. 12.—SHOWING CONNECTION OF LOCAL TO TOLL SUBSCRIBERS. WESTERN ELECTRIC "C."

Generally, the recording operator is furnished with cord circuits each having a single plug and two lamps. One of these lamps (the holding lamp) is placed under the control of the calling subscriber when the plug with which it is associated is inserted in the proper toll trunk jack, and the second is a disconnect lamp. The operation of the latter lamp will be described below.

It will be seen that the method by which the recording toll operator receives the information from a calling subscriber is the same as that used in the Kellogg system, with the exception that the connection between the calling subscriber's line and the recording toll trunk is made by means of special pair of cords instead of by regular cords, as in the Kellogg system, and also through the multiple jack of the calling subscriber's line, rather than through his answering jack.

After making out the ticket the recording operator has two courses of action open to her, her decision depending on whether or not she has reason to believe the connection called for may be at once obtained. If she thinks it will be some time before it will be possible to establish the connection desired, she will tell the calling subscriber to hang up his receiver and wait until called. The hanging up of the subscriber's receiver will light the white lamp of the tone test cord used in making the connection, but the subscriber's operator will pay no attention to this, her signal for taking down the connection being the lighting of the red lamp. Having told the calling subscriber to hang up his receiver, the recording operator will then pass the ticket to the toll line operator and remove her plug from the recording toll trunk jack, which will light the red lamp in the tone test cord circuit at the multiple switchboard. The lighting of this red lamp gives the signal to the subscriber's operator to take down the connection, and she therefore pulls down both of the tone test plugs leaving the calling subscriber's line free for other use.

The object of the white lamp in the tone test cords is not to serve as a disconnect lamp, but to provide at all times a signal by means of which the local subscriber can attract the attention of the operator even while his line is being held for the toll connection.

If, after making out the ticket, the recording operator has reason to believe that the connection may be at once obtained, she will press an order-wire key enabling her to speak directly to the toll switching operator at the multiple switchboard and give her the number of the line with which the connection is to be made. In response to this the toll switching operator will give the recording operator the number of the trunk line which is to be used, and the recording operator will place this number on the ticket. The toll switching operator will then test the multiple jack of this line, and will receive the special "busy" test, due to the presence of the tone test plug in the multiple jack at the section at which the call was initiated. She is instructed, however, to disregard this special busy test, but to all other operators in the exchange this test has the same significance as the regular "busy" test.

After the toll switching operator has inserted the designated trunk plug into the multiple jack of the calling line, the recording operator will withdraw her plug from the recording trunk jack and insert it into a multiple jack of the toll trunk line designated. These trunks are multipled on all toll and recording sections. After speaking to the subscriber, thus satisfying herself that the connection is, so far, complete, and that the subscriber has given his proper number, she will tell him to "wait a minute." She will then pass the ticket to the toll operator who has charge of the toll line with which the connection is to be established. The act of withdrawing the recording plug from the recording trunk jack will light the red lamp in the tone test circuit at the multiple board, and the operator will remove the tone test plugs from both the subscriber's and recording trunk multiple jacks. It will then be impossible for the subscriber to signal his operator, but the act of moving his receiver will flash the holding lamp at the recording operator's position. As, previous to removing the tone test cords at the multiple switchboard, the white lamp in this circuit was under the control of the subscriber, it will be seen that there is no time that the subscriber cannot signal the exchange.

It will be seen that if the recording operator thinks it will require some time to obtain the toll line desired, she causes the local subscriber's line to be freed, and leaves the toll operator to order up the toll trunk. If, however, she believes that the connection can be immediately made up, she causes the local subscriber's line to be held as busy, and will order up the toll trunk herself. In the former case the ticket received by the toll operator will have no trunk line designated upon it, while in the latter case, it will.

When, therefore, the toll line operator receives the ticket from the recording operator, she will, if no trunk is designated, first insert an answering plug into the multiple jack of the desired toll line and ring. After the call has been answered, the toll operator will give to the switching operator over an order wire, the number of the subscriber's line with which connection is to be made, and receive in return the number of the trunk line to be used, whereupon she will insert the calling plug, which is associated with the answering plug in use, into the multiple jack of the designated trunk line and call the desired subscriber by ringing. If she finds that the trunk line is designated on the ticket and that the recording operator has already ordered up the connection at the toll switching section, she will first insert an answering plug into the jack of the trunk designated on the toll ticket. This act will light the disconnect lamp in the cord circuit of the recording operator, and this operator will remove the plug from the toll trunk jack. The supervision of the connection will then be entirely in charge of the toll line operator, as the multiple board subscriber will light the supervisory lamp in the toll cord circuit by operating his receiver hook. Having inserted the answering plug into the jack of the toll trunk line designated, she will test the multiple jack of the toll line. If, by testing, the toll line operator finds that the desired toll line is not in use, she will insert the calling plug of the pair used, into the multiple jack of this line and call up the toll subscriber. She will listen in at short intervals so as to know when the subscriber answers and the conversation has begun.

At the end of conversation the act on the part of the toll subscriber or of a distant operator of sending current over the line, or on the part of the common battery subscriber of hanging up his receiver, will operate the relay in the toll cord circuit and light the supervisory lamp. The operator will then throw the listening key, thus extinguishing the lamp, and, after having assured herself that the signal is for disconnection, take down the plugs. When she withdraws the plug from the toll trunk circuit, she will automatically light the disconnect lamp associated with this trunk line at the toll-switching position of the multiple switchboard, and the toll-switching operator will remove the toll trunk plug from the multiple jack of the subscriber's line.

The toll trunk line leading from the toll board to the toll-switching operator's position of a local multiple board consists of two wires only, and in order to bring about the advantage of having the cord circuits on the toll positions universally adaptable to any kind of a connection, the repeating coils are placed in the toll trunk circuits rather than in the toll cord circuits. In spite of the presence of this repeating coil, however, the toll operator, in this system, rings the local subscriber instead of having the trunk operator perform this operation, as in system A. This arrangement is made possible by a series of relays so wired that when the toll operator rings on the trunk line, the generator current which she thus causes to flow over the trunk line and through one side of the repeating coil at the toll-switching end of this line, will pull up a relay which will send generator current out on the subscriber's line without passing through the other side of this repeating coil.

When a person at a long distance station desires to converse with a common battery subscriber the current from his generator will energize a relay which will light a lamp at the toll board. From this it will be seen that the latest Bell practice discards the old scheme of having drops for line signals on the toll boards, as well as for supervisory, lamps being used in their places.

When the toll operator answers a call the act of inserting the plug into the answering jack will extinguish the line lamp. Having found that the call is for a common battery subscriber, the toll operator will speak over an order wire to the toll-switching operator at the multiple board telling her the number of the common battery line with which the connection is to be made and the toll-switching operator will designate the trunk, and, after testing and finding that the line is clear, insert the plug of this trunk into the multiple jack of the local line. The toll operator will insert the calling plug associated with the answering jack in use into the multiple jack of the toll trunk line and ring the local subscriber. At the end of the conversation the disconnect signals will be received in the same manner as described, the signal coming to the toll operator, who, when she takes down the connection, conveys the disconnect signal to the toll-switching operator.

If in a call from a toll for a local subscriber the call-switching operator in testing the multiple of the designated local line, as described, finds it busy, she will insert this plug into a busy back jack, and thus notify the toll operator by tone that the connection cannot be put up immediately. The toll operator will then tell the person at the toll station, who is making the call, to hang up his receiver and that as soon as possible he will be called.

Meanwhile the toll operator will frequently remind the toll-switching operator to test the multiple jack of the local subscriber's line in order to ascertain when it is no longer busy, so that the connection may be made.

It would seem that this latter feature might be improved upon, and that a signal should be provided for notifying the toll operator automatically as soon as the local subscriber's line was no longer busy, after which she could immediately complete the connection.

For the handling of toll-to-toll calls, a separate position or positions is provided on the toll board called "through" positions. If the toll operator receives a call from a toll line for another toll line she will make out a ticket for it in the same manner as if the call were for a local line and, on completing the ticket, will establish the connection herself if the line called for is not busy. If, however, it is in use, she will pass the ticket to the through operator, who has in front of her a multiple jack of each line, and, in some exchanges, a lamp which remains lighted as long as that line is busy. This operator, as soon as she finds that both lines are free, either by noting that the lamps of both lines are extinguished, if her position is provided with lamps, or by testing, in case she has none, will establish the connection. At the end of the conversation on such a connection the supervisory lamp will light in the ordinary manner when either of the toll subscribers turns his generator crank.

Recent Electrochemical Developments.

ELECTROMETALLURGY OF STEEL.

Among the successful European metallurgists who have introduced electric furnace methods into the metallurgy of iron and steel is Mr. C. A. Keller, of Paris, whose steel process is in use at Kerrousse, in the Houille·Blanche ("white coal") district. It has recently been stated that Messrs. Keller, Leleux & Co. are contemplating a steel works in this country. For this reason a patent granted on March 15 to Mr. C. A. Keller is of special interest. He uses a double furnace, the upper furnace operating as a stack furnace for the reduction of the metal, while the lower furnace serves for refining or alloying purposes. The upper furnace is characterized by the continuity of its operation and the possibility of the utilization of great power and great capacity. It contains four vertical electrodes disposed upon the four corners of a square, their lower extremities being placed in the refractory vessel which constitutes the fusion chamber. The column of ore charged into the furnace may serve at the same time for a chimney with return flue, and has an exterior diameter such that it may be located between the upper extremities of the electrodes which emerge above the roof of the fusion chamber. Two electrodes are connected to the positive pole and the other two electrodes to the negative pole of the supply circuit. With this arrangement the operation of the furnace is rendered continuous, since one of the four electrodes may be easily replaced without stopping the operation. Readings of the four ammeters, in the branch circuit of each electrode, permit adjusting the intensity of the current in the four heating zones. Each of the electrodes is provided with an operating mechanism which permits its vertical regulation.

IRON-NICKEL STORAGE BATTERY.

Two patents granted to Mr. Thomas A. Edison refer to details of mechanical construction of his iron-nickel storage battery. One patent relates to the use of glass tubes or rods for mechanically supporting and separating the electrodes, and at the same time for electrically insulating the electrodes from the bottom and sides of the containing vessel. The other patent relates to a light, cheap tray, arranged to carry and securely hold together a series of storage batteries, so that, by assembling several such trays with their cells, a complete outfit is produced which is particularly adapted for use on automobiles.

Vertical Motor-Generator Set.

A short time ago the Lend-Gastein (Austria) branch of the Neuhausen Aluminum Industrie Gesellschaft was equipped completely with electrical apparatus furnished by the Oerlikon Company, of Oerlikon, near Zurich, Switzerland. The most interesting feature of this installation is the use of vertical motor-generator sets, of which there are six in all. This type was chosen owing to the satisfactory service given by the vertical generators used in connection with the turbines in this plant. It was found that the vertical arrangement permitted the machinery to be handled with greater ease. The carbon and copper dust falls directly downward and, therefore, cannot get into the armature windings.

The motors of each set are of the synchronous type, each built to give 1,000 hp at 10,000 volts, 45 cycles, 340 r.p.m. The 160-volt, direct-current generators are each of 560-kw capacity.

The generator field is made of cast iron. The motor armature is placed directly above the field of the generator, and is enclosed by a single-piece cast-iron frame. The rotors of both machines are rapidly attached to each other and revolve around the stationary shaft, which is lubricated by means of the oil cup shown at the top of the shaft in Fig. 3. The total weight of the rotors is 27,500 pounds. This weight is taken up by a spur foundation located beneath the commutator of the generator. The stationary cast-steel spur plate is frustum-shaped and rests in a cast-iron pan. The shell of the lower foundation, which is built into the commutator, has a flange at its bottom resting on the spur plate. Both the spur plate and flange have a circular groove for taking up the oil after lubrication. This oil is pumped through the machinery under a pressure of ten atmospheres. The entire supporting foundation, including the pumping machinery, is built in a cast-iron housing completely filled with oil so that lubrication is insured even if the pump fails. The oil is kept cool by a spiral copper pipe which conveys cold water through it.

The generators have twelve poles each and are shunt wound. The armature has an outside diameter of 4.9 ft. and a core diameter of 1.3 ft. The core is cooled by two ventilating slits. The armature contains 204 open slots for the windings, each slot containing four insulated copper wires. The connection between the armature winding and the commutator is made according to a new system devised by the Oerlikon Company, consisting in the use of copper forks, each of which combines two commutator laminations, separated from each other by twice the polar division, with the corresponding armature winding. The commutator consists of 408 segments of hard-drawn copper, 24 in. long, and with an outside diameter of 36 in. All insulating rings in the interior of the commutator are of mica. The twelve poles which carry the shunt windings are built of soft sheet iron and are screwed to the field frame. Corresponding to the twelve poles the brush holder has twelve brushes, each of which is furnished with 11 carbon tips. These brushes are arranged so that all of them can be raised simultaneously when necessary to clean or true the commutator.

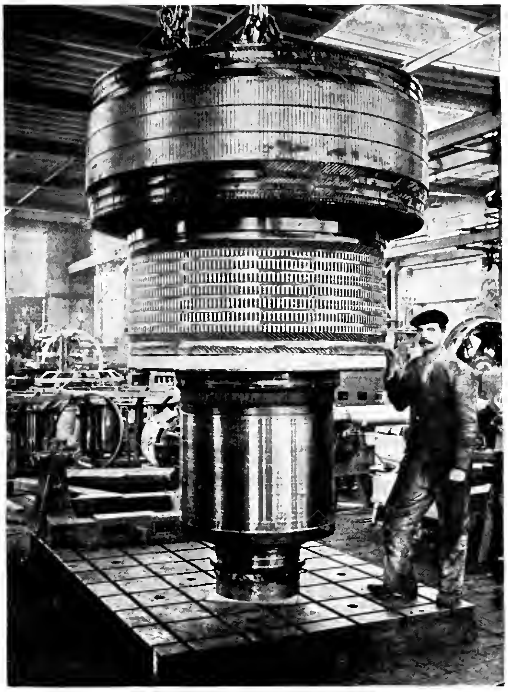


FIG. 2.—VIEW OF THE ROTORS.

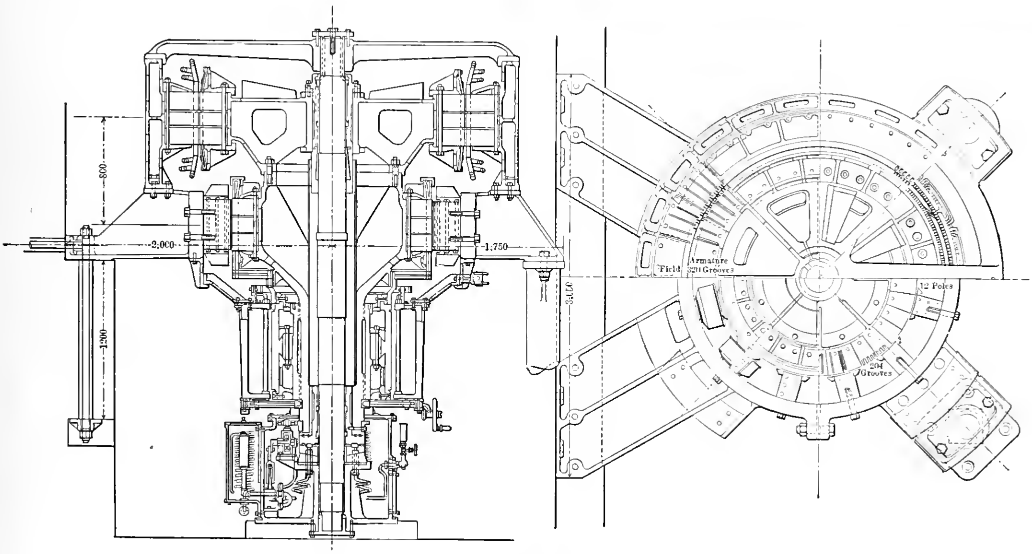


FIG. 1.—DETAILS OF VERTICAL MOTOR-GENERATOR SET.

The motor has sixteen poles. The high-tension winding is laid in 192 slots. Each slot contains eighteen series wires insulated from each other by mica sheets .1 in. thick. The winding is hand-wound, and the wires have a diameter of 4 mm. The rotor of the motor has

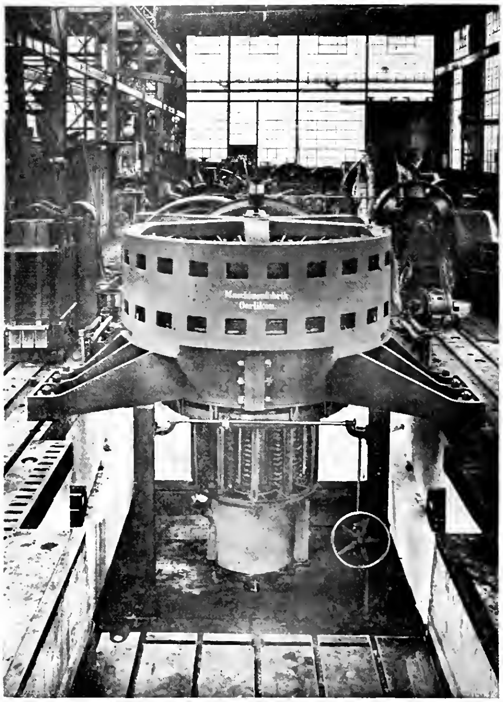


FIG. 3.—GENERAL VIEW OF MACHINE.

a short-circuited winding laid in 320 semi-open slots. Each slot contains two spool halves. Each spool forms a closed winding, and consists of three parallel copper strips 8 x 2.5 mm. cross-section. It is noteworthy that the motors have an air-gap of 2.5 mm., though *cos ϕ* attains a maximum of 0.94.

Drying Out High-Tension Transformers.

To the March issue of the *Electrical Club Journal* Mr. J. S. Peck contributes an article on "Methods of Drying out High-Tension Transformers." Three methods are described, namely, by the use of internal heat, external heat and internal and external heat combined. In applying the first-mentioned method, the transformer should be placed, if possible, in its case, though this is not essential, as it may be left in its shipping case or even placed on the floor of a dry room. If dried out in a case the cover should be removed to give free circulation of air. The low-tension winding should be short-circuited, and a sufficient voltage impressed on the high-tension winding to circulate the desired current through the coils. For large transformers (250 to 500 kw), approximately one-fifth normal full-load current will be sufficient to raise and maintain the coils at the desired temperature, viz.: approximately 90° C. (194° F.). For small transformers a somewhat larger current will be required. For circulating this current through the windings, from 1 per cent. to 2 per cent. of the normal high-tension voltage at normal frequency will be required; thus, for a 10,000-volt transformer from 100 to 200 volts is necessary. For controlling the current a rheostat may be placed in series with the high-tension winding.

In applying the external heat method, the transformer should be placed in a wooden box, the packing case answering the purpose very well. An opening should be made near the bottom and another at the top of the box to permit a circulation of air and also to serve as a means of controlling the temperature of the air inside the box. The heat may be applied by circulating current through resistances, the iron grid form is frequently most suitable, placed at the bottom of the box. It should be applied at such a rate that the transformer coils will be maintained at approximately 90° C. (194° F.). Care should be taken to protect the transformer from direct radiation from the heaters. Care must also be taken to see that there is no inflammable material near the heaters which may catch fire. This method of drying out has an advantage over the method outlined in (*a*) in that direct current may be used for heating.

Instead of placing the heater inside the box containing the transformer, it may be placed outside and the heat carried into the box through a suitable pipe. Where this plan is used the heat may be generated by the direct combustion of gas, coal or wood, but none of the products of combustion should be allowed to enter the box containing the transformer. Heating by direct combustion is not advised except in case where electric current is not available.

In the internal and external heat methods the transformer should be placed in a wooden box as in the above method, and external heat applied, while at the same time a small amount of current is circulated through the transformer windings. The method of circulating the current should be the same as given in the first method discussed, and the method of applying the external heat the same as given in the second method. The current should, of course, be considerably less than when no external heat is used, the value being determined, to a certain extent, by the amount of external heat applied. This method is used occasionally where direct current only is available, a certain amount of current being passed through the high-tension winding only, as the low-tension winding is ordinarily wound for so heavy a current that it cannot be obtained economically from a direct-current circuit.

The length of time the drying-out should be continued will depend largely upon the condition in which the transformer is received, and unless in very bad shape, a week's run should be sufficient to put the transformer in good condition. In certain cases, however, it has been found necessary to continue the run for a somewhat longer time.

It will be found that when the current is first applied and the transformer heats up, the insulation resistance will drop very rapidly, until the desired temperature is reached; then, as this temperature is maintained constant, the resistance will gradually increase. It will also be found that variations from a constant temperature will cause wide changes in resistance. Resistance readings should be made every few hours and the drying continued until the resistance no longer increases, or increases at a very slow rate.

Certain precautions are to be observed in the work. In order to dry out the transformer, it is necessary to maintain it at a temperature which approaches the point where fibrous materials deteriorate. Great care must, therefore, be observed during the whole period of drying out to see that the temperature does not reach a value much in excess of 90° C.

For measuring the temperature of the transformer coils, several thermometers should be used. These should be placed well in between the coils, near the top of the transformer, and screened from air currents, so that they will indicate the maximum temperature of the windings. As the temperature will rise quite rapidly at first, it is necessary to watch the thermometers carefully to see that the maximum allowable temperature is not exceeded.

As the transformer is soaked with oil, on account of the test which it receives in the works, the material is in an inflammable condition, and while hot it may be ignited very easily by a very small arc, or from a blaze of any kind. Before beginning the drying out, it is well to have some chemical extinguisher, or at least a supply of sand, at hand, which may be used in case of necessity. In general, it is not safe to attempt the drying out of transformers unless constant attention can be given to them.

Wireless Telegraphy in the Navy.

The United States Navy Department at Washington has recently made arrangements for the trial of several wireless telegraph systems between the Brooklyn Navy Yard and the station at Navesink Highlands, N. J. The system which produces the best result later will be tested between shore stations and ships and between ship and ship. The Navy Department continues to receive encouraging reports of wireless telegraphic achievements at sea.

New Telephone Patents.

RECEIVER HOLDER.

One has only to see a receiver dangling upon the end of its cord, representing the condition of holding the line while leaving the telephone, to wonder why some auxiliary support for the receiver is not provided. H. L. Goodwin, of Kansas City, has thought that such an auxiliary should be provided and he has put his thoughts into definite form in a receiver holder for which he has obtained a patent. This holder is bent up out of wire having a U-shaped form at one end into which the receiver may be slipped. The other end is given various shapes, according to the type of telephone instrument upon which it is to clamp. Clamping for all types results, however, from the natural spring of the wire. The only objection that can be advanced against such a support is that a receiver left upon it in error, resulting in the "hold-up" of the line, is much more likely to attract attention when swinging about at the end of a cord than when placed upon a support.

ANTISEPTIC MOUTHPIECE.

A new development in the antiseptic mouthpiece line is a joint invention of Messrs. W. M. English and A. H. Ten Broeck, of San Francisco, recently patented. This consists of a metal bell piece from one side of which an antiseptic-containing receptacle projects. The wall of the bell piece contains many fine perforations leading into the receptacle. Access to the receptacle for the insertion of antiseptic may be made in any one of various evident ways, for example, by making the bottom removable.

REPEATING APPARATUS.

S. Kitsee, of Philadelphia, has produced a most odd-looking repeater. It consists essentially of a galvanometer, the motions of whose needle is mechanically transferred to a pair of microphonic contacts. The galvanometer coil is, of course, included in the incoming circuit, and we are told that its resistance must be adjusted to suit the particular line in use. The needle of the galvanometer is compound, consisting of three independent needles upon the same spindle, their magnetic axes varying in direction by approximately 15°. The spindle is mounted in jeweled bearings. It carries not only the needles, but a long, horizontal arm, each end of which is bent downward. These ends carry conducting points which dip into small vessels containing dilute sulphuric acid. The variation of resistance of the primary of the repeating circuit results from the variation of the distance in the acid between the conducting point of the moving arm and a contact point in the bottom of the vessel. It would certainly seem impossible to proportion such an apparatus that the moving system might come anywhere near synchronizing with complex rapidly changing voice currents.

ANTISEPTIC MOUTHPIECES.

Things seem to be running in pairs in this patent issue and it is therefore not surprising to find two patents for antiseptic mouthpieces. One of these describes an apparatus commonplace enough, being merely a special form of perforated metallic mouthpiece lining with a space for antiseptic cotton or similar material between it and the mouthpiece proper. This is the combined invention of W. M. English and A. H. Ten Broeck, of San Francisco.

The second is entirely different, being built on the barbed-wire fence principle in that the ordinary mouthpiece is provided with a crown of round-headed pins so distributed that one cannot get his lips in contact with the transmitter. Its utility is certainly questionable from at least two points of view. In the first place, good transmission demands that the lips approach the mouthpiece closely, and secondly the metal crown should apparently be almost as good a receptacle of infection as such part of the hard rubber mouthpiece as one is liable to bring his lips in contact with. Mr. J. Blum, of Baltimore, has patented this latter device.

Plan to Merge Long-Distance Telephone Lines in Central States.

An important meeting was held at Indianapolis, Ind., on March 19 and attended by a number of the most prominent telephone men in the Central States. The purpose of the meeting was to formulate plans and discuss means of effecting a consolidation of all independent long-distance telephone companies operating in Western Pennsylvania, Ohio, Indiana, Illinois, Kentucky and Missouri, thus forming a chain of lines from Philadelphia, Cleveland, Indianapolis to Louisville and St. Louis. The United States Long-Distance Telephone Company, over whose lines the traffic of numerous independent telephone companies is now carried on, is said to be backing the enterprise, although the idea was originally conceived by S. P. Sheerin, of Indianapolis. In addition to the above named company the following are interested in the merger: The Pittsburg and Allegheny Telephone Company, the Cuyahoga Telephone Company, of Cleveland; the Citizens' Telephone Company, of Columbus, Ohio; the New Long-Distance Telephone Company of Indiana; the newly organized Indianapolis Telephone Company; the United Telephone Company of Bluffton, Ind. (covering the oil belt), and the Kinloch Telephone Company, of St. Louis. It is understood that an arrangement was agreed upon between the various companies represented whereby they will use each other's line for long-distance service in other States, and that where necessary short connecting lines will be built, so that coöperative service may be put into effect. The following prominent telephone men attended the meeting: J. C. Splain, of Pittsburg; Max Reber, J. B. Hoge and F. S. Dickson, of Cleveland; James E. Brailey, Jr., of Toledo; C. M. Foster, C. H. Ledlie, Breckinridge Jones, W. D. Orthwein, W. F. Nolker, Philip Stock, J. I. Drummond, Philip Scanlon, H. L. Reber, W. H. Bassett, E. B. Denison, W. R. McCanne and W. D. Pitman, of St. Louis; J. D. Powers, J. A. Armstrong, M. R. Telu and M. Brailey, of Louisville; Hugh Dougherty, of Bluffton, Ind.; C. S. Ramsey, of Crawfordsville, Ind.; S. P. Sheerin, H. B. Sales and H. B. Gates, of Indianapolis. After the meeting the officials of the New Long-Distance Telephone Company, of Indianapolis, gave an elaborate dinner to the visitors, at the Columbia Club.

Electricity Versus Steam.

A discussion as to the relative merits of steam and electricity took place recently at Public School No. 5, New York City, when it was voted that steam was now in second place. The case for electricity was brilliantly and cogently presented by Master Gainer, whose clinching arguments we quote from the daily papers, as follows:

"Electricity is better than steam, for gas hurts the eyes, and then besides, the coal trust is against steam. Steamships can be propelled by electric motors, without smoke, so can trains, as was showed by the race the other day in the papers, when an electric car beat the Empire State Express. If there was not sich a thing as steam there wouldn't a been that awful cave-in down town, when 25 live men were killed. There's lots of other sich things I could quote if they was time. Electricity cures people that are nervous and sick people, too, and there is electric fans in all theatres in summer. What does steam do but boil?"

CURRENT NEWS AND NOTES.

HIGH-TENSION MEETING IN CHICAGO.—The Chicago branch of the American Institute of Electrical Engineers will hold its meeting for the discussion of high-tension transmission on March 29 at 1741 Monadnock Block at 8 P.M., as usual.

WIRELESS TELEGRAPHY IN THE WAR.—One of the Port Arthur dispatches says: "The wireless telegraph station opposite the light house has failed to work, its instruments having been disturbed by currents sent out by the Japanese ships equipped with the wireless system."

QUICK CABLING.—A remarkable piece of quick cabling was done a few days ago between Melbourne, Australia, and London, England, a distance of some 17,000 miles. The result of a cricket match was transmitted by the British Pacific Cable, Canadian Pacific Telegraphs and the Commercial Atlantic Cable in two and one-half minutes. This is without doubt a record time. The message was relayed nine times.

MAGNETIC CLUB DINNER.—A complimentary dinner will be given by the Magnetic Club, of New York, to the officials of the New York Telephone Company and the New York & New Jersey Telephone Company. The dinner will be held about April 21 and a large attendance of telephone men is expected. The idea of this dinner is to afford an opportunity for telephone and telegraph men to meet and become better acquainted with one another.

IMPROVEMENTS IN DELIVERY OF TELEGRAMS.—The Postal Telegraph-Cable Company has adopted a new form of message blank and delivery envelope. The envelope is of the kind having an opening, technically called a "window," cut out of the front surface, a transparent oiled paper filling the space. The message blank is so folded that the address thereon will come in front of the "window" when the message is enclosed in the envelope. This innovation obviates the liability of error in rewriting the address on the envelope in the old way, and saves much time in handling. The Postal Company has always been quick to adopt new ideas tending to facilitate the handling of its business.

GERMAN TROLLEYS.—Mr. F. H. Mason, United States Consul-General at Berlin, writes: "Most, though not all, of the city lines are the property of one incorporated company, the Grosse Berliner Strassenbahn-Gesellschaft, which carried last year the imposing contingent of 316,000,000 passengers, an increase of 18,000,000 over the traffic of the previous year. For this service it received as fares 28,903,833 marks ($6,879,722), an average—including commutation and all other tickets—of 2.17 cents per fare. Within the city limits of Berlin the uniform fare for any distance is 10 pfennigs (2.5 cents), but there are no transfer tickets and the same fare must be paid on each line traversed by the passenger. Tickets from the central portions of the city to the outlying suburbs cost 2.5, 4 and 5 cents, according to distance, but all these are subject to slight reductions for commutation tickets. The importance of the Grosse Berliner as a factor in the transportation system of the city may be inferred from the fact that out of a total city and suburban population of 2,500,000 souls its lines carry an average of 865,000 passengers per day. The electric elevated and underground railway carried 29,473,355 passengers, for which the company received as fares 3,557,785 marks ($46,752), or an average of 3 cents for each person. The heaviest traffic of the year was during the month of December, when 2,870,653 persons were carried; next came March, with 2,700,000; and last, July, with 2,093,000 passengers."

LETTERS TO THE EDITORS.

What Constitutes Invention.

To the Editors of Electrical World and Engineer:

SIRS:—I am interested in your editorial in the issue of March 19 on invention vs. engineering development. No one regrets more than patent lawyers the issue of unnecessary and trivial letters patent for invention; nevertheless I think your editorial is somewhat severe on the Patent Office, and on those who apply for what they regard as inventions.

The federal judges have always declined to define in advance what is invention, saying that each case must stand upon its own circumstances. You will doubtless pardon my saying that *ex cathedra* definition is no more to be looked for from an editor of a technical journal than from the courts; and I venture to say that it will be no more successful as a test, if made. It should be borne in mind that from 50 to 60 per cent. of the letters patent litigated are declared invalid for one reason or another: this certainly seems "drastic" enough without recommending that the courts go into legislation. They are sufficiently inclined that way now to suit most lawyers.

An intesesting side light is thrown on your editorial by the next but one on "High Tension Insulation," as follows:

"At pressures of 50,000 volts * * * * * * the insulation of the transformer leads becomes a problem even tougher than the insulation of the line * * * * * * . Of insulating compounds having good mechanical properties and able to withstand moderate voltages, there are many; but when it comes to dealing with many thousand volts, the number dwindles to evanescence. * * * * * In the region of pressures where coronal discharge is prominent, the situation is greatly complicated and insulation is a formidable question."

Yet insulation has been applied to conductors for certainly a hundred years, and it seems that current engineering development has not been sufficient. Just here some of us feel that invention is necessary, in this old and well-ploughed field; and that when Mr. Moody or some other transformer engineer devises a solution which proves in practice a thoroughly good one, good enough to become the best practice in the art, and to stand the test of time, he would be entitled to letters patent.

The editorial seems to me to fail to distinguish scientific investigation and invention; and to omit the qualification of the statute which grants letters patent for what is "new and useful."

If it simply confined its criticism to the granting of letters patent for so-called inventions which are not useful; or to the leniency shown to those who make random sketches subsequently swelled out by the arts of the patent solicitor to dominate the ideas of those who apply the underlying physical conception to some useful work, perhaps we could all agree with it.

NEW YORK CITY. T. J. JOHNSTON.

The Foucault Pendulum Experiments.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the editorial in your issue of January 30 on the Foucault pendulum, and Mr. E. K. Adams' article suggesting means for reinforcing its action. These means, though very ingenious, do not appear to be entirely practicable. For purposes of instruction and for most any purpose to which this interesting pendulum can be put, a bob of soft iron would seem to do as well as any other metal and answer the same purpose as the inside coil which is suggested. It would also be easily possible to design a mechanism magnetically sensitive to the presence of the iron bob over the central coil, whereby the switching on and off of the electric current would be done automatically.

But it is also possible to restore the pendulum energy by mechanical means without thereby disturbing its plane of vibration. Force may be applied vertically at the point of suspension by gently and regularly lowering that point a short distance during the inward and correspondingly raising it during the outward motion of the pendulum, in which case the amplitude of vibration will be preserved. A suitable clockwork might regulate this operation. To regulate it by the pendulum itself I can think of no other means than the one above referred to, unless it be through the closing of an electric circuit by the point of the pendulum dipping into mercury when passing the center.

May I presume to make a suggestion? Would it not be a good idea to have a Foucault pendulum, equipped for continuous motion, at the St. Louis World's Fair? Such an exhibition undoubtedly would be an attractive feature of the Exposition.

CHICAGO, ILL. S. TIDEMAN.

Individual Motor Drive.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of March 12 there appears a letter from Mr. H. H. Cutler, of Milwaukee, criticizing my article on "Individual Motor Drive" in the February number of *Cassier's Magazine* and abstracted in your issue of February 20. Mr. Cutler takes exception to the rules that I have laid down for the determination of the size of motors for any given application, and, according to different methods of speed control used. He attempts to elucidate in a few words the causes that produce sparking in a motor with a weakened field. The elucidation is more or less lucid, depending upon the point of view, but any engineer who has had any considerable experience in the design of direct-current motors would probably consider that he has left a good deal unsaid, and has said a good deal that perhaps bears on the subject, but to a very insignificant degree. However, it is not important to the subject in hand to know just exactly what the innermost workings are that produce the result. It is sufficient to know that the results of operating a direct-current motor with its magnetic field considerably weakened, tend to make it spark; and it is a fact that motors operated under this condition do spark to a greater or less degree, depending upon the comparative load put upon them.

Mr. Cutler has substituted for the rules that I have laid down another set of rules. I quote the third rule as follows: "The horse-power capacity under variable field strength will remain constant." It would seem that it needs no argument to prove that this rule is not a rule at all. We have only to refer to another part of Mr. Cutler's letter to see that he does not believe it himself. He says: "It is certainly true of a great many makes of motors now on the market that they will actually develop the same horse-power at double their normal speed with weakened field, but most of them will spark badly at the commutator on the higher speeds when transmitting their rated horse-power, simply because they were designed to run at a constant speed." This quotation proves that a great many motors of the best makes have, as they should have, a certain margin under normal operation.

He states that it is only necessary to order motors specially wound in order to produce these phenomenal results. He lays considerable stress on a quotation which he received for a motor that would develop 5 hp at 300 r.p.m. with full field, and 5 hp at 1,200 r.p.m. with weakened field, without undue sparking at the commutator. This motor as normally considered was a 15-hp motor at 900 r.p.m. I have no doubt at all that he received such a quotation, as there are numerous instances in which such quotations have been made and in which such motors have been furnished; but in every case the result has been the same.

A great many designers of direct-current motors have attempted to hypnotize the motors in order to cause them to produce these results. It is not a question of who builds the motor, as Mr. Cutler suggests, because all motors will perform exactly the same if they are built with the same margins. Mr. Cutler seems to lay great stress on what he says the builders will guarantee to do, but he does not state any instances in which these guarantees have been fulfilled, nor does he state how a motor shall be designed, especially in order to meet these requirements. He does not make this statement, for the simple reason that it is not possible.

The writer knows from a long and bitter experience in the individual application of motors that these rules as given by Mr. Cutler cannot be maintained in practice. If rule three, as laid down by Mr. Cutler, could only be proven true, it would be a great boom in the individual application of motors, and not only in the individual application of motors to machinery, but to motors in general, as it would be perfectly possible to construct a motor for general purposes at a considerably less expense than is ordinarily involved; for this rule simply states that the amount of magnetic flux in the field of a motor is unimportant, and can be made anything, as it is only necessary to have some flux and as many conductors on the armature as will give the desired speed.

It does not seem necessary to criticize the other rules laid down by Mr. Cutler, as they are all based on this assumption, with the exception of the ones which refer exclusively to variable voltage.

CINCINNATI, OHIO. W. COOPER.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Pulsations of the Direct Current of Synchronous Converters.—ELSAESSER.—An article illustrated by diagrams in which the author investigates by analytical methods why the direct current taken from a rotary converter is pulsating. He endeavors to show that the main reason of the pulsations is the superposition of the ohmic voltage drop for direct current and alternating current in the armature conductors. His main conclusions are as follows: Every single-armature converter with only one armature winding for direct current and alternating current produces a pulsating e.m.f. on the direct-current side, the cause being the superposition of the ohmic voltage drops of the direct-current and alternating-current sides. Compared with this, other reasons of the pulsations are of secondary importance only. The frequency of the alternating voltage which is superposed to the direct-current voltage is twice, three times, six times the frequency of the supplied alternating current for single-phase, three-phase and six-phase converters, respectively. The amplitude of the pulsations depends upon the load and upon the pole shape of the converter. With an open direct-current circuit (that is, with no load), there is always a pulsating increase of voltage. The period of pulsation is equal to that of the loaded converter. For the single-phase converter this increase of voltage varies between zero and a value approximately equal to the voltage drop of the direct-current machine. With polyphase converters this increase of voltage is always greater than zero, but smaller than the voltage drop of a direct-current machine. It is, therefore, incorrect to determine the e.m.f. of the converter from the voltage at the terminals with open direct-current circuit. The superposition of the ohmic voltage drop of the direct and alternating-current sides also manifests itself on the alternating-current side and produces not only a distortion of the voltage curve, but also a considerable decrease of the ohmic drop of voltage. The distortion is small in the single-phase converter, but becomes greater with the increase of the number of phases. A phase difference between current and e.m.f. on the alternating-current side is generally of no great influence upon the phenomena upon the direct-current side, but manifests itself considerably on the alternating-current side.—*Elek. Zeit.*, March 3.

REFERENCES.

Circular Diagram of Induction Motors Above Synchronism.—MÜLLER.—A mathematical article illustrated by diagrams. If the rotor of an induction motor is operated above synchronism, it returns current to the supply mains. The author shows that the well-known (Heyland-Behrend) circular diagram, if applied to the operation above synchronism, gives wrong results. His calculations are made by Steinmetz's symbolic method and show, for instance, that in the non-synchronous motor the current is always lagging in phase behind the e.m.f., while in the generator it may be leading under certain circumstances. The short-circuit current for a slip + 100 per cent. (i. e., with the motor at rest) is generally much smaller than at the slip—100 per cent.—*Elek. Zeit.*, March 3.

Alternators in Parallel.—BOHLE.—The first part of what seems to be a very long paper giving a summary of the whole subject. While in the parallel connection of direct-current machines it is only necessary to have equal e.m.f., in alternators it is necessary to have equal e.m.f's, equal periodicity and phase equality. These different requirements are discussed with the aid of diagrams and the action of the "synchronous force" is dealt with. The paper is to be continued.—Lond. *Elec.*, March 4.

High-Voltage, Direct-Current Dynamo.—A note on a direct-current machine built by the Company of Electrical Industry in Geneva (Thury) for experimental work in a technical college. It gives one ampere at 2,000 volts when running at 600 to 700 r.p.m. The commutator has 96 segments, condensers being connected in parallel to the armature coils, in order to avoid sparks. The exciting current is furnished by a small 110-volt exciter.—*Zeit. f. Elek.* (Vienna), March 6.

LIGHTS AND LIGHTING.

Mercury Vapor Lamp.—An article in which it is claimed that on account of the peculiar light of the mercury vapor lamp it is suitable only for purposes in which the distinction of colors is not important; it is, therefore, especially suitable for photography without colors, etc. The old Arons lamp is distinguished from the Cooper Hewitt lamp since the former had no automatic lighting arrangement and had to be started in a somewhat complicated way. Arons stated in a recent lecture that if in his lamp the arc has a length of 750 mm., the lamp consumes a voltage of 15, and that if the length of the arc is increased, the voltage also increases by 6 to 7 volts for each 100 mm. He mentions the peculiar fact that in his lamp, consisting of a reverse U tube, with mercury in both vertical tubes, the mercury evaporates from the anode over to the cathode, until the one vertical arm of the tube is filled with mercury, which is thus made to flow over. This produces a stationary condition without disturbing the light.—*Elek. Neu. Anz.*, February 15.

REFERENCE.

Long Life of Carbon Incandescent Lamps.—A note on some carbon incandescent lamps which had a life of 14,000, 21,800 and 17,000 active hours. In the second lamp the candle-power had, however, decreased from 32 to 9 and in the third from 25 to 5. While this long life of carbon filaments may be remarkable, it is not economical to use lamps for such a long while.—*Elek. Neu. Anz.*, February 15.

Power.

Swiss Water Power Plant.—Collischonn.—The conclusion of the long illustrated description of the Kubel water power plant. The power house contains four turbine-driven generators, each of 500 hp, two turbo-driven generators, each of 1,000 hp, and one steam dynamo of 1,000 hp. The generators have a stationary armature and a revolving field system and produce directly a voltage of 10,100. To protect the switchboard attendants against any accidents from the high voltage, the following method is made use of. All instruments, phase indicators, etc., are connected to a few coils separated from the other windings of the machine, and the voltage, thereby lost, is regained by a transformer which is primarily connected to the measuring coils and secondarily to the armature winding. If the ratio of transformation of this transformer is one to one, the primary and secondary currents are equal, so that the current measured by the instruments is equal to that of the machine. The e.m.f. measured at the instruments is to be multiplied with the ratio of the number of coils of the armature to that of the separated coils; the voltmeters are, of course, calibrated so that they give at once the voltage of the machine. A map is added which shows the distribution of power from the station. There are two main lines from which go off several branches; the most distant point is at a distance of about 23 km. from the plant. There are about 900 consumers of lighting current with a consumption equivalent to 17,000 lamps of 56 watts. There are connected to the plant 47 motors with 1,602 hp capacity, while 126 kw are used for 242 heating apparatus. In order to encourage consumers to use current for power purposes, four different tariffs have been devised to suit every possible customer.—*Elek. Zeit.*, March 3.

Electric Power in Ship Yards.—Brown.—An illustrated article on electric power in British ship yards, with special references to the northeast coast. From figures supplied by a shipbuilding firm which adopted electric driving in its early stages, he gives a comparison of the cost of power per "pound of wages paid" in the years 1894 and 1901; that is to say, before and after the use of electricity. In 1894 the cost for coal, gas and labor for driving the engines scattered around the yard was 8.66 pence per "pound of wages paid," and in 1901 the cost of coal, labor and other incidentals for producing the power electrically, was 4.88 pence per "pound of wages paid," or, in other words, the wages paid in 1901 were practically double those paid in 1894, and the cost for power was the same, and this in spite of a very great increase in the number and size of the machine tools employed, which, in the year in question, practically amounted in 1901 to six times what were in use in 1894. There are three systems in use; in the older ones 125 volts direct current is employed, in later ones 220 or 250 volts direct current, and some of the very latest installations employ three-phase currents at 400 to 440 volts. There is some advantage in the use of three-phase currents over the direct-current system, especially if a higher pressure than 250 volts be required, in view of the difficulty of lighting the offices from a two-wire, direct-current system at a higher pressure than 250 volts; but on the score of simplicity there does not seem to be any advantage on one side or the other, and though the question of maintenance naturally arises, as far as could be gathered from works with direct-current systems in use from 8 to 9 years, only a small amount of attention is required to the commutators and brushes. The principal repairs in both direct and alternating-current systems are in connection with the starting systems and regulating apparatus. The author describes several installations and the equipment of various machine tools.—*Cassier's Mag.*, March.

Engine Tests and the Effect of Superheating.—Morcom.—A paper on the equipment of an engine test house, as used by manufacturers for their own purposes, as well as to demonstrate guarantees, so as to avoid the inconvenience to a station engineer of having his station turned into an experimental apartment. A plant for testing combined sets for electricity stations is described, the general routine of such tests is given and special notes are added on temperature tests, exhaust, brake tests, the instruments and apparatus used, switchboards, and the benefit due to superheating. Concerning the latter point he says that on an engine properly designed to run under superheated steam conditions full advantage is taken of the improved economy with but little extra trouble in running. It is only in using superheat on an engine quite unsuited for the purpose that troubles are experienced. The point has sometimes been raised, that as clearance for expansion must be allowed in the pistons and valves on an engine designed for superheat, so if the superheat fall the engine will be very extravagant of fuel. Experiments have been made which prove that this is a mistaken notion. An engine designed to run with 250° superheat has been tested with dry steam at saturation temperature and the result shows that with these valves and pistons the engine is only 2.1 per cent. less economical than when fitted with valves as pistons designed for ordinary conditions. With a three-cylinder triple engine of 200-kw capacity, the steam consumption in pounds per hp-hour was determined as function of the degrees of superheat, and it was found that the percentage of improvement for any given rise in temperature is approximately the same at full and half loads. The gain due to 200° of superheat was found to be 41 per cent. The actual gain due to superheat is, of course, less than this, as extra lubrication and increased fuel consumption are required. The increased cost of oil for cylinder lubrication amounts to about 0.08 cent per 100 hp-hour, and is, therefore, a very small item. Fuel consumption trials run on a 522-hp triple-expansion engine with 160 pounds pressure and 26-in. vacuum gave the following figures: Fuel per hour with saturated steam, 1,193 pounds; in boilers with superheat, 833 pounds; in superheater to give a temperature of 600°, 173 pounds. Accordingly, the gain in fuel is 19 per cent. The fuel was slack of poor evaporative value. The superheater was very lightly loaded, and the lagging of the steam pipe was not so good as it might have been. Allowing for these points, it seems that a saving of, say, 25 per cent. might be expected by superheating to 600°. Another interesting trial taken on a 120-hp compound engine at 450 r.p.m. was on the influence of forced lubrication on the indicated horse-power at light loads. The engine was run free, and friction cards taken with oil pressure of 30 pounds, 5 pounds and 0 pound. The horse-powers in each case were 2.128, 2.409 and 3.333, respectively. This is interesting as showing that a great increase in oil pressure will not bring a correspondingly big advantage.—Lond. *Elec.*, March 4.

References.

Earth Return in Direct-Current, High-Tension Transmission Systems.—An illustrated note stating that Thury made some years ago experiments in order to use the earth as return in his well-known direct-current series system. If in such a system the earth is used as return, 15 per cent. of copper weight is saved for the same percentage loss, or, if the same copper is used, the losses are reduced to one-quarter of their original value. The resistance of the earth is negligibly small for industrial currents. Only the contact resistances are to be taken into consideration; by proper arrangements they may be reduced at will (for instance, to one ohm). Recently Thury has suggested an arrangement in which the earth is used as the neutral wire in a high-tension, direct-current, three-wire system. —*Zeit. f. Elek.* (Vienna), March 6.

Labor Saving by Power Applications.—The whole number contains profusely-illustrated articles on this subject. Hunt writes on the world's great labor-savers and labor-servers from James Watt to George Westinghouse; Rose on the rise of labor through labor-saving machinery; Sweet on the prime-mover and its influence on the world's progress; Waitt on labor-saving devices as the basis of the railway's growth; Baxter on hydraulic appliances in the engineering industries; Moldenke on labor-saving machinery in foundry operations; Robertson on the development of power-driven machinery in mines; Bolton on mechanical auxiliaries to the economy of the fire room, and L. Bell on the relation of electrical inventions to human activity.—*Eng. Mag.*, March.

Steam Turbine.—Porte.—An illustrated paper read before the Dublin Section of the Brit. Inst. Elec. Eng. describes the construction and operation of the De Laval steam turbine.—Lond. *Elec.*, March 4.

Traction.

Swiss Railway.—The conclusion of the long and well-illustrated article on the electric railway between Freiburg, Morat and Anet. The third rail is used along the line, except at street crossings and in railroad stations. The third rail is placed alternately at the left side and at the right side of the track. There are, of course, two sliding contacts on the train, one on each side. The two sub-stations supply the third rail by an underground cable, the road being divided into three sections which may be supplied with current or disconnected at will from one or the other station. The equipment of the cars is described in detail.—*L'Eclairage Elec.*, March 5.

Single-Phase Traction.—EICHBERG.—The conclusion of his paper on single-phase railroads. The author gives several diagrams in comparing the behavior of two 600-volt, direct-current motors with that to two 6,000-volt, single-phase motors, based on the experimental runs with the Winter-Eichberg motor near Berlin. He concludes that the single-phase motor is able to fulfill the most rigid requirements of traction.—*Zeit. f. Elek.* (Vienna), March 6.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Voltage Regulation in Alternating-Current Systems.—MEYER.—The conclusion of his paper, the first parts of which have already been abstracted in the Digest. He discusses automatic voltage regulation and compounding. The first method dealt with is by means of mechanical influence on an exciter rheostat, which is shown in

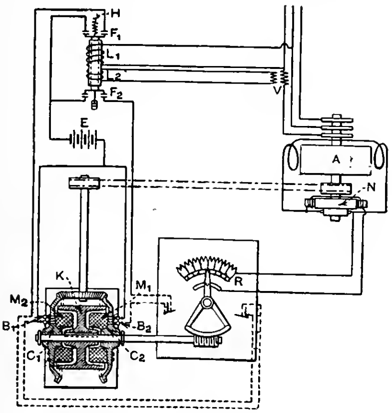


FIG. 1.—VOLTAGE REGULATION.

Fig. 1. *A* represents the alternator, *N* the exciter, *R* is the rheostat in the exciter field. Its handle is worked by means of a worm gearing from a magnetic clutch, *K*, which is controlled by the relay, *L*. The latter device is shown as a solenoid acting against a spring. In accordance with a lower or higher supply voltage either the spring or the solenoid will be more powerful, thereby closing the energizing circuit of M_1 or M_2, thus increasing or reducing the resistance, *R*. By adding a second coil, L_2, wound in opposition to L_1, and controlled from the secondary of a current transformer, *V*, the primary of which is in series with one of the main lines, over-compounding with increasing current can be obtained. This scheme has been successfully used in a number of plants where the nature of the load introduces only very gradual changes in load. For all other purposes it is not recommended, since the time lag between action and reaction is too much to allow a satisfactory regulation of the voltage. A second method is the use of a pulsating excitation in the exciter field. The device of Tirril, of the General Electric Company in America, belongs to this class. In the same the control of voltage is obtained by rapidly opening and closing a shunt circuit across the exciter field rheostat, thus giving the exciting current of the exciter a more or less pulsating character. The frequency of the make and break of this circuit is controlled by the voltage and, if desired, also by the current of the generator, and varies from about 1 to 20 per second. The apparatus is described in detail. It is well known in this country since more than 100 of these regulators have been installed here within the last 18 months. A third class of regulation is by means of influence on the armature reaction of the exciter. The compensated generator of the General Electric Company, of this country, of which about 3,000 kw are in successful use in sizes from 50 to 500 kw, belongs to this class, as also does the compound generator with special exciter of Le Blanc, which was exhibited at the Paris Exposition. However, the complications inherent to the arrangement of the latter have apparently prevented its commercial introduction. The fourth method discussed by the author is compounding by means of rectified or low periodicity alternating currents. Older arrangements of the General Electric Company and the Westinghouse Company and Ganz & Co. belong to this class. These alternators are provided with a commutator and a series winding on the field in a manner similar to compound-wound, direct-current generators. The new arrangements of Latour and Heyland also belong to this class.—Lond. *Elec.*, March 4.

Water Resistance.—MORCON.—In a paper on the equipment of an engine test house the author says that after considerable trouble and expense in connection with wire resistances both in wooden and iron frames, the following form of water resistance for taking up the load was devised: The poles are of iron, arranged in wooden tanks. Water from a neighboring canal is passed continually through the tanks by a bye-pass on the condenser circulating pump, and flows out over a weir. The poles are connected to a load-adjusting switchboard, and can be coupled into the load in many combinations. Three tanks are used for different ranges of voltages, and these ranges are further divided by adjustments of the outflow from the tank. Specially subdivided tanks are used for polyphase work. The first experience when using a water resistance was not very satisfactory. The apparatus consisted of an iron tank about 3 ft. wide and 6 ft. long, with two large iron plates for the electrodes. This tank did not last very long, for the current, as well as passing from plate to plate, found a shorter passage by way of the sides and bottom of the tank. An improvement of this arrangement was a large wooden tank 4 ft. wide by 10 ft. long and about 4 ft. deep. Into this were fitted four hollow cone-shaped castings, large and upwards. Inside each of these cones was a smaller one, suspended from above on a screwed spindle and hand wheel. The outer cone was coupled to one terminal of the dynamo on test, and the inner through a flexible lead to the other terminal. Load could then be varied by raising or lowering the inner cone on the screwed spindle. It was necessary to keep the water level a little higher than the top edge of the outer cone, so that the heated water in the space between the cones might rise naturally and flow away. This arrangement gave very satisfactory results; in fact, some cones are still in use which were fitted about 18 months ago. For higher voltages it was proposed to use a metal rod dipping into the water at the center of the cone, but the conducting area of water to the outer cone was too large and the length of water resistance too small for many machines. Accordingly, a wooden trough of small cross-section and great length was designed for high-voltage work. The use of wooden troughs did away with the need for conical poles, and it is now found more useful to substitute iron plates fixed at the top to flexible terminals and movable on insulated rollers along wooden runners. The load can thus be varied by sliding the plates along so that the cross-section between them is varied. By using a considerable number of smallish plates a very flexible load is obtained, and if care be taken with the circulating arrangements a very steady load results.—Lond. *Elec.*, March 4.

ELECTRO-PHYSICS AND MAGNETISM.

Thermoelectricity of Iron and Steel.—BELLOC.—A paper presented to the French Association for the Advancement of Science. Concerning the temperature coefficient of the thermo e.m.f. of steel-platinum couples (comprising the Peltier and Thomson effects) he arrives at the following conclusions: The curves representing the same show a minimum common to all couples near 380°, the minimum being 8.75 microvolts. All curves reach a maximum at a higher temperature, but the position of this maximum depends upon the contents of carbon in the steel; the temperature at which the maximum occurs varies between 680 and 820° and the maximum itself between 16 and 20 microvolts. Each curve shows afterwards another minimum at a temperature about 120° above the temperature at which the maximum takes place, and the second minimum differs from the maximum of about 4 microvolts.—*L'Eclairage Elec.*, March 5.

Selenium Cells.—BERNDT.—An account of experiments in which the author reaches the conclusion that the decrease of resistance of a selenium cell, when lighted, cannot be explained by a chemical action. He offers the hypothesis that crystalline selenium exists in two modifications which are in dynamic equilibrium with one another. When the cell is lighted this equilibrium is changed, but in the dark the original condition is gradually brought back. If, however, the cell is roughly handled, then so much is formed of the one modification that a part of it assumes a stable state of equilibrium and does not return to the former condition in the dark.—*Phys. Zeit.*, March 1.

Energy of Röntgen Rays.—Wien.—Of all hypotheses on the nature of Rontgen rays the author considers as the most plausible one that of Wiechert that they represent electromagnetic oscillations of short duration, caused by the quick retardation of the negative electrons hitting the surface with great speed. On this basis the author calculates the energy of Rontgen rays, making special assumptions. If in a discharge tube 0.001 amp. electricity is transported in the cathode rays, this makes 4.1×10^{15} electrons per second, and the total energy changed into Rontgen rays is 0.000125 watt. Since the radiation of a theoretically black body of 100° C. to one of 0° with 1 sq. cm. surface is 0.073 watt, the energy of the Röntgen rays is about 500 times more.—*Phys. Zeit.*, March 1.

Polarization of Röntgen Rays.—Lieben.—The author had formerly investigated the effect of Rontgen rays upon heavy metals in the vacuum. Since Blondlot has found that every Röntgen ray tube emits polarized N-rays, Lieben has now investigated whether these N-rays have any influence on the effect found in his former work and attributed to Röntgen rays. For this purpose he eliminated the N-rays by interposing a layer of water of 3 mm. thickness. This acts as a filter, absorbing the N-rays, but allowing the X-rays to pass through. He obtained the same results as before, so that his former results were not influenced by the N-rays. He found, however, that his former observation of the polarization of Röntgen rays was wrong, being due to improper arrangement of his former experiments.—*Phys. Zeit.*, February 1.

Electrodeless Ring Currents.—Hærden.—An account of experiments in which he used an evacuated electrodeless tube, filled with mercury vapor, the pressure of the vapor having such a density that about 5,000 volts were necessary to obtain a light effect in the tube. Some windings of a cable were placed around the tube and the oscillating discharges of a condenser of about 0.004 microfarad were conducted through them. On the other side of the condenser, which was charged with an alternating current of about 35,000 volts, there was a mercury air-gap, the other connections being as usual. When set into operation the tube showed a strong light effect and the glass became heated. In other words, the lamp behaved as though 5 to 6 amp. direct current were passing through it. He shows, however, that any currents directly induced in the mercury vapor are of very little importance for the phenomenon which is rather an electrostatic one, the high e.m.f. due to the impedance of the primary windings charging the glass tube on the outside and influencing a charge on the inside of the tube. These inside charges afterwards discharge through the vapor and cause the lighting. In another article he describes an arrangement in which a pure induction effect is produced and no static phenomena take place.—*Phys. Zeit.*, February 1.

REFERENCE.

N-Rays.—Charpentier.—An account of experiments in which he found that the transmission of N-rays can be accomplished not only by conducting substances, but also by bad conductors such as glass and wood, although to a somewhat smaller extent. He has, in conjunction with Blondlot, even succeeded in transmitting the fluorescence across an air-gap between two condenser plates.—*Comptes Rendus*, February 5; abstracted in Lond. *Elec.*, March 4.

Electro-Chemistry and Batteries.

Dielectric Constants.—Schlundt.—In former investigations of a great number of inorganic solvents he had tested the Nernst-Thomson rule, according to which a close parallelism exists between the dissociating power of solvents and their dielectric constants. He found a number of exceptions to the rule and a number of new examples which followed the rule. The solvents studied at that time, however, follow the rule in a general way, although the parallelism between the ionizing power and the dielectric constant was far from close in several instances. The author has now investigated the dielectric constants of some halogen compounds of phosphorous, arsenic and antimony. The value for the dielectric constant for the compound in the solid state is less than the value for the liquid and the structure has a great influence on this difference. Most of the compounds studied follow the Nernst-Thomson rule.—*Jour. Phys. Chem.*, February.

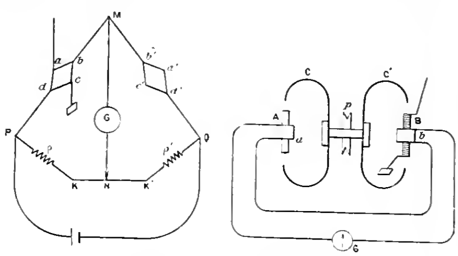
Storage Battery.—A note on the Lacroix storage battery, made by a French company. The wire of the very fine webbed network from which the plates are made consists of a special alloy, called pontinium and consisting of a thousand parts of lead, 15 parts of tin and 1 part of sodium. In spite of the very thin but nevertheless very resistant network of the plate, the active mass is claimed to be kept very firmly in it, so that it can drop out.—*Elek. Neu. Anz.*, February 15.

Units, Measurements and Instruments.

Electrical Methods of Measuring Temperature.—Callendar.—An abstract of a lecture in which he said that the electrical methods for measuring temperatures are more accurate, speedy and generally convenient than the other methods yet known, and are at the present time used almost exclusively in research work. There are two kinds of electrical methods, one based on measuring the resistance due to the change of temperature and the other on measuring the potential difference at the junction of two different metals when it is heated. The first method is more accurate, as a rule, than the second, especially for low temperatures, and has the further advantage of giving readings almost instantaneously. It is also very convenient for measuring mean temperatures. The second method, using a thermo-couple, is valuable for determining the temperature at a particular point. He discussed briefly the methods for determining resistances, pointing out the great accuracy of the zero methods, and drew special attention to the proper way of connecting up the very fine platinum resistance wire of the thermometer to the resistance box. The proper way to do is to make the connections so that the current passing through the resistance wire of the thermometer also passes through the resistance in the third arm of the bridge. The current passing through the wire is thus small, and the error due to its heating the wire is reduced to a minimum. He described an electrical temperature recorder which may be used for various purposes; for instance, for recording the duration and intensity of sunshine. It is much more sensitive than the burning-glass method, which is generally used for this purpose.—Lond. *Elec.*, March 4.

Telegraphy, Telephony and Signals.

Electric Wave Detector.—Tissot.—A paper presented to the French Association for the Advancement of Science. The author has found that the bolometer may be used as a detector of waves over a distance of several kilometers. His arrangement, shown in Fig. 2, consists essentially of two identical systems of thin platinum wires, *a, b, c, d* and *a', b', c', d'*, arranged on the branches of the Wheatstone bridge, *M, N, P, Q*. The bridge is brought into equilibrium by means of the two coils, *S* and *S'*, immersed in the same bath of petroleum, and connected together by the sliding contact, *K, K'*. The vertical wire is connected to *a*, and *c* is connected to earth. A sensible galvanometer is used in *G.* The author uses one of the Thomson (Broca-Carpentier) type, the coil of which has a resistance equal to that of the other branches of the bridge. The quantity measured is the total energy received by the vertical wire. For other purposes the author has employed a modification of the Rutherford-Marconi magnetic detector. Observations are made by a gal-



FIGS. 2 AND 3.—ELECTRIC WAVE DETECTOR.

vanometer, instead of a telephone. The instrument, shown in Fig. 3, consists essentially of a double detector, each consisting of a magnet, *C* and *C'*, a primary coil (*A* and *B*) with steel wires and a secondary coil (*a* and *b*). The magnetic, *C* and *C'*, are mounted on the same axle. The coils, *a* and *b*, are connected in opposition to a sensible ballistic galvanometer, *G*, or to an electrodynamometer of the Bellati type. The arrangements are so made that there exists perfect equilibrium of *G* during the rotation of the system. This equilibrium is destroyed by the arrival of an electric wave if the coil, *B*, is connected at one end to the vertical wire, and with the other end to earth.—*L'Eclairage Elec.*, March 5.

REFERENCE.

Type-Printing Telegraph.—LINDLOW.—An illustrated description of the Steljes type-printing telegraph, a characteristic feature of which is the use of alternating current.—*Elek. Zeit.*, February 25.

MISCELLANEOUS.

Cure of Cancer by Radium.—WALSH.—An article in which the author states that while it is not yet possible to speak with certainty as to the exact therapeutic value of radium, yet he is confident that by its means it is possible to modify profoundly and in some cases apparently to cure surface rodent ulcers and epitheliomata. The method of application is to enclose the radium in a small India rubber capsule with a mica window or in a small glass tube. The radium is used most conveniently in the form of the bromide and should be of good quality. The small tube containing the salt must be placed directly in contact with the ulcerating surface. It apparently is of no use if applied to the unbroken skin surface. The action of the radium is strongest at the immediate point of contact and lessens in power according to the distance from that point of contact. The radium may be applied for a quarter of an hour or more up to 30 or 40 minutes, but the length of application should be most carefully regulated by individual results. A reaction occurs usually on the eighth day of treatment and may be due to the formation of an antitoxin. The radium cure has even been applied to a rapid malignant invasion of the upper throat. Four small sealed tubes with radium bromide were fastened at the end of a curved holder and enclosed in a covering of India rubber extemporized from a finger stall. The throat was then cocainized and a gag inserted between the teeth. A light thrown into the mouth by a mirror enabled the physician to pass in the radium and press it with decision on the desired part. By this treatment the ordinary process of the disease has been profoundly modified, if not, as is hoped, even been arrested.—Lond. *Elec.*, March 4.

REFERENCE.

Biographical.—A sketch, with portrait, of P. M. Lincoln, of the Westinghouse Company.—*Cassier's Mag.*, March.

New Books.

MY AIR SHIPS. By A. Santos-Dumont. New York: The Century Company. 400 pages, 75 illustrations. Price, $1.40.

This is not exactly a scientific treatise on aerial navigation, nor does it profess to be. It is rather a chronicle of successive attempts to solve some of the many problems connected with the subject, including more particularly those of dirigibility, and incidentally one picks up a lot of practical information from the narrative unfolded in these simple and direct pages. Mr. Santos-Dumont has, indeed, achieved no small measure of success from his courageous and persistent efforts, and one wonders that the young Brazilian is really alive to tell the tale. The probability is that had he been a few pounds heavier he might not have traveled so fast and so far in the air, modern flying, like modern fighting, being distinctively in favor of the small man. In these later attempts at airship steering, electricity does not play so much of a part as it did, for example, in some of the earlier work of Krebs and Renard, and the Tissandier Brothers, who employed motors and accumulators; but in real hard work the turn of electricity may come again. Mr. Dumont makes incidental reference to his conference with Mr. Edison on the subject.

LA TECNICA DELLE CORRENTI ALTERNATE. 2 volumes. By Guiseppe Sartori. Milan: Ulrico Hoepli. Vol. I, 336 pages, 260 illustrations; price, 8 lire. Vol. II, 495 pages, 293 illustrations; price, 12 lire.

These two volumes taken together form the best text-book on alternating-current theory and practice that we have yet seen in the Italian language. The writer has a clear and descriptive style. There are abundant illustrations, diagrams and numerical examples.

Volume I is written on the practical side of the subject, with curves, diagrams and illustrations of machinery, but with scarcely a single algebraic equation. The subjects treated are single-phase and polyphase currents, induction coils, transformers, alternators, synchronous and asynchronous motors, both single-phase and polyphase, converters and transmission lines. The information given is simple, definite and reliable.

Volume II is devoted to the engineering mathematics or technical algebra and arithmetic of the same subject. In this direction vector methods and diagrams are plentifully introduced. The treatment is excellent and clear. A number of numerical examples are scattered throughout the work.

The first volume is well adapted for study by those who are not interested in the quantitative relations of the subject. The second volume is an excellent text-book for students of alternating-current engineering. To all interested in this subject and to whom the Italian language is familiar, the work is to be strongly recommended.

THE UNIVERSAL ELECTRICAL DIRECTORY. By J. A. Berly. London: H. Alabaster, Gatehouse & Co. 1,446 pages. Price, 10s.; U. S. A., duty free, $3.75.

This valuable publication has now reached its twenty-third year of annual issuance, and has again been thoroughly revised and brought up to date. The sections are as usual: Continental, United States, Colonial and General, British, and Geographical, each alphabetical list of names being accompanied also by a classified list as to manufacturers, engineers, etc., so that the finding can be easily accomplished in connection with any name wanted. The American list is very full and complete and is valuable also by giving telephone calls or cable addresses. In fact, one feature of value of the book is the number of cable addresses given in connection with all the lists of names. The book has now reached a total of nearly 1,500 pages, large octavo, a simple fact which will convey an idea of the immense amount of work put upon the compilation. The preface discussing the outlook does not speak very cheerfully with regard to the past year in England, but is a little more hopeful with regard to the outlook during the present year. It points significantly to the fact that electric traction is beginning to boom, not merely with regard to street railway enterprises, but those of larger range and scope. England is indeed an ideal country for the conversion of short trunk railroads from steam to electricity, and although the conservatism of the country is notorious and is a good factor in a great many instances, it is hard to believe that it can stand much longer in the way of this needed change of motive power. England is a country where steam locomotion has been of inestimable value, but has brought in its train a great many evils, some of which electricity can certainly cure or ameliorate, to say nothing of its own inherent advantages not possessed by its elder competitor.

BOOKS RECEIVED.

THE LOCALIZATION OF FAULTS IN ELECTRIC LIGHT AND POWER MAINS. Second Edition. By F. Charles Raphael. New York: D. Van Nostrand Company. 205 pages, 112 illustrations. Price, $3.00.

TESTING OF ELECTROMAGNETIC MACHINERY AND OTHER APPARATUS. Vol. I. By B. V. Swenson and B. Frankenfield. New York: The Macmillan Company. 420 pages, 95 illustrations. Price, $3.00.

VORLESUNGEN ÜBER TECHNISCHE MECHANIK. By Dr. Aug. Foppl. Leipzig: B. G. Teubner. 471 pages, 176 illustrations. Price, 10 marks.

FREE-HAND LETTERING. By Victor T. Wilson. New York: John Wiley & Sons. 95 pages, 13 illustrations. Price, $1.00.

THE METRIC FALLACY. By Frederick A. Halsey and Samuel S. Dale. New York: D. Van Nostrand Company. 231 pages. Price, $1.00.

ENTROPY; or, Thermodynamics from an Engineer's Standpoint, and the Reversibility of Thermodynamics. By James Swinburne. Westminster: Archibald Constable & Co. 137 pages. Price, 4s. 6d. net.

MODERN WIRING DIAGRAMS AND DESCRIPTIONS FOR ELECTRICAL WORKERS. By Henry C. Horstmann and Victor H. Tousley. Chicago: Frederick J. Drake & Co. 154 pages, illustrated. Price, $1.50.

THEORIE UND ANWENDUNG DES ELEKTRISCHEN BOGENLICHTES. By H. Birrenbach. Hannover: Gebruder Janecke. 350 pages, 266 illustrations. Price, 9 marks.

AMERICAN TELEGRAPHY AND ENCYCLOPEDIA OF THE TELEGRAPH. By William Maver, Jr. New York: Maver Publishing Company. 656 pages, 490 illustrations. Price, $5.00.

CARE AND HANDLING OF ELECTRIC PLANTS. By Norman H. Schneider. New York: Spon & Chamberlain. 104 pages. Price, $1.00.

PHENOMENES FONDAMENTAUX ET PRINCIPALES APPLICATIONS DUE COURANT ALTERNATIF. By R. Swyngedauw. Paris: Ch. Dunod. 174 pages, illustrated.

Steam Boilers: Their Theory and Design. By H. deB. Parsons. New York: Longmans, Green & Co. 375 pages, 155 illustrations. Price, $4.00.

A Treatise on Friction and Lost Work in Machinery and Millwork. By Robert H. Thurston. New York: John Wiley & Sons. 430 pages, 77 illustrations. Price, $3.00.

Electric Traction. By John Hall Rider. London: Whittaker & Co. 442 pages, illustrated. Price, $3.00.

American Meter Practice. By Lyman C. Reed. New York: McGraw Publishing Company. 196 pages, 78 illustrations. Price, $2.00.

Die für Technik und Praxis Wichtigsten Physikalischen Grossen. By Olof Linders. 396 pages, 43 illustrations. Price, 10 marks.

Technical Mechanics. By Edward R. Maurer. New York: John Wiley & Sons. 382 pages, 250 illustrations. Price, $4.00.

National Electric Light Association. Twenty-sixth Convention. Published by order of Executive Committee. New York: James Kempster Printing Company. 1221 pages, illustrated. Published for members only.

Machine Design. Part II. By Forrest R. Jones. New York: John Wiley & Sons. 426 pages, 243 illustrations. Price, $3.00.

Electro-Ingenieur-Kalender. 1904. By Arthur H. Hirsch and Franz Wilking. Berlin: Oscar Coblentz. 279 pages, 2.50 marks.

Kalender für Elektrochemiker. 1904. Beeloge zum Kalender für Electrochemiker. By Dr. A. Neuburger. Berlin: M. Krayn. 575 pages.

Luftverunreinigung und Ventilation. By Dr. Josef Rambousek. Liepzig: A. Hartleben. 244 pages, 48 illustrations. Price, 7 marks 50 pfennigs.

Les Chemins de fer Electriques. By Henri Marechal. Paris: Ch. Beranger. 596 pages, 516 illustrations.

The New Epoch as Developed by the Manufacture of Power. By George S. Morison. Boston: Houghton, Mifflin & Co. 134 pages and portrait. Price, 75 cents.

Leçons D'Electrotechnique Generale. Professees a L'Ecole Superieure D'Electricite. By Paul Janet. Second Edition. Vol. I. Paris: Gauthier-Villars. 369 pages, 165 illustrations.

Electrical Trades Directory. 1904. London: *The Electrician* Printing & Publishing Company. Price, $5.00.

Alternating Currents: Their Generation, Distribution and Utilization. By George T. Hanchett. New York: John Wiley & Sons. 180 pages, illustrations. Cloth. Price, $1.

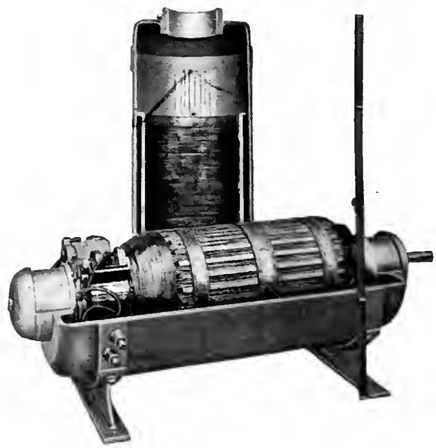
The Dialt Motor.

By N. H. Edgerton.

Now while public attention is turned to alternating motors for single-phase circuits, and especially for street cars, interurban and very long-distance work, the following description of a motor that embodies a rather novel departure from the ordinary lines of modern construction may not be without interest. This motor, which is now just appearing commercially under the name "Dialt," did not in its early stages have the advantages of great mechanical skill, nor has it had the admirable engineering touch of Mr. Lamme, yet I am convinced that it is laid upon lines that will add materially to the perfecting of the electric motor for nearly all practical purposes.

The distinctive features are that it employs a wireless field; that each field is completely isolated magnetically from every other field, and that with a given potential it will operate on any current, with little regard to quality or condition.

The construction is exceedingly simple. A preferred form is to have the cylindrical frame of diamagnetic metal, divided into two halves, longitudinally through the axis, hinged together at the back, and suitably locked in front. In each one of these semi-cylinders is fastened half of the field equipment, whether it be bipolar or multipolar. At each end of this frame a suitable bearing is arranged so that the center of the armature shaft shall be the central line of the structure. This allows of the easy withdrawal and replacement of the armature, as the bearings also divide on line; the cups being carried in the upper half of the shell, thus exposing the shaft journals when the top is thrown back. The fields themselves are formed of circular laminations of soft steel or charcoal iron of suitable gauge insulated from each other in the usual manner or by tinning. When this latter method is employed, the laminæ of each field may be assembled together and sweated into one piece; laminated as to its magnetic function, but solid as to its mechanical structure. The question as to whether this tinned construction of the field gives rise to eddy currents therein, will have to be answered at a later day, but as the whole surface is subjected at all times to the same magnetic stress, it would seem from a theoretical standpoint that the inequality of magnetization necessary to produce such currents is wanting. Should it be found, however, that eddy currents are developed, the ordinary method of insulating the laminæ can readily be adopted. When the lid is closed down about the armature, it will be observed that with all the fields of the same dimensions and the armature wound symmetrically, there will be contiguous to, and operative upon, each field, exactly the same number of armature turns. Consequently, with any given current flowing through the armature the ampere-turns will



DIALT MOTOR.

likewise be the same and the resulting magnetization of each field the same and likewise the reaction of each field upon the armature the same.

Observing it first as a direct-current motor, we find that this construction frees us at once from two very important conditions. The first is that, having no windings, the fields are capable of being used on any voltage without change; that is to say, if it becomes desirable to change from a higher potential, say, of 550 volts to 220 or 110, or even 50 volts, or visa-versa, it is only necessary to rewind or obtain an armature of that voltage, leaving the frame fields without change. The second is that there can be no short-circuiting or burning out of the field coils or any complications between the field and armature circuits, which will happen even in the best equipments as at present installed. This feature will undoubtedly interest all those having motors under heavy service on rough roads and in all conditions of weather.

As the windings of the armature are parallel with the shaft and the laminations of the fields are at right angles thereto, it is also obvious that the armature coils are in the best position for making an electromagnet out of each separate laminæ and consequently a compound electromagnet of great power out of the assembled laminæ.

As a corollary, this machine will act as a generator for direct current, building up and energizing itself from the residual magnetism of the fields, without making any change except to swing the brushes to the opposite point of commutation or else (letting the brushes stand in the same place) drive the machine in the opposite direction. The reason for this is that by isolating the fields, so arranged, the action of the armature coils on the fields is localized, or, so to speak, concentrated in the fields themselves and not dissipated and lost in the yoke; in fact so sensitive are the fields to the armature current that I have seen an armature weighing 100 pounds wound for 88 volts and 30 amp. start up under the application of 4.5 amp. at 10 volts, or 45 watts, and run at 250 turns on 25 watts, equal to an expenditure of one watt for every 10 revolutions. It will be noted that as the armature circuit is the exciting circuit of the fields also, and that any increase of the armature current and magnetization, will be followed by equal increase in field magnetization, the motor has the chief characteristics of a series motor, namely, variable speed with variable load, but of course without the wire losses of the field windings due to resistance counter e.m.f., etc.

The armature may be any one of the usual forms, either ring, drum or barrel, either toothed or plain, providing the windings of the armature are parallel with the shaft as mentioned above. A preferred form is to have the teeth cut in the form of an acute equilateral triangle, with the apex of the angle in the circumference of the armature and even with the outer layer of wire. The reasons for this are, first, to present to the field the greatest number of ampere-turns so as to realize the maximum magnetization of the fields; and, secondly, to minimize the iron loss in the armature due to the bunching of magnetic lines on the edges of the teeth, especially when using alternating current.

It will be seen from the foregoing description that this construction supplies a motor for direct current having series characteristics and especially well adapted to varying loads, because the current increases automatically with the load, the magnetization with the current, and the torque as the square of the current.

It is not, however, till we take up the motor to apply it to the alternating current that the full significance of its peculiarities dawn upon us. We have seen above that the field construction is such that it is independent of the armature windings so far as potential of current utilized by the armature is concerned; that is to say, if you take two armatures of equally good mechanical construction, one of which is wound for ten volts potential and the other for ten hundred or any intervening potential, and supply the required current to them, replacing one by the other alternately within the fields, the operation of the one will equal that of the other per watt energy employed. This discloses the fact that the armature is the controlling member of the combination and that the field adapts itself to, and responds automatically to, the conditions for the instant existing in the armature.

Take now an armature that has been running on the 110-volt direct current with its proper fields and supply it with 110 volts single-phase, alternating-current within the same fields; without having even changed the plane of commutation the motor will rotate as smoothly and evenly as with the direct current and the torque will be in the same direction, but will change by changing the position of the brushes. Now, supply two-phase currents to the same potential and the same result is obtained, and so also with other polyphase currents and for the reason stated, that the field responds instantly and automatically to every change of current condition in the armature. The value of this proposition in electrokinetics cannot well be overestimated. Especially is this the case in electric traction. For example, the instance narrated in a late number of the *Street Railway Journal* (and there are many such) where an aggregation of trolley companies combined their interests for the completion and operation of a long-distance line, using their individual plants over their individual roads and compelling their passengers to change cars at their termini. This transfer nuisance would be entirely done away with by such a motor, as the cars could then be run from section to section over the whole road.

As the question of the weight of the single-phase alternating motor is receiving considerable attention, it might be well to state that the Dialt motor is lighter in construction per unit of horsepower developed, for the following reasons: First and principally, because the large annular laminated ring-yoke uniting all the pole pieces is omitted entirely, while the radial depth of the poles themselves is limited to about that used for the field winding in the single-phase motor. There is, therefore, a saving in weight of the entire laminated annulus from which the pole pieces project, and this in large machines is a matter of considerable moment. In the armature there is probably no saving in weight, for the armature of the Dialt motor being relied upon to fully magnetize the field, is allowed a third more ampere-turns than in the ordinary field-wound, direct-current machine, it having been found that this increase is sufficient to insure saturation of the fields at 40 per cent. overload. There is also an elimination of the entire weight of the field windings, whatever that may be, which still further lightens the construction of the Dialt motor.

Both these motors then have reached the same result, namely, satisfactory operation on the single-phase current, but by different ways. They are also in many respects similar. We find in both the same extra-sized powerful armature, the same disposition of the poles about the periphery of the armature, and the same careful lamination of the pole pieces; each one is designed in its own way to produce the same result; that is, the concentration of magnetic energy on the faces of the pole pieces, the one doing it by means of toothed or grooved fields wound with their appropriate field coils and energized by current through those coils; the other, the Dialt, accomplishing the same result by smooth-faced unwound fields, each one isolated from all the others and energized by the current flowing through the armature coils. The one is based upon carefully observed facts and the most accurate calculations; the other on the careful disposition of the iron of the pole pieces to receive a maximum of magnetization from a minimum of current.

Electrically Equipped Parlor Car.

The accompanying illustrations show the electrical arrangements of a handsome parlor car recently supplied by the Barney & Smith Car Company, of Dayton, Ohio, to the Erie Railroad for its Tuxedo service. In addition to an unusually complete installation of lamps, the circuits are so arranged that the illumination can be graduated over a very considerable range, and the car is supplied with electric fans and a ladies' hair-curling outfit.

The car is wired throughout with No. 12 wire for 1 per cent. loss at 25 volts. The dynamo and battery wiring to the switchboard is of No. 1 cable run through heavy canvas hose and strapped to the bottom of the car. From the switchboard a double-circuit, two-wire system is used, by means of which each side from the center line of the car is supplied with a complete system. There are 15 circuits, all told, as follows: Eight to the center fixtures, four on the two deck sills, two for the three fans and one for the curling-iron heater at a ladies' dresser.

FIG. 1.—VIEW OF INTERIOR OF CAR.

One side of each circuit unites in a common return or negative main at the switchboard. The other, or positive sides of the lighting circuits, are connected single-pole in pairs through double-pole Bryant switches and double-pole plug cut-outs, thereby keeping the circuits separated, and at the same time enabling the two sides (right and left) of the car to be operated simultaneously.

The fans and curling-iron heater are on independent circuits. Each fan has in the wall near it a Hart flush electrolier switch which is so connected with the fan resistance as to enable three speeds of the fan to be obtained. By the above system of wiring it is possible to get in the main part of the car on the four auxiliary or day circuits any number of lights from one to ten, and by bringing into service the other eight circuits almost any number of lights from one to forty-six may be put in service.

The main switchboard connections are on the front and made up

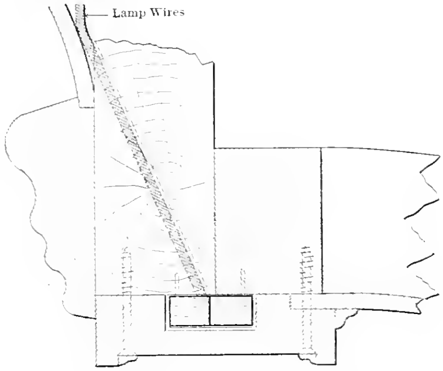


FIG. 2.—DIAGRAM OF WIRE CLEAT.

of bar copper, formed in shape and taped, and then several taped together; thus in case of disconnecting each section will remain intact. The wires are run in metallic cleats and taping in grooves in

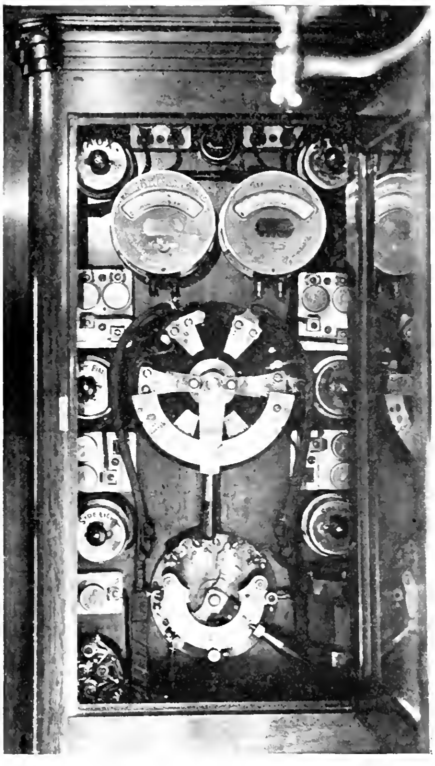


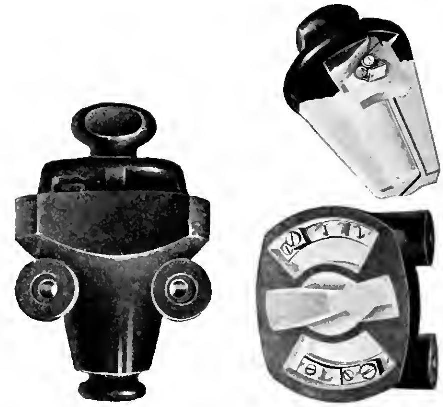
FIG. 3.—SWITCHBOARD ON CAR.

the soft mould, which is screwed to the deck sill, as shown in Fig. 2. All leads in branching therefrom pass up through a mullion over the deck openings to the center fixtures. Six hundred feet of No. 1 cable with over 3,000 ft. of branch and lamp conductor make up the wiring, and 68 8-cp. 25-volt clear, spherical globe lamps are installed. Three 12-in. Diehl fans and one curling-iron heater complete the electrical equipment. The generating and storage battery equipment is of the Gould type. Mr. D. D. Tate designed and installed the switchboard and circuits.

Transformer Primary Cut-Out.

An improved form of a transformer primary cut-out designed to protect the high-tension side of transformers is being introduced by the Westinghouse Electric & Manufacturing Company. It is made entirely of porcelain, and its form is such that it has high insulating and arc-breaking qualities. The plug to which the fuse is attached projects between the terminals, the upper end of it rising well into the top of the block and interposing an effective barrier, and thus making it impossible to maintain an arc. The fuse is eleven inches in length, making a long break, and is so placed that the vapors of a discharge are blown down and out of the device and away from the terminals.

The line wire is carried directly to the top of the device and attached to it as to an ordinary insulator, which it thus displaces. To reach the terminal the wire must be bent around the edge of the block and is so supported in an angle between the terminal post and



FIGS. 1 AND 2.—TRANSFORMER PRIMARY CUT-OUT.

the porcelain case that it cannot be loosened by any swaying of the wire in the wind.

The plug enters from the bottom. When it is raised into place a partial turn draws the knife blades on the plug into the jaws on the block, preventing the plug from dropping out or being blown out.

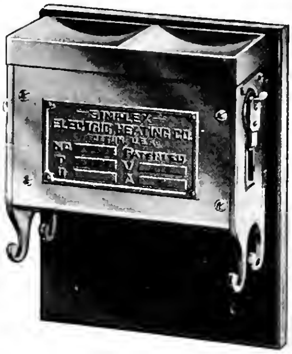
All live parts are protected from the weather by the projecting edges of the block, and by placing the terminals well above its lower surface, with no apertures in the side or top. A bend in the fuse wire brings it into plain view at all times, and it is thus possible to observe its condition without removing the plug, guarding against any liability of opening the circuit when there is a current upon the line.

It is fastened to the cross arm or other support by two screws, passing through porcelain tubes which form a portion of the block. It has a rated capacity of 2,500 volts, 30 amp., and is small, light, easy to install and to re-fuse.

Electric Heat in Theatres.

The effort to reduce theatre hazards to the minimum on the part of owners, managers and insurance companies has made a demand for electric curling iron and grease paint heaters so as to enable gas to be eliminated from stage dressing-rooms. In addition to its previous product in this line, the Simplex Electric Heating Company has recently brought out a new type of combined grease paint and curling iron heater. While it is a combination device, the heating of the grease paint is independently controlled.

The grease paint heater is divided in two sections and forms the top of the device and is controlled by a quick opening switch on the left side of the device. The curling iron is inserted at the right side and the current is automatically turned on or off by the action of putting in and removing the curling iron. Hooks are provided for hanging the curling iron when out of use. The device is polished nickel finish, mounted on enamel slate and arranged to fasten to standard outlet box or on wall as ordered. This product is the result of the co-operation of an expert theatre electrician, George A. Mc-



STAGE DRESSING-ROOM ELECTRIC HEATER.

Curdy, of New York, and the company's engineers, and has been installed in several new theatres.

The company's combination curling iron and grease paint heater, known as No. 1280, is in extended use, and the two types are calculated to meet all requirements.

High-Voltage Oil Fuse.

OIL FUSE.

The accompanying illustration shows a high-voltage oil fuse made by the Anyun Lamp & Electric Company, of Buffalo, N. Y. The fuse is connected to brass rods as shown, and brass terminals are screwed to the latter at the end caps. At the top are air tubes, which also serve for the introduction of the oil.

The glass tube is partly filled with a high grade of transformer oil, which is poured in through one of the air pipes, just enough oil being used to completely submerge the fuse wire. When a short-circuit occurs, the oil enters the space between the two ends of the broken fuse wire, and effectually smothers any arc. The oil becomes darkened after a short-circuit, the discoloration being caused by gases, but resumes its natural color after standing some time. Rubber discs and washers allow expansion and contraction of the glass, and prevent the oil from leaking out. The air space between the surface of the oil and the upper cap allows the oil to rise in the case of a very severe short-circuit, and reduces the amount of pressure against the glass, which is very thick and tough, the air pipes allowing the gases to escape. The fuse is self-indicating, the fuse wire being visible until a short-circuit occurs, which, as stated above, is manifested by the discoloration of the oil. A fuse can be refilled at the power house as often as it blows out, thus practically eliminating any further expense after the fuse has once been installed.

Electricity in a Modern Hospital.

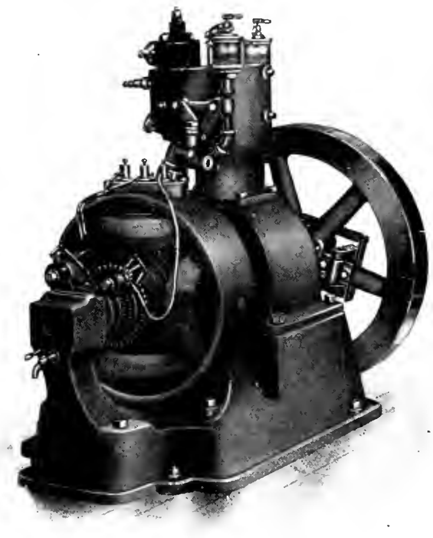
One of the largest hospitals in the country has just been opened in New York City, namely, the Mount Sinai, occupying an entire square block, between Madison and Fourth Avenues and One Hundred and One Hundred and First Streets. There are ten buildings within this space and provision has been made for 456 beds. The equipment is of the most modern and up-to-date character possible.

The electrical service includes 6,000 lamps and 200 hp in motors. There are five General Electric direct-current generators directly connected to five Ball & Wood engines. Three of the units are of 100 kw each and two of 50 kw each. The marble switchboard in the dynamo room is 28 ft. long, 8 ft. high, with bronzed frame and with a grille. A very interesting feature is the use in all the rooms in the private hospital and in all the wards of the Sayles regulators for turning the electric lights up and down. This feature of convenience is very highly appreciated and is now becoming quite common in hospital work. The laundry is operated entirely by electric power and heat, all the ironing being done with electrical irons. There is also a complete interior telephone system of 125 stations and an intercommunicating system of 50 stations. All the clocks, 88 in number, are operated electrically, and there is a storage battery equipment operating telephones, clocks, watchman's detectors, bells, etc., a motor-generator being installed for use in the day time and the battery being a reserve in case of break-down. Everything is in duplicate. There are all told about 100 miles of wire in the building for various purposes. The Charles L. Eidlitz Company was the contractors for all of the electrical equipment.

Lighting Set for Small Yachts.

The compact electric generating set illustrated below has been designed for use on gasoline launches, yachts and sailing vessels, where there is no means of driving a steam engine. The engine of this generating set is a gasoline engine of 2½ hp. The dynamo is of 1-kw capacity and furnishes 10 amp. at 110 volts. The speed of the dynamo is 750 r.p.m. Flexible couplings, etc., are avoided and the armature is mounted on a sleeve which slips over the crank shaft and is held securely in place by means of a long key.

In order to make the set complete, the circulating pump is attached directly to the engine and is driven by means of an eccentric from the cam shaft. The governor is contained in the fly-wheel and is of such sensitiveness that the speed is maintained within 2 per cent. from no load to full load. As weight is to be considered on shipboard all parts are made as light as possible consistent with strength.



GENERATING SET FOR YACHTS.

The dynamo frame is a steel casting of highest permeability. Bedplate and engine frame are made light, but strong enough for the purpose.

The weight of the complete plant is 475 pounds, including fly-wheel and all accessories. The floor space occupied is 20 in. by 34 in. and height is 30 in. The space occupied is so small that this little plant can be placed in an out-of-the-way corner where it will do its work faithfully and conscientiously with not much more noise than a sewing machine. It will furnish sufficient current for lighting 20 incandescent lamps of 16 cp. or a 1,500-cp searchlight and eight or ten incandescent lamps. The manufacturer is the Carlisle & Finch Company, of Cincinnati, Ohio.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was marked improvement in prices of stocks and general activity in speculation, largely on short covering following the announcement of the adverse decision in the Northern Securities case. The market, although professional, was more cheerful in tone at the ending of the suspense, and the favorable crop reports and reported better demand for iron were factors in the improvement. London showed an increaseed disposition to bull American stocks. The Steel shares were the strong features on the better trade outlook, though the general list is higher throughout. The money market continued easy, although there was a slightly increased inquiry for time loans. Metropolitan Street Railway attracted much attention by reason of a break to 104¾ on unfavorable rumors regarding the local traction situation, but it afterwards rallied and closed at 111¾, being a net gain on the week's trading of 4⅞ points. The sales aggregated 65,200 shares. Brooklyn Rapid Transit, after receding to 39⅛, closed at 43⅞, which was the highest quotation of the week, and a net gain of 4⅜. All of the electric securities were also favorably affected by the better feeling in the market. General Electric was quite active, 3,000 shares having been sold. The range of prices was between 160, the lowest, and 167, the highest, the closing figure being 166—a net gain of 6½ points. Westinghouse also made a gain of 6 points, closing at 163, the number of shares changing hands being 5,100. Western Union remained practically steady as to prices, closing at 89⅜, thus netting ⅞-point increase. There was little done in the outside market. Fluctuations were irregular, Interborough Rapid Transit and Electric Boat being firm. Following are the closing quotations of March 22:

NEW YORK.

	Mar. 15	Mar. 22		Mar. 15	Mar. 22
Allis-Chalmers Co.	..	6⅛	Electric Vehicle	7½	7
Allis-Chalmers Co. pfd	..	39¾	Electric Vehicle pfd.	10	10
American Tel. & Cable	84	84	General Electric	162¼	168
American Tel. & Tel	121	124	Hudson River Tel	..	..
American Dist. Tel	22	22	Metropolitan St. Ry	107½	112⅛
Brooklyn Rapid Transit	41¼	43	N. Y. & N. J. Tel	..	..
Commercial Cable	180	176	Marconi Tel	..	..
Electric Boat	22	20	Western Union Tel	88½	88
Electric Boat pfd	52	50	Westinghonse com	159	163
Electric Lead Reduction	⅛	¾	Westinghouse pfd	175	175

BOSTON.

	Mar. 15	Mar. 22		Mar. 15	Mar. 22
American Tel. & Tel	122	124	Western Tel. & Tel. pfd	78	75
Cumberland Telephone	11	*115	Mexican Telephone	1½	1¼
Edison Elec. Illum	23	233	New England Telephone	118	117
General Electric	162	168	Mass. Elec. Ry	18	19
Western Tel. & Tel	8½	8½	Mass. Elec. Ry. pfd	71½	72

PHILADELPHIA.

	Mar. 15	Mar. 22		Mar. 15	Mar. 22
American Railways	42½	43	Phila. Traction	..	95½
Elec. Storage Battery	52	57	Phila. Electric	5⅞	6
Elec. Storage Battery pfd.	52	57	Phila. Rapid Trans	13½	14
Elec. Co. of America	7⅞	8			

CHICAGO.

	Mar. 15	Mar. 22		Mar. 15	Mar. 22
Central Union Tel.	..	..	National Carbon pfd.	97½	99⅞
Chicago Edison	..	150	Metropolitan Elev. com	14	16½
Chicago City Ry	156	155	Union Traction	5	5
Chicago Tel. Co	..	..	Union Traction pfd	30	30
National Carbon	25	28			

*Asked

THE MACKAY-BENNETT PROPERTIES:—An interesting analysis of the financial condition of the Mackay-Bennett telegraphic and cable properties is made as follows by the *Wall Street Journal:* "Applying the earnings of the Commercial Cable Company for the year 1903 to the securities of the proposed Mackay companies, the $1,708,526 surplus after charges equals 4 per cent. on the $30,000,000 cumulative preferred stock, and 1.6 per cent. on the $30,000,000 common. The stock of the Mackay companies, if the plan is successful, will be exchanged for the $15,000,000 stock of the Commercial Cable Company now outstanding at the rate of two shares of new preferred and two shares of new common for one share of Commercial Cable. As the latter is now paying 8 per cent. dividends, the full 4 per cent. required on the new preferred stock could be paid without increasing the present dividend requirements. The new common stock would represent the present individual earnings of Commercial Cable. It is possible that a larger earning capacity might be figured for the new common stock. In addition to the $500,000 reserve charged off from the surplus after dividends, Commercial Cable charged another reserve sum to operating expenses, under the item "land line repairs and reserve for reconstruction and extensions." This item last year amounted to $2,025,383, compared with $1,806,015 the previous year. The great growth in the business of the Commercial Cable Company in the last few years suggests possibilities for the common stock of the proposed company. In the last six years gross earnings have increased 65 per cent.

UNITED STATES TELEPHONE.—The financial report of the United States Telephone Company, of Cleveland, Ohio, made last week was exceedingly gratifying to the stockholders. One year ago the company had a deficit of $21,138, but the report last week shows the deficit entirely wiped out and a net balance of $15,972 on hand at the end of business for 1903. Plainly speaking, the company made $37,706.17 for the year 1903, instead of losing $21,138.32, as it did in 1902, and President Dickson says the profits for 1904 will be very much larger. It was the best report the stockholders had ever received from the company and the meeting had the flavor of a love feast. The company's balance sheet is as follows:

ASSETS.

	1903.	1902.
Property and plant	$4,054,887.30	$3,925,016.04
Material and supplies	30,651.93	53,073.47
Treasury stock	390,000.00	....
Treasury bonds	105,000.00	....
Current assets	99,926.83	86,202.27
Deferred assets	4,582.16	1,133.85
Total assets	$4,685,048.22	$4,065,425.73

LIABILITIES.

	1903.	1902.
Capital stock, common	$2,000,000.00	$2,000,000.00
Capital stock, preferred	500,000.00	....
Mortgage bonds	1,970,000.00	1,865,000.00
Current liabilities	187,817.16	215,201.00
Deferred liabilities	11,258.88	6,363.05
Total liabilities	$4,669,076.04	$4,086,564.05
Surplus	15,972.18	21,138.32
Total liabilities	$4,685,048.22	$4,065,425.73

The company's gross earnings for the year were $379,235.10, a gain of $76,838.85 over preceding year. Its net increase was $140,275.69, a gain of $17,165.48. The surplus was $37,706.17, a gain of $14,470.52. Deducting the $21,733.99 deficit, leaves a surplus of $15,972.18. The directors elected are H. A. Everett, F. S. Dickson, E. W. Moore, J. R. Sprankle, J. B. Hoge, J. W. Marsh, C. W. Wason, J. B. Hanna, R. Mahler. The officers are: F. S. Dickson, president; E. W Moore, vice-president; James B. Hoge, secretary; R. W. Judd, treasurer.

DIVIDENDS.—The American Telegraph & Telephone Company has declared the regular quarterly dividend of 1½ per cent. The dividend is payable April 15. Detroit United Railway directors have declared the regular quarterly dividend of 1 per cent., payable May 2. The Union Switch & Signal directors have declared the regular quarterly dividends of 2½ per cent. on the preferred and 2 per cent. on the common, payable April 10. United Gas Improvement, Philadelphia, has declared the regular quarterly dividend of 2 per cent., payable April 15. Bell Telephone, of Philadelphia, directors have declared a regular quarterly dividend of 1½ per cent., payable April 15. The General Electric Company has declared a dividend of 2 per cent. payable April 15, on the common stock. The Metropolitan Street Railway Company, New York City, has declared a regular quarterly dividend of 1¾ per cent. on the capital stock, payable April 15.

NEW BULLOCK COMPANY.—The incorporation papers of the Bullock Electric Manufacturing Company, of Norwood, Ohio, have been filed at Columbus, Ohio. The new company is incorporated with a capital stock of $500,000, the incorporators being Richard P. Ernst, Alfred C. Cassatt, Frank F. Cattle, James C. Marshall and John E. Shepard. It will be the leasing company of the present Bullock Company, which is now, through this leasing company, controlled by the Allis-Chalmers Company. The president of the new company is George Bullock and the vice-president Joseph S. Neave. Other details of this contemplated action were given in our issue of March 12.

CONNECTICUT MORTGAGE.—The Connecticut Railway & Lighting Company has filed a mortgage for $1,000,000 in favor of the Central Trust Company, of New York, to secure an equal amount of bonds.

NEW YORK-PHILADELPHIA TROLLEY.—The Middlesex & Somerset Traction Company, which has fifty miles of track in Middlesex and Somerset Counties, New Jersey, has been sold to the Public Service Corporation of New Jersey for $2,250,000. The Middlesex & Somerset Traction was owned by ex-Judge Gotfried Kreuger, of Newark; Andrew Radel, of Bridgeport, the heirs of the late John Radel and Edward H. Radel. The buying of the local trolley system completes the Public Service's through line from New York to Philadelphia. The corporation added very recently to its through line by purchasing the line from Camden to Trenton, and is now building a road from the terminus of the Camden road at Trenton to connect with the end of the Trenton fast line at the fair grounds. The Public Service closed the deal a short time ago for the right of way over the Trenton fast line, and, it is understood, will take over this road probably within the next thirty days.

FIGURES OF FRANCHISE TRUSTS.—In his recent work on the trusts, Mr. John Moody shows that there are 318 important industrial trusts in this country, controlling 5,288 plants, and having a total capitalization outstanding of $7,246,342,533. The eight leading franchise trusts are the American Bell Telephone, the Western Union Telegraph Company, the Commercial Cable Company, the Federal Telephone Company, the Consolidated Telephone Company, the International Telephone Company, the Interstate Telephone Company and the United Telephone & Telegraph Company. These control 136 plants and have a total capitalization of $629,700,500. There are also 103 leading gas, electric light and street railway consolidations, making a total of 111 important franchise trusts, controlling 1,336 plants, and having a total outstanding capitalization of $3,735,456,075.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from distributive centers still complain more or less of the backwardness of spring trade, which is generally attributed to the bad weather, yet there have been several favorable developments. Chief among these is the arrival of much-needed moisture in the southwestern wheat belt; the continued improvement in the iron and steel trade, and the decision of the bituminous coal miners not to strike against the proposed reduction of wages. The railway situation shows improvement, in that February made a slightly better comparison than January, an increase in gross receipts being indicated for the former month. Money continues easy, but collections are still classed as unsatisfactory at several points. The agricultural situation, though marred by the irregular condition in winter wheat, is on the whole very promising. An immense acreage will undoubtedly be planted in cotton in the South. In cotton liquidation has been a feature, induced by poor trade reports and slightly heavier receipts, the suspension of a large speculator resulting on Friday. A net loss of over 1½ cents per pound is shown on the week. In iron and steel large buying by leading interests has induced free purchasing by smaller concerns, hence advances are noted of 25 to 50 cents per ton on all grades of pig iron. Agricultural implement manufacturers are doing the best business in years. *Bradstreet's* reports 193 business failures during the week ending March 17, against 200 the week previous and 194 the corresponding week last year.

GOULDS PUMP CONTRACTS.—The Goulds Manufacturing Company, of Seneca Falls, N. Y., reports the following large recent contracts: Baltimore and Ohio Railroad Company, for its plant at Glenwood, Pa., three 13-inch x 12-inch Triplex power pumps with Westinghouse motors; Proctor & Gamble Co., Kansas City, Mo., 22 power pumps of various sizes for its new plant; E. J. DuPont Co., Penns Grove, N. J., 6 power pumps for the general water supply and distribution system; Indestructible Fibre Company, for Massena, N. Y., one 14-inch x 12-inch power pump, and one other of smaller size; Hurtig & Seamon's Music Hall, New York, a 500-gallon fire pump; Princess Theatre, New York, a 500-gallon fire pump; American Machinery and Export Company, one double-acting 14-inch x 16-inch Triplex power pump, for the water works at Vera Cruz; Brooklyn *Daily Eagle*, Brooklyn, N. Y., a 500-gallon fire pump, one Triplex deep open well pump, and also one house pump; Muller, MacLean & Co., New York, one Triplex power pump for water works plant, at Manila, P. I.; George A. Fuller Co., for the New York *Times* Building, New York, all Triplex power pumps on the specifications, with Crocker-Wheeler motors.

CUBAN LIGHTING AND TRACTION EQUIPMENT.—Contracts will be let very shortly for the construction and equipment of a large water power plant in Cuba, intended to develop current for lighting and traction in Cienfuegos and the towns of Caonao, Palmira, Harmiguera and Cruces, and for operating large sugar mills in the vicinity. The Cienfuegos, Palmira & Cruces Railroad & Electric Power Company will undertake the work. Mr. Bruno Diaz, a large Cuban cigar manufacturer, is president of the company. Mr. Cornelius C. Vermeule, 203 Broadway, is consulting engineer. The plant will be built at the Falls of Hababinalla, located about 30 miles from Cienfuegos. The available head is 480 ft. The initial capacity of the plant will be 6,000 hp. Four units of 1,500 hp will be put in. There will be about 40 miles of electric traction system constructed. About five miles of line will be built in Cienfuegos, which is without tramways of any description. The track will be standard gauge and 4,400 tons of T rails (70 pounds) will be ordered, with 4,100 trolley poles. Construction will be begun early in April and the entire system is expected to be in active operation inside of twelve months.

A 35,000-H.P. MEXICAN WATERPOWER PROJECT.—The construction of a hydraulic plant whose capacity is expected to be about 35,000 h.p. is contemplated in the State of Puebla by Mexican capitalists, who propose to supply light and power to various towns and industrial establishments in that part of the world. The necessary concession has been obtained from the Mexican Government authorities. The Falls of Flatlahuqui, on the Apulco River, will be utilized for furnishing the energy. These falls are reputed to be about 400 feet in height. Luis Fernandez Castillo, of Mexico City, is the concessionaire.

MEXICAN SUGAR FACTORY.—The Mexican Tropical Planters' Company, in which Boston and Kansas City capitalists are primarily interested, is about to let contracts for the construction of a large sugar factory on its 50,000-acre property known as the Columbia plantation, on the Coatzacoalcos River, Isthmus of Tehuantepec. It has not been fully determined yet whether or not the plant will be electrically operated. A large lighting equipment will, however, be installed. Mr. Louis Kunz is general manager at the plantation.

BULLOCK ORDERS.—The Bullock Electric Manufacturing Company of Cincinnati, Ohio, has just received an order from the Denver Gas and Electric Company, Denver, Colo., for one 1,500 kw 2,400 volt, 3-phase, 100 r.p.m., 60 cycle, fly wheel type generator. This machine is a duplicate of one they installed for this company about a year ago. The Denver Gas and Electric Company has also installed four 600 kw 3-phase, 2,400-volt alternators which makes a total of 6,000 kw in Bullock alternators installed.

THE AUTOMATIC ELECTRIC COMPANY announces that the Citizens' Telephone Company, of Columbus, Ohio, has increased the order placed with it some time ago. The original order called for complete Automatic equipment for 7,000 stations initial installation. The new order makes the number of stations to be installed in the beginning, 8,000. The Citizens' Company will build a new house for the Automatic Exchange, which will be designed specially for this type of equipment.

THE INDIANA RUBBER AND INSULATED WIRE COMPANY, Marion, Ind., has just finished sending out four orders to foreign countries. The first order was for 200,000 ft. of telephone wire or cable, which was shipped to Yokohama, Japan; the second for one ton of rubber tape, shipped to Alexandria, Egypt; the third one ton of tape to Berlin, Germany, and the fourth one ton of tape to Paris, France. Other foreign orders have been received and will be shipped soon.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph makes the following instrument statement for the month ended February 29:

	1903.	1902.	1901.
Gross output	84,402	91,844	95,584
Returned	37,093	35,188	36,855
Net output	47,309	56,656	58,729
Total outstanding	3,880,616	3,296,527	2,637,355

BALL ENGINE CONTRACT.—On March 11 the Ball Engine Company, of Erie, Pa., made a shipment, composed of four cars, carrying a large 20 x 38 x 30 horizontal cross-compound side-crank engine, of their Corliss type, direct-connected to 400-kw alternator; alternator and wheels placed between the frames. This shipment went to the National Tube Company, Pittsburg, Pa.

EQUIPMENT WANTED IN ARGENTINA.—A large preserved meat factory is about to be built in the Argentine Republic, which will be lighted and largely operated by electricity. Alberto de Permentier, of Buenos Ayres, will be in charge of the construction. Interested parties writing him would do well if they used either the French or Spanish language.

STREET CAR CONSOLIDATION.—The J. G. Brill Company, the great street car builder, of Philadelphia, has secured control of the G. C. Kuhlman Street Car Manufacturing Company, of Cleveland, and will reorganize it.

THE EASTMAN KODAK COMPANY, of Rochester, N. Y., the well-known manufacturer of cameras, has purchased two 16 x 28 x 18 vertical cross compound engines of the Ball Engine Company, Erie, Pa.

General News.

THE TELEPHONE.

DENVER, COL.—The Wray Telephone Company has secured franchises in the eastern portion of the state for the extension of its system.

WASHINGTON, D. C.—The Kurtz International Telephone Company has been incorporated with a capital stock of $10,000,000. The incorporators are: J. W. Kurtz, J. A. Thompson, Harvey T. Winfield, Joseph A. Rath and Charles Fitts.

ALBION, ILL.—The Edwards County Mutual Telephone Company has been incorporated with a capital stock of $8000. Directors: W. J. Reid, T. B. Mitchell and others.

SALEM, ILL.—The Maron County Co-operative Telephone Company has been incorporated with a capital stock of $1000. The directors are: J. Herchberger, W. J. Martin and others.

HERMON, ILL.—The Hermon & St. Augustine Telephone Company has been incorporated with a capital stock of $1000. The directors are: W. A. Bogan, G. M. Brown and others.

DANVILLE, IND.—The Farmers' Co-operative Telephone Company has filed articles of incorporation. John F. Hardwick is president, and A. C. Underwood, secretary.

SOUTH BEND, IND.—The South Bend Home Telephone Company has purchased the property of the Electric Investment Company, of Mishawaka, paying therefor $14,000.

DANA, IND.—The Citizens' Mutual Telephone Company has incorporated. The capital stock is $6000. De Witt C. Keruse, Harry Bales and S. E. Scott are the incorporators.

TERHUNE, IND.—The Terhune Co-operative Telephone Company has filed articles of incorporation. Capital stock, $2000. Louis A. King, Albert Robison and Simon Cox are the directors.

ELBERFELD, IND.—The Elberfeld & Millersburg Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $4500. Dr. L. Brown, Fred Kampe and Henry Menke are the directors.

SELMA, IND.—The members of the Selma Co-operative Telephone Company held a meeting last week and decided to purchase an exchange building and install a new switchboard, and otherwise improve and extend the plant.

TANGLEWOOD, IND.—The Tanglewood Telephone Association will construct a line to the corporation line of Versailles, where it will connect with the Spencer telephone system. This line will start with a large number of subscribers. Chas. Braley is president, and J. E. Waters, secretary.

WARREN, IND.—The Warren Home Telephone Company's plant has been sold to the Warren Telephone Company, recently incorporated with a capital stock of $25,000 for the purpose of taking over the old company's property. The plant will be improved and the lines extended throughout Huntington and Grant counties. W. Griffith heads the new company.

JONESBORO, IND.—A war has been declared on the Bell Telephone Company by the merchants of this city. Two companies have franchises to operate—the Bell and the Independent. The merchants grew tired of the dual systems, and adopted the Independent. The Bell Company's telephones have all been ordered out of places of business and a rule passed that any merchant in the future who uses a Bell telephone in his business or at home will be expelled from the association. The Bell Company now proposes to enter the mercantile business by establishing a large department store and low prices in Jonesboro.

INDIANAPOLIS, IND.—At a meeting of the stockholders of the New Telephone Company, on March 10, the following directors were elected: L. C. Walker, B. E. Parrott, J. W. Bowles, F. L. Holweg and I. D. Wiest. L. C. Walker was elected president to succeed S. P. Sheerin, who retired to become president of the Indianapolis Telephone Company. The lease of the properties of the New Telephone Company to the Indianapolis Telephone Company was authorized. The rapid growth of the business of the New Telephone Company made it necessary to raise additional capital in order to meet all the demands made for service. The report made to the stockholders showed that the gross earnings of the New Telephone Company during the year ending with February were $227,196, an increase over the previous year, after deducting operating expenses, depreciation, fixed charges and dividends, amounting to $177,410. The company now has a total surplus of $130,223. By the extensions to be made to the property by the Indianapolis Telephone Company, the earning capacity of the company will be increased nearly $250,000 a year, or nearly 20 per cent. gross on the $1,200,000 capitalization.

DURANT, I. T.—The Chickasaw Choctaw Telephone Company will erect an exchange here and extend its line to Bennington.

RICE, KAN.—The Hillsdale Telephone Company has been incorporated with a capital stock of $2500.

CLARENCE, MO.—A new telephone company is being organized here by farmers, to be known as the Independent Telephone Company. Frank Dorrell was elected president.

RALEIGH, N. C.—The Raleigh Telephone Company recently re-elected the present board of directors. The rumor of the sale of the company is stoutly denied. There are three companies in Raleigh.

ASHEVILLE, N. C.—At Asheville recently a number of citizens signed an agreement to use only the service of the Asheville Telephone Company, now sold out, and the question has arisen as to who is responsible for the low rates. The attorney of the new merger holds that the stockholders of the old company are responsible.

GREENSBORO, N. C.—An interesting fight is now on here over the attempt of the Southern Bell Telephone Company to raise its rates to "standard" rates, which the company claims is allowed it by the state corporation commission.

PAINESVILLE, OHIO.—A new telephone company has been organized here to install an exchange at Le Roy. W. M. Baker was elected president.

NORTH BENTON, OHIO.—The North Benton-Deersfield Telephone Company has increased its capital stock from $1000 to $15,000.

BRYAN, OHIO.—The Bryan Telephone Company has increased its capital stock from $40,000 to $75,000. W. W. Morrison is president.

LAKE, OHIO.—The Tri-County Telephone Company has been incorporated with a capital stock of $10,000. The directors are: N. B. Biddleman, M. M. Bauer and others.

NEWARK, OHIO.—The Newark Independent Telephone Company has now over 1400 connections. It has recently installed 70 new telephones and has orders for 25 more.

CALDWELL, OHIO.—The Farmers' Telephone Exchange Company has been incorporated with a capital stock of $10,000. The directors are: J. M. Harding, L. W. Wheeler and others.

FORT SUPPLY, OKLA.—The Fort Supply Telephone Company has been incorporated to construct a telephone from Beaver City to Gaery.

HARRISON, OKLA.—The Gotebo Telephone Company has been incorporated with a capital stock of $10,000. The directors are: H. Dalke, W. H. Kuda and others.

WILKESBARRE, PA.—A new telephone company is being organized here, with C. H. Randall as president.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company will extend its system to the south and west.

COLUMBIA, S. C.—The new telephone law in South Carolina, just passed by the state legislature, places all telephone companies under the supervision of the corporation commission. On account of alleged conflicting clauses, it is said that the bill will scarcely be effective. The commission has already applied to the attorney-general for an interpretation of the measure.

VOLGA, S. D.—The Dakota Central Telephone Company will extend its lines to Wentworth.

BROOKINGS, S. D.—The Thompson, Caldwell & Wilson Rural Telephone Company has been formed here. Materials have been ordered for the building of 60 miles of line.

DEADWOOD, S. D.—The Harrison Telephone Company has been succeeded in eastern South Dakota by the Home Telephone Company, recently organized to take over the system and business.

KNOXVILLE, TENN.—The People's Telephone & Telegraph Company has asked for a right to lay about one mile of underground conduit.

RIVES, TENN.—A new telephone company has been organized here by T. J. Bonner, B. J. Wade and others.

HUNTINGDON, TENN.—The Western Dixie Telephone Company has been organized at Vale, this county, with E. B. Simmons, president; Dr. Florence, vice-president, and A. N. Presson, secretary and treasurer. The company has lines in operation between Camden and Huntingdon and several subscribers at both places. It is the intention of the company to extend its service.

SAN ANTONIO, TEX.—The Southwestern Telegraph & Telephone Company will expend about $80,000 in extending and improving its system in this city.

NEW BRAUNFELS, TEX.—The Independent Commercial Telephone Company has applied to the City Council of New Braunfels for a franchise to install a telephone exchange here.

SAN ANTONIO, TEX.—Frank C. Smith, of San Antonio, president of the Commercial Telephone Company, announces that he has just purchased for his company the independent telephone exchanges at Austin, Taylor, Temple and Belton, and that he has leased from the Beaumont Northwestern Telephone Company the long distance lines and local exchanges belonging to that corporation. Mr. Smith denies the published report that he was acting for H. E. Huntington, of California, in making these purchases. He says that extensive improvements will be made to the acquired properties.

SALT LAKE CITY, UTAH.—It is stated by the management of the Independent Telephone Company that by May 1 its system will be in operation in Salt Lake and Ogden and that by that time the company will have expended $1,000,000 on construction work. Buildings in both cities are now almost ready for occupancy. A switchboard which will accommodate 12,000 connections is being installed here. The plans of the company include the invasion of Idaho and Montana within the next year.

LYNCHBURG, VA.—The Southern Bell Telephone Company has applied for a new franchise at Lynchburg, and a warm fight is expected. A minority report of the Council committees has been made asking for lower rates.

LENA, WIS.—A telephone company with a capital stock of $4000 has been organized here. It was promoted by A. W. Larson, of Wausaukee, and it will be known as the Farmers' & Merchants' Telephone Company.

MONROE, WIS.—Prominent farmers of Adams and Washington townships are organizing a telephone company for the purpose of building a line out through the towns. E. Holcomb, F. Hefty and others are interested.

VERA CRUZ, MEX.—The Government of the State of Vera Cruz has granted a concession to A. Espinosa, of Vera Cruz, for the establishment of a complete telephone system here.

CITY OF MEXICO, MEX.—The Department of Communications and Public Works of the Mexican Government has ordered the construction of an extensive system of telephone lines in the Yaqui district, State of Sonora. It is proposed to connect every town and hamlet in that district with telephone communication. This action is taken in order that the movement of troops in pursuit of Yaqui Indian outlaws may be expedited and also to help in the settlement and development of that rich region. The Secretary of Communications and Public Works, City of Mexico, can give information in regard to the proposed work.

Electric Light and Power.

CLANTON, ALA.—J. P. Van Derveer has a franchise for an electric light and power plant. The details will be ready in a short time.

MENDOCINO, CAL.—The Mendocino Electric Light & Power Company has been formed by A. Brown, of Mendocino, and others, with a capital of $25,000. They have purchased the electric light plant at Mendocino and will furnish light to the coast towns.

SANTA CRUZ, CAL.—The Big Creek Power Company, of Santa Cruz, contemplates erecting an additional generating station at Chittenden from which it can supply light and power to Watsonville, Gilroy and Hollister, if satisfactory terms can be obtained. A steam plant will also probably be constructed.

GLENWOOD SPRINGS, COL.—The Colorado Power & Irrigation Company is making preparations to begin immediate work on a plant at the Shoshone Falls, on the Grand River, near here, as soon as the weather conditions will permit. It is estimated that the plant will have a capacity of about 20,000 horse-power, which will be a sufficient supply for this city, Leadville and a number of adjacent mining towns.

WOODBURY, CONN.—An electric light plant will probably be erected this spring, at a cost of $15,000, by the local company. E. S. Boyd is secretary.

THOMASTON, CONN.—The Thomaston Electric Light Company has decided to construct a new plant in the spring. The plant was destroyed by fire last fall.

SANDPOINT, IDAHO.—The Sandpoint Water & Light Company has been incorporated, with a capital of $50,000, by J. D. Sherwood, Wm. G. Malloy and B. C. Riblet, of Spokane, Wash., and L. D. Farmen, of Sandpoint.

GEORGETOWN, ILL.—W. C. Dukes and Edw. Cooley have secured a franchise for an electric light plant.

HARMON, ILL.—The citizens and the Village Board are considering the advisability of constructing an electric light plant.

QUINCY, ILL.—The City Council has appointed a committee to investigate the feasibility of constructing conduits and placing all wires underground in the business district of the city, contemplating a general system over the entire city, to be owned and controlled by the city, users to lease the same. Address F. C. Hancock, city engineer.

NORTH VERNON, IND.—The Town Council is taking steps to enlarge and improve the electric light plant.

JASPER, IND.—It is reported that the Town Council is preparing to contract for the construction of an electric lighting and power plant.

HOPE, IND.—The Hope Canning Company has incorporated to install an electric plant to light its factory and also to sell light and power to the citizens of the town of Hope.

NEWHAVEN, IND.—Bids will be received April 5 by the Board of Town Trustees for furnishing material and constructing a complete electric light plant. H. H. Schnelker is chairman.

ANDERSON, IND.—The municipal electric light plant of this city has been enlarged to a capacity for a city of 50,000 inhabitants. The commissioners have announced that on April 1 a 30 per cent. reduction will be made in the rates for electric light service. The maximum rate at this time is 10 cents per kilowatt and the minimum is 6 cents.

ELKHART, IND.—The Elkhart Electric Company and the Home Electric Light & Power Company, of this city, have merged and filed amended articles of incorporation with the Secretary of State. The capital stock of the former company is $100,000 and of the latter company $50,000. The name of the merged or united company is the Elkhart Electric Company, and the capital stock is increased to $250,000. The operation of the new company will be carried on in Elkhart and Elkhart County.

CORNING, IA.—A receiver has been appointed for the Corning Electric Company on the application of the Hanover National Bank, of New York, and the First National Bank, of Corning, who are creditors of the company.

UNIONTOWN, KY.—G. F. Cecil, of Springfield, Ky., has purchased the electric light plant, and will make improvements to the same.

BALTIMORE, MD.—It is stated that the Maryland Telephone & Telegraph Company will enter the electric lighting and electric power field. This move will bring it into direct competition with the United Electric Light & Power Company, which has heretofore had a monopoly in this line. The Electrical Commission has granted a permit to the telephone company to enter the subway conduits with wires for furnishing electric lights and power. President Webb, of the telephone company, states that the company has purchased the plant of Mr. J. H. Purnell for immediate use, and that plans are being prepared for a larger plant, to cost about $1,000,000. The United Electric Light & Power Company has protested against the granting of such conduit privileges to the Maryland Company.

GRAND RAPIDS, MICH.—The question of enlarging and improving the electric light plant, at a cost of about $11,000, is under consideration by the Council.

GRAND RAPIDS, MICH.—The Cascade Electric Company, of Grand Rapids, has been organized to construct a power house on Thornapple River and transmit electricity to this city; capital, $15,000. The company proposes to construct a dam at Cascade, which will raise the river 22 feet, and furnish 1000 horse-power. E. C. Follmer is president and E. A. Stowe secretary.

SOUTH STILLWATER, MINN.—B. L. Hanks, Recorder, writes that the citizens have voted to issue bonds for an electric lighting plant.

HELENA, MONT.—The Bow Power Company, which was recently incorporated in South Dakota, is reported to have in contemplation the construction of a dam across the Missouri River below Helena and the generation of electric power to be conveyed to Helena, Butte, Anaconda and other points. About $750,000 will be expended.

SODUS, N. Y.—The Town Board has granted the Sodus Gas & Electric Company a franchise for an electric light plant.

PENN YAN, N. Y.—N. S. Dailey, Village Clerk, writes that it was voted March 15 to issue $35,000 bonds for the construction of an electric light plant.

ROCHESTER, N. Y.—As a result of negotiations between Mayor Cutler and the Rochester Gas & Electric Company, the poles and wires on Monroe Avenue in this city will be removed and the wires run through underground conduits.

NEW YORK, N. Y.—A bill has been introduced in the Assembly at Albany to confer additional powers upon the Board of Aldermen of New York City. One of the most important of these powers is the permission to establish, build or equip telegraph, telephone or other alarm system or systems of communication for the police and fire departments and for the construction of subways and pipe galleries for the purpose of containing wire tubes, conductors, sewer pipes, gas or water pipes, and for other similar purposes. This would affect the Empire Subway Company, which has a monopoly in its line in New York City now.

ASHEVILLE, N. C.—Bids are wanted April 1 for constructing an electric light plant. B. M. Lee is City Engineer.

OXFORD, N. C.—The Town Commissioners have granted Mr. Ehert, of Watertown, Conn., a franchise for water works and an electric light plant.

KINSTON, N. C.—Bids will be received by N. J. Rouse, Mayor, April 18, for constructing water works, a sewerage system and an electric light system.

HICKORY, N. C.—K. C. Menzies has been appointed temporary receiver of the Thornton Light & Power Company, of Hickory. The liabilities include a complete city lighting plant valued at about $25,000.

MINOT, N. D.—It is stated that an extensive addition may be built to the electric light plant this spring.

BEDFORD, OHIO.—The People's Electric Light Company, of this place, has passed into the hands of E. E. Mandeville and Edwards Robert, of Philadelphia, who will make considerable improvement in the machinery and equipment of the plant.

PITTSBURG, PA.—The Allegheny County Light Company has secured the contract for lighting the city for one year at $96 per 2000-cp arc lamp; and $35 for 50-cp incandescents.

COLUMBIA, TENN.—The Board of Aldermen has authorized the street commssion to investigate the question of constructing an electric light plant.

HEMPSTEAD, TEX.—An electric light plant is to be installed here. W. P. Lipscomb can give information.

SALT LAKE CITY, UTAH.—The Council is investigating charges against the Utah Light & Railway Company, which is accused of using inferior meters, unsatisfactory service, and charging the city and citizens for lighting which was not furnished. A similar investigation was made a short time ago by the Commercial Club, but no definite action was taken.

NEWPORT NEWS, VA.—The Consumers' Light, Heat & Power Company, of Newport News, has been placed in the hands of a receiver, J. A. Willett being appointed as such. T. T. Thompson, one of the largest stockholders, applied for the receivership, claiming that the business was not on a paying basis.

RICHLAND CENTER, WIS.—It is reported that the city will construct an electric light plant, at a cost of $20,000.

NEENAH, WIS.—The City Council has granted the Wisconsin Traction, Light, Heat & Power Company a 10-year franchise for lighting the city.

MARSHFIELD, WIS.—The City Council has come to an agreement with the Marshfield Water, Electric Light & Power Company, whereby the city is to buy the electric light and water plant at $150,400.

KEWAUNEE, WIS.—The question of issuing bonds for a new electric light plant and water works will be submitted to the people at the coming spring election. At the same time the question of municipal or private ownership will also be voted upon.

HAVANA, CUBA.—In consequence of the extension of the plans for the construction of the Cienfuegos, Palmira & Cruces Electric Power & Railway Company's system, bids for the work on the modified plans will be readvertised, to be received about June 15.

WHITBY, ONT.—Bids are wanted April 4 for $15,000 electric light and $50,000 water works bonds. Jos. White is Town Treasurer.

TORONTO, ONT.—The Electric Development Company, of Ontario, has made public some of its plans for transmitting power from Niagara Falls to Toronto. As a start, 50,000 horse-power will be transmitted. The company has a private right of way, and, in place of wooden poles to support the wires, galvanized steel towers will be used. These towers will be 400 feet apart and the west cross arm will be 45 feet high. There will be four circuits, so that in case of any accident to one of the circuits, three others will be available. The voltage on the line will be 60,000 volts. There will be a transformer house at Niagara Falls, at which the voltage will be stepped up, and another at Toronto where it will be stepped down to the voltage commercially in use. The works at Niagara are proceeding very rapidly and about 450 feet of the main tunnel has been excavated. The coffer dam is practically completed and the work on the wheel pit is progressing very rapidly. It is expected that the excavation of the pit will be completed about the first part of August next. The transformer houses will also be erected this season.

OTTAWA, ONT.—It is announced that one of the Canadian Pacific Railway Company's interesting changes, now in progress in the west, is the new stage reached in the work on the $500,000 power improvement to the company's facilities at Fort William, Ont. The motive, light and heating power is all to be changed to electricity. The work of installing the machinery in the new power house has just begun, and is proceeding apace. The power house is now complete with the exception of the machinery. The plant, when finished, will be capable of developing 3000 horse-power, which will be distributed over all the operations of the Canadian Pacific at Fort William, including the lighting systems, operation of the elevators, water works and machine shops.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has bought a piece of property near its power house, so as to enlarge the plant. Several new boilers, a 60-cycle, three-phase, 2300-volt alternator and a new direct-current, 1600-kw, 575-volt generator will be installed.

OAKLAND, CAL.—The San Francisco, Oakland & San Jose Railroad Company, operating the Key Route, is preparing to erect new shops and enlarge the power station capacity. Eight-car trains are frequently operated on this line.

DENVER, COL.—General Manager C. W. Sells, of the Manitou & Pike's Peak Cog Road, announces that after this year the road will be operated by electricity. The work of changing the motive power from steam to electricity will cost approximately $200,000.

LOVELAND, COL.—It is said that W. A. Riley, who constructed the Loveland-Estes Park road, has under consideration a plan to build an electric railway on the road. Mr. Riley, it seems, built the road for the county at a cost of $18,000, and it is said that they would grant him a franchise over it for a like amount.

GLENWOOD SPRINGS, COL.—Albert C. Johnson, who says he represents considerable southern capital, has been here looking into the feasibility of building an electric railway from Glenwood Springs to Mt. Sopris, 12 miles south, and has incidentally looked into the practicability of building a similar line over the mountains to Trapper's Lake, about 25 miles north.

LEADVILLE, COL.—The Leadville-Denver Mining, Tunnel & Tramway Company has voted to issue $500,000 worth of bonds for the purpose of building an electric railway from Leadville 6 miles to a point where a tunnel will pierce the mountains for half a mile. This new electric road will cost, with its equipments, $260,000, and will be a connecting line for the steam railroads between Denver and Leadville. It will cut down the distance between the two points mentioned 175 miles by the Denver & Rio Grande Railroad and 40 miles by the Colorado & Southern Railroad. The new line will be equipped for carrying both freight and passengers. The officers of the company are: James A. Shinn, president; Alfred C. Phelps, vice-president; Byron Tifft, secretary. The company is incorporated for $2,000,000.

HARTFORD, CONN.—The board of directors of the Danbury & Harlem Traction Company has elected D. E. Leowe, of Danbury, president; Stephen B. Quick, of North Salem, vice-president; J. N. Cronley, of New York, secretary; Phillip Simon, of Danbury, treasurer. Technical difficulties arising from a transfer of control of the corporation resulted in a cessation of construction work, but it is expected that operations will be resumed this spring.

HILLSBORO, ILL.—Application for incorporation has been made to the Secretary of State for the Hillsboro Electric Railway Company.

CHICAGO, ILL.—Fire recently destroyed the Blue Island Avenue barns of the Union Traction Company. Six hundred cars burned and the building was totally destroyed. The loss will be about $300,000.

SPRINGFIELD, ILL.—Articles of incorporation for the Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company, with a capital stock of $50,000, have been filed. The principal offices will be located at Bloomington. The incorporators are: Lafayette Funk, of Shirley; D. W. Hart, of Lincoln; A. G. Kingman, of Peoria; J. F. Prather, of Williamsville, and Logan Hay, of Springfield. The board of directors is composed of S. E. Prather, Lafayette Funk, F. W. Aldrich, W. H. Evans, A. G. Kingman and J. W. Hoblit.

INDIANAPOLIS, IND.—The French Lick & West Baden Electric Railway Company has increased its capital stock to $50,000.

COVINGTON, IND.—The Fountain & Warren Traction Company, which plans to build an interurban railroad from Covington east to Lafayette and west to Danville, Ill., is stated to have financed its project, to have made all arrangements for building the line and to have awarded equipment contracts.

KOKOMO, IND.—New officers and directors have been chosen at a meeting of the Kokomo, Marion & Western Traction Company. They are as follows: George J. Marott, of Indianapolis, president; L. J. Kirkpatrick, of Kokomo, vice-president; F. C. McReynolds, of Kokomo, secretary and treasurer; Lee Hall, of Marion, superintendent of construction. It has been decided to proceed at once to extend the line as far east as Bluffton and west to Lafayette and Lebanon the coming season.

INDIANAPOLIS, IND.—The Interstate Traction Railway Company, composed of Ohio capitalists, has filed articles of incorporation with the Secretary of State. The company will build between Dayton, Ohio, and Indianapolis. The road will be 120 miles long. The capital stock of the concern is $50,000. The principal offices of the company will be at Liberty, Ind. The incorporators are: John D. Boroff and W. H. Heinz, of Dayton; E. R. Phillips, of New Carlisle, O., and B. A. Landis, of Camden, O.

LANSING, MICH.—The Indiana & Michigan Electric Company is reported to have been organized in Trenton, N. J., with a capital stock of $2,000,000, for the purpose of furnishing light and power and operating electric railway lines in the states named. The incorporators of the company are: G. W. Flaacke, Jr., H. Hobart Porter, Jr., and Francis Blossom, of Jersey City.

GRAND RAPIDS, MICH.—The Grand Rapids & Ionia Railway Company, Ionia & Owosso Railway Company and the Jackson & Lansing Railway Company are all owned and controlled by the same interests. They will build lines from Grand Rapids to Ionia, from Ionia to Owosso and from Jackson to Lansing, 33 miles, 45 miles and 37 miles long, respectively. No contracts for building any of the lines have been let. The office address of the companies is 1114-17 Majestic Building, Detroit.

LANSING, MICH.—The Lansing & Suburban Traction Company has been incorporated under the street railway law of Michigan, with a capital stock of $1,000,000, for the purpose of taking over the property of the Lansing City Electric Railway, the Lansing, St. Johns & St. Louis Railway, and building a proposed extension from Lansing to Pine Lake, a resort about 10 miles from the city of Lansing. The stockholders of the company are: Nelson Miles and Myron W. Mills, of Maysville; George G. Moore, of Port Huron, and James H. Elliott, of Lansing. James H. Elliott, the present manager of the Lansing Street Railway Company, will, it is understood, be the managing director of the new company.

MAGNOLIA, MISS.—S. E. Shilling and associates are having a line surveyed from Magnolia, through Fernwood, McComb City and Summit, 12 miles, with a view of constructing an electric railway.

JACKSON, MISS.—The Senate has passed the House "Jim Crow" street car bill, which provides that street car companies shall provide separate compartments for whites and blacks.

ST. JOSEPH, MO.—Mrs. Anna Butler, of Des Moines, Ia., representing New York and Cleveland capitalists, who are promoting an electric railway between St. Joseph and Kansas City, and also a new line north of St. Joseph toward the Iowa line, is planning to go before the local Council in behalf of the interests she represents with an application for a street railway franchise.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company plans to dispose of $2,000,000 of bonds when market conditions are favorable, so as to pay for improvements to the property last year and to provide for improvements to be made this year. A new power house, to cost about $500,000, is now under construction, and a number of important extensions of the company's lines have recently been made. The plans of this year provide for carrying out the general improvements begun last year and for building a number of important new lines.

MORRISTOWN, N. J.—The Morris County Traction Company plans to begin the construction of its proposed road Aug. 1. All contracts for building the line and furnishing the equipment have been let. The line will run from Dover to Morristown, Summit and Elizabeth. Power will be hired. Robert D. Foote is president; F. H. Alleman, secretary and manager.

NEW YORK, N. Y.—The New York City Railway Company, of Manhattan, and the Brooklyn Rapid Transit Company, have agreed to co-operate in operating cars over the new Williamsburg bridge. The effect of the agreement is that the two companies will each use two of the six tracks on the bridge for the carrying of their passengers to the opposite bridge terminal, while the remaining two tracks will be used for the running of shuttle bridge cars. The power for these shuttle cars will be supplied by the two companies. Terms satisfacotry to the two companies are yet to be fixed by the Bridge Commission.

NEW YORK, N. Y.—In a circular issued by the Municipal Art Society still another plan for the relief of the traffic congestion on the Brooklyn Bridge is suggested. The idea is to make a loop on Manhattan Island for the tracks now running over the bridge. It is suggested that the north or Manhattan tracks be continued by a curve to the north in descending to a subway at Reade and Elm Streets, and thence passed under the present subway and across under Reade Street to West Street, under West to Liberty, under Liberty to Broadway, under the subway in Broadway, and continuing east to Nassau, under Nassau Street and the east side of Park Row back to and over the Brooklyn Bridge as its southern track. New stations are proposed at Reade Street and Broadway, Reade Street and West Broadway, West and Warren, West and Fulton, West and Liberty and Liberty and Nassau Streets.

OKLAHOMA CITY, O. T.—The latest in interurban electric railway projects here is a plan to build a line to connect Oklahoma City, Lawton, Norman, Shawnee, El Reno and Chickasha. Pennsylvania capitalists, among whom are H. E. Ahrens, of Reading, and J. H. McDonald, of Reedsville, are said to be interested.

KANE, PA.—Another effort is being made to organize a company to build an electric railway connecting Kane, Johnsonburg, Ridgway and St. Mary's.

PUNXSUTAWNEY, PA.—The Jefferson Traction Company has completed securing right of way for an extension of the Punxsutawney & Reynoldsville line from the latter place to Sykesville, a distance of about 6 miles. Work on the extension will be begun as soon as the weather permits. The Jefferson Company has an agreement with the DuBois Traction Company to build a line from that place, which will connect with the Reynoldsville & Sykesville line at the latter place. The DuBois Company will also begin the work of constructing this spring. The Sykesville and DuBois division will be about 9 miles in length.

POWNAL, VT.—The Selectmen of Pownal have granted a franchise to the Bennington & North Adams Street Railway Company for the construction of a line through that town. The company desires to build from Williamstown through the town of Pownal to the Bennington line.

RICHMOND, VA.—The Seaboard Traction Company has been chartered, with a capital of $250,000, to build an electric railway from Richmond to Portsmouth. The principal offices will be at Suffolk, Va. The officers are as follows: L. R. Britt, president; W. H. Robinson, of Norfolk, first vice-president; W. D. Southall, treasurer; Geo. H. Lewis, of Norfolk, general manager; Lee Britt, of Suffolk, secretary and auditor. The line will open a quick outlet for the great trucking interests of eastern Virginia. Power houses will be erected, and part of the power may be secured from the new Appomattox River plant at Petersburg. The charter provides that work shall begin at once. The capital stock may be raised to $800,000.

CHIPPEWA FALLS, WIS.—The Chippewa Valley Electric Railway Company has mortgaged its property for $750,000 to the Security Trust Company, Camden, N. J. Of the sum, $250,000 will be used for building new lines.

MONTREAL, QUE.—Notice is given that application will be made to the Parliament of Canada at the next session for an act to incorporate the Canadian Traction & Power Company, with power to construct a railway from a point in or near the city of Montreal to a point in or near the city of Ottawa, with branch lines. Louis Boyer, of Montreal, is solicitor for the applicants.

NEW INDUSTRIAL COMPANIES.

THE CITIZENS' ELECTRIC COMPANY, of Amsterdam, N. Y., has been incorporated; capital, $50,000. Directors: W. W. Dickson, M. G. Walsh and G. C. Stewart, Amsterdam.

THE NEW YORK & PENNSYLVANIA RAILWAY (reorganized) has been incorporated; capital, $570,000. Directors: F. A. Cobb and Howard Cobb, Ithaca, and H. M. Cook, Hornellsville.

THE EDGERTON ELECTRIC MOTOR MANUFACTURING COMPANY, of Philadelphia, has changed its name to Dialt Motor Company and increased its capital stock from $300,000 to $1,250,000.

THE SWITCHBOARD MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $15,000. The directors are: August Schraam, Louis Freund and Ernst Ohnell.

THE STUDEBAKER AUTOMOBILE COMPANY, South Bend, Ind., has filed articles of incorporation with the Secretary of State. The capital stock is $100,000. The company will manufacture and sell automobiles.

THE REPUBLIC BUILDING COMPANY has been organized in Cleveland, O., with a capital stock of $500,000. The purpose of the company is to erect a 10-story power building for light manufacturing concerns.

THE ROBBINS ELECTRIC COMPANY has been incorporated at Washington, D. C., with a capital stock of $150,000, the names of the incorporators being H. Clay Campbell, Charles Embrey and Ralph E. Campbell.

THE RIO DE JANEIRO TRAMWAY, LIGHT & POWER COMPANY has been incorporated in Jersey City; capital, $200,000. Incorporators: Horace S. Gould, Otho S. Lee, Edgar E. McWhinnery and Charles A. McCredy.

THE GLOBE ELECTRIC COMPANY has filed incorporation papers at Camden, N. J. Its purpose is to deal in and sell electrical machinery. The capital is $100,000. The incorporators are Henry S. Riebenack, W. C. L. Eglin and James E. Hays.

THE WARREN & JAMESTOWN STREET RAILROAD COMPANY (merger and reorganization) has been formed at Jamestown, N. Y.; capital, $200,000. Directors: David M. Siggins and H. M. Preston, Warren, Pa., and C. H. Clifford, Jamestown.

THE ELECTRIC SUPPLY COMPANY has been chartered at Savannah, Ga., with a capital stock of $25,000, with the privilege of increasing to $100,000. The purpose of the company is to carry on a general electrical supply and repair business with headquarters at Savannah.

THE ELECTRIC BLOCK RAILWAY SIGNAL CORPORATION has filed incorporation papers at Augusta, Me., with a capital stock of $10,000. The officers are: President, F. C. Robinson, Farmington, Me.; treasurer, W. H. Cook, Farmington, Me.; director, E. H. Whitney, Farmington, Me.

THE EASTERN ILLINOIS TRACTION COMPANY has been incorporated at Mattoon, Ill., with $5000 capital. The road will run from Mattoon, Coles County, to Champaign, Champaign County. E. A. Potter, of the American Trust & Savings Bank, Chicago, is one of the incorporators.

THE INDIANA & MICHIGAN ELECTRIC COMPANY has been incorporated in Jersey City; capital, $2,000,000. Incorporators: George W. Flaack, Jr., H. Hobart Porter, Francis Blossom, Herman L. Crawford, Lyman J. Dwyer, Frederick P. Delafield, Frederick W. Longfellow, Henry C. Colwell and Harold S. McKee.

LEGAL.

TO REORGANIZE.—The business of Robert L. McOuat, wholesale dealer in electrical supplies at 125 S. Meridian Street, Indianapolis, Ind., has been turned over to A. F. Potts, as trustee, for reorganization. The trustee will continue the business until the new company takes charge.

LANGE LAMP SOCKET PATENT SUSTAINED.—The Lange patent on the present method of fastening together the cap, shell and insulation of incandescent sockets has been sustained in a decision of the United States Circuit Court of Appeals of the Third Circuit. The present owners of the Lange patent are the Bryant Electric Company.

THE W. H. SMITH COMPANY, Indianapolis, Ind., dealer in electrical supplies and power equipment, has been placed in the hands of a receiver—Mr. George B. Elliott—on the petition of the Gillmore Electric Company, of South Boston, Mass. The prolonged illness of President W. H. Smith is given as the reason for the concern's embarrassment.

COMPETING TELEPHONE LINES.—The Supreme Court of Iowa has held that where neither of two telephone companies had the exclusive right to string its wires along a particular side of a street or highway, it was proper for the court to require that their wires should be constructed a sufficient distance fom each other so that the use of one would not unreasonably interfere with the use of the other.

INDIANAPOLIS, IND.—A suit has been filed here asking for a receiver for the Edwards Railroad & Electric Light Company. The company was incorporated under the laws of Indiana and has its business office in Chicago and its factory in Ohio. The company was organized to manufacture and repair steam engines, electric dynamos, electric arc lights, etc. The complaint charges that the company has violated the corporation laws of the three States; also mismanagement.

ERECTING POLE LINE.—The Supreme Court of Pennsylvania, in the suit of the city of New Castle, Pa., vs. the Central District and Printing Telegraph Company, decided as follows: 1. A city may provide by reasonable regulations for the use of its streets by a telegraph or telephone company. 2. An ordinance that a telephone company may apply to the council to have its poles located, and that the council may designate the location of each pole, or authorize the street committee or the city engineer to make the location, is not invalid, as preventing the company from erecting poles in any street in the city, or impairing its right to so do. 3. A city ordinance required that telephone poles should be located under the approval of the city engineer, and under his supervision. A mere verbal approval by the engineer of a general plan showing the place where the poles were to be erected does not authorize their erection at the points designated without further supervision by the city engineer.

LEBANON, IND.—Judge Artman, of the Boone Circuit Court, has rendered a decision of great importance to the telephone men in Indiana. There are two telephone companies in Thorntown, and one in Lebanon. The cities are 16 miles apart. The Lebanon Telephone Company entered into a contract with the Thorntown Independent Company whereby the latter was to be granted exclusive service between Thorntown and Lebanon. Then the Thorntown Co-operative Company applied for admission to the Lebanon Company's switchboard, but was refused because of the contract with the other company. The Co-operative Company then applied for a writ of mandate to compel the Lebanon Company to admit it to its switchboard, alleging that the Lebanon Company was a common carrier and could not discriminate against companies. In making up the issues of the case two months ago, Judge Artman held that if the allegations in the complaint were true the Lebanon Company was a common carrier, and as such would be bound to grant connection to all companies seeking admission. However, the case went to treat on the question of facts, and after taking the matter under advisement for two months Judge Artman rendered a special finding holding that the allegations in the complaint were not sustained; that it had not been established that the Lebanon Telephone Company was a common carrier, and for these reasons his decision must be for the defendant and the petition dismissed. The case will be appealed to the Supreme Court.

DUTY AS TO BROKEN WIRE. On the appeal in the case of a man who had been killed by contact with a broken wire of an electric light company in a storm, the Supreme Court of Louisiana has ruled as follows: A wire of an electrical company, detached from the poles and lying in the streets of a town, is, of course, out of place, and those having control of it and charged with the legal duty of taking due care of it have the burden of accounting for its being found in that condition and situation (Maus vs. Broderick, 25 South. 977, 51 La. Ann. 1153), and to show that it was not due to its negligence. It is the absolute duty of an electric light company conveying electricity by overhead wires strung through the streets of a city to keep its wires constantly insulated so as to be prepared to guard against the effect of objects coming in contact with them regardless of the facts and causes which may bring about the contact. The fact that a telephone company may have strung its wires above those of the electric light company already in position, and should have taken no steps to guard against the coming in contact of the wires of the two companies at the crossing points, and that in stringing its wires it did so negligently and loosely that one of its wires fell, in a storm, upon an uninsulated wire below, causing it to burn and fall on the street, is no excuse to the electric company in not having performed its own duty of additional and special precautions in the premises. A fault on the part of the telephone company did not relieve it from the consequence of its own fault. The falling of the telephone wire on the wire below would have been attended with no disaster but for the uninsulated condition of the latter, and that condition is to be attributed as the proximate cause of the death of the husband and father of the plaintiffs.

ORDINANCES FOR LIGHTING.—In an action by J. Le Feber, et al, against the Northwestern Heat, Light & Power Company, et al, as to a franchise granted, the Supreme Court of Wisconsin has reversed a judgment for the defendants. The place was West Allis, Wis., and the ordinance was assailed as unreasonable. The Supreme Court's views are: 1. Though the discretion of municipal corporations in the exercise of the powers conferred upon them by the Legislature will be given a broad scope and accorded great deference by the courts, nevertheless that power must be exercisd for public purposes and, if an ordinance be so remote from such purposes that no relation thereto can be discovered, it will be held unauthorized and invalid. 2. A village ordinance granted to a certain company the exclusive right to furnish lights for the city and its inhabitants for a period of 30 years, and if, within a period of four months immediately preceding the expiration of the 30 years, the city should fail to make arrangements to purchase the plant, then for an additional period of 20 years. The village was located within a few miles of a large city, and had come into existence because of the location there of large manufacturing establishments. The electric street car lines from the city had been extended to the village at the time the ordinance was passed. The prices which the ordinance authorized the company to charge for the various kinds of light which it was to furnish were from 30 to 75 per cent. in excess of those paid elsewhere under similar circumstances, the greatest excess being upon the only variety of lights which the company could be compelled to furnish. The contract contained no provisions by which the village could compel the company to extend its gas mains or electric wires or to furnish any other than gasoline lights. It was provided that the company should commence active work within five months from the time the ordinance was accepted, but there was no provision as to when such work should be completed. The village had sufficient inhabitants to make it a city, though the fact could not be established until a State census was taken; and Rev. St. 1898, Sec. 925-52, subd. 34, provides that cities shall not make lighting contracts for a longer period than 10 years. Held, that the ordinance was void for unreasonableness. 3. The grounds of the invalidity of the ordinance so permeated the whole, and were so interdependent, that the unreasonable and illegal features could not be eliminated so as to allow the remainder to stand. 4. The fact that a village ordinance has been submitted to a popular vote and assented to by a majority of the electors of the village does not prevent it from being held void as unreasonable.

PERSONAL.

ARTHUR WARREN.

MR. ARTHUR WARREN.—In enlarging extensively its sphere of operations, the Allis-Chalmers Company has found it desirable to increase the scope of its Publishing Department, and it has been fortunate enough to secure the services of Mr. Arthur Warren, whose work in the field of technical journalism and whose success as what one may perhaps call a "publicity promoter" is too well known to everyone in the electrical field to need dwelling upon. Mr. Warren is a Bostonian with remarkable qualifications for the work to which he has of late devoted himself. Coming of a family of considerable mechanical aptitude and distinction, he prepared himself for the technical side of his work by actual machine shop practice. After this he began to travel, and while traveling wrote about things which he saw. The transition to journalism was easy, and in 1883 Mr. Warren joined the staff of the *Boston Herald*, then as now one of the most influential journals in the country. With this newspaper he remained for 14 years, becoming its leading special article writer and discussing not only economic topics, but venturing into the fields of biography and of dramatic and literary criticism. Meantime Mr. Warren took up other editorial work and was assistant editor of the *Beacon*, a well-known Boston weekly, and from 1886 to 1888 editor of the *Boston Home Journal*. In December, 1888, Mr. Warren was sent abroad by the *Boston Herald* as its London correspondent, in which capacity he served it most efficiently for some nine years, besides writing for a number of other American and British publications. His London home, which he still retains, was thus for many years a charming center of social and literary intercourse, in which many famous Americans and Europeans participated. In November, 1897, Mr. Warren returned to the United States at the invitation of Mr. George Westinghouse, a man quick to recognize the talent suited to carry out important new plans; and he immediately proceeded to organize the Westinghouse Publication Bureau, whose record of solid achievement in the way of publicity of the best kind as to articles, pamphlets, advertising and the diplomatic aspects, has certainly never been surpassed. In February of this year, his work in that connection both in this country and in England being practically completed along the original lines laid down, Mr. Warren resigned. He has been actively engaged since then in this city on literary work of all kinds for the leading magazines and newspapers, and had planned to sail for Europe on March 12, when he was invited by the executive of the Allis-Chalmers Company to become manager of publicity for that corporation under its new regime. The field of available talent had been thoroughly looked over, and it was felt that by training and experience Mr. Warren was the man for the very important post. Mr. Warren has accepted the offer, and has already taken up his new duties. While he may himself entertain regrets at not following up the purely literary work offered him in really embarrassing abundance, it is a matter of congratulation that he will devote his time and energies to the publicity side of one of the greatest and most comprehensive mechanical enterprises in the United States.

MR. M. L. MORA, of the General Electric Company, is in Cuba. He is expected back in a week or ten days.

MR. W. K. PALMER, the well-known consulting mechanical and electrical engineer in Kansas City, has moved his office to 402 Lyceum Building.

MR. JAMES BLAKE CAHOON, electrical and hydraulic engineer, has removed his offices to suite 1725-6, in the new building, 42 Broadway, New York.

MR. W. MURRAY CRANE has been elected a member of the board of the Western Telephone & Telegraph Company, to succeed the late J. Malcolm Forbes.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company of Ampere, N. J., has sailed this week for Europe, and will be gone for some six weeks on the trip.

MR. H. K. WOOD, of the Hartford Time Switch Company, Hartford, Conn., was in New York for a day or two last week. On this occasion he arranged with F. H. Lovell & Co. to represent his switch and his company in New York City.

MR. T. A. EDISON.—The report has been so widely circulated that he was going to London in May, that Mr. Edison, now on his plantation in Florida, has felt compelled to make a flat contradiction of the rumor sent over by cable.

MR. HAROLD D. PATTERSON, formerly superintendent for Mr. Max Osterberg, has become connected with the United States Battery Company of New Rochelle, N. Y., in the capacity of electrical engineer, and has assumed his new duties.

MR. H. C. TUNNELL.—The Lincoln Electric Company, of Cleveland, O., announces that its New York representative is Mr. H. C. Tunnell, 65 Bank Street, Newark, N. J. The Lincoln Company has manufactured dynamos and motors for some years past.

MR. CORNELIUS C. VERMEULE, 203 Broadway, is back from Cuba, where he recently went in connection with the construction of the Cienfuegos, Palmira and Crucas Electric Power and Railway Company, of which concern he is the consulting engineer.

MR. D. J. BURNS, of the Ward Leonard Electric Company, Bronxville, New York, recently arrived in New York after an extensive trip in the West and Southwest. He reports that business conditions in general are good, while they are excellent with respect to the affairs of his company.

MR. G. H. MUNROE.—New York newspaper men and special representatives of the leading newspapers out of the city were entertained at dinner at the Waldorf-Astoria on March 14 by George H. Munroe, of the banking firm of Munroe & Munroe, who managed the underwriting of the Marconi company.

MR. W. S. TURNER, manager and engineer at Auckland, New Zealand, for the British firm of J. G. White & Co., for some time past, has returned to New York after staying also some months in London. While in New Zealand Mr. Turner superintended the construction of a fine street railway system for Auckland.

MR. CHARLES M. SWIFT, of Detroit, Mich., who is president of the Manila Railway, Light and Power Company, has gone on a trip to the Philippines to inspect the progress made in the construction of the company's system, the contract for which is being carried out by J. G. White & Co., of New York City.

MARKS—VAN PRAAG.—The marriage took place on March 15, of Mr. Louis Benedict Marks, of New York City, to Miss Sadie Van Praag, daughter of Mr. and Mrs. Leon A. Van Praag. The happy pair are now on their honeymoon. Since perfecting his work on the enclosed arc, Mr. Marks has been practicing as a consulting electrical engineer.

MR. RAY D. LILLIBRIDGE, who has been making a two months' trip through the West, visiting particularly the power transmission plants of the Pacific coast and Colorado, has just returned home to New York much benefitted by the change. In behalf of the Stanley Company Mr. Lillibridge has prepared and issued some most interesting technical literature as to power transmission plants on the Pacific Slope.

MR. ARVID REUTERDAHL is the author of two recent pamphlets, one of which is entitled "The Radioactive Atom," and the other "Electrolysis According to the Energonic Hypothesis." In the former of these Mr. Reuterdahl develops a new and radical theory of the constitution of matter and the role of energy. The latter presents criticisms against the accepted theory of electrolytic dissociation, and offers a substitute based upon a new bypothesis concerning the ultimate constitution of matter.

MR. J. H. HALLBERG has severed his connection with the Cincinnati Gas & Electric Company. Less than a year ago, he took charge of the Cincinnati system, one of the largest in Ohio and in the country, as general superintendent of the electrical department. He reorganized the station, increased the output of the plant, straightened out the system of feeders, increased the economy of operation and obtained the respect and admiration of all who came in contact with him, for his ability and honesty of purpose. At the last meeting of the Cincinnati chapter of the American Institute of Electrical Engineers, he was elected vice-chairman. Mr. Hallberg, who resigned last week, intends to leave Cincinnati, it is said.

MR. C. O. BAKER, JR., for so many years the popular and efficient master of transportation for the National Electric Light Association, has resigned from that position. Mr. Baker expects to be in Europe at the time of the Boston meeting, to be held May 24-27 next, and feels that he should not continue in the office unless he can personally attend to the duties connected with it. President Edgar has appointed Mr. George F. Porter to succeed Mr. Baker. Mr. Porter had charge of transportation matters before he became secretary of the association, and organized special trains for the Philadelphia convention, February, 1887, the Chicago convention, February, 1889, and the Kansas City meeting, February, 1890. During the ten years that he was secretary, he had more or less to do with transportation arrangements, and being very popular with the railroad people as well as with the delegates to conventions, his appointment is another instance of President Edgar's good judgment in the selection of willing men to work for the welfare of the association.

MR. PHILETUS W. GATES and Mr. Henry W. Hoyt, respectively general superintendent and second vice-president of Allis-Chalmers Company, are about to retire from active participation in the management of that company. Mr. Gates was president and Mr. Hoyt secretary and general manager of Gates Iron Works for fifteen years prior to the incorporation of Allis-Chalmers Company in 1901. They have been prominently connected with the manufacturing interests of Chicago and have taken an active part in all of the manufacturers' associations. The late P. W. Gates (father of Philetus W. Gates) was the pioneer manufacturer of Chicago and the region west of the Alleghenies, having established his business in 1842. From 1861 to 1871, the Eagle Works Manufacturing Company, of which he was president, employed about one thousand men, and in those days was a noteworthy industry. In 1871 the Eagle Works Manufacturing Company went out of existence and from it were organized Gates Iron Works and Fraser & Chalmers, each taking a portion of the business. Both of these companies in turn were taken over by Allis-Chalmers Company in 1901. Messrs. Hoyt and Gates, after a well-earned vacation spent in traveling, will re-engage in business in Chicago.

COMMANDER B. A. FISKE, U. S. N.—In the first edition of the "Text Book of Ordnance and Gunnery," prepared by Lieut. Commander W. F. Fullam and Lieut. T. C. Hart, U. S. N., for the use of midshipmen at the Naval Academy, a very brief reference was made to the history of the telescope sight, and the first of a series of patents, made by Lieut. (now Commander) Bradley A. Fiske, U. S. N., in 1890, was mentioned. Commander Fiske is widely known in electrical circles. It is with a view to giving well deserved credit to Commander Fiske for originating, and for persisting in the advocacy of the telescope sight for naval guns, that the following note (addendum) has now been inserted in the "Text Book of Ordnance and Gunnery:" "Addendum: Par. 7, page 233, Text Book of Ordnance and Gunnery, 1903, 'The Telescope Sight.' It is but just to Lieutenant (now Commander) Fiske to state that to him belongs the credit for first demonstrating the fundamental advantages of this type of sight over all kinds of open sights for naval use. Following the patent of 1890, he obtained four patents between 1891 and 1895 in which he provided for attaching the telescope to the gun sleeve and for making compensation for drift and speed; and he proved the practicability of using this form of sight for naval guns by official tests at sea during the years 1892, 1893 and 1894. The Bureau of Ordnance of the U. S. Navy was the first to recognize the value of this invention; and it is plain that the essential principles of the latest type of naval telescope sight do not differ from those covered by Lieutenant Fiske's patents, which were embodied in his original instruments."

EDUCATIONAL.

DELAWARE COLLEGE, DEL.—The Department of Mechanical and Electrical Engineering has during the past few weeks added to its equipment in the dynamo laboratory some useful apparatus. This has been given through the interest in the electrical work at Delaware College of certain manufacturing companies, principally the Baldwin Locomotive Works, of Philadelphia; the Joseph Bancroft & Sons Company, Rockford, Wilmington, and the E. I. Dupont de Nemours & Company, Wilmington. This apparatus includes one 5 horse-power continuous-current shunt-wound motor from the first of the above companies and two small motors and a voltmeter from the Bancroft works. The larger part, however, comes through the courtesy of Mr. Alfred Du Pont, namely, one 2 horse-power direct-curent motor, two transformers, complete patterns for an alternator of 40-kw capacity, four La Roche meters and one Queen & Company ammeter. The department has also recently received from the Navy Yard, New York, a standardized 32-cp lamp for accurate testing with the photometer, and a hydraulic ram from the Gould's Manufacturing Company, Seneca Falls, N. Y. The apparatus for the dynamo laboratory, while not for the most part of the latest designs, will however enable work under Prof. A. J. Wood to be carried on much more successfully than it could without this additional equipment.

Trade Notes.

THE POLICE TELEPHONE & SIGNAL COMPANY, of Chicago, has changed its name to Chicago Fire Alarm Company.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, O., will supply the storage batteries for the electric launches at the St. Louis World's Fair.

OIL FILTERS FOR FRANCE.—A cable order from Paris, France, for a large shipment of Cross oil filters has been received by the Burt Manufacturing Company.

THE HERTNER ELECTRIC COMPANY, Cleveland, O., has closed a contract for some special motors for the operation of electric launches at the St. Louis Fair.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., has just completed the installation of common battery equipments at Gainesville, Tex.; Denton, Tex.; Springfield, Ohio, and Elyria, Ohio. It reports a good demand for this class of work for the coming year.

STORAGE BATTERIES FOR RAILWAY PLANTS.—The Electric Storage Battery Company, Philadelphia, devotes its Bulletin No. 81 to a description of the installation of Chloride accumulators for the San Francisco, Oakland & San Jose Railway Company. The plant is well illustrated.

THE H. O. S. ENGINEERING COMPANY, 88 Warren Street, New York, is sending out to the trade its bulletin No. 41, relating to covers for "H. O. S." panelboard cabinets. Three styles of these covers are illustrated and general data as to cabinets and covers are given. Tabulated price lists and code words are also included.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, of Niles, O., has opened a New York office at 19 Park Row with Mr. J. Rice, general sales manager in charge. Stock will be carried for quick delivery and partict.. r attention given to pushing the Standard Company's latest additions to its lines—the 3¾-inch frosted bulb reflector lamp.

RAILROAD BONDED INDEBTEDNESS.—Poor's Railroad Manual Company, New York, has issued a supplement to its Manual of Railroads, giving a great deal of information about railway bonded indebtedness. It contains all important facts required by investors, bankers and others relative to the financial status of the leading railway systems in the United States.

"GOOD MOTIVES" is the title of a little double-fold pamphlet of recent issue by the Peerless Electric Company, Warren, O. The subject is Peerless motors, and the illustrations show motors of different sizes, and motors coupled, either by belt or gearing, to machine tools of various kinds. The text matter is an interesting argument in favor of the "Peerless" machines. The company's fan motors, transformers and lamps are also well known to the trade.

PHOSPHOR-BRONZE.—Price list No. 22 of "Elephant Brand" phosphor-bronze has been issued by the Phosphor-Bronze Smelting Company, Ltd., 2200 Washington Avenue, Philadelphia, Pa. It is replete with information regarding phosphor-bronze in rolls and sheets, wire, rods, wire rope, ingots, castings, etc. The company's new rolling mill is now in successful operation. The company carries on hand a well-assorted stock of manufactured goods for prompt supply.

THE EAGER ELECTRIC COMPANY, Watertown, N. Y., has issued a neat catalogue on the subject of its direct-current generators and motors for lighting and power. The generators are of the direct-connected or belted types. The company also makes motor generators, plating dynamos and boosters. These machines are of excellent design and are illustrated. The catalogue gives complete information and data regarding the various types of machines produced by the company.

McLEOD, WARD & COMPANY, 27 Thames Street, New York, in a little pamphlet admonish the readers thereof to save their eyes. While the admonition is quite justifiable these strenuous days, the pamphlet points to a way to put the suggestion into practice, namely, by using the Kinsman type of lamp as manufactured by this firm. The desk lamps of this firm are extensively used and well known. This pamphlet gives complete information regarding these lamps in their different styles.

"BEFORE AND AFTER."—An attractive pamphlet has been issued by the Calculagraph Company entitled "Before and After." This title refers to the use of the Calculagraph for timing telephone toll messages. It tells a little story as to what was done by the old method of figuring and comparing time tickets and the great saving that was effected when the Calculagraph took all of this mechanical work from the operator. The pamphlet is a convincing argument for the use of the Calculagraph.

MINE AND ORE CARS.—The Atlas Car & Manufacturing Company, Cleveland, Ohio, has issued a very completely illustrated catalogue of its products, which consist of dump cars of every description for smelting and roasting plants, furnaces, foundries, cement works and general use, also overhead trolleys, industrial railway equipment, frogs, switches, rails, etc. The illustrations show this varied line of articles, each one being accompanied by a description, data, etc. The catalogue (No. 1018) has over 100 pages and covers the ground very thoroughly.

POWER TRANSMISSION APPLIANCES.—Price list No. 10 of power transmission appliances of the Case Manufacturing Company, Columbus, Ohio, takes up no less than 136 pages. There is a vast number of articles listed, and the final production of this list represents a great amount of time, labor and care. The pages are of a bright yellow paper, which is very pleasing to the eyes. Among the articles included may be mentioned: hangers, bearings, belting, bolts, conveyors, couplings, gears of all kinds, elevators, power shovels, jacks, pulleys, transmission rope, scales, truck, etc., etc.

GAS ENGINES.—The Walrath gas and gasoline engines as manufactured by the Marinette Iron Works Manufacturing Company, Marinette, Wis., have become pretty well known since their introduction to the market. The engine possesses many features that appeal to power users the more they become known. A catalogue issued by the company gives detailed information regarding this well-known type of engine, and several illustrations show the different designs. Engines direct-connected to electric generators are also shown. One of the engines shown, of the 3-cylinder type, is of 150 horse-power.

WIRES AND CABLES.—The Hazard Manufacturing Company, Wilkesbarre, Pa., gives very complete information—much of it in tabular form—of its extensive line of products, in a neatly gotten up pamphlet of recent issue. This company, as is well known, manufactures electric wires and other equipment for electric railways, electric light and power circuits, telephone and telegraph systems. All copper wires used in the manufacture of its insulated wires and cables are drawn in the company's own wire mill. The pamphlet is copiously illustrated, showing sections of cables of many varieties and for all purposes. The pamphlet is replete with tables.

THE WILLARD STORAGE BATTERY COMPANY, of Cleveland, is now fully settled in its new plant at the corner of St. Clair and Water streets. There are two buildings, embracing over 25,000 sq. ft. of floor space. The company has recently installed a large amount of new special machinery, and is now prepared to handle more than double its former output. It is manufacturing batteries for all purposes and just now is doing an unusually large amount of work for railway signal outfits, electric launches and electric automobiles. Improved processes of manufacture and close attention to mechanical details have resulted in a considerable decrease in the weight of the Willard battery and at the same time the efficiency has been increased.

KELLER, PIKE & CO., of Philadelphia, have been awarded the contract for the complete mechanical and electrical equipment of the new Court House for Camden County, N. J. This building, which has been designed by Messrs. Rankin, Kellogg & Crane, will cost about $700,000. The equipment consists of return tubular boilers of 300 hp, two simple high-speed engines, two direct-connected 55-kw. generators, foundations, switchboard, power steam piping, heating and ventilating systems, with Johnson temperature regulation, electric motors for fans, blowers and pumps, electric elevators, and electric light and power wiring. It will be recalled that the same company recently secured the large contract for the new Pennsylvania state capitol.

H. W. JOHNS CONVENTION.—The H. W. Johns-Manville Company held a convention last month at New York and Hartford, Conn., of its branch managers, department managers and salesmen. The company has issued a pamphlet giving a report of the meeting. The programme was a varied and extensive one, the subjects of the papers referring to matters directly or indirectly related to the company's field of work. Representatives to the number of about 35, from all parts of the country, were present. The object of the convention was to bring all branches into closer touch with one another and to afford opportunity for a general discussion of all the greatly varied lines manufactured by the company. The meetings were held at Hartford on February 15, 16 and 17, and at New York on February 18, 19 and 20.

HYDRO-CARBON PAINTS.—The Hydro-Carbon Manufacturing Company, Denver, Col., has just issued a couple of small pamphlets relating to its hydro-carbon paints, their advantages and uses. It is stated that this paint possesses to a high degree the property of withstanding extreme climatic conditions and yet retains its preservative value. The basis of the paint is a hydro-carbon ore, which is stated to be a natural product of petroleum mined in Utah and Colorado. It is claimed that the paint resists the corrosive action of steam, vapor, water and gases. One of the pamphlets is given up entirely to a dissertation on iron corrosion and its prevention. The information given on the general subject is valuable to those concerned. The Hydro-Carbon Manufacturing Company will be glad to send copies of these pamphlets on application.

STURTEVANT CATALOGUE.—The second edition of catalogue No. 115, the general condensed catalogue of the B. F. Sturtevant Company, Boston, Mass., is now ready for distribution. This catalogue describes and illustrates a number of new apparatus manufactured by this enterprising company, among which are a new type of hand-blower, several new types and sizes of forges, new sizes of vertical single and double engines, a new type of enclosed vertical compound engines, new type of semi-enclosed bi-polar and 4-pole motors, new sizes of generating sets with vertical compound engines, factory equipments, such as bench-legs, pattern storage shelf brackets, electric hoists, cast iron sinks, trench cover-plates, etc.; industrial railway equipments, such as cars, truck ladles, turntables, T-rails, etc. It also contains a description of the various Sturtevant systems, such as heating and ventilating, special ventilating, drying, conveying and mechanical draft systems.

THE NATIONAL ELECTRIC COMPANY, successor to the Christensen Engineering Company, Milwaukee, will exhibit its electrical and air brake apparatus at the St. Louis Fair. Part of its electrical exhibit will include a 1500-kw alternating-current generator. This unit will be in operation at the central power station, furnishing power for various purposes. In addition, a number of smaller alternating and direct-current machines will be exhibited at its space, including a very complete exhibit of the Christensen air brake equipment, so well known in the street railway field.

THE WELLMAN-SEAVER-MORGAN COMPANY and the Electric Controller and Supply Company, of Cleveland, are now occupying a handsome and spacious office building erected exclusively for their use adjoining the plant on the Pennsylvania tracks and Central Avenue, Cleveland. The Electric Controller & Supply Company occupies practically one entire floor, including general office room, six private offices and large drafting room. All rooms in the building are illuminated with Nernst lamps and over each table in the drafting rooms are single glower Nernst lamps suspended from cords. The drafting rooms are connected by dumb waiter with the blue-print room in the basement, which is provided with electric blue-print machines. In the basement there are dining rooms for officials and office employes. On each floor there are two toilet rooms, and there is a private bath room and barber shop for officials. There is a private telephone exchange connecting all offices and departments in the building, as well as throughout the plant, and there is a Postal telegraph office in the main entrance. The various offices are equipped with every convenience and are tastefully and handsomely furnished.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 15, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

754,406. ELECTRICALLY OPERATED STOPPING MEANS AT RAILWAY DANGER SIGNALS; William L. Adamson, Philadelphia, Pa. App. filed June 12, 1903. When the signal at the roadside is thrown to danger from a tower, a contact is at the same time thrown into position to be struck by a train to close a circuit which shuts off the steam on the locomotive and prevents the train from running past the signal.

754,414. OUTLET FOR INTERIOR CONDUITS; William F. Bossert, Utica, N. Y. App. filed Dec. 19, 1903. A sheet metal sleeve is adjustable in position in the front opening of the box to be made flush with the plaster.

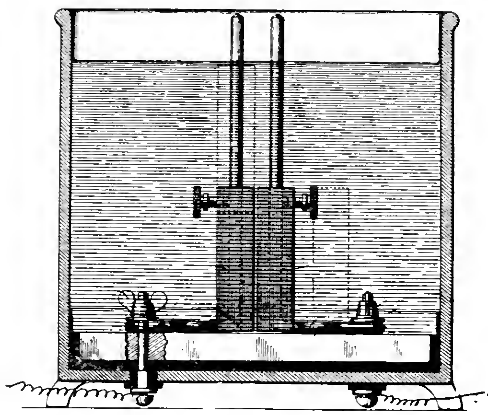
754,429. MEANS FOR ELECTRICAL DISTRIBUTION; John L. Creveling, New York, N. Y. App. filed May 10, 1901. A centrifugally operated circuit controller and rheostat for train lighting systems.

754,451. ELECTRICAL WATER HEATER; Harry M. Hill, St. Louis, Mo. App. filed June 1, 1903. Two carbon electrodes adjustably mounted in a tank; the water circulating between them becomes heated by the passage of current.

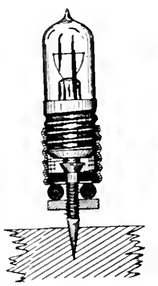
754,465. AUTOMATIC ELECTRIC HEAT REGULATOR; Daniel N. Leib, Elkhart, Ind. App. filed April 10, 1902. Details.

754,473. GUIDE WHEEL; Alexander H. Mathesius, Brooklyn, N. Y. App. filed Feb. 14, 1901. The shape of the tread of a trolley wheel and the cross section of the conductor are so related as to reduce slipping and abrasion of the contact surfaces.

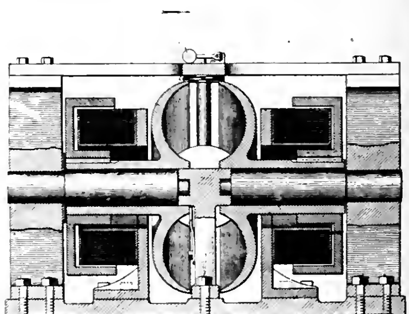
754,496. LIMITING DEVICE FOR ELECTRIC CIRCUITS; Charles W. Potter, Denver, Col. App. filed Feb. 10, 1902. A device applied in the meter loop which is adjusted so that upon an increase of the load above the amount contracted for, the device will automatically cut off the current.



754,451.—Electrical Water Heater.



754,762.—Electric Socket Support.



754,804.—Speed Regulating Magnetic Clutch.

754,505. AUTOMATIC CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed June 18, 1903. Various improvements in the details of construction.

754,534. THERMOSTATIC GAS DETECTING MEANS; James E. Baldwin, East Williston, N. Y. App. filed Sept. 10, 1902. Details.

754,555. AUTOMATIC FIRE ALARM; Mason K. Fred, Pleasanton, Tex. App. filed March 9, 1903. A protective fusible wire is connected in parallel with an alarm and a resistance and in series with a battery; the resistance normally prevents the alarms from ringing, but the destruction of the fuse wire sends the entire current through the alarm.

754,565. ELECTRIC RAILWAY; Rudolf Alfred Emil Haber and Hans Hugo Carl Behn-Eschenburg, Zurich, Switzerland. App. filed Dec. 23, 1901. An application of the Ward Leonard railway system relating to the use of alternating current line sections of different voltages; for example, a high voltage for the open country and a low voltage for large railway stations.

754,596. GAS DETECTOR; George A. Nelson, Providence, R. I. App. filed Feb. 10, 1903. A balloon which floats in a normal atmosphere will lower in the presence of a gas and close an alarm circuit.

754,622. ELECTRIC CLOCK; David W. Thompson, Chicago, Ill. App. filed Dec. 5, 1895. Details.

754,631. LAMP FOR CANES, UMBRELLA STICKS OR THE LIKE; James W. Allen, St. Louis, Mo. App. filed Nov. 2, 1903. A bull's-eye electric lamp and battery all located in the head of the cane.

754,656. ELECTRIC FURNACE; Charles Albert Keller, Paris, France. App. filed Jan. 17, 1902. (See page 608.)

754,660. RHEOSTAT; Lamar Lyndon, New York, N. Y. App. filed Aug. 8, 1902. A rheostat which by being properly connected with a translating device and the line, will permit the total current to flow through the device when it is desired, and with which it will be possible to vary at will the potential of the current in the device from zero to maximum.

754,666. INDUCTION COIL; Reuben Miller, Jr., Pittsburg, Pa. App. filed Jan. 7, 1904. A magnet operating an interrupter is in circuit with all of the primaries of a number of induction coils, supplying the spark respectively to the cylinders of a multiple-cylinder engine.

754,681. ELECTROMAGNETIC DEVICE; Eugen K. Muller, Zurich, Switzerland. App. filed Sept. 20, 1902. Details of an alternating-current magnet adapted for massage purposes.

754,689. ELECTRIC SELECTIVE APPARATUS; Frank D. Pearne and Charles L. Krum, Chicago, Ill. App. filed Feb. 3, 1902. A sensitive relay by which one or two or three branch circuits may be closed in combination with a magnetic lock arranged to hold the selected branch in a closed condition.

754,692. RHEOSTAT; Claude R. Pitrat, Amsterdam, N. Y. App. filed Aug. 8, 1903. Details.

754,694. ELECTRIC POCKET LAMP; Angelica E. Post, Boston, Mass. App. filed Dec. 30, 1903. A flat battery case for the vest pocket, the cover having a lamp which can be thrown into circuit at will.

754,756. PROCESS OF SEPARATING ORES FROM MAGNETIC GANGUE; Thomas A. Edison, Llewellyn Park, N. J. App. filed May 29, 1903. App. filed March 15, 1903. The small proportion of non-magnetic material in a body of ore is recovered by first grinding to a fineness to free the non-magnetic particles, then adding a larger bulk of the coarser non-magnetic material, then passing the mixture through a magnetic separator to separate the entire body of non-magnetic material and finally separating the coarser material from the original non-magnetic material.

754,762. ELECTRIC SOCKET SUPPORT; Edwin R. Gill, New York, N. Y. App. filed March 14, 1902. A lamp socket having brads in its base to puncture the insulation of conductors and a central screw by which the socket can be supported on any structure.

754,778. TROLLEY WHEEL RETAINER; James A. Kelpatrick, Niles, Ohio. App. filed Dec. 19, 1903. Details.

754,804. SPEED REGULATING MAGNETIC CLUTCH; Charles A. Pratt, Oakpark, Ill. App. filed Dec. 7, 1903. Two transmission disks mounted to rotate independently and having opposed spherical faces in which friction pulleys are located. By shifting the position of the pulleys, the difference in speed of rotation is obtained.

754,832. ELECTRIC RAILWAY PLOW; John H. Akers, Washington, D. C. App. filed Aug. 8, 1903. Details.

754,858. STORAGE-BATTERY TRAY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Nov. 28, 1902. (See page 608.)

754,859. REVERSIBLE GALVANIC BATTERY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Nov. 28, 1902. (See page 608.)

754,863. ELECTRICAL PLUG AND RECEPTACLE; Gilbert W. Goodridge, Bridgeport, Conn. App. filed Oct. 9, 1903. Details.

754,868. FIRE AND WATER-PROOF INSULATING COVERING FOR METALLIC SURFACES; John A. Heany, Philadelphia, Pa. App. filed May 10, 1902. An agglomeration of a gluey substance and asbestos.

754,884. CABLE CLIP; James McFarlane, Allegheny, Pa. App. filed June 3, 1903. A strap having a hook at each end which passes over the wire in opposite directions.

754,885. AUTOMATIC FIRING DEVICE FOR ORDNANCE; Ludwig Obry, Triest, Austria-Hungary. App. filed Sept. 12, 1903. Details.

754,894. SELF-ADJUSTING WHEEL; Edgar A. Root and Charles M. Wallace, Huntington, W. Va. App. filed May 23, 1903. Details.

754,904. WIRELESS SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed June 11, 1902. A freely oscillating circuit, an inductance winding included therewith and a radiating surface connected to the terminals of the winding.

754,935. RINGING AND LISTENING KEY; Charles H. North, Cleveland, O. App. filed Sept. 14, 1901. Details.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, APRIL 2, 1904. No. 14.

ELECTRICAL WORLD AND ENGINEER.

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, APRIL 2, 1904.

CONTENTS.

KIND WORDS.

The recent issuance of our Thirtieth Anniversary Number has been the subject of a great many kind letters and messages from readers and advertisers in this country, while we are now beginning to receive such congratulations in equal volume from abroad. Up to the present time, considerably over 500 such communications have reached us, and we feel that we can do no less than extend here our sincere thanks for these heartily appreciated expressions of esteem and good will.

UNDIGESTED EXPORTS.

While the country may have been suffering from the amount of "undigested securities" on hand, it would appear that the effect of financial dullness on foreign trade has not been serious, but that our exports of raw material, or "undigested exports," have continued heavy, and that the quantity of manufactures sent abroad, or "digested exports," has shown a notable gain during the past year. What is needed in this foreign trade is to lessen the "undigested" part of it by converting it into "digested," just as Europe does in her trade with us. She does not send us stuff in crude form and big bulk, but ships her goods in neat little packages; so that while the steamers may appear to come in light, a few pounds represent in value several tons of the raw material, in food, cotton, etc., that we may be sending across the Atlantic.

Meantime it is worthy of note that for the eight months including February the total exports from the United States were valued at one billion forty-eight million dollars against nine hundred and eighty-two millions, in 1903, while the imports fell off, representing six hundred and fifty-four millions against six hundred and eighty-one millions. A large proportion of this export is manufactures, being fully two hundred and eighty-eight millions as against two hundred and sixty millions in the previous period. The month of February alone showed thirty-eight millions against thirty-four millions in 1903. All this is very satisfactory in view of the depressed or agitated condition of more than one part of the globe. The electrical portion of this trade is holding its own very well.

SIMULTANEOUS TELEGRAPHY AND TELEPHONY.

In 1882, Van Rysselberghe—an ill-rewarded Belgian—first proposed the conjoint use of telephone circuits for both telegraphy and telephony simultaneously, and initiated ingeniously the use of composite circuits for such purposes. At the present time, a large number of long-distance telephone circuits are used for telegraphic purposes over and above their regular telephonic duty. The general and striking facts concerning composite circuits are fully set forth in the very interesting article by Mr. L. W. Stanton, on page 635. Broadly speaking, such a circuit passes both low-frequency telegraph impulses and higher-frequency telephone currents, receiving these in respectively selective branch circuits. It is curious to note that the signaling, or calling, telephone currents ordinarily belong to the low-frequency class, and that consequently special precautions are sometimes necessary to keep these telephone currents from interfering with the telegraph. Yet another kind of composite circuit not coming within the scope of the article, is the conjoint use of telephone receivers with telegraph apparatus under the name of the phonoplex system, which is in fairly extensive use. In this arrangement high-frequency impulses are used to actuate the telephone receivers for telegraphic instead of telephonic purposes.

These technical aspects and considerations have their value and importance, but they seem to us minimized, comparatively, by the commercial possibilities, outlined briefly by Mr. Stanton at the conclusion of his very suggestive article. The details given by him as to the amount of work already done in the application of the system will astonish most people, including not a few familiar with the twin telegraphic and telephonic arts. It is true that the figures quoted deal with what is going on in one section of the independent telephone field, but there could be a good deal said from the Bell side also, although the management have so far preferred to maintain an exuberant reticence as to what they are doing in that respect.

And this brings out the "political" aspects, as noted by Mr. Stanton as follows: "We cannot but expect to see two great telephone companies competing for both telegraph and telephone business, which will eventually bring about a consolidation between one of the telephone companies and one of the telegraph companies. This may compel an alliance between the two remaining companies, for the telephone and telegraph companies combined can reduce operating expenses very materially. The same official staff, the same buildings, the same conduit system, pole lines, etc., can be used by the two; and many other decided economies could be effected." There is food for thought here, especially as the idea is predicated upon such facts as those which Mr. Stanton sets forth.

Bell Telephone Figures

Very impressive are the statistics furnished by Mr. Fish as to the workings of the Bell telephone system last year, in his annual presidential report to the stockholders printed elsewhere. The financial condition is reflected in the ledger balances of $13,319,533 cash and deposits, and $22,397,407 bills receivable; offset by but $8,931,804 bills payable, nearly $3,000,000 of which was the dividend payable in January. The company earned $16,545,632, paid $8,619,150 in dividends and carried to reserve and surplus, $1,945,514. That looks like a pretty stable and comfortable business, whatever the "independents" may be doing—and they are doing a good deal. Indeed it is remarkable that the growth is so well kept up, and it is evident that whatever losses from competition are sustained in rural territories, the growth in the cities has fully offset them. The growth is also shown by the fact that new construction and real estate last year required a sum of $35,368,700. The increase in stations was 247,184 up to a total of 1,525,167, and the mileage of circuit increased 677,229 miles up to the splendid total of 3,958,891.

The Reciprocating vs. Turbine Types of Steam Engines.

During the past year or more the steam turbine has almost entirely monopolized attention in the field of steam engineering, and its advocates have not been sparing in setting forth invidious comparisons with the reciprocating type of engine which, indeed, by some of these has been treated as already an anachronism. Perhaps this aggressive spirit has been fostered by the silence of those with whom lay the defense of the type attacked, but on another page we print an article in which at last the challenge is accepted and the issue most vigorously met. The case which Mr. Seymour makes out is a strong one, fortified as it is by data drawn, not from shop tests, but from the results of trials conducted by disinterested engineers. The remarkable efficiency of the engines tested, and particularly the efficiency at light load, shows that the reciprocating engine has had a margin of undeveloped economy which even in the recent past has been overlooked. The showing, in fact, is such that the steam turbine is put on the defensive as regards economy, and the issue presented can only be met by reports of tests under trial conditions and disinterested supervision similar to what obtained in the cases cited. Finally, all, we believe, will concur with Mr. Seymour that in general comparisons of performance of the reciprocating and turbine types of engines, the new-comer should select the latest development of the older type and not evolve for its purposes an "average" type—in other words, should squarely meet its real competitor.

Legal Aspects of Electric Affairs.

Mr. Ball's paper on this topic, printed elsewhere, gives an instructive view of some English precedents in decisions involving particularly the rights of operating companies. Although English and American decisions rest in general upon the same organic body of common law, yet the statutory provisions in the two countries are not always parallel and the general tendency of decisions is not precisely in the same direction. Mr. Ball deals with the liabilities of supply companies under the heads of negligence and nuisance. Now, from the general trend of recent opinions it is quite safe to assert that these two divisions as made here and in England would differ greatly in relative importance. The point of view here and there differs more than the statutes differ, and it is often the point of view that determines the final result. Broadly, the law regarding nuisances is far more rigorously applied in England than it is here. An operating company for electric supply, or in fact an industrial establishment of any kind, can seldom be successfully attacked here under the general principle of nuisances. Enjoining an electric light company on account of excessive vibration produced by its machinery, as was done in England the other day, would be difficult if not impossible in any American city. It has proved to be next to impossible here to really abate a smoke nuisance effectively. In general, the rights of the private citizen or private householder as against the acts of his neighbors are upheld very ineffectively, under American decisions. The idea of individual liberty is carried so far here that in practice a man may infringe the natural rights of his neighbors to a very objectionable extent without serious hindrance. Electric supply companies as a whole get the benefit of this sentiment in comparative immunity from a very annoying class of suits.

In another important particular the American plant has an advantage. In England there is a group of Acts dealing with the liability of employers and the rights of workmen in a fashion far more severe than any American statutes. On their faces English and American laws on these subjects are to about the same purport, but the former are backed up by a far more drastic series of decisions than the latter. We referred not long ago to a decision holding an employer responsible because a workman on the roof of a small building under construction was struck by lightning. Very likely the decision may be reversed on appeal, but it would have been practically impossible to get such a decision here, even in a jury trial much less from the Court. Juries are as a rule very liberal to employees who are injured, but they draw the line somewhere. On the other hand, so far as liability in case of injury to persons not employees is concerned, the American jury goes to considerable lengths. It will hold a company up in a matter of alleged negligence on very small provocation. Were it not for this tendency, fraudulent suits against street railway companies in particular would be far less frequent than experience has shown that they actually are. Sometimes claims of the most absurdly unjust character are successfully pushed, and the result is that operating companies have time and time again settled unjust claims out of court, knowing from bitter experience the treatment that they are likely to get at the hands of a jury. The "ambulance lawyer," so called, is a product of the easy jury, and much just complaint has been made of the practice of bringing suits ostensibly in the interest of the injured plaintiff, but really in the interest of the attorney. In such instances it seems to us that the fault lies largely with the forms of procedure that have gradually grown up.

We do not believe that the ordinary jury is hopelessly incompetent and prejudiced. On the other hand, it could by proper selection unquestionably be made very much better than it is. The ordinary jury is scarcely up to the level of the panel from which it is drawn, owing to the kind of selection which the respective attorneys have fallen into the vicious habit of making. Too many challenges and far too trivial causes are often allowed, and it seems to us that the firm exercise of a wise discretion by the Court could be and should be made to remedy the evil. The rules of evidence now in use are hardly suited to put the facts clearly before the jury that is obtained, and when there is, as not infrequently happens, an obvious effort on the part of the attorneys to keep pertinent facts from the ears of the jury, one can hardly expect to escape from questionable verdicts. But perhaps the most serious obstacle in the path of strict justice is the secrecy that often involves the real parties to the suit. As procedure now is, it is likely enough that while the ostensible parties are a grievously injured citizen and a wealthy and negligent corporation, the real parties may be an "ambulance lawyer" and a casualty insurance company. If the jury knew this they would be far less likely to be misled by unreasoning sympathy than is now the case. It is perfectly true that the jury trial has come to be looked at askance and held in some contempt, but the fault is not so much the fault of the system as of the way, cumbersome and indirect, in which it is worked. We are not aware that it works any better in England than here, perhaps not quite so well to judge from the large number of mistrials, but the fault is not inherent in the system. By and large, American electrical companies and interests are pretty well looked after by the laws, but the system is far from perfect, and we may as well keep our eyes frankly open to its defects with a hope of an ultimate remedy.

Shielded Balances.

On page 647 we print this week an interesting article by Mr. G. A. Campbell, which has many practical applications. When we measure the resistance of any conductor, say a coil of insulated copper wire, by the ordinary continuous-current Wheatstone bridge, we obtain a perfectly definite result, at any one temperature, if all the conductive connections are good, and if there are no appreciable leakages, or defects in insulation. If, however, we use an alternating-current Wheatstone bridge, the balance involves the magnitudes of both resistance and reactance. Unless both these quantities are balanced a perfect balance in the bridge is impossible. Moreover, if the telephone be employed as the measuring instrument in place of the galvanometer, it is most difficult to secure a complete zero of sound. This difficulty increases with the frequency, and at a frequency of 1,000 cycles per second, which is not high from a telephonic standpoint, Mr. Campbell shows that the dielectric susceptance of the air all round the apparatus plays a very appreciable part. In fact, air, while a perfect insulator for direct currents, is no insulator in this sense, for alternating currents. The alternating-current circuit is subject to all-pervading electrostatic susceptance, resembling leakage through the air; just as the magnetic circuit is subject to all-pervading magnetic leakage through the air. Air ceases, in fact, to be an insulator for the alternating-current circuit, just as in the magnetic circuit. The air acts in the same manner in both the alternating current and the magnetic circuits, that at all telephonic frequencies the energy is stored in the air elastically—electrostatically in the one case, and magnetically in the other—without any necessary waste in the process.

It is not merely the disturbance of the position of balance by the presence of the susceptance currents in the air, but also, as pointed out in the article, the liability to variation in the balance by such extraneous changes in the air currents as by the movements of the body of the operator. In such upper-frequency alternating-current bridge measurements, the operator may be said to have a personal equation that is not only mental, but also physical. The solution of the difficulty proposed by Mr. Campbell consists in making all the air susceptance currents definite and invariable, by enclosing the essential parts of the apparatus in metal boxes, or condenser shields. The various elements of the bridge are provided, as explained, with connected shields, and the entire apparatus is placed in a floating shield. This arrangement has the effect of adding certain definite susceptances to each of the conductances in the bridge; but these susceptances are at least invariable, and are capable of elimination in deducing the results of observations.

The plan somewhat resembles the expedient adopted in electrometers of the attracted-disc type. The force attracting two opposed parallel plane surfaces or discs at a definite distance apart in air, for any given difference of potential between them, is known to be $e^2/8\pi$ dynes per square centimeter, where e is the electric intensity in abstatvolts per centimeter. Near the edges of the discs, however, the electric intensity is weakened, and bent out of the perpendicular, in a complicated manner. In order to restore definiteness and simplicity to the arrangement, a guard ring is arranged so as virtually to extend the plane surface of the disc, and keep the electrostatic flux density sensibly uniform all over the surface of the disc, where the attractive force is measured. In a certain sense the expedient given in the article for restoring definiteness and simplicity to the alternating Wheatstone bridge, consists in supplying virtual guard rings to all the apparatus capable of being affected by the alternating electrostatic flux. In wireless telegraphy and in researches on Hertzian waves, the detecting apparatus has frequently to be included in metallic boxes to keep electrostatic waves *out*. In the case here considered Mr. Campbell places his apparatus in metal boxes to keep electrostatic waves *in*.

We shall hope to receive a subsequent article from Mr. Campbell giving the results of the practical use of the apparatus. We regard this article as of importance, not merely from its technical value, but also as marking what is in our judgment a decided advance in the policy of the long-established telephone industry. We have long been aware that telephone engineers have carried on valuable and important technical researches in connection with their work, which researches the telephone administration always decided to withhold from publication, as a matter of policy. This policy we have always protested against as short-sighted, imprudent and immoral. None will deny that an industry has a perfect right to withhold trade secrets and manufacturing data that may have cost time and industry to acquire. We offer no criticism against the policy of withholding trade secrets, and none would be likely to be influenced by such criticisms if offered. But when the matters relate merely to technology, or applied science, as distinguished from business or manufacturing details, we think everyone will agree that there is no use in withholding from publication matters which the general progress of science will inevitably make known within a few years at most, and which if made known only redound to the credit of the industry disclosing, while adding to the world's general stock of knowledge in applied science. When the knowledge is arrived at by outsiders, in the regular subsequent course, the original work done earlier by the industry has lost credit, and has lost the evidence of progress. The time has gone by, let us hope, forever, when a chemical formula, like that of Greek fire, could be kept a secret in the arsenal of Constantinople for nearly six hundred years. For the above reasons we welcome Mr. Campbell's article as a contribution of telephone engineering to technology, which is a good augury for future policy.

Tesla Split-Phase Motor Patent Decision.

Judge Kohlsaat on Saturday of last week handed down a decision in a case involving the Tesla split-phase motor patent brought before the U. S. Circuit Court for the Northern District of Illinois, which decision upholds the Tesla patent and grants an injunction against the use of the split-phase principle in a wattmeter made by the defendants in the action. The opinion cites the opinions of Judges Archbold, Hazel, Townsend and Lacombe sustaining the patent, and the opinion of the Court of Appeals reversing the Lacombe decision, which latter ruling was followed by Judge Colt in another case. All of the above cases have been reported in these columns.

Judge Kohlsaat says that the decision of Judge Lacombe was reversed largely upon the ground that it did not appear from the record that Tesla's invention was not anticipated or described in a paper read by the late Prof. Ferraris before the Royal Acadmy of Sciences, of Turin, Italy, on March 18, 1888, and published, in part, in an electrical journal issued at Milan on April 22, 1888. He holds, however, that in the later cases—those decided by Judges Archbold and Hazel—the records, together with certain original proofs offered in the present case, establish that Tesla's invention in suit antedated the Ferraris article, was original with Tesla, and that his patents are valid.

Discussion of Institute Papers.

The regular monthly meeting of the American Institute of Electrical Engineers last Friday was devoted to the discussions of papers of Messrs. Blackwell, Stillwell, Hewlett and Moody, full abstracts of which were printed in our issue of March 19. The following council nominee ticket for the coming election was announced: President, Mr. John W. Lieb, Jr.; vice-presidents, Messrs. W. E. Goldsborough, J. J. Carty and Samuel Reber; managers, Messrs. L. A. Ferguson, H. G. Stott, J. G. White and S. S. Wheeler; secretary, Mr. R. W. Pope; treasurer, Mr. G. A. Hamilton.

The discussion of the papers of the evening was very extensive, as may be judged from the fact that a transcript in full would cover about 12 of these pages. Consequently, it is only practicable to give here a mere summary, the reader being referred to the report in full, which in due course will be published by the Institute.

Those taking part in the discussion were Messrs. Chesney, Perrine, Dow, Peck, Townley, Mershon, Skinner, Arnold, Stott, Scott, Nunn, Lincoln, de Muralt, Lyford and Stillwell. Written contributions to the discussion were submitted by Messrs. Tobey, Hazard, Roberts, Bayne, Walters, I. A. Taylor, D. C. Jackson, Wright, J. B. Taylor and N. M. Snyder.

The greater part of the discussion of the evening was on the relative safety with respect to fire risk, of oil and air-cooled transformers, and provisions that should be made to reduce the fire hazard in the case of the former. The opinion was almost unanimous that the oil transformer, if proper precautions are taken, is safer than the air transformer. In support of this view, Dr. Perrine mentioned that the fire underwriters, and particularly the instructions of the Mutual Fire Insurance Company, favor the oil over the air-cooled transformer. Mr. Peck stated the case against the air-blast transformer, which he said is more susceptible to damage by fire from static discharges, arcs, bad contacts, etc., than the oil-insulated transformer; though, he added, on the other hand, owing to the small amount of combustible material in the former, it is possible to have such material entirely destroyed with comparatively little fire risk to neighboring apparatus or buildings. As to precautions to be observed in installating oil transformers, all concurred that the case should, where possible, be made of riveted boiler iron which will withstand a pressure of 100 pounds per square inch, and that it should be properly vented. Mr. Peck said that where sheet iron construction is necessary the case should be made practically air-tight and provided with a very large safety valve, so that an internal explosion cannot burst the case. It was generally agreed that transformer units should be located in fire-proof compartments and some advocated locating them in vaults. In any case the transformer case should be so constructed as not to be broken in the case of the floor or walls of a burning building or heavy weights falling upon it.

Mr. Mershon disapproved of a bottom drain, owing to the fact that as oil went out air would enter the transformer case, and might cause an explosion. He described an arrangement which he had used which provides for pumping water into the bottom of a transformer, which forced the oil out at the top. He dwelt upon the necessity of so arranging the draining system that in case of falling floors or walls the pipes would not be broken. One suggestion was that the transformers should be placed in vaults that could be closed and to which steam could be admitted to smother flames in case of the oil taking fire. Several of those taking part in the discussion drew attention to the fact that the oil-cooled transformer was not an extreme fire hazard, if proper precautions were observed, and that this should be made plain in order that the discussion would not cause alarm.

The matter of transformer terminals was considered in the discussion. Mr. Skinner pointed out the difficulty of bringing out such terminals from transformers of 20,000 volts or more. This trouble was increased when there were requirements for combinations of transformer voltages and where high-tension windings were to be tapped for regulating purposes. The terminals should be brought through porcelain insulators with the lower ends located beneath the level of the oil in the transformer. In the installation to which Mr. Mershon referred the terminals were brought through stuffing boxes in order to make the case air-tight. Mr. de Muralt said that in Europe the air-blast transformer is considered a greater fire risk than the oil-cooled transformer. The desirability of fire-proofing the buildings of electrical plants was illustrated by Mr. Lyford, who cited the fact that the only two buildings left intact in the Baltimore burned district were the new power house and sub-station of the electric company. Mr. Hazard suggested sealing the space above the oil in the transformer with an inert gas such as carbon dioxide supplied by a gas generator. One suggestion was that the oil used in transformers should have a fire test of approximately 400° F., and another that it should have a flash test not below 175° C., as in that case there would practically be no evaporation at 100° C. Mr. I. A. Taylor said that in the case of transformer terminals he had used a porcelain tube filled with sulphur, and he advocated that transformer cases should be adequately grounded to prevent fire and for personal safety. Marble terminal boards were generally criticised.

In the discussion on high-tension switches, Mr. Chesney, after classifying such switches into four types, concluded that the oil switch in the present state of the art is the only one to be used in high-tension work, and he laid down a number of requirements in connection with such switches. Dr. Perrine described some experiments with oil switches on the 40,000-volt line of the Standard Electric Company in California. The full load of four 2,000-kw machines was broken a number of times by such switches, in every case satisfactorily opening the circuits. Mr. Alex Dow favored oil over air switches. As to switching, he considered that while in some cases the conditions permit the running of everything on the same set of mains in multiple, the general condition, however, indicated their separation into groups. Mr. Mershon expressed the opinion that the oil switch is at least as reliable as the apparatus which it controls up to 10,000 volts, but he does not consider it necessarily a final development, since it is not yet entirely adapted to high-voltage work. Mr. Stott said he looked upon group switches in the light of an insurance against interruptions of service, which insurance had to be paid for in complication and first cost. Mr. Scott considered that the air switch still has a large field where the voltages are large and where the oil switch is expensive to install. Mr. P. N. Nunn said he could not defend the air switch as in the 40,000-volt Provo plant such switches are being displaced as rapidly as possible by oil switches. Mr. de Muralt favored the oil type switch, but considered the horn type of switch as applicable in special cases.

In the discussion on group switches, Mr. Stillwell said that if in a plant there should be three shut-downs in the course of a year from using single switches, it would be better to install group switches and eliminate the shut-downs entirely. Prof. D. C. Jackson criticised the arrangement of group switches described by Mr. Stillwell as being of limited usefulness, and said that an arrangement whereby individual circuits are brought directly to the main bus-bars is usually to be preferred. Mr. I. A. Taylor considered that the advantages enumerated for group switches might be more simply and cheaply obtained by the use of multi-point control switches used in parallel with the ordinary ones. Mr. Gilbert Wright was of the opinion that group switches and duplicate buses involve a cost much too large in proportion to the results obtained. Mr. John B. Taylor commented in detail upon the various considerations put forward by Mr. Stillwell concerning the use of group switches, his comment in general being adverse to use of the system except where the conditions specifically indicate its advantages. He advocated an arrangement which is essentially a single main bus-bar and a series of group buses, which may be interconnected to form a reserve main bus in case of trouble or to facilitate work upon the main bus.

Simultaneous Telephone and Telegraph Equipment.

By Le Roy W. Stanton.

The apparatus entering into the equipment of a modern long-distance telephone line includes not only special telephone apparatus, but also apparatus for making practical the use of the telegraph in connection with the telephone, so that simultaneous telegraphy and telephony may be accomplished.

The revenue derived from telegraph leases on long-distance telephone lines, in many cases equals, and quite often exceeds that derived from the long-distance telephone service. While this practice is not new, its application has not been extensive, owing to the meagre knowledge of the principles, and the limited number of

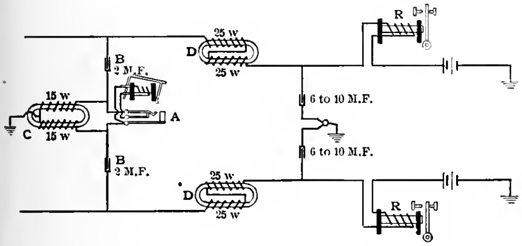


FIG. 1.—DIAGRAM OF COMBINATION CIRCUIT.

long-distance telephone lines. The successful operation of the system depends upon the proper proportion and arrangement of inductance and capacity. The effect of high and low-frequency currents upon impedance coils and condensers being directly opposite. The comparatively slow vibrations of the impulses in a telegraph circuit pass readily through the impedance coils, but are almost totally obstructed by the condensers, while on the other hand, the vibrations set up by the voice in the telephone transmitter, produce in the line a current of very high frequency, which has a directly opposite effect upon the condenser and impedance coils arranged in the circuit.

Fig. 1 shows diagrammatically the arrangement of the circuit where each side of the line is used as a separate telegraph circuit, and the two circuits or sides of the line form a metallic circuit for telephone purposes. *A* represents a telephone set, *B* a two-M.F.

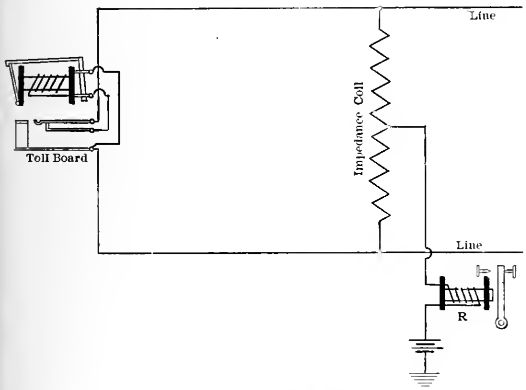


FIG. 2.—CIRCUIT WITH IMPEDANCE COIL.

condenser, *C* an impedance coil wound to 30 ohms. The coil is large and massive so as to have a high inductance. The core is composed of a complete iron circuit, and the windings are wound on two spools and so connected as to give the greatest impedance to voice currents, this being necessary, as the coil is bridged in parallel with the telephone set across the line; the function of the coil is to reduce the click from the telegraph circuit, caused by the opening and closing of the telegraph key, which produces a rise and fall of potential on the line, and tends to charge and discharge the condensers, which are in series with the telephone set across the line. This coil being grounded in the center allows the condensers to discharge to ground through one-half of the coil instead of through the telephone set to ground on the other side of the line.

If r represents the resistance of one-half of the coil, *C* and *L*, its inductance then to the slow discharge current from the condenser to the ground, due to the making and breaking of the telegraph circuit, its total impedance to ground will not much exceed its resistance, r, which in this case is 15 ohms. But the telephone current has a very high frequency, and owing to the high inductance of coil *C* almost the total telephone current passes through the telephone set. The total impedance to the voice currents through coil

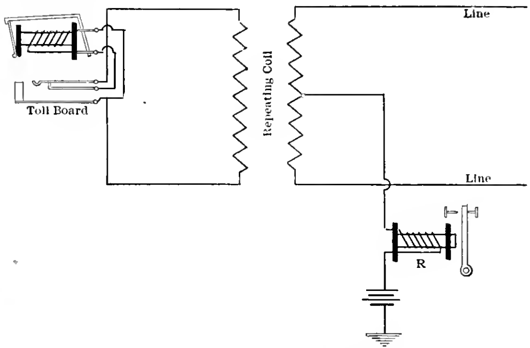


FIG. 3.—CIRCUIT WITH REPEATING COIL.

C may be expressed by the formula: Impedance $= \sqrt{R^2 + (2\pi\, n\, L)^2}$ in which n is the frequency and L the inductance. The average value of n is about 1,000. Taking the value of L at 10 henrys, the impedance $= \sqrt{30^2 + (2 \times 3.1416 \times 1{,}000 \times 10)^2} = 62{,}832$ ohms. In this case r (30 ohms) is so small compared to the reactance that it does not appreciably affect the result, 62,832 ohms, at all and could just as well be neglected. Coil *D* is similar to coil *C*, but is wound to 50 ohms. The two windings on this coil are connected so that the inductive reactance of the two coils oppose each other. This is very important, for it has been determined by trial that otherwise the self-induction from this coil in making and breaking the telegraph circuit causes a very perceptible click in the telephone.

Fig. 5 represents diagrammatically the form of the current wave when the telegraph current passes through a coil having a very high coefficient of self-induction. Upon the breaking of the telegraph circuit by the key, the potential instantly rises, which causes the high

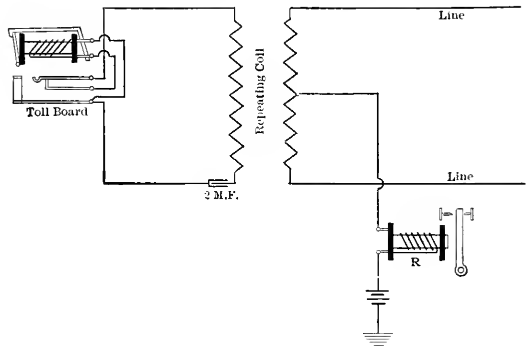
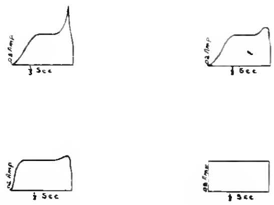


FIG. 4.—CIRCUIT WITH REPEATING COIL AND CONDENSER.

peak. This high instantaneous voltage is what produces the very severe click in the telephone set and very materially interferes with the use of the telephone. If the two windings of this coil are connected so that the inductive reactance of the coils neutralize each other, there is a very slight click in the telephone set and the lag in the telegraph circuit is very materially reduced. The sluggish working of telegraph instruments is very noticeable when there is a high inductance in the circuit of the telegraph sets. Fig. 6 represents the form of current wave when the coils are connected so as to neutralize each other. Fig. 7 illustrates diagrammatically the form of the current wave in an ordinary telegraph circuit in which the current rises almost instantly from zero to its maximum strength when the key is closed, and then remains constant or continuous about the duration of the signal and then falls suddenly to zero when the key is opened. Fig. 8 represents the form of current wave in a telegraph circuit in which there is no inductance or capacity.

While the inductive reactance of the two windings of coil D to the comparatively slow oscillation in the telegraph circuit tends to neutralize each other, owing to the neutralizing effect of the windings, it is not so with the high-frequency voice currents; for here the rate of oscillation is very high, and as a matter of fact the effect is comparatively the same, whether the coils are connected to neutralize each other or to give what would be expected to be the greatest inductive reactance.

The impedance of the coil to the telegraph current would not much, if at all, exceed its resistance. For the impedance =



FIGS. 5, 6, 7 AND 8.—FORMS OF CURRENT WAVES.

$\sqrt{R^2 + (2\pi n L)^2} = R$; since the current circulates in opposite directions through the two coils around the same iron core. If the windings were not exactly balanced, the impedance would be a little greater than R, but not much even then, because n is comparatively low, not over about 15 per second.

While the above is true of slowly changing currents, it does not apply to extreme high-frequency currents. The core of coil D forms a complete magnetic iron circuit, and is large and massive, which makes it sluggish. This prevents a complete reversal of its magnetism throughout the whole core when the very high-frequency telephone currents tend to reverse it; therefore, instead of one complete magentic circuit we have two. The lines of force set up in each coil find a return path through the air rather than through the iron; moreover, the two coils oppose each other inductively, which further tends to make each coil and its core act as an independent impedance coil. Such being the case, we have two similar impedance coils in series to oppose the telephone current. The impedance of the two coils in series is given by the formula:

$$\sqrt{(2R + 2R)^2 + (2\pi n L - 2\pi n L)^2} = \sqrt{(R)^2 + (4\pi n L)^2}.$$

The proper arrangement of condensers and their capacity is also

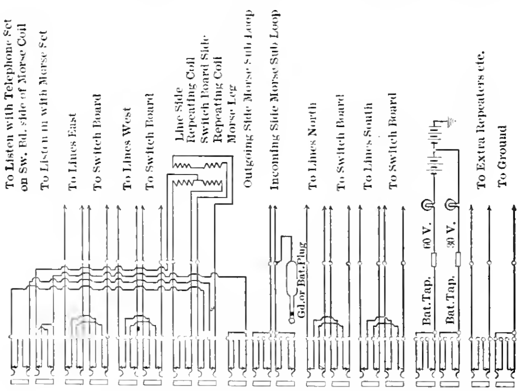


FIG. 9.—TEST PANEL USING REPEATING COIL FOR MORSE WORK.

quite important. The greater the capacity of a condenser within certain limits, the more efficient it becomes for transmitting speech. For this reason, a large capacity condenser would naturally suggest itself for use in series with the telephone set, which is bridged across the line. Experience has proven that if a large condenser is used in this connection, that it causes quite a perceptible disturbance from the telegraph in the telephone set, due to the fact that the greater the capacity of the condenser the larger the charge and discharge as the potential on the telegraph line rises and falls when the key is closed and opened. The larger charge and discharge currents flowing between the condenser and ground, produce, of course, a greater variation of potential in the circuit in which the receiver is connected. Thus the telephone receiver is interfered with if the capacities of the condensers B and B' are too large.

The condensers which are bridged to ground, between the im-

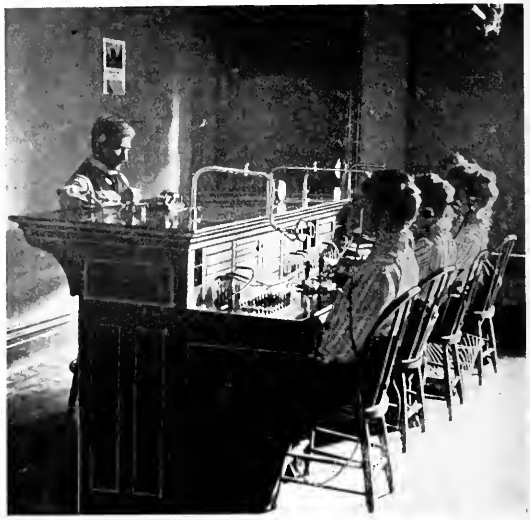


FIG. 11.—TICKET WIRE OPERATOR AND LONG-DISTANCE TELEPHONE OPERATORS.

pedance coils and telegraph instruments, should be from six (6) to ten (10) microfarads. The greater the capacity of these condensers, the less the disturbance in the telephone circuit from the telegraph.

It is sometimes advisable to bridge the telegraph key with a two (2)-microfarad condenser, which absorbs the sudden rise of potential due to the self-inductance of the line and coils when the circuit is broken by the key, thus preventing a sharp fluctuation on the line tending to cause a disturbance in the telephone set.

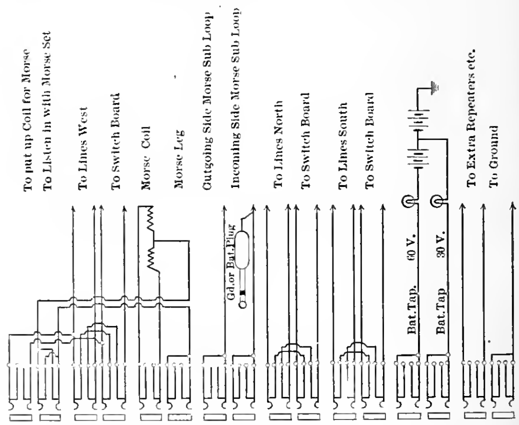


FIG. 10.—TEST PANEL USING IMPEDANCE COIL FOR MORSE WORK.

The above arrangements of circuits and apparatus gives a very satisfactory service, both from a telegraph and telephone standpoint, and admits of the use of a pair of wires for carrying on intelligence between three pairs of parties at the same time, without interference, which very materially increases the earning powers of a long-distance line. The principle disadvantage of the system is the difficulty of securing suitable signalling apparatus between the telephone operators. Signalling over a composited long-distance line in the ordinary way with telephone generator seriously interferes with the telegraph service and does not signal the distant telephone operator, owing to the comparatively low frequency of the regular generator, and the arrangement of the apparatus in the circuit.

60-cycle current is used, there is no interference to the telegraph service, and the signalling between telephone operators is positive if a properly designed line drop is used.

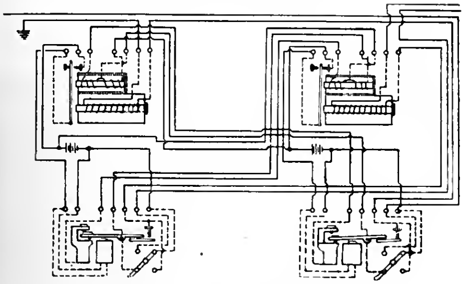


Fig. 12.—Wiring of Weiny-Phillips Repeater.

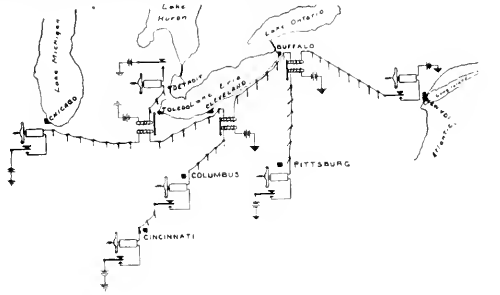


Fig. 13.—Diagram of Through Lines and Branches.

The slow alterations of the signalling generators are somewhat impeded by condensers B and B', and shunted from the line drop in the telephone set by coil C, which does not offer a very high impedance to a 16-cycle ringing current, but if a 133-cycle or even a

Within the past few months there has been installed on some of the long-distance lines apparatus that enables the ordinary ringing currents to be used; the ringing currents being passed through a vibrator, which in turn passes through a small transformer, the secondary of

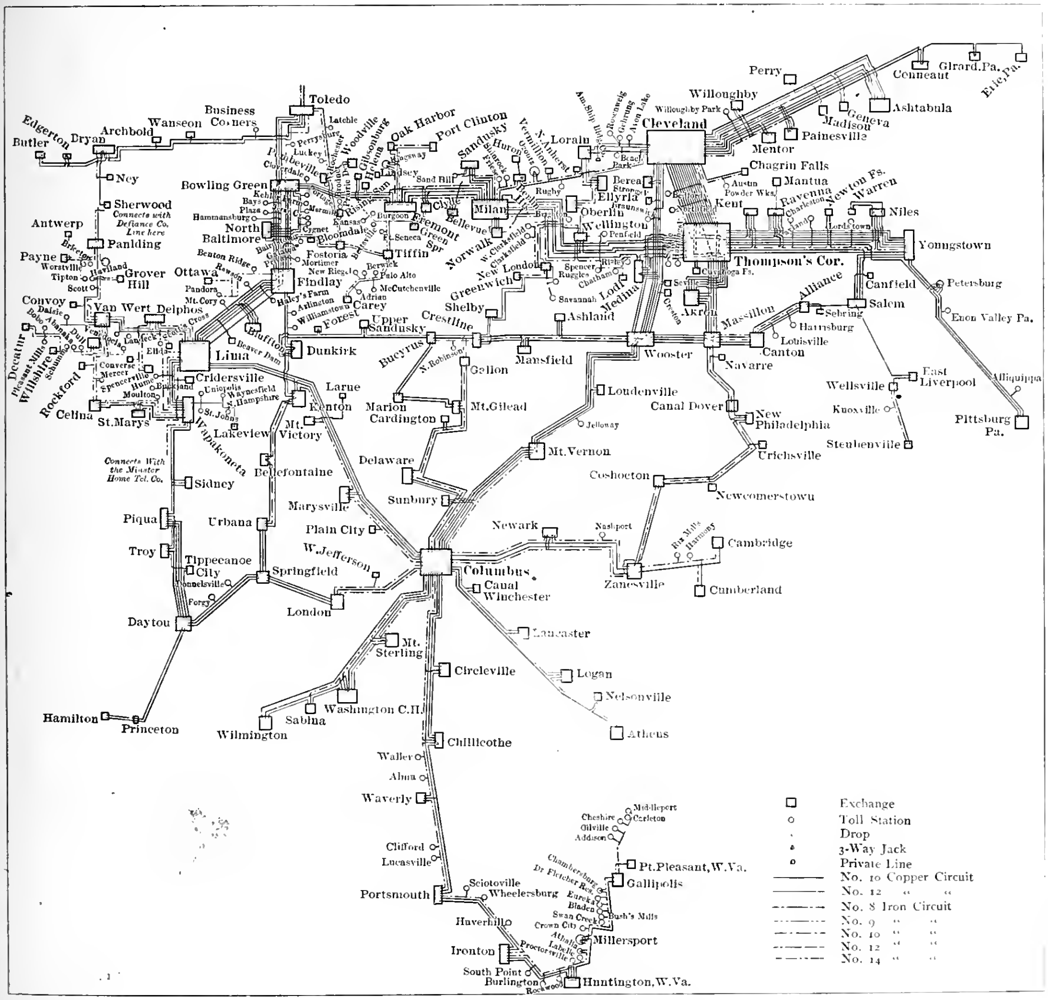


Fig. 14.—Circuit Map, United States Telephone Company.

which delivers to the line a comparatively high-frequency current, which operates a specially-designed relay, which in turn operates the line drop, thus signalling the operator at the distant station.

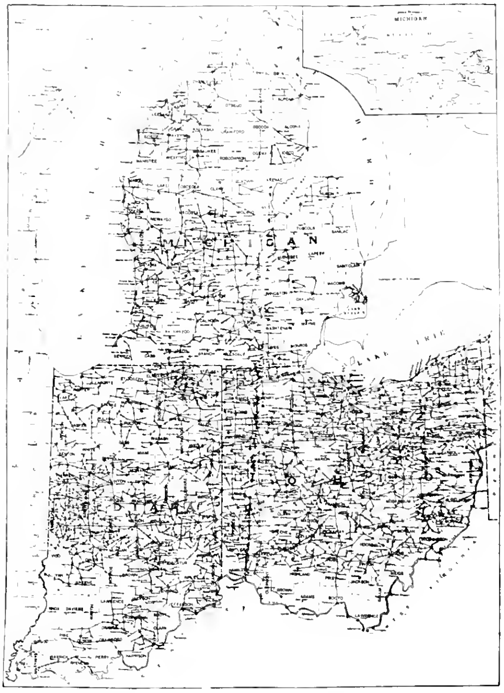


FIG. 15.—MAP OF TOLL LINES IN MICHIGAN, INDIANA AND OHIO.

The disadvantage of the high-frequency currents is that they tend to produce noise on the lines. When lines are composited, the telephone connections are usually ordered up by telegraph or order

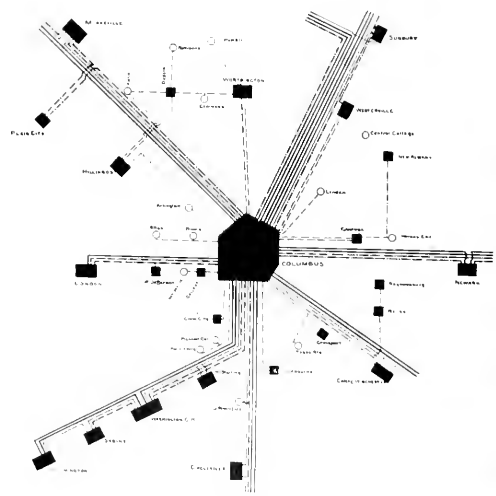


FIG. 16.—TROUBLE DISTRICT.

wire, most generally by the telegraph. Fig. 11 shows view of a ticket wire operator sitting at the rear of tollboard, making appointments and ordering up telephone connections by telegraph.

Fig. 2 shows another method of using a telephone line for telegraph purposes. This system possesses advantages as well as disadvantages over the one so far described. It is much cheaper to install, but it requires both sides of the line to make one telegraph circuit. It possesses, however, the advantage of the telephone operator being able to signal in the regular way without the use of special apparatus. The impedance coil, which is bridged across the line, has very low resistance, but high inductance, which prevents the voice currents from being short-circuited. The telegraph circuit being tapped in the center of the winding of the impedance coil, there is no inductance to oppose the telegraph current and to produce

FIG. 18.—REPEATER AND SWITCHING STATION, TOLEDO, OHIO.

a lag in the telegraph circuit, which tends to make the telegraph instruments act sluggish. The principal disadvantages of this system are: First, there can be but one telegraph circuit derived from each telephone circuit; second, the interference to the telegraph service by telephone operators signalling with ringing generators, which become accidentally grounded or which are permanently grounded. This trouble could be remedied by using a special generator at the terminus of the Morse lines, if it was not for the fact that the same circuit is often connected to other long-distance telephone lines, which extend to scores of other offices, any one of which, by ringing with a grounded generator, interferes with the telegraph service. A third objection is that unless condensers are used between the impedance coil and the terminus of the line on the tollboard, the Morse circuit is liable to become grounded, and interfere with the telegraph service by a telephone operator connecting this circuit with another long-distance line, which is accidentally grounded. The last two conditions can be eliminated by terminating the telephone lines, which are also used for Morse work on smaller size jacks on the tollboard, and using connecting cords, which have repeating coils in circuit, and which terminate on large

FIG. 17.—REPEATER AND SWITCHING STATION, THOMPSON'S CORNERS, O.

and small-sized plugs. This slightly interferes with the rapid handling of telephone traffic and cuts down the talking efficiency of the line, to some extent, but effectually prevents interference to the telegraph service.

Fig. 3 shows the use of a repeating coil for deriving a telegraph circuit from a telephone circuit. This system possesses the advantage of operators being able to signal each other with an ordinary generator, providing it has sufficient voltage and output, and there is no interference to the telegraph service in case the derived line is connected with a line which is grounded. The telephone service

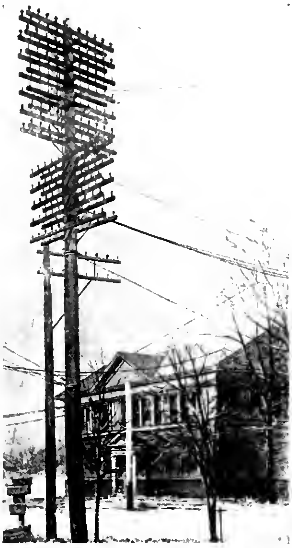


FIG. 19.—TERMINAL POLE SHOWING LEADS.

over this system is very inferior owing to the number of repeating coils which are liable to be used if the telephone circuit is of any great length and built up at a number of stations.

The repeating coils used in this system have to be specially designed so that they will transmit the ringing current, otherwise the telephone operators would not be able to signal each other. Such coils, while efficient for ringing purposes, are quite inferior for transmitting the voice currents, with their high frequencies.

The system also has the disadvantage of the telegraph service interfering with the telephone service. This is caused in three ways: First, if there is an escape caused by a slight ground on one side of the line, it causes a greater flow of the telegraph current through the winding of the repeating coil that is connected to the side of the line from which there is an escape. This allows the click of the telegraph to be heard in the telephone. Second, if one side of the line is of higher resistance than the other, which is always the case

FIG. 21.—TEMPORARY TEST PANEL, TOLEDO, OHIO.

to a greater or less extent, it causes an unequal division of the current which produces a disturbance, as above mentioned. The same disturbance is noticeable if the windings of the coils are not perfectly balanced.

The circuit illustrated in Fig. 4 is the same as Fig. 3, except that there is a 2 m.f. condenser in series wihh the coil leading to the toll-board. It has been found that a condenser so placed assists in throwing the line drop.

FIG. 20.—VIEW OF WIRE CHIEF'S ROOM, THOMPSON'S CORNERS, O., SHOWING REPEATER TABLES, TEST PANEL AND PORTION OF COIL RACK.

Figs. 9 and 10 represent diagrammatically the wiring of what is known as a Morse test panel. Fig. 9 represents the method of wiring where repeating coils are used, and Fig. 10 represents the method of wiring where impedance coils are used. Wiring for composite work is somewhat more complicated owing to the fact that each side of the line is used for a separate telegraph circuit. The wiring of these test panels must be such that great flexibility is secured in building up circuits and replacing breaks in a long line. If a New York-Chicago composite circuit gives trouble, the wire chiefs at the various switching stations along the line must be able to immediately locate the trouble and remedy same. The section which is in trouble will be located between two switching stations. This portion of the circuit must be discarded and another wire from some other circuit substituted without a moment's delay, as the telegraph circuits are kept busy by brokers and other classes of important business, in which a slight delay often means considerable loss. For to give a thoroughly reliable service the company should have several different leads throughout the country over which to route the business in case one lead wire was entirely broken down by a sleet storm, etc.

The test panels are equipped with instruments for making tests for locating trouble and listening in on telegraph lines to see if same are working properly. The wire chief must be able, by listening in with a telegraph instrument, to determine whether there is a swinging ground on the line, an escapement, insufficient battery, etc., and be able to remedy same without delay. (Morse wire chiefs become very expert in detecting the slightest trouble by listening to a Morse instrument.) The test panels are so wired that a line between New York and Chicago which is being used in sections for telephone work; for instance, between New York and Buffalo, parties may be carrying conversation over one section, Buffalo-Toledo parties using another section, and Detroit-Chicago parties using another section, and at the same time the entire line is being used as

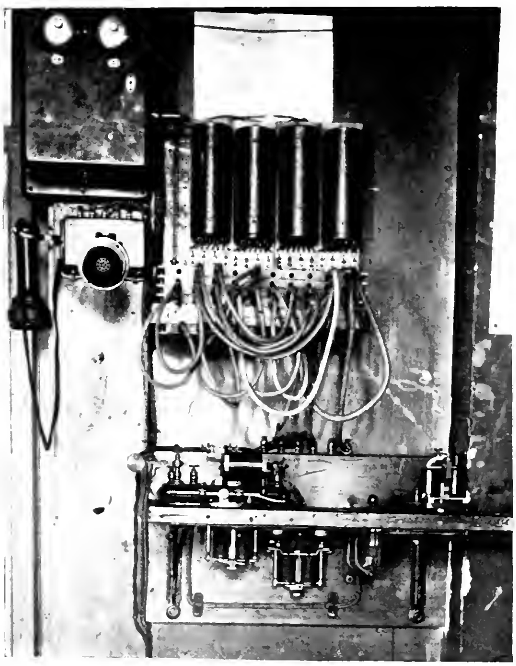


FIG. 22.—EQUIPMENT USED IN SMALL SWITCHING STATIONS.

one complete telegraph circuit. It is also practicable to use one side of one line in one section and another side of another line in another section to make up one complete telegraph circuit without interference in any way.

The test panel is also arranged so that any voltage which may be required up to 120 volts can be cut into any telegraph circuit. This is accomplished by the means of storage batteries located in the switching stations. Various voltages are used according to the distance between the stations and the number of instruments in circuit and the amount of leakage. However, with too high a voltage there is a greater liability of the telegraph interfering with the telephone. Arrangements are such on the test panels that repeaters can be cut in or out according to the requirements, and side line repeaters added, if necessary. The wiring of the Weiny-Phillips repeaters is shown in Fig. 12.

Fig. 13 shows diagrammatically a through line between two terminal points with branch lines taken off at intermediate cities. In

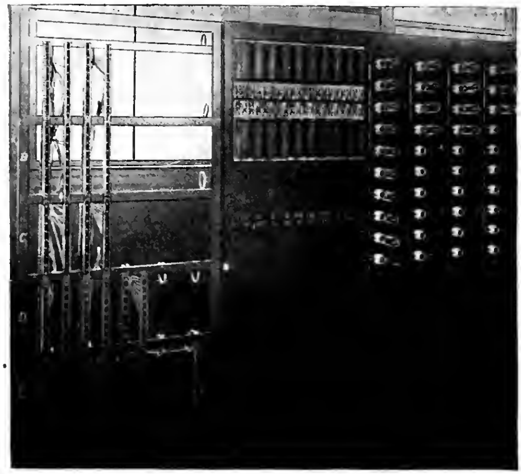


FIG. 23.—VIEW OF CROSS-CONNECTING RACK, MORSE COILS AND BATTERY RESISTANCE LAMPS.

newspaper work, for instance, between New York and Chicago, a number of cities not directly on the line, receive the service over a signal branch line from the main line, while the main line remains continuous. At the point where the branch is made, a side line repeater is used. If a loop was used double the mileage of wire would be necessary to serve the branch cities and in addition there would be added considerable impedance to the circuit and a greater liability to trouble, such as breaks, grounds, etc.

The geographical location of long-distance switching or repeater stations is a very important matter both from a telephone and telegraph standpoint, and from a point of economy in buildings, equipment, and in superintendance, they should be located at the same place. These stations should be located near and on direct lines between the large business centers and at distances from three to four hundred miles apart. From a telephone standpoint, it is much more economical to have the long-distance lines divided into sections, for instance from Chicago to New York or Boston, the line should be in sections; say, from Chicago to Toledo, from Toledo to near Buffalo, Buffalo to Albany, Albany to New York or Boston. If the telephone circuit was continuous, the company would be unable to receive as high earning powers from the line. By being divided into sections, each section is capable of transacting a toll business between intermediate cities when the line is not in use between the terminal points. This very materially increases the earning powers of the line. From a telegraph standpoint, it is quite often necessary that the line be continuous. Unlike the telephone, the telegraph is more efficient when repeaters are located every three or four hundred miles along the line. By means of automatic repeaters and separate sets of batteries for each section of the line, telegraphing is carried on more satisfactorily than when a continuous circuit is used. The earnings of long-distance lines are oftentimes more than doubled by being able to telegraph over the same line at the same time. The rental usually charged is $20 per mile per year for 12 hours' service and $30 per mile per year for 24 hours' service. The American (Bell) Telegraph & Telephone Company base the distance on which to charge on the railroad mileage. The Independent United States Telephone Company base their mileage distance on the air line distance between the cities receiving the service. The distance between New York and Chicago is approximately one thousand miles. At

$20 a mile per year the rental for one side of a telephone line for telegraph purposes would be $20,000. As a matter of fact, there are a number of telephone circuits between New York and Chicago for which brokers, newspaper companies and large business interests pay $18,000 a year for a single wire, which brings the earnings of a telephone circuit for telegraph use up to $36,000 per year. In addition to a very large toll earning from the use of the long-distance telephone, a telephone company is at very little additional expense when supplying telegraph service, or what is often termed leased wire service, as the parties who lease the service supply their own telegraph operators. The maintenance of the line is practically the same whether the telephone lines are used for telegraph purposes or not. The copper circuit furnished by long-distance telephone companies are much superior to the ordinary iron wire used by the telegraph companies. The United States Telephone Company, whose offices are in Cleveland, Ohio, has several thousand miles of long-distance telephone line, over which they are doing a very heavy simultaneous telegraph and telephone business, having leased lines to a number of brokers in Cleveland and other cities, such as Pittsburg, Pa.; Youngstown, Ohio, and Columbus, Ohio. Their lines also carry the bulk of telegraph work done by the Associated Press in Ohio, and some business for the Steel Corporation between Cleveland, Ohio; Pittsburg, Pa.; Wheeling, W. Va., etc., as well as for some of the coal mining companies. They have been successfully carrying on this line of work, now, for more than two years. The simultaneous telephone and telegraph equipment was put in operation by the writer while engineer for the United States Telephone Company.

Fig. 14 shows a circuit map of the United States Telephone Company's lines in Ohio. This territory is subdivided into districts over

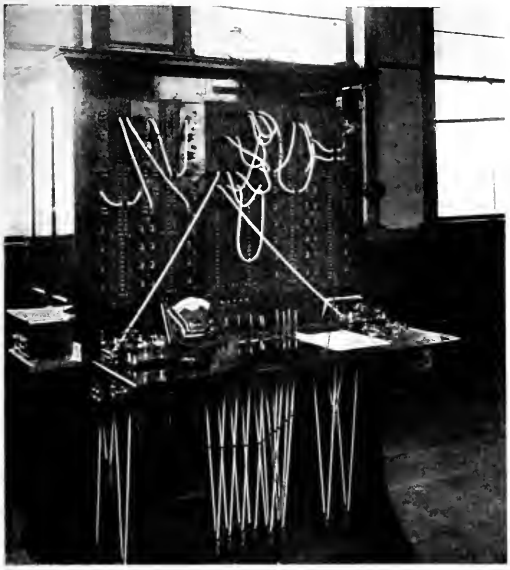


FIG. 24.—TEST PANEL, SHOWING METHOD OF BUILDING UP SIMULTANEOUS TELEPHONE AND TELEGRAPH CIRCUITS.

which the superintendent of that district is held responsible for the service of both telegraph and telephone equipment.

Fig. 15 is printed merely to indicate the density of toll line service operated by the various independent companies in Ohio, Indiana and Michigan. As a matter of fact, the network lacks many new lines. These lines are tributary to the United States Telephone Company's long-distance trunk lines. In the State of Ohio the United States Telephone Company now operate more than 19,000 miles of copper metallic circuit and is connected with 498 independent telephone exchanges, which operate more than 140,000 telephones and through the tributaries, such as various independent toll lines, reach 1,470 cities, villages, towns and hamlets in the State of Ohio. Fig. 16 is a map of the lines radiating from Columbus and illustrates how territories are mapped out for the various district superintendents.

A number of engravings are presented herewith, made from photographs in regard to features of the work. Fig. 17 is a view of the United States Telephone Company's repeater and switching station at Thompson's Corners, Ohio, and Fig. 18 of the repeater and switching station at Toledo, Ohio. Fig. 19 shows a terminal pole, with leads north, south and west. Fig. 20 illustrates the wire chief's room with repeater tables, test panel and a portion of the coil rack, Thompson's Corners. Fig. 21 shows a temporary test panel at Toledo, Ohio, and Fig. 22 shows the equipment used in small switching stations, in the wire chief's office of the local telephone company. Fig. 23 shows the cross-cennecting rack, Morse coils and bank of battery resistance lamps. Fig. 24 is a test panel and illustrates the method

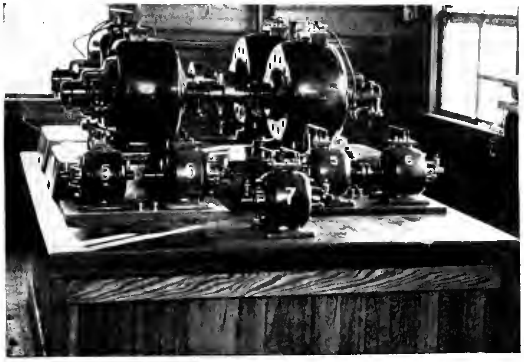


FIG. 25.—DUPLICATE SETS OF CHARGING AND RINGING MACHINES.

of building up simultaneous telegraph and telephone circuits. In Fig. 25 is seen an equipment of duplicate sets of charging and ringing machines. The generators are designed for charging storage batteries, for operating the systems as described above.

Within a short time the United States Telephone Company will be able to communicate with all the large cities of the central west, of the northwest, of the southwest and all the principal cities in the east except New York and Boston.

There is at the present time, with the exception of two breaks of 40 miles each, a solid copper metallic circuit of Nos. 8 and 10, from Topeka, Kan., to Atlantic City, connecting Topeka, Kansas City, St. Louis, Indianapolis, Columbus, Cleveland, Pittsburg, Baltimore and Philadelphia. Paralleling this, with the exception of two short breaks, is a solid copper metallic circuit connecting Albany, Syracuse, Buffalo, Cleveland, Toledo, Detroit and Grand Rapids.

With the building of less than 200 miles of line there will be a solid trunk line of copper metallic circuit connecting the northwest with the southwest, starting at Duluth, passing through Minneapolis and St. Paul, down the Mississippi River to La Crosse, Wis.; Dubuque, Iowa; St. Louis, Mo.; San Antonio and Galveston, Texas.

The Illinois Telegraph & Telephone Company is at the present time perfecting plans for joining the independent toll trunk lines of the central west with its large automatic exchange in Chicago. This will not only give switching facilities for the through trunk line systems, but will enable the independent telephone companies of the west to reach Chicago, which is their business center.

With the rapid consolidating of independent telephone properties that has been progressing for the past few years, we cannot but expect to see two great telephone companies competing for both telegraph and telephone business, which will eventually bring about a consolidation between one of the telephone companies and one of the telegraph companies. This may compel an alliance between the two remaining companies, for the telephone and telegraph companies combined can reduce operating expenses very materially. The same official staff, the same buildings, same conduit system, pole lines, etc., that is used by one can be used by the two; and many other decided economies could be effected and give a more effective and superior service.

Water Power Transmission Plant at Elliotts Falls, Ontario.

By Charles L. Fitch.

THE Province of Ontario, situated as it is, immediately contiguous to the populous and agriculturally active States of New York, Pennsylvania and Ohio, would long since have rivalled them in wealth and importance were it not for the fact that its soil, with the exception of a strip along the southern border, is to a great extent rocky and barren, yielding at best but meagre return to the labor of the farmer. Nature, however, as if to make amends for its niggardness in this respect, has provided an abundant supply of water; and the surface is dotted with myriads of lakes connected by innumerable small streams, forming indeed an almost unbroken chain from Hudson Bay on the north to Lake Ontario on the south.

These streams as a rule are quite small, their average flow in many cases being less than 200 cu. ft. per second; but though the volume of water is not large, in most cases it is quite constant, owing to the immense natural reservoirs in the lakes above which constitute the sources of supply. For this reason they are admirably adapted to the development of power, as their even flow not only insures that the full amount of power counted on will be obtainable every day in the year, but does away with the expensive construction so necessary in less favored localities to take care of floods.

As it has become patent to all that the poverty of the soil in this region has rendered farming but a thankless occupation, increasing attention is daily being given to industrial enterprises as a means of livelihood, and although development must necessarily be slow, owing to the—as yet—limited resources of the people, it is not beyond the bounds of belief that we shall one day see the Province of Ontario prospering as a manufacturing district supplying the vast market which will then be found in the great agricultural Northwest, which even now shows signs of its coming importance. In this development, the many water powers along the small streams with which the country abounds, will play no unimportant part.

FIG. 3.—THE FALLS.

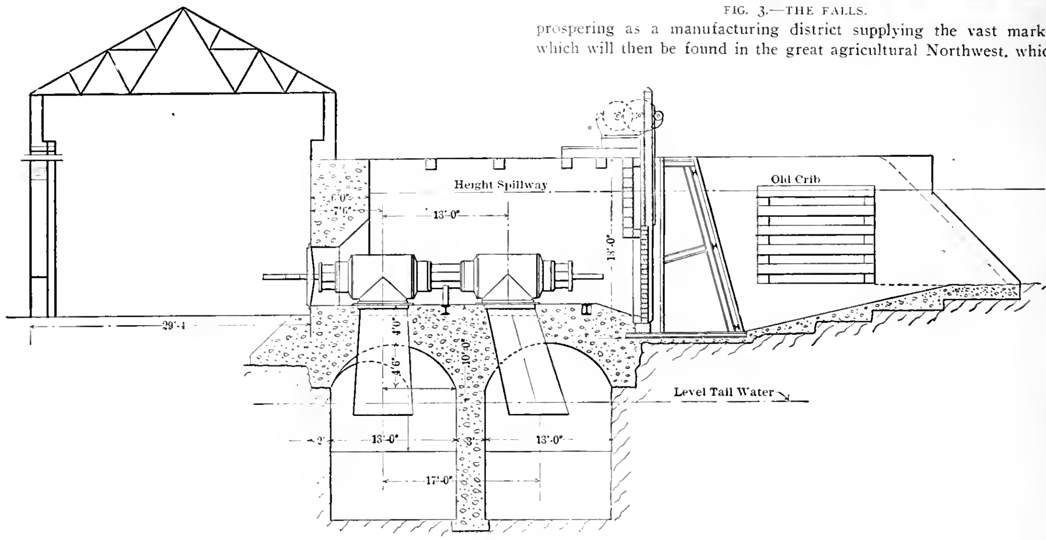


Fig 1.—Sectional Elevation of Generating Plant.

FIG. 2.—VIEW OF OLD DAM FROM BELOW.

Among the more recent enterprises set on foot in this section, not the least important is the cement works of the Raven Lake Portland Cement Company, a six-kiln plant of modern design located at Raven Lake, in Victoria County, about eighty miles north of Toronto on the Grand Trunk Railway. This manufactory, which will be ready for operation early in the coming summer, was designed by the well-known cement engineer, Robert F. Wentz, of Nazareth, Pa., and represents the most advanced ideas in the economic manufacture of cement. The marl forming one of the ingredients is to be dredged from the bottom of the lake, which covers a deposit of great depth, and the clay to make the mix will be brought in by rail from one of the near-by beds.

One of the most important considerations in an enterprise of this character is the power for operating the machinery and grinding the cement. This may be estimated at about 24 hp-hours per barrel of output; and when steam is used this item constitutes a very considerable factor in the cost of manufacture. Power for the Raven Lake enterprise will be obtained from Elliotts Falls, thirteen miles to the north, where a water power electric generating plant for the purpose is under construction; and it is with the development of power at this point that the present article will principally deal.

Elliotts Falls is on the Gull River, a small stream in one of the principal chains of lakes in this locality, which flowing south and east find their way eventually into Trent River and Lake Ontario. For many years the government has maintained a dam at this point, and a sluiceway to facilitate the "running" of logs, and the place was once the site of a small mill, which, however, utilized but little of the power available. The flowage of the river when last measured was somewhat under 600 second-feet, and the fall from the spillway of the dam to the surface of tail water when operations were commenced was about 17 ft.

After careful consideration, it was decided to raise the dam 18 in., and by blasting out a ridge in the river below. lower the tail-water 3 ft., giving a total head of 21½ ft. With these changes it was considered feasible to develop a maximum of 1,200 hp, and the work of designing the plant and supervising its construction was placed in the hands of the writer.

FIG. 4.—EXCAVATING THE TAIL-RACE.

Referring to the sketch map at the beginning of this article, showing the falls and their immediate surroundings, it will be seen that the river flows in a southerly direction, and just below the falls, expands into a sort of basin or lagoon lying somewhat west of the general course of the stream. The government works, most of which have been utilized, consisted of a wood dam at the top of the falls proper, and a timber crib connecting with it, extending up and down the stream and confining the water to the easterly channel. The dam is provided with a sluiceway at each end and extensive runways for the passage of logs.

The plan of development included a tail-race and wheel-pit to be blasted out of the solid granite rock formation just east of the crib referred to, and extending up from the lagoon below to a point about 50 ft. above the dam. This was then to be covered by arches of concrete masonry supporting the three wheel chambers, which were made to communicate with the river above the dam through the medium of a fore-bay, formed by removing a section of the crib and enclosing the space by concrete wing walls above and below. The dotted lines on the map show the relative location of the new work.

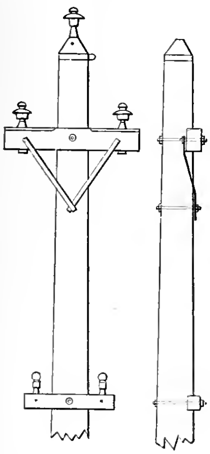


FIG. 5.—TRANSMISSION POLE.

The south wing wall was deflected at a right angle and carried down stream about 35 ft. to form the west wall of the sluiceway at the west end of the main dam, thus making it feasible at any future time to remove the main dam and replace it with a concrete structure without interrupting the continuous operation of the plant. The north wing wall was extended out 15 ft. beyond the up-stream face of the crib, which was heavily sheet-piled and reinforced by a puddle wall 3 ft. thick protected by a bank of gravel at a slope of one to one, riprapped with coarse broken stone.

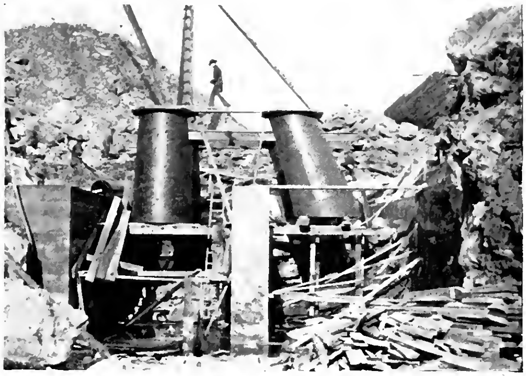


FIG. 6.—SETTING THE DRAFT TUBES.

As the main dam itself was very leaky, extensive repairs here were found necessary, but they will be only of a temporary nature, pending an entirely new structure in the near future.

In order to carry on the hydraulic work as above outlined, it was necessary to construct a coffer-dam from the west end of the spillway of the main dam to the west bank above the crib. The greatest depth of water found was about 7 ft., and the structure decided on was a cribwork of 10-in. x 12-in. hemlock sawed timber, 6 ft. wide on top, loaded with stone and sheet-piled with two layers of 1½-in. plank. This was found to answer the purpose satisfactorily

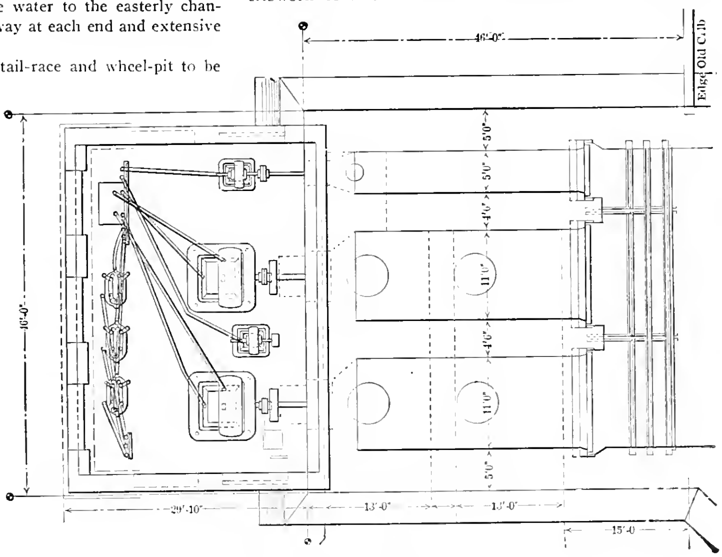


FIG. 7.—PLAN OF POWER HOUSE AND FOREBAY.

The excavation of the wheel-pit and tail-race was carried on with rock drills of Canadian manufacture. the work being commenced at the north end and extended in a southerly direction toward the lagoon; the final breaking through into the river being deferred until everything was completed in the wheel-pits, and the draught-tubes and masonry supporting them were in place. The separating ridge was then blasted out, letting the water in, the debris being removed by dredging. In this way the necessity of a coffer-dam below the falls was avoided.

The entire masonry structure was of concrete composed of Portland cement, sand and crushed stone in the proportions of 1, 2 and 5. The cement was of Canadian manufacture, and suitable sand and stone were obtained on the ground. The concrete was mixed by a Jeffrey spiral mixer.

As the necessity for early completion required that much of the masonry be put in place during the cold winter months, a temporary building framed of rough poles and sheathed with inch boards covered with tar paper was constructed over the entire work, and the interior was kept heated with stoves and steam coils to a temperature of not less than 40° F. day and night until completion. In this way the progress of the work was rendered independent of weather conditions.

The power house was constructed with concrete walls and a wood-sheathed felt roof supported on steel trusses. The general arrangement may be seen from the ground plan and section elevation shown herewith.

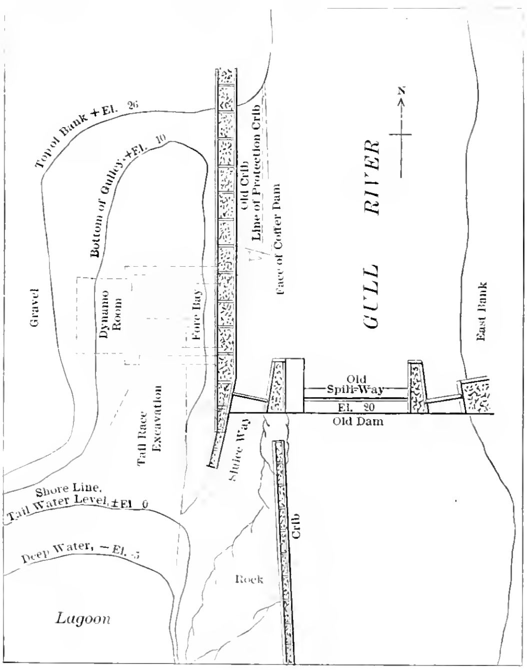


FIG. 8.—SKETCH MAP OF LOCATION.

The generating units, two in number, are each direct-driven by a bank of four 25-in. horizontal turbine wheels mounted on one shaft, which pierces the breast wall separating the wheel chambers from the dynamo room.

The turbines were furnished by the Jencks Machine Company, of Sherbrooke, Ontario, and each bank of four has an ultimate capacity at full head, of 600 hp on the wheel shaft. They are equipped with Woodward governors.

The generators have each a rated capacity of 350 kw and generate alternating current of 25 cycles. There are two exciters, each sufficient for the entire output of the station. One of them is designed to be belt-driven from the shaft of either of the main dynamos, while the other is provided with its own pair of turbines and is direct-driven.

The low-tension switchboard is of marble and is located at the north end of the building. It consists of a main panel, two generator panels, an exciter panel and a feeder panel, all equipped with the usual instruments and switches. The high-tension switchboard is of similar material and is placed at the south end of the room, the space between the two being occupied by the static transformers, which step the current up to 16,000 volts for transmission to Raven Lake. All wiring is carried in conduits placed beneath the concrete floor, and the station is protected by lightning arresters of the General Electric type. The entire electrical equipment was furnished by the Canadian General Electric Company.

The transmission line, between the generating station and the cement mill at Raven Lake, is supported on cedar poles, spaced 115 ft. apart. The general arrangement may be seen from Fig. —, representing a trimmed pole. Each pole has a single cross arm 4 in. x 6 in. of Georgia pine, with steel braces and Locke porcelain insulators. The conductors, three in number, of No. 2 aluminum cable, are carried, two on the cross arm and one on the peak, forming an equilateral triangle, 28 in. on a side. There is also a telephone circuit of two No. 12 galvanized iron wires, supported on a smaller cross arm placed 6 ft. below and transposed every 500 ft. Both the cross arms and the braces are bolted through the poles with galvanized bolts.

The poles vary in length from 30 ft. to 45 ft., being set to a profile, avoiding all abrupt changes in level; and the line runs partly along the public highways and partly over private property, keeping it as straight as possible.

At the Raven Lake end there is a masonry sub-station 25 ft. x 37 ft., in which are placed the static transformers which step the current down to 600 volts for use in the mill.

In this connection, it is interesting to note the strides forward which mark the present era in the history of our cousins across the border; and the case in point, where almost everything needed was obtained from native sources, is but a slight indication of the growth which has taken place in the last decade.

The Canadian is nothing if not conservative, and turns his back squarely on the bubble of inflation. Born of a self-reliant stock, he thinks well of his own judgment, but does not disdain the assistance of others. While making haste slowly, his progress is exceeding sure, and unmarred by the fiascos which have brought many to ruin. With a supreme confidence in the good-will of his fellow-men, he takes kindly to a new idea only when he has become satisfied that it will pay, but once satisfied he embraces it eagerly, subscribes to it as far as his means will permit, and works with a will to help it along. For these reasons his banks are secure and his shares generally pay dividends.

The Raven Lake Portland Cement Company is a Canadian institution having its headquarters at Toronto. John Lucas is its president and Thomas McLaughlin its secretary-treasurer, and to the untiring energy and devotion of these gentlemen may largely be traced the success which has attended the launching of this enterprise.

Cable War Messages.

A telegram to the newspaper press from Chicago of March 21 says: "Two Associated Press war bulletins raced from Yin-Kow to Chicago to-day, one by the European route and the other across the Pacific. The one from the east reached here at 11.12 o'clock, and the one from the west just eight minutes later. Both were filed at Yin-Kow to-day at 7.30 P.M. Each was about 100 words in length, and they were almost identical in matter. They were sent by different routes to test the rapidity of transmission. They were not censored or held up in any way en route." In this connection the *Chronicle*, of San Francisco, asserts that that city is now the center for the world of news from the Pacific.

N. E. L. A. Index.

A very comprehensive and much needed index of all the volumes of proceedings of the National Electric Light Association since its first convention is now in process of compilation. This work has been undertaken by Mr. T. H. Creden, who is not only one of the best statisticians in the electric lighting business, but is also a constructing and operating electrical engineer, having served in both capacities with the Chicago Edison Company and with Messrs. Stone and Webster. In giving his services for this work, Mr. Creden will deserve much gratitude from the members of the Association and others interested in the reports, as it now becomes an easy matter to find at once any topic or paper to which reference is desired. Until the book of the twenty-sixth convention was printed no attempt at a topical index has been made. It is the intention to have the complete index printed before the Boston meeting, to be held May 24, 25 and 26.

Electricity and the Law in England and America.

By W. Valentine Ball, Barrister-at-Law.

THERE is no subject which awakes a wider interest on both sides of the Atlantic than electricity. The extraordinary development of its varied uses in recent years, the facilities which it has afforded for locomotion and the transmission of messages, not to mention all the other multifarious needs of mankind which it serves, tend to give it the foremost place among those branches of modern science, which have been found capable of practical application.

Seeing that the application of electricity on a commercial scale is of comparatively recent growth, it is not surprising that the law which affects its generation and distribution is to be found in statutes passed and cases decided within the last few years. But the search, even when conducted by a lawyer in England, should not be confined to English statutes and law reports. If exhaustive treatment is required or an argument is to be pointed by references to a decided case, he must often refer to the work of American lawyers, for numerous interesting cases upon the laws of electricity have from time to time been decided in the courts of the various States of the Union.

It is to be observed, however, at the outset, that although English and American lawyers have advanced along the same lines in ascertaining the application of legal principles to the vagaries of electricity, the decisions in the one country can only be regarded as useful precedents by lawyers in the other. Further, the decisions in the various States of the Union are by no means uniform, nor does it appear that the opinion of a judge in one State is binding upon that of his judicial brother in another State. Nevertheless, the general principles—with which it is my object to deal in the present article, may, broadly speaking, be taken to apply not only in England and America, but throughout the countries which are inhabited by English-speaking races.

In England, the manufacture and supply of electricity to consumers is an industry in which any private person may indulge without legal restriction, so long as he complies with the ordinary law relating to nuisance and negligence. In view, however, of the difficulties attendant upon the laying of wires and mains across private and public property, and the necessity of allowing electrical companies to have power to break up roads, etc., for this purpose, certain acts have been passed under the provisions of which the supply may be carried out under powers which impose upon each company the duty of supplying every consumer in its district on equal terms. Of these, an act passed in 1882, is the most important, and one of its provisions is worthy of particular attention, *e. g.*, Section 17, which provides that in the exercise of the powers in relation to the execution of works given them under the act, or any license, order or special act, the undertakers shall cause as little detriment and inconvenience and do as little damage as may be, and shall make full compensation to all bodies and persons interested for all damage sustained by them by reason or in consequence of the exercise of such powers, the amount and application of such compensation in case of difference to be determined by arbitration. This clause makes it plain that the company cannot plead their parliamentary powers in answer to an action for damage caused by them in the execution of their works.

Their liabilities are further declared by another provision which forms part and parcel of every order under which they work, and which provides that nothing shall exonerate electric lighting undertakers from any indictment, action or other proceedings for nuisance in the event of any nuisance being caused by them.

The effect of these sections is that they are subject to what is known in England as the common law. There is nothing which better illustrates the adaptibility of the English law to the needs of the public than the way in which the legal questions incidental to the supply of electricity are found to be solved in so far as they are not dealt with in special statutes by the recognized principles underlying the leading cases decided by English judges in days gone by

It is proposed to deal here with the liabilities of supply companies under the heads of (1) negligence and (2) nuisance.

There are many ways in which a supply company may be guilty of negligence. At the generating station itself perpetual care has to be taken that the apparatus is in such order that employees shall not be exposed to unnecessary risk. Heavy machinery involves danger to those who are employed to work it, while men employed around dynamos and at a switchboard are constantly exposed to the risk of electric shocks. Accidents at generating stations give rise to claims for compensation under the Workmen's Compensation Act, 1897, and the other acts which render employers liable to pay damages for injuries which are caused by their negligence in permitting the use of defective machinery, or employing persons whose negligence occasions injury to their fellow servants. As questions of this kind are of common occurrence and are determined upon principles which apply to all actions for personal injuries, it is not necessary for our present purpose to discuss them further.

I pass on to consider the question of liability for accidents which may arise during the transmission of electricity. Dealing first with electric lighting companies, it is necessary to point out that for the purpose of their undertaking they usually require to lay their lines overhead or underground along public streets. The Electric Lighting Acts, subject to any special modifications which may be introduced in favor of any particular company, confer upon the undertakers the right to exercise the power, subject to their making compensation for any damage or injury which they may occasion to any property interfered with. In the case of overhead wires, attachments may have to be made to houses or private property along the roadway, or to posts erected on the street itself. Again, when wires are laid underground, it is often necessary for the lighting company who wish to lay their wires to remove temporarily water pipes or gas pipes which may be in the way. In all these cases the company is liable for negligence.

But the liability of the company does not end with construction of works. They are also bound to make good any damage which may be occasioned to the public by falling wires, escape of current and electric shock. If we may refer to a case which has to do with electric traction, in a case which was heard some years ago, it was proved that a wire which was fully charged, fell upon and killed a horse. The Court held the company liable. But where, in another case, the damage was caused by a telephone wire falling on a trolley wire and so earthing the return current, it was held that inasmuch as the falling of the telephone wire was the proximate cause of the accident, the electric supply company was not liable. It was held in that case that the injury was really caused by the negligence of the telephone company in allowing its wire to get into such a state of repair that it broke and fell. It follows from this that if a wire were to break and do damage to private property of any kind, the electrical company might be held responsible.

No liability, however, will be incurred in respect of damage which results from an act specially authorized by statute, or which is the necessary consequence of what is so authorized; but for this exception to apply, the power specified by the statute must be strictly adhered to, and if a choice exists as to the manner in which the powers may be exercised, due regard must be had to the individuals or the public affected by the exercise of the powers.[1] Hence if we may again borrow an illustration from the law relating to tramways, if a company has authority to conduct electricity along naked wires or rails, it will not generally be liable for any injury to a person coming into contact with them, nor will it be liable for any injury caused by the accidental breaking of a wire or rail merely by reason of such breakage. Where there is negligence on the part of the company, however —as if wires are allowed to sag so as to be within reach of persons passing along the street—the company will be liable for injuries arising out of such negligence, and in such cases the burden of proving negligence is not on the person claiming damages. In a case from Cape Colony[2] the defendants were owners of a telegraph wire and poles, which they had erected along a street under proper authority. A boy passing along the street either touched accidentally or took hold of a wire hanging from a pole, and his right hand was seriously injured by the electric current. It was given in evidence that the day before the accident the wire was hanging slack within the reach of passers-by, and this had been duly reported by a lineman to his superiors, and that the wires were usually inspected every four days. The company was held responsible. It was urged on behalf of the company that the plaintiff had been guilty of contributory negligence, but the Court held that there was a distinction to be observed between contributory negligence in a child and in a man.

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[1] Seward Brice on Tramways, 1902.

[2] *Kift v. Town Council of Cape Town*, 1 South African L. J. (1901) 181.

Cases of negligence decided in the American and Canadian Courts are exceedingly useful to English lawyers. The effect of these cases is admirably stated in Mr. Robertson's work on "Tramways and Light Railways," 1903, p. 240. Thus, with regard to the care required from owners of electric apparatus, it has been decided that such care should be in proportion to the dangers which it is their duty to avoid, although, as was decided in the case of Perham v. Portland General Electric Company,[3] they are not bound to have perfect apparatus or construction. In another case it was held that a company who have wires and poles in the streets are bound to maintain such poles properly, but are not liable for subsequent defects which inspection would not reveal.[4]

In placing a pole near existing electric apparatus they are bound to take due measures to avoid contact, and to inspect from time to time, in order to keep their apparatus in suitable condition with reference to the previously existing apparatus. Mr. Robertson also deduces the following statement of law from American cases: "Generally, the grant of the privilege to encumber the highway with dangerous electric apparatus imposes a duty not to injure persons lawfully on the highway, and to make the highway substantially as safe for them as it was before, and also to consider the safety of persons, such as workmen, whose employment will naturally bring them into proximity with such apparatus. A storm, which is the immediate cause of the accident, is no excuse where there is such a want of care, but it may be, where there has been reasonable care, and the storm is an extraordinary one."

The case of Royal Electric Company v. Heir (21 *Can. Law Times*, 442, 1901), which was decided by the Court of Appeal of Quebec, well illustrates the obligation of a company contracting to supply electricity. In this case the plaintiff claimed damages for the death of her husband (to whose house the defendant company supplied electricity for lighting purposes) caused by his taking hold of an electric lamp (supplied by the defendant company in the ordinary course of their business) with the intention of turning on the light. The precise cause of the accident was not proved, but it was suggested by the Company that it was due to contact between the wire supplied by them with a guy wire of another company's system. Damages were awarded to the plaintiff and an appeal by the company was dismissed, the Court holding that there was negligence on the part of the company, and that the burden of proof of the fact, act or omission constituting negligence was not on the plaintiff.

The cases above referred to are drawn without discrimination from American, English and Colonial Law Reports, as so far as the law of negligence is concerned the judiciary of both countries appears to rely upon similar principles.

With regard to nuisances, it is important to again refer to the provisions of Section 17. It provides, as we have seen, that the undertakers are to do as little damage as may be. It follows that if and in so far as they do more damage than is necessary, or use a process which is (1) not the best known process, or (2) an unapproved process, they are, to that extent, common tort feasors, and amenable to the ordinary law, as well as to any statutory penalties and liabilities which may be imposed.

In dealing with the legal liability for nuisance much that has been said with regard to negligence has to be carefully borne in mind. A nuisance, however, may be created as incidental to the manufacture and supply of electricity. In these circumstances how far is the supply company to be held responsible? In the English case of *The National Telephone Company v. Baker*[5] a tramway was worked on the overhead trolley system. The current, after traversing the trolley wire and the car, returned by the rails and an uninsulated copper conductor running under the roadway parallel to the rails and connected with each rail. The telephones of the plaintiff company were worked on the single wire system with an earth return. The consequence was that the telephones were rendered practically useless, and the company claimed an injunction to restrain the defendant from using tramways so as to be a nuisance to or interfere with their telephones. The Judge who tried the case was inclined to decide in favor of the telephone company, but was prevented from doing so by the fact that the tramway company were protected from actions of this kind by their private act. In coming to the conclusion that the tramway company would have been liable if not so protected, he was guided by the decision in the famous case of *Fletcher v. Rylands*, where it was held that "The person who for his own purposes brings on to his land and keeps there anything likely to do mischief, if it escapes, must keep it at his peril, and, if he does not do so is *prima facie* answerable for all the damage which is the natural consequence of its escape. He can excuse himself by showing that the escape was due to the plaintiff's default; or perhaps that the escape was the consequence of *vis major*, or the act of God."

It is somewhat doubtful whether this principle can be properly applied to the use of electricity. If a man who makes use of delicate electrical apparatus were entitled to prevent a tramway or electric lighting company from doing anything which may affect his instruments, the progress of electricity in its application to great undertakings would be wholly arrested. The doctrine of *Fletcher v. Rylands* protects a man in the natural use of his property, and it cannot be said that the employment of delicate instruments is a natural use. Of course, the provisions of a particular tramway act may deprive him of his remedy; but it is submitted that wholly independent of statute law a telephone or telegraph company could not succeed.

A recent case in the Privy Council, which came before that august tribunal on appeal from the High Court of Cape Colony would seem to support the view that *Fletcher v. Rylands* must not be pressed too far in connection with electricity. In that case an action was brought by a telegraph company against a tramway company for interference by induction. In deciding for the tramway company, Lord Robertson said: "The appellants cannot claim higher privileges than other owners of land, and cannot create for themselves, by reason of the peculiarity of their trade apparatus, a higher right to limit the operations of their neighbors than belongs to ordinary owners of land who do not trade with telegraph cables." It is true that this decision was based not upon English law but upon Cape Dutch law; but it is important to notice that the sound principle which underlies it has long been adopted in the United States. In the case of *Cumberland Telephone and Telegraph Company v. United Electric Railway Company*[6] it was held that a telephone company could not restrain an electric railway company where the escape of electricity from the wires of the railway company was incidental to the conduct of their business, and where the telephone company could protect itself at much less expense than would be incurred by the railway company in preventing the escape of electricity. It may therefore be assumed that in future English judges will administer the law as it has been laid down in the Capetown Tramway case.

Further, the principle there laid down is consistent with what is usually recognized as a correct statement of the law of nuisance in England. Thus, Mr. Garrett, in his work on the law of nuisances, states: "If the owner of land uses it for any purpose which from its character may be called non-natural user, such, as for example, the introduction on to the land of something which in the natural condition of the land is not upon it, he does so at his peril, and is liable if sensible damage results to his neighbor's land, or if the latter's legitimate enjoyment of his land is thereby materially curtailed."

It might also be mentioned that a telephone company cannot claim any monopoly in the use of the earth for the purposes of return currents. At least the law has been so decided in a number of American cases that a telephone company has no vested interest in or exclusive right to the use of the "ground circuit" or "earth return" as against an electric street railway authorized by statute.[7]

Thawing Out Pipes.

Writing us on the subject of frozen water pipes, Mr. W. M. Bell, of the Conshohocken Electric Light & Power Company, of Conshohocken, Pa., says: "I beg to inform you that we have thawed out frozen service pipes and water mains by electric current, using a 10-kw transformer and taking from 75 to 160 amp. at 110 volts and not failing to start water running in from 3 to 45 minutes. The service water pipes are, as a rule, ½-in., ¾-in. and 1-in. pipe; also ½-in. lead pipes, and the mains thawed out were 1½-in., 2-in. and 2½-in., thawing at one time 2½-in. pipe about 450 ft. long in 45 minutes. This has been done in every instance without digging, connections being made at house of owner or on fire plug. We charge $5 a service, and have found it very profitable work. This work was carried out under my supervision, as superintendent of the company, and is the first done in this section."

[3] (1898) 33 Or. 451.
[4] City of Denver v. Sherett, (1898) U. S. C. C., Colo.
[5] (1893) 2 Ch. 186.
[6] (1890) U. S. C. C., Tenn.
[7] (*Cincinnati Inclined Plane Railway Company v. City and Suburban Telegraph Association*, 48 Ohio State Rep., 390.)

The Shielded Balance.

By G. A. Campbell.

Experience shows that an ordinary balance when employed with an alternating current of the order of 2,000 cycles per second is variable and indefinite. It is the purpose of this article to show how this source of error may be entirely eliminated by shielding.

The difficulty encountered lies mainly in the direct capacity between the different parts of the system. Since the ether permits the flow of alternating currents in all directions, the attempt to employ an ordinary balance for alternating measurements is much the same as the attempt to measure resistance with a Wheatstone bridge immersed in a conducting fluid, such as acidulated water. In general a movement of the observer will change the distribution of the capacity effect and will change the adjustment required for a balance. Since it is necessary that the observer make certain movements in order to adjust the apparatus for a balance, this is a serious difficulty. Again, the entire generator circuit and connections form a part of the system, and any change in their capacity or leakage may affect the adjustment required for a balance. In case the generator is run from a lighting circuit, there is, of course, a direct capacity from the alternating-current side of the generator circuit to the lighting circuit, and this introduces the entire lighting system into the balance.

Even although the capacity of the entire system were kept invariable, there would be the difficulty that its distribution could not be determined. Thus, there may be direct capacity bridged between any number of points of the balance. This is illustrated in Fig. 1, where condensers are drawn in to illustrate this effect. Ex-

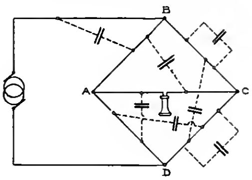


FIG. 1.

perience has shown and theory confirmed the fact that, with telephonic frequencies and impedances, these capacities are sufficient to cause large errors in the balance measurements.

As an example, take a balance having ratio arms of 1,000 ohms each, coils of .25 henry and 10 ohms effective resistance in the other arms and a frequency of 1,592 cycles per second, making $p = 10{,}000$. Then 100 micro-microfarads shunted around one ratio arm will introduce an error of 2.5 ohms, i. e., 25 per cent. in the effective resistance of the coil. The error varies as the square of the frequency and thus amounts to 100 per cent. at a frequency of 3184 cycles per second.

It is impracticable to isolate the different parts of the balance sufficiently to reduce these capacities to a negligible amount. The only practical way is to shield the different parts of the balance from each other and from any outside sources of disturbance.

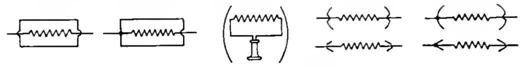
Shields may be divided into three classes, namely, 1°, magnetic; 2°, leakage, and 3°, capacity.

Magnetic shields are most advantageously made of thick iron castings. For alternating-current work they may also be made of masses of any conducting material, but iron seems to be the most efficient, considering its low cost and high permeability. In any case an efficient magnetic shield requires a large amount of material. Fortunately, the greater part of the apparatus does not require magnetic shielding. In resistances and condensers the magnetic field is very weak, and by winding inductance coils and transformers in toroidal form their external field can be made quite small. In the case of such inductance standards as have a large stray field, it is undesirable to introduce a magnetic shield on account of the difficulty of avoiding dissipative losses. Such standards must be put at a distance from other apparatus so as to avoid mutual disturbance. It is my expectation that inductance standards can be made toroidal in the future, so that the apparatus for standard alternating-current work can be used without magnetic shielding.

Leakage and capacity shields must ordinarily surround one of the two systems to be mutually shielded. Since it is usually a comparatively small capacity and leakage which is to be cut off by the shield, it is not necessary that the shields should have a small impedance. They may thus be as thin as is convenient to handle, and of any conducting material. While it is not necessary to keep the resistance of the shield small, it is desirable that the shield be so arranged that the flow of current in it shall be as direct as possible. In case the shield were spiral enclosing an iron core, the inductance of the shield circuit might be sufficient to make trouble, even although the resistance was negligible.

Fig. 2 shows diagrammatically a resistance coil with a shield entirely surrounding the coil, with the exception of two terminals. This shield is not connected to the coil and may be called a *floating* shield. Fig. 3 shows the same arrangement with the shield connected directly to one of the terminals of the resistance. This may be called a *connected* shield.

In case these shields have capacity to any other part of the system, it is evident that, with the connected shield, this capacity is



FIGS. 2, 3, 4, 5 AND 6.

definitely localized and terminates on one terminal of the resistance. It is also evident that, in the case of the floating shield, the capacity is not in general localized on any one part of the resistance, for the current to the shield will divide and a part will reach every part of the resistance which is exposed to the floating shield. In general, a floating shield is of use only when it entirely surrounds a system or a portion of a system connected only by mutual inductance with the remainder of the system. In other cases a connected shield is necessary if it is to shield one portion of a system from another portion of a system.

It is convenient to adopt a symbol for shields, since it is confusing to indicate them upon a diagram in case they form an extensive system. Figs. 4 and 6 show a symbol which I would suggest, the idea being that parentheses enclosing a network or any portion of a network represent a shield surrounding that much of the network. In case the terminals project through the shield they are shown projecting through the parentheses. In case the shield is short-circuited to one of the terminals of the network that is shown by a dot connecting the proper parenthesis with the terminal. It is to be understood that the parentheses are electrically connected. The parenthesis may degenerate into an arrow head for convenience. When several shields are employed, brackets, braces and quotation marks may be introduced. By designating shields by letters, as *S*, *S'*, *S''*, . . . their connection may be shown in the same conventional way as a ground connection. See Figs. 7 and 13.

Fig. 7 shows a shielded balance. Each of the six branches has its individual shield, which is connected to one of its terminals, and

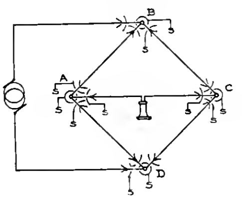


FIG. 7.

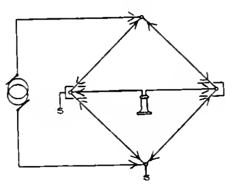


FIG. 8.

the entire balance is surrounded by a shield which is shown floating. The six terminals to which the six individual shields are connected may be disposed with respect to the four corners of the bridge in any one of the possible ways. To each of the four corners individual shields may be connected or one of the corners may have no individual shield connected to it, as shown in Fig. 7, corner *C*. The floating shield may be directly connected to any one of the four corners of the bridge. If the connection were made to a corner, such as *D*, where three of the individual shields terminate, as is shown in Fig. 7, then a material reduction in the complexity of the system would result, for three of the branches would be reduced to a single shield, and only the remaining three branches would have a double shield. In fact, but one double shield would be absolutely necessary, for, if the telephone circuit has a double shield, it does not make any material difference whether a leakage or capacity is shunted from terminal B to terminal D, provided it is not so large as to introduce serious shunting and does not contain an alternating e.m.f. and is not fluctuating rapidly itself. This arrangement is shown in Fig. 8.

Returning to Fig. 7, if the capacities of the corners to the floating shield are C_A, C_B, C_C, C_D, as shown in Fig. 9, then the equivalent set of direct capacities, C_1, C_2, C_3, C_4, between the bridge corners is:

$$C_1 = C_A C_B / (C_A + C_B + C_C + C_D)$$
$$C_2 = C_B C_C / (C_A + C_B + C_C + C_D)$$
$$C_3 = C_C C_D / (C_A + C_B + C_C + C_D)$$
$$C_4 = C_D C_A / (C_A + C_B + C_C + C_D)$$

If the impedances inserted directly between the corners are Z_1, Z_2, Z_3, Z_4, the condition for a balance is:

$$\frac{Z_1}{1 + Z_1 C_1 pi} \cdot \frac{Z_3}{1 + Z_3 C_3 pi} = \frac{Z_2}{1 + Z_2 C_2 pi} \cdot \frac{Z_4}{1 + Z_4 C_4 pi}$$

This makes the balance perfectly definite. The formulæ show that there is an advantage in leaving the outside shield floating, as this reduces the effect of any slight error in the determination of the capacity of the bridge corners to the floating shield.

In case an adjusting condenser is provided, the capacity to the floating shield may be so proportioned as to be eliminated in the equation for a balance. Thus: If Z_1, Z_2 are the bridge arms which are to be kept constant during a series of measurements, by making $C_A / C_C = Z_2/Z_1$, this condition is fulfilled. This may always be accomplished by adding a capacity at A or C, as the case may be, and balancing with Z_3 and Z_4 removed. It is, of course, necessary to consider the conductances as well as the capacity, and to balance this requires an adjustable leakage. Of course, the same balancing and elimination of the capacity may be carried out if the shield, S, is connected to the corner, D, which is necessary in a large class of work.

It is evident that there is in the preceding no limitation to equality ratios. Inequality ratios may be employed, and in fact the two ratio arms need not be of the same character. For instance, one might be resistance while the other was capacity.

Expressed in terms of the four admittances, Y_1, Y_2, Y_3, Y_4, directly connecting the four corners of the balance and the four admittances, Y_A, Y_B, Y_C, Y_D, directly connecting the four corners of the balance with the shield, S, the general condition for a balance is:

$$\left(Y_1 + \frac{Y_A \cdot Y_B}{Y_A + Y_B + Y_C + Y_D}\right)\left(Y_3 + \frac{Y_C\, Y_D}{Y_A + Y_B + Y_C + Y_D}\right)$$
$$= \left(Y_2 + \frac{Y_B\, Y_C}{Y_A + Y_B + Y_C + Y_D}\right)\left(Y_4 + \frac{Y_D\, Y_A}{Y_A + Y_B + Y_C + Y_D}\right)$$

If none of the eight admittances vanish or are infinite, a balance might be obtained by suitably adjusting any one of the eight.

In case the admittance of corner B to the shield is equal to zero, the ratio of the balance will be equal to Y_2/Y_1, irrespective of the other admittances to the shield, S.

In case $Y_C / Y_A = Y_2/Y_1$, the ratio of the balance will be independent of the admittances of corners B and D to the shield S.

In case either pair of diagonally opposite corners is shielded from S, the balance is independent of the capacity of the two remaining corners to the outside shield, S.

In case $Y_B = 0$, and $Y_D = Y_A + Y_C$, the potential of the shields when a balance is obtained will be half-way between the common potential of C and A and the potential of D.

The shielded balance shown in Fig. 7 has a double shield entirely surrounding the generator system and another double shield entirely surrounding the telephone circuit, telephone and observer. One or the other of these shields may, as explained above, be reduced to a single shield. Even as thus simplified, however, the arrangement is not in general convenient. It is not practicable to shield a generator which is connected directly to a lighting plant, and it is not convenient to shield an observer. In order to avoid these difficulties, we may introduce transformers into both the generator circuit and the telephone circuit.

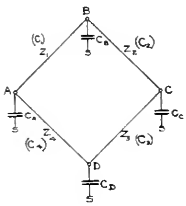


FIG. 9.

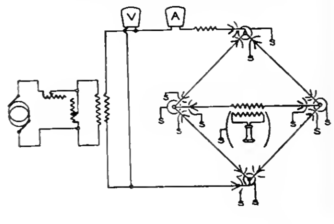


FIG. 10.

Fig. 10 shows an arrangement of shielded balance with two transformers. This balance leaves the generator, generator circuit and observer entirely unshielded, and is a perfectly practicable arrangement. Any change whatever in the generator circuit or the generator circuit transformer can have no effect upon the integrity of the balance so long as the shielding remains perfect. Thus, the generator may become grounded to the outside shield, either side of the repeating coil may become short-circuited to the shield surrounding it, or any number of convolutions may become short-circuited. These changes may affect the efficiency of the generator circuit, but can in no way introduce an error into the balance. The same is true of the telephone circuit. So long as the telephone is shielded as shown, any changes in itself or in its transformer will affect only its efficiency. It cannot introduce a false balance. Furthermore, the observer may change his position and his capacity and leakage to the outside shield and to the generator and generator circuit without in any way affecting the integrity of the balance.

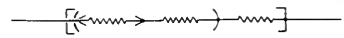


FIG. 11.

Fig. 10 shows, in addition to the balance, the rheostats for varying the e.m.f., and the voltmeter and ammeter for measuring the current employed, all properly shielded. This shielding precludes any disturbance of the balance.

In case two impedances are to be placed in series in any branch of the balance, each may have its individual shield connected to one of the bridge corners. See Fig. 12, where the inductometer and resistances are arranged in this way.

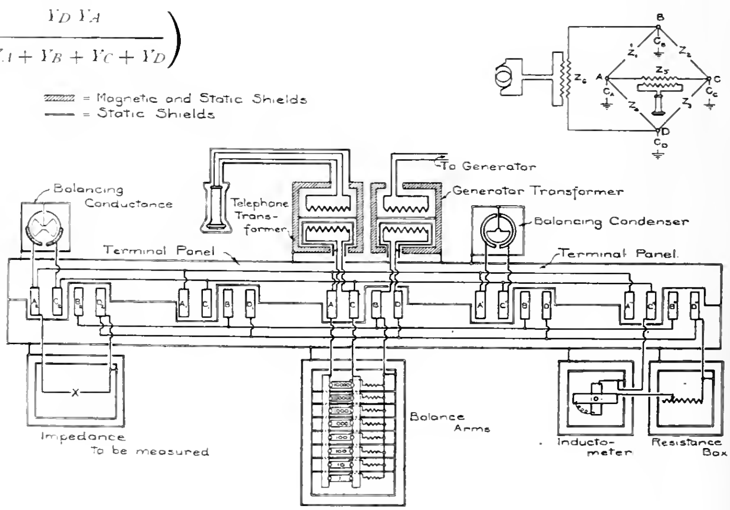
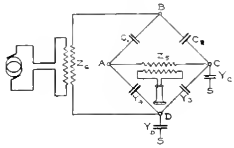


FIG. 12.—DIAGRAM OF SHIELDED BALANCE.

In case three impedances are to be connected in series, at least three courses are open. We may measure the capacity of the individual shields to the general shield and allow the proper correction.

We may so adjust the capacities, C_A, C_B, C_C, C_D, as to make the potential of the outer shield the same as that of the third shield. In general this would necessitate the use of considerable conductance and possibly inductance. Finally, we may shield the third shield by enclosing it within one of the others, and allow for the capacity thus directly shunted around one of the impedances. This use of shields within shields seems to be of considerable practical importance, and will be taken up again in connection with resistances and with switches. It is illustrated in Figs. 11 and 13.



Figs. 12 and 13 show more in detail two arrangements

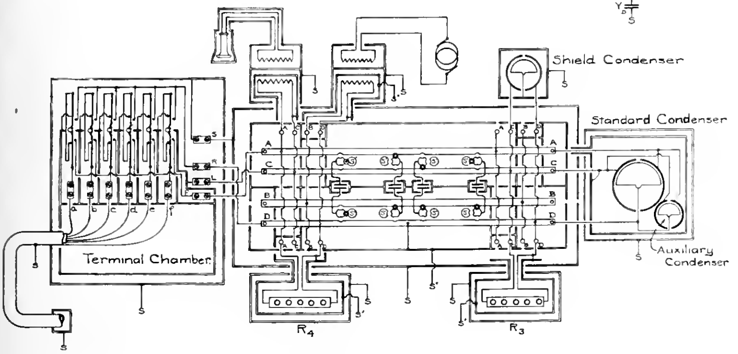


FIG. 13.—DIAGRAM OF SHIELDED BALANCE.

for shielded balances. Fig. 12 is arranged for inductance measurements and Fig. 13 for capacity measurements, but either may be employed for both measurements. Each arrangement presents certain practical advantages. The practical details of design will be reserved for description after they have been more completely tested by actual experience.

To summarize:

1. The balance arms are shielded individually and collectively in order to make the balance invariable and definite.

2. Shielded transformers are introduced into the generator and telephone branches in order to make the arrangement practicable.

3. The bridge corners are suitably shielded or their admittances to the outside shield suitably proportioned in order to make the numerical computations simple.

Important Electric Railway Tests at St. Louis.

Among the most valuable technical features of the St. Louis Exposition will be the elaborate series of electric railway tests which will be conducted there under the auspices of a special commission appointed by the Exposition authorities. The personnel of the Electric Railway Test Commission has already been announced in this paper, and consists of J. G. White, New York, chairman; H. H. Vreeland, New York; W. J. Wilgus, New York; James H. McGraw, New York, and George F. McCulloch, Indianapolis.

On the grounds of the Exposition the authorities will provide special tracks, having an almost level grade and well ballasted, for the operation and testing of railway car and locomotive equipments. These special tracks consist of one section, 1,400 ft. in length, and one section 2,000 ft. in length, the two sections being parallel. Upon these tracks it is proposed to carry on the greater part of the operating, acceleration, braking, coasting and motor-heating tests, as well as tests to determine car and train friction.

In addition to the trials which will be conducted on these tracks, as detailed above, the commission will carry on a number of tests in the Electricity Building. All of these tests will be supervised by some engineer of national reputation, to be selected later, and all instruments and appliances used in connection with them will be calibrated by the National Bureau of Standards. The latter bureau will erect in the Palace of Electricity a laboratory for this purpose, equipped with all appliances needed for the accurate standardization of all the instruments, meters, etc., required. Before deciding upon the detailed tests to be made, the Test Commission appointed four engineering committees to draw up a series of recommendations of the various tests, which, in their opinion, would cover the main branches of electric railway work as at present developed. These committees were as follows: Engineering Committee on Test of City and Suburban Equipments—M. G. Starrett, chief engineer, New York City Railway Company; D. F. Carver, chief engineer Public Service Corporation, of Jersey City; W. S. Twining, chief engineer Philadelphia Rapid Transit Company. Engineering Committee on Test of Interurban Equipments—A. L. Drum, assistant general manager Indiana Union Traction Company; Chas. Jones, chief engineer Elgin, Aurora & Chicago Railway; C. A. Alderman, chief engineer Appleyard System, Springfield, Ohio. Engineering Committee on Test of Heavy Traction Equipments—F. J. Sprague, New York City; Bion J. Arnold, New York City; W. J. Wilgus, New York Central & Hudson River Railroad, New York City; F. R. Slater, assistant engineer to L. B. Stillwell, New York City. Engineering Committee on New Electric Railway Systems—Bion J. Arnold, New York City; Paul M. Lincoln, Westinghouse Electric & Manufacturing Company, New York City; W. B. Potter, General Electric Company, Schenectady, N. Y.

The following are briefly the tests which have been recommended by the first two of these committees, and which have tentatively been adopted by the commission. The digest of the tests in the departments of heavy traction equipments and new electric railway systems will be published is an early issue.

The tests on apparatus in the Electricity Building suggested are as follows:

1. Tests of various kinds of electric railway motor equipments under constant load, regulated by brake, to determine rate of heating (*a*) of the armature, (*b*) of the field coils.

2. Tests of electric railway motor equipments of the various kinds, to determine the motor efficiency under different fixed conditions of operation, including varying number of stops per mile.

3. Tests on motor equipments to determine their torque curves and accelerating power.

4. Tests on electric railway motor equipments under constant loads, to determine the rheostatic losses corresponding to various lengths of time consumed in application of full-current strength.

5. Tests on electric railway motor equipments to determine at what loads, speeds and frequency of stops it becomes economical to adopt automatic control in place of hand control for single cars.

6. Tests of hand, automatic and multiple-control systems to determine their relative economy, certainty and regularity of starting motor car equipments under fixed conditions of load and track.

7. Tests of electric railway motor equipments to determine safe load during continuous operation, as compared with rated capacity of motors.

The tests on the experimental track are as follows:

8. Tests to determine the relative values of two-motor and four-motor car equipments (*a*) as to power consumption with fixed loads, and with varying loads; and (*b*) as to acceleration with both fixed and varying loads.

9. Tests to determine the proper method of mounting a two-motor equipment on an eight-wheel, two-truck car, viz.: on which two of the four axles shall the motors be mounted?

10. Acceleration tests on single cars and on motor cars and trailer, showing rate of acceleration and power used with both hand and automatic control.

11. Comparative tests on different types of power brakes, both electric and mechanical, in respect to efficiency and economy.

12. Braking tests on single car and on motor car with trailer, under varying conditions, with both hand and power brakes.

13. Tests on single car equipments to determine motor and truck friction at different speeds.

For tests on storage battery cars the following are recommended:

14. Tests to determine the efficiency of batteries under maximum, average and varying loads; also

15. Tests to determine life of batteries under average and adverse conditions of service.

The tests on apparatus to be conducted in the Electricity Building for interurban equipment are largely the same as those recommended for city equipment. For the experimental tracks the committee has recommended a series of tests with various classes of cars and equipments, provided time will permit. If only one type of equipment is tested the committee suggests a car body weighing 16 tons to 20 tons, exclusive of trucks and motors, with a pair of trucks weighing 8 tons to 12 tons per pair and a standard four-motor equipment of 75-hp motors, equipped with different types of hand and train controlling apparatus.

The three points to which effort will chiefly be directed, in case facilities for conducting high-speed tests are available, are as follows:

1. The relation between the average electrical losses in the motors and the rise in temperature attained under various conditions of high-speed service.

2. The train resistance (or power required to propel a car or train at uniform speed) at very high speeds.

3. The performance of cars equipped with controllers so arranged that the acceleration is automatic, as compared with the performance under similar conditions, where the rate of acceleration depends upon the handling of the controller by the motorman.

In the test on electrical losses an effort will be made to determine, of course, the average losses at different schedule speeds with a given rise in temperature and with different periods of stops and lay-overs.

The train resistance tests recommended are with single cars, and also with trains made up of different numbers of cars at various speeds, from 40 miles per hour upwards, and measured in different ways, viz.: by direct measurement of instantaneous power input when running at uniform speed, and by the coasting method.

In the test of control systems it is proposed to investigate not only the efficiency of different systems of control, but the effect of automatic acceleration on the power consumption, etc.

Cables for Electric Light and Power.[1]

The current issue of the *Electric Club Journal* prints a lecture delivered by Mr. H. W. Buck February 29 before the Electric Club, of Wilkinsburg, entitled "The Installation of Electric Cables," in which the subject is considered from the standpoint of electric light and power work. In opening Mr. Buck said that if statistics were compiled it would be found that more shut-downs of electric power plants had their rise in cable trouble than from any other cause—not troubles which could be blamed upon the cable manufacturer for defects in construction, but ones which are directly attributable to dangerous methods of installation. Referring to lead-covered cables, he says that these should not be used in a power house except in places where protection against water is required. The lead sheath being necessarily grounded makes the cable vulnerable to puncture from ground throughout its entire length, which danger does not exist in a braided cable. On account of the softness of lead, it serves as a very poor guard against mechanical injury. If a lead-covered cable is struck the grounded lead is very likely to be driven through the insulation to copper, and the cable is put out of business. Braid-covered rubber cables are not exposed to this risk. As a protection against fire, a lead covering is useless, for the lead melts at a very low temperature, and exposes the inflammable insulating compound to ignition. When once started, a lead-covered cable will support its own combustion until completely destroyed.

In high-voltage work a single-conductor lead-covered cable is especially objectionable. Static discharges seem to take place through the insulation to the lead, which rapidly injures the insulation—especially rubber—and a break-down soon follows. I have known a number of instances where such single-conductor cables have withstood a test of three times normal voltage and have broken down at normal voltage a few hours after being put in service. These breakdowns occur usually near the ends of the cable. In multiple-conductor cables this action does not seem to occur, the static activity probably being neutralized.

The present practice of putting cables in ducts as a protection from fire is condemned. As a general proposition, especially in high-voltage work, the best way to wire a power house is to use braided rubber insulated wire, supported in free air upon porcelain or other insulators which in themselves have sufficient insulation to withstand the operating voltage of the cable. The rubber insulation then serves only as a safeguard to life in case of momentary contact, and to prevent a short-circuit in case of temporarily lying tools or such things upon the cables. Cables should be spread out as far as possible from each other, in order to obtain the best possible ventilation and to minimize trouble in case of short-circuit.

Attention is called to the fact that the temperature of the outside of a cable does not indicate its maximum temperature. Some experiments made at Niagara by Mr. H. W. Fisher show that there may be a difference as high as 40° C. between the outside of the cable and the inside of the insulation. For this reason cables should have their outside temperature kept lower than is ordinarily the case. In laying out a cable system the matter of ventilation should, therefore, be regarded as of prime importance. The following method of fire-proofing cables, which is employed by the Niagara Falls Power Company, was given:

Asbestos strip, about 3 in. wide and 3/16 in. thick, is soaked in a silicate of soda solution until it is thoroughly impregnated. It is then, while soft, wrapped spirally around each cable, which has been put in place on its rack in the subway. This covering very quickly hardens and forms a coating like stone over the braid of the cable, which is fire-proof. Asbestos applied in this way has many advantages. It needs no binding wire or steel bands to hold it in place around the cable, which are apt to uncoil when most needed, for the silicate serves as a firm bond. Furthermore, the asbestos, having its pores entirely filled, becomes a good conductor of heat, and the heat from the copper losses can get out by conduction. Dry asbestos, on the other hand, in a porous, cloth-like condition, is a good insulator of heat, which is likely to subject the insulation of the cable wrapped with it to a high temperature. The method described has been given severe fire tests, and it has served its purpose in every case.

In underground cable work the lead covering is absolutely necessary for cable protection on account of water, and also because paper cables must be used for reasons of economy, and all cables must be drawn into ducts underground, for any form of subway with bracket supports for the cable would be prohibitive in cost. The objection to the single-conductor lead-covered cables still holds for underground use for voltages over 5,000. Such high-voltage conductors should, if possible, be placed in the form of multiple-conductor cables, where breakdown in insulation from static effects is seldom experienced if liberal-sized bells are used at the terminals of the cable.

Cable ducts should never be grouped more than two in width, in order that every duct may have an outlet for heat conduction through the surrounding earth. The heating in ducts should not exceed three watts per duct-foot for copper loss in the cable. In conduits built of insulating material, such as vitrified clay, little trouble need be feared from electrolysis if the conduit is well drained and dry. If the ducts, however, contain water and the cables are partially submerged, the lead covering will rapidly disintegrate, unless the sheath is bonded at frequent intervals to the nearest railway return circuit.

Where single-conductor lead-covered cables are used in underground installations for carrying large alternating currents at low voltage, trouble from induced current in the lead sheath should be guarded against. This does not refer to local eddies, but to the current which flows in the lead sheath of two parallel cables as secondary induced by the current in the copper of the same cables as primary. When the lead circuit is closed at two manholes by contact with supporting iron brackets the current which flows in the lead is very considerable, and the resulting loss is nearly equal to the I^2R loss in the copper, even at 25 cycles. At higher frequencies this loss will probably be greater. As a specific example some readings were cited which were taken on two parallel 300-ft. length of 1,250,000-cm. cable carrying 800 amp. in the copper at 25 cycles. The open-circuit voltage induced in the lead was 15 volts, and with the lead sheaths short-circuited at one end through an ammeter, the current was found to be approximately 200 amp. These figures indicate that the matter is one of the greatest importance, and special precautions should be taken in all underground work to meet it. The lead sheaths of all cables should be either bonded together carefully in every manhole or else carefully insulated. If neither one thing nor the other is done, sparking will occur from this lead current at the cable supports at the manholes, which will burn through the lead sheaths and cause a break-down.

The Economy of Reciprocating Engines at Light Loads as Compared With That of Steam Turbines.

BY J. A. SEYMOUR.

A NUMBER of articles have been recently published giving comparisons between the steam consumption of turbines and reciprocating engines, in which a relatively poor economy for reciprocating engines at light loads is assumed. This assumption is unwarranted by the actual performance of these engines. Whatever advantages in actual commercial use the steam turbine may ultimately prove to possess, there are no indications at the present time that among these advantages will be a better sustained economy at light loads than with the reciprocating engine. It is true that "the usual" or "average" rate of steam consumption of reciprocating engines at light loads is excessive, as compared with the full-load economy, but the usual or average reciprocating engine is really an uneconomical and out-of-date machine. The ideal reciprocating engine working with non-conducting cylinder walls, without loss from leakage, cylinder condensation or radiation, should expand to back pressure to secure greatest economy. To expand to back pressure in an actual engine would load it much below its most economical point. It follows that since a modern engine of economical type, having a much lower rate of steam consumption at full load, approaches more nearly the ideal engine than the above-mentioned average engine, it should effect proportionately a still greater saving at light loads; that is, it should have a flatter economy curve. In actual practice this is found to be true.

It is manifestly proper that a steam turbine should be compared, as regards economy at light loads, as well as at full load, only with an engine of some economical type which fairly represents the best practice of the present time, and also that in computing the difference between electrical and indicated horse-power readings the combined efficiency of a well-designed, up-to-date unit, should be assumed. The well-sustained economy at light loads of a reciprocating engine is well illustrated in Fig. 1, in which are plotted economy

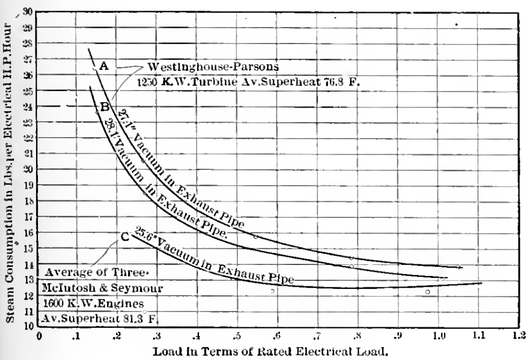


FIG. 1.—ECONOMY AT DIFFERENT LOADS.

curves in terms of electrical horse-power obtained from the results of a shop test of a 1,250-kw Westinghouse-Parsons turbine, described in an article by Mr. A. M. Mattice in the ELECTRICAL WORLD AND ENGINEER for February 20, and also the results of acceptance tests of three 1,600-kw McIntosh & Seymour engines referred to in a paper by Messrs. Moultrop and Curtiss, presented at the Boston meeting (May, 1902) of the American Society of Mechanical Engineers, published in Vol. XXIII of the transactions of that society.

Each engine is of the vertical cross-compound type, with a direct-driven 1,600-kw, direct-current generator of the General Electric Company make, and runs at a speed of 100 r.p.m. The cylinders are 29-in. and 60-in. in diameter, with a stroke of 56 in., and the engine, as is usual with this make, is provided with an interheating receiver which superheated the steam entering the low-pressure cylinder during the test from 55° F. to 69° F. The steam condensed in the jackets and heating coils in the receiver is included in the rates of steam consumption given. As stated by Messrs. Moultrop and Curtiss, no troubles have been occasioned by the use of superheated steam with these engines, although of standard construction throughout, which is true in all power stations where these engines have been used with superheated steam.

The economy curve, *C*, represents the average results of all tests made with superheated steam and with receiver heating coils in use upon engines No. 9, No. 10 and No. 11 in the station. The tests of engine No. 8 are excluded on account of conditions which prevented the correct economy of the engine from being ascertained. The best results obtained (with engine No. 9) are also indicated.

It should be understood that these were not shop tests made by the builders under ideal conditions, securing results not obtainable later in actual service, but were acceptance tests instituted by the purchaser to determine upon the fulfillment of contract conditions made at different times under actual working conditions after the engines had been from four to seven months in regular service. All instruments used for taking observations in the tests were accurately calibrated for each test, including the special instruments, used in the tests only, for taking electrical readings. The results were quite consistent for all three engines, the two tests indicated for engine No. 9 showing a greater variation from the average curve than any other test. The average results of tests obtained in such a manner from three engines should be unusually accurate and reliable. The conditions of steam pressure, superheat, etc., also correspond quite closely to those of the turbine tests except that the average vacuum was not nearly as good.

The nominal full-load rating of these engines, on the basis of 165 pounds gauge pressure at the throttle valve and 27-in. vacuum in the exhaust pipe, corresponds to 22/100 cut-off in the high pressure, or approximately to 19½ expansions by volume. The governor allows a maximum cut-off of over 7/10 in the high-pressure cylinder, which permits of a large working overload. It will be noted not only that the economy curve for the reciprocating engine shows a better result at light loads, but also that the point of greatest economy is more favorably located than for the turbine. Central station managers will hardly consider it practical to run steam turbines at their most economical loads without a greater overload capacity than it is proposed to give them, where the station load is a fluctuating one. At times of maximum station load it quite often happens that the steam pressure and vacuum fall off and the loss of pressure in the pipes, etc., increases so that the actual maximum output of the unit under these conditions may fall short of the nominal overload capacity under normal conditions to a serious extent. In the case of a turbine a very high vacuum is necessary in order to maintain either its capacity or its economy. To secure this high vacuum, particularly under heavy overloads and in warm weather, with condensing apparatus of a commercially practicable size, in most locations, will be an extremely difficult problem, a much more difficult problem than is generally understood, but one which will have to be met.

Additional data concerning both the turbine and engine tests for half and full loads are tabulated in the accompanying table. The results given for the turbine at half load with 28-in. vacuum are estimated, no test being reported. These data include the British thermal units per indicated horse-power per minute, and the ratios of the actual thermal efficiency to the efficiency of a corresponding ideal engine working on the Rankine cycle recommended as a standard of comparison by the Institution of Civil Engineers of Great Britain, assuming in all cases a feed water temperature corresponding to that of saturated steam at the pressure in the exhaust pipe. The British thermal units and the efficiency ratios on the basis of electrical horse-power are also given. In the latter case a perfect engine and dynamo, having a combined efficiency of unity, is assumed.

The water condensed in the receiver coils is included in the rates of steam consumption for reciprocating engines. In order to measure this water accurately during the tests its heat was necessarily wasted. In computing the British thermal units and the efficiency ratios this water was assumed to be returned to the boiler at a temperature of saturated steam 5 pounds below the throttle pressure, as this actually takes place in regular working conditions. The heat saved in this way amounts to between 1½ per cent. and 2½ per cent. of the total.

The consumption of British thermal units per horse-power per minute is more closely related to the coal pile than the pounds of steam, and the efficiency ratios afford by far the best means of comparing the economy of different engines. They take into account the more or less favorable conditions of steam pressure, superheat and vacuum under which the engines operate. Any increase of economy which is secured by increasing this ratio is so much clear gain. On the other hand, if a lower steam consumption is obtained entirely by raising the temperature of the steam supplied and lowering that of the exhaust, it is always partially (and may be more than entirely) offset by both an increase in first cost and an increased cost of maintenance for boilers, condensers, piping, etc. The efficiency ratio given in Fig. 2 for the reciprocating engine at full load exceeds

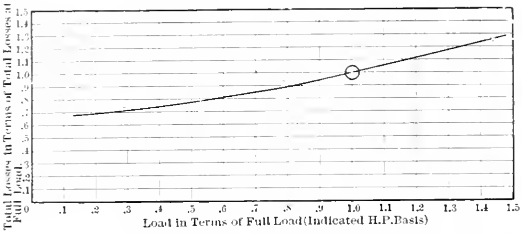


FIG. 2.—RELATION OF LOSSES AT DIFFERENT LOADS AND FULL LOADS.

that of the turbine by 15 per cent., while at half load it is 33 per cent. higher.

The combined efficiencies of these engines and generators were remarkably uniform for all cases, varying from the average less than 1 per cent. at either half or full load. A curve showing the relation of the total losses at various loads to the total losses at full loads plotted from reliable observations from a number of engines similar to these is shown in Fig. 2. While the total losses are fairly constant as predicted in the article of Mr. Mattice, there is an appreciable falling off for lighter loads. When the tests represented by curve *C*, Fig. 1, were made it was not considered worth while to make any determinations for less than half load. The form of the economy curve for these engines, however, has been determined by other tests for from quarter load to 50 per cent. overload, both with and without superheat.

A 1,500-kw McIntosh & Seymour engine recently tested by Prof. Ira N. Hollis, of Harvard University, under the direct supervision of Prof. L. S. Marks, is similar to these engines in every way, except that the stroke is shorter. The test conditions also were nearly identical except that the superheated steam was from 55° F. to 70° F. and the steam pressure somewhat lower. The efficiency ratios obtained in this series of tests on the basis of indicated horsepower for full, half and quarter load were .742, .733 and .668, and the B.T.U. 227, 227 and 242, respectively. For the curve *C* in Fig. 1, the corresponding ratios are .742, .768 and .690 and the B.T.U. 210, 208 and 232, showing a very fair agreement. In general, the results of tests of similar engines at different loads on the basis of indicated horse-power show the curve for overload to be nearly a straight line with a gradually increasing rate of steam consumption. For engines tested without receiver coils in use, and without superheat, an economy constant within two per cent. is indicated for from about .6 load to 1.3 load. The corresponding limits for the same engines with receiver coils in use are from .5 load to 1.2 load, and with superheated steam from 75 to 100° from .4 load to full load; the point of best economy becomes earlier as the rate of steam consumption decreases.

RESULTS OF TESTS AT FULL LOAD AND HALF LOAD.

	Rated Capacity in Kilowatts.	Test Load in Electrical H. P.	Steam Pressure at Starting Valve.	Superheat at Starting Valve.	Vacuum in Exhaust Pipe.	Steam Consumption in Lbs. per Indicated H. P. per Hour.	British Thermal Units per I. H. P. per Minute.	Thermal Efficiency (I. H. P. Basis).	Ratio of Therm. Eff. to That of Ideal Engine.	Combined Efficiency.	Steam Consumption in Lbs. per Electrical H. P. per Hour.	British Thermal Units per E. H. P. per Minute.	Thermal Efficiency (E. H. P. Basis).	Ratio of Th. Eff. to That of Ideal Engine with Perfect Dynamo.
FULL LOAD.														
Average of McIntosh & Seymour engines No. 9, No. 10 and No. 11	1600	2003	160.6	88.4	25.6	11.54	216.1	19.63	.742	.909	12.69	237.7	17.84	.674
McIntosh & Seymour engine No. 9	1600	2014	161.85	92.3	25.42	11.21	209.6	20.24	.768	.912	12.29	229.8	18.46	.70
Westinghouse-Parsons turbine	1250	1735	146.3	76	27.1						13.78	263.5	16.09	.586
	1250	1708	146	78.3	28.1						13.17	255.3	16.61	.573
HALF LOAD.														
Average of McIntosh & Seymour engines No. 9, No. 10 and No. 11	1600	1146	163.7	74.3	25.6	11.25	208.2	20.37	.768	.870	12.93	239.3	17.72	.668
McIntosh & Seymour engine No. 9	1600	1206	167	78.3	25.8	10.72	198.9	21.33	.797	.878	12.21	226.5	18.72	.699
Westinghouse-Parsons turbine	1250	891	151	77	27.15						15.9	304.5	13.93	.503
	1250	875	149	76.9	28.08						15.1	292.5	14.50	.500

An Electrified English Steam Railroad.

Aside from several lines on the Continent, England is the first country to apply electricity to heavy railroading; and this not through the electrical equipment of a new line, but by displacing steam on

FIG. 1.—VIEW SHOWING THIRD AND FOURTH RAILS.

an old road. The Lancashire & Yorkshire Railway, to which we refer, was described as to its location and electrical equipment in our issue of January 30, and we give below the details of the track construction.

The track is furnished with two third rails, one for distributing and one for returning the electric current to the power stations. The former is carried alongside each track in the usual way, while the other rail is placed between the running rails, uninsulated on the ties, this forming the principal part of the return circuit. While the joints of both the third and the fourth rail are bonded in the ordinary way, in the manner described below, the fourth rail is, also, cross-bonded to the running rails at their ends. While, by this arrangement, the troublesome bonding of the running rails is avoided, as are also the complications involved in using an insulated fourth rail for the return, the further advantage is obtained that the iron in the running rails are utilized as part of the return current. No collector shoe is provided on the train for the fourth rail, the current being delivered through the wheels to the running rails, and thence through the cross-bonds to the fourth rail. The insulation of this rail also makes it a comparatively simple matter to renew the running rails, without unduly interfering with the continuity of the return circuit.

The third and fourth rails are both of equal section, and consist of mild steel of special high conductivity, the resistance being proved by test to be not greater than seven and one-quarter times that of pure copper. As a matter of fact, the average resistance is somewhat lower. The rails weigh 70 pounds per yard, and are in lengths of 60 ft.

The third rail is supported at intervals of about 10 ft. on insulators of reconstructed granite, held in position by two clips, the center of the rail being exactly 3 ft. 11½ in. from the center line of the track, and the top of the rail 3 in. above the surface of the track rails. This dimension may be regarded as the British standard, having been agreed upon by all the main line steam railroad companies, at a meeting held at the Railroad Clearing House, on March 3, 1904, in order to obtain uniformity in case of extensions of third-rail system. It is of ample section to convey the full amount of current required by the trains, when between two substations, without causing any appreciable loss in voltage. Generally the third rail is placed in the 6-ft. way between the tracks, but occasionally it is brought outside the track to suit special conditions, and at all grade crossings the gaps are bonded with cable underground. Timber guards have been provided at all the busy places on the line, to prevent the possibility of any person coming into contact with the third rail. The fourth rail is supported on wooden blocks, and is placed in the middle of the 4-ft. way, between the two running rails.

FIG. 2.—A CROSSING AT SAND HILLS

FIG. 3.—JUNCTION AT SAND HILLS.

At most stations the third rail is interrupted and the ends are connected by cables to section switches. This apparatus consists of four knife switches, one for each end of the up and down line, which, in the ordinary way of working, are connected in parallel. By cutting out one of these switches in two adjacent boxes any part of the up or down line may be made currentless.

In providing for expansion and contraction, due to change of temperatures in the rails, they are divided into sections of 300 ft., and the joints between the rails making up this section are known as "fixed joints." The joints connecting the sections themselves are known as "expansion joints." At the fixed joints no provision is made for expansion or contraction, this being concentrated at the expansion joints. The fish-plates at the fixed joints are made as rigid as possible, and the bonds are four in number, two bonds being fixed in the web of the rail and two bonds in the flange of the rail.

It was deemed advisable to use bonds of semi-flexible type, which have a conductor built up of parallel strands of copper ribbon or "flat wire" with solid copper terminals. They are thus sufficiently flexible to provide for any movement which may take place at the joints, and are more easily adjusted in case of any variation in distance between the bond holes at the time of construction. The bonds at the expansion joints are four in number, of the same cross-section as those at the fixed joints, but all four are fixed in the flange of the rail. These bonds are also made of "flat wire."

The fish-plates at the expansion joints are of special design and properly slotted to provide for any change of length which may take place in the 300-ft. section. This system of bonding is carried out on both the third and fourth rails. The terminals of all the bonds are of solid copper, and are expanded in the bond holes by

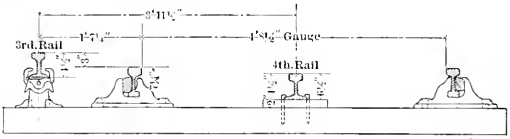


FIG. 4.—CROSS SECTIONAL VIEW OF TRACK AND CONDUCTOR RAILS.

means of screw or hydraulic compressors. Each track rail is bonded to the fourth or negative rail by means of flexible cable bonds. The bonds were supplied by the Forest City Electric Company.

Of the accompanying illustrations, Fig. 1 shows a section of ordinary track, Fig. 2 a section at a crossing and Fig. 3 the track at a junction. The traction rails and third and fourth (conducting) rails are shown in the cross-sectional view, Fig. 4.

Wireless Telegraph Newspaper at Sea.

A project is being worked out to publish a "multiple" daily newspaper on the Atlantic steamships each summer. The Marconigram says: "The newspaper will be of standard size, and will contain full telegraphic reports from the Associated Press. Its advertisements will be contracted for ashore, and it is expected that a very profitable business will thus be established. The combined circulation of this journal on board all steamships will be large enough to warrant its use by advertisers, whereas the issuance of different papers on board each separate vessel renders none of them a profitable medium, by reason of the comparatively small circulation of each. The projector of this publication is said to have contracted with the Marconi Company to receive as many words per day as the company can transmit with its facilities, at a rate per word which will prove extremely profitable to the company. The same matter will be printed in each edition of the paper, whether issued on board the *Lucania*, the *Kaiser Wilhelm* or the *Minnehaha*. The editorial rooms will be located ashore, either in America or Europe, and the news, editorials and miscellaneous matter for each edition will be furnished fresh each day by wireless, as well as the changes for advertisements. This is rather a revolutionary undertaking, but by no means chimerical. There are at times a population of 20,000 to 30,000 people afloat in ocean steamers between the United States and Europe. To furnish this vast multitude with a summary of the day's happenings, in various languages, is an enterprise which cannot fail to become popular."

Annual Report of the Bell Telephone System.

President F. P. Fish has made the following annual report to the stockholders of the American Telephone & Telegraph Company:

The results of the business for the year 1903, as shown by the treasurer's statement appended, were as follows:

Gross Revenue	$16,545,632.39
Expenses, including interest and taxes	5,980,967.30
Net revenue	10,564,665.09
Dividends paid	8,619,150.75
Carried to Reserve	728,139.97
Carried to Surplus	1,217,374.37

The following were the corresponding figures for the year 1902:

Gross Revenue	$13,277,457.33
Expenses, including interest and taxes	5,442,185.14
Net revenue	7,835,272.19
Dividends paid	6,584,403.75
Carried to Reserve	522,246.71
Carried to Surplus	728,621.73

The net output of telephones during the year 1903 was 629,197, making the total number in the hands of licensees 3,779,517. The number of exchange stations at the end of the year was 1,525,167, an increase of 247,184. The total mileage of wire for exchange and toll service was 3,958,891 miles, of which 677,229 miles were added during the year. Including the traffic over the long-distance lines, the daily average of toll connections was about 258,000, and of exchange connections about 9,876,000, as against corresponding figures in 1902 of 239,700 and 9,323,000; the total daily average for 1903 of connections both toll and exchange reaching 10,134,000, or at the rate of about 3,263,000,000 per year.

The total amount added to construction and real estate by all the companies constituting our system in the United States, during the year 1903, was:

For Exchanges	$24,060,900
For Toll Lines	8,866,000
For Land and Buildings	2,441,800
	$35,368,700

The amount added in 1900 was $31,619,100; in 1901, $31,005,400; and in 1902, $37,336,500.

The expenditure by this company in 1903 for the construction, equipment and supplies required for its long-distance lines was $4,365,614, making the total investment in long-distance lines and equipment up to the close of the year $26,861,805.

The development and course of the business of the company during the year have been satisfactory and the returns, as indicated by the foregoing figures, clearly such as to meet all reasonable expectations. In view of the general business conditions of the country, the increase in the number of subscribers and in the amount of telephone business done, shows that the efforts of your company and of the companies associated with it to give a service of substantial value, are appreciated by the public. The increase in gross and net revenue and in the amount carried to reserve and to surplus after the payment of interest and dividends, is a satisfactory indication that the investment that has been and should be made from year to year to build up a comprehensive telephone system that is adequate to the needs of the community will receive a proper return.

In former reports to the stockholders the necessity for developing and extending the facilities of your company to meet the demands of the public throughout the United States has been recognized and asserted. The history of each year emphasizes the soundness of this policy. Not only have the specific returns from such extensions proved to be adequate, but the strength and earning capacity of the company in all parts of the country are definitely increased by such development. No new toll lines are built, exchanges established, or telephones installed, without bringing in additional revenue from the construction already existing, as well as from the new construction. The conditions of modern business require communication over such large areas, and with so many people, that the public immediately responds when it has the opportunity of telephonic communication with new territory or with new subscribers; for the value of the service to users generally, largely increases with the extent of territory covered and the number with whom connections may be made. Your company and its associated companies are in a position to supply the comprehensive service required, and a proper return for the investment will surely reward their efforts to meet the demand that is made upon them. The extent of development required will vary from time to time with general business conditions. But even when those conditions are least favorable, extension of telephone facilities will still be called for, inasmuch as each year a larger proportion of the community recognizes the importance of the telephone in social and business life, as is shown by the constantly increasing number of Bell telephones in proportion to population.

Equally important is the matter of good service. Our companies are thoroughly impressed with the necessity of maintaining the Bell service at the highest practicable standard, and every effort is made to produce this result. The constant and intelligent study of operating methods that has been going on from the beginning and the many successive improvements in apparatus, have resulted in a definite control of this problem, the effect of which is everywhere shown in improved service. The complicated equipment required to make it possible to establish intercommunication between any two of hundreds of thousands of telephone users has now been standardized to a large extent. Standard methods of operating have been devised and put into practice. The result is not only an increased efficiency and better service, but also marked economy in maintenance and operation. Improvements in cables and devices to be used in connection therewith, and greater engineering knowledge, have made it possible to develop underground construction to a constantly increasing extent, and the field for underground work is now believed to be capable of an ultimate extension beyond anything that seemed possible to the engineers of a few years ago. This results in economy of operation and also, by reducing to a minimum the danger of accident to the outside construction, in an improvement in the service. It is safe to say that there is an element of permanency in the apparatus and equipment of to-day which did not characterize that in use a few years ago. The time will never come when further improvements may not be expected, both in methods of operating and in apparatus. There is no doubt, however, that the telephone service has now been so far standardized in these respects as to be on a par with many industries that are much older and which have had the intelligent and careful study of experts for a far greater period of time.

The work of perfecting the Bell service is not complete; but in view of the zeal and intelligence with which it is being pushed throughout the country, there is every reason to expect that the high standard now definitely established, and already attained in many places, will characterize the service generally.

In the report to the stockholders for the year 1902, reference was made to the significant fact that many of the competing telephone companies were beginning to realize that the rates adopted by them were too low and were seeking to raise those rates. This movement has continued with added force during the year 1903. The competing companies, in almost every city of any size in the country in which they have established exchanges, have found, sometimes as the result of a bitter experience, that the cost of doing the business was far greater than they anticipated. This has resulted in an increasing number of efforts on their part to raise their rates to a point nearer the Bell standard.

In particular they have learned that charges for maintenance and depreciation, which were lost sight of during the promotion stage of their business, were necessary expenses which must be taken care of before there was any question of earnings applicable to interest on bonds or dividends on stock.

The lesson has not even now been thoroughly learned, and not unfrequently the prospectuses of competing companies practically ignore those expenses. It is common for them to present figures showing that the entire cost of carrying on the business is from forty-five to sixty per cent. of the gross receipts that may be expected. The history of the business shows conclusively that an attempt to operate a telephone plant on any such basis is doomed to failure.

This matter of maintenance and depreciation is constantly before the eyes of our companies. The system of accounts, which is practically uniform for all the Bell organizations, forces them fairly to face this expense from month to month and from year to year. Before there is any question of profits, each company recognizes the necessity of reserving from its earnings such amounts as experience has shown to be adequate to keep its property in repair and replace it when worn out or destroyed. The sum properly to be charged varies to some extent in different parts of the country, on account of climatic conditions and the character of the plant employed, but the average allowance for maintenance of the Bell companies for the year 1903 was over thirty per cent. of their gross revenue.

As was stated in the report to the stockholders for the year 1902, the competition to which our companies are subjected is embarrassing chiefly to the extent to which it leads the public to believe that service can be given at rates that are too low to permit good service and a reasonable profit. The situation is now more favorable than ever before in this regard, and will continue to improve as the competing companies and the public become more correctly informed as to the conditions of the business. On the whole, it seems every year less probable that competition will have any substantial effect upon the prosperity of the Bell companies.

THE FIGURES IN LOWER LINE SHOW INCREASE FROM YEAR TO YEAR.

Dec. 20, 1899.	Dec. 20, 1900.	Dec. 20, 1901.	Dec. 20, 1902.	Dec. 31, 1903.
1,580,101	1,952,412	2,525,606	3,150,320	3,779,517
455,255	372,311	573,194	624,714	629,197

This would show 1,889,758 stations.

TOLL LINES IN THE UNITED STATES OF THIS COMPANY AND THE COMPANIES ASSOCIATED WITH IT.

	Jan. 1, 1900.	Jan. 1, 1901.	Jan. 1, 1902.	Jan. 1, 1903.	Jan. 1, 1904.	Increase.
Miles of Pole Lines....	89,292	101,087	110,459	122,409	130,178	7,769
Miles of Wire..........	501,832	607,599	716,265	837,912	975,702	137,790

TOLL CONNECTIONS.

The average daily number of toll connections is....................	257,618
Or a total per year of about..........	82,953,000

EXCHANGES OF THE BELL COMPANIES IN THE UNITED STATES.

	Jan. 1, 1900.	Jan. 1, 1901.	Jan. 1, 1902.	Jan. 1, 1903.	Jan. 1, 1904.	Increase.
Exchanges	1,239	1,348	1,411	1,514	1,609	95
Branch offices..	1,187	1,427	1,594	1,861	2,131	270
Miles of wire on poles and buildings	524,123	644,730	841,140	1,109,017	1,358,140	249,123
Miles of wire underground..	489,250	705,269	883,679	1,328,685	1,618,691	290,006
Miles of wire submarine.....	3,404	4,203	4,200	6,048	6,358	310
Total miles of wire	1,016,777	1,354,202	1,729,019	2,443,750	2,983,189	539,439
Total Circuits..	422,620	508,262	592,467	742,654	798,901	56,247
Total Employees	25,741	32,837	40,864	50,350	53,795	3,445
Total Stations..	632,946	800,880	1,020,647	1,277,983	1,525,167	247,184

EXCHANGE CONNECTIONS.

The estimated number of exchange connections daily in the United States, made up from actual count in most of the exchanges, is...	9,876,402
Or a total per year of about................................	3,180,200,000

The number of daily calls per station varies in different exchanges, the average throughout the United States being 6 5/10.

LEDGER BALANCES, DECEMBER 31, 1903.

DEBTORS.		
Construction, Equipment and Supplies........	$26,876,805 50	
Telephones	6,767,189 75	
Real Estate................................	2,009,749 21	
Stocks and Bonds...........................	130,678,449 28	
Patent Account.............................	173,864 35	
Machinery and Tools........................	48,126 58	
Cash and Deposits..........................	13,319,533 13	
Bills and Accounts Receivable..............	22,397,407 09	
American Bell Telephone Co.................	22,110,400 00	
CREDITORS.		
Capital Stock..............................		$154,179,300 00
Capital Stock Instalments..................		1,972,380 00
Surplus		4,710,664 60
Bonds		28,000,000 00
Reserves		7,942,075 07
*Accounts Payable..........................		8,931,894 97
Contingent		18,645,210 25
	$224,381,524 89	$224,381,524 89

WM. DRIVER, *Treasurer.*

*Of this amount, $2,859,050.25 is for the dividends payable Jan. 15, 1904, to stockholders of record Dec. 31, 1903.

The developments of the past year also show that the feeling that it is better for the community that there should be one comprehensive system of telephonic communication instead of several, which was referred to in former reports, is clearly growing in all parts of the country.

It is an interesting and significant fact that many telephone companies which have started exchanges and to some extent toll lines in various parts of the country, independently of the Bell companies, but in territory which the Bell companies did not occupy, have by contract with our operating companies taken the Bell telephones and become connected with our system on terms favorable to both parties. There are now over 120,000 of such sub-licensee stations connected with the lines and exchanges of the Bell companies, and the movement in that direction is gaining.

Generally speaking, the business of your company and of the companies associated with it is on a sound basis and, with good management and a proper development to meet the demand, the continued prosperity of the Bell organization seems secured.

The suit of the Western Union Telegraph Company against this company, which has been pending since the year 1884, and which was decided in favor of this company by Judge Lowell, sitting as master, and by Judge Colt in the Circuit Court of the United States, has been decided adversely to this company by the United States Court of Appeals for the First Circuit.

The decision is to the effect that, under a technical reading of the contract made by the predecessor of this company with the Western Union Telegraph Company and its associated companies in the year 1879, this company may have to account to the Western Union Company for a certain percentage of some of the stocks and bonds which it received from its licensee companies prior to 1896, when the contract expired.

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

	1902.	1903.
EARNINGS.		
Dividends	$6,023,523 20	$7,802,833 63
Rental of Instruments......................	2,299,378 52	3,047,088 35
Telephone Traffic..........................	4,199,708 59	4,888,158 34
Real Estate............................	56,030 54	73,332 15
Interest	698,816 48	734,219 92
	$13,277,457 33	$16,545,632 39
EXPENSES.		
Expenses of Administration................	$964,827 30	$962,297 84
Legal Expenses............................	124,645 57	95,564 60
Interest and Taxes........................	1,970,947 99	1,993,680 08
Telephone Traffic.........................	2,381,764 28	2,929,424 78
	$5,442,185 14	$5,980,967 30
Net Revenue...............................	$7,835,272 19	$10,564,665 09
Dividends Paid............................	6,584,403 75	8,619,150 75
Balance	$1,250,868 44	$1,945,514 34
Carried to Reserves.......................	$522,246 71	$728,139 97
Carried to Surplus........................	728,621 73	1,217,374 37
	$1,250,868 44	$7,945,514 34

WM. R. DRIVER, *Treasurer.*

That the validity of this decision is doubtful is shown by the fact that Judge Lowell and Judge Colt took a contrary view, and at the proper time every effort will be made to secure a revision of the decision of the Court of Appeals. Meanwhile the matter has been referred to a master, who will report as to the amount, if any, which this company should pay the Western Union Company under the decision of the Court of Appeals, and his report, when made, will be subject to revision by the courts. Even if there should be any ultimate recovery against us—which, as we are advised by counsel, is by no means certain—it is not believed that the amount recovered will be relatively large. It certainly will not be large enough to impose any appreciable burden upon the company. Certain classes of the stocks in question are expressly excluded from the accounting by the opinion of the Court of Appeals, and there are many considerations which, in the opinion of our counsel, will reduce substantially the amount, if any, that may be recovered in the case of the remaining stocks.

Your directors desire to express their appreciation of the zeal and intelligence with which the employees of this company and the officers and employees of the operating companies are co-operating to bring about the best results in our business. There is an excellent spirit throughout the organization and everywhere a harmony of effort and aspiration which is most satisfactory.

The report is accompanied by the foregoing important statistics as to instruments in the hands of Bell lincensees, under rental and by the financial statements given.

The Telephone Substation.—II.

By ARTHUR V. ABBOTT, C.E.

SOME experiments upon induction coils have recently been made in the Electrical Engineering Laboratory of the Iowa State College. A set of 23 coils was obtained, four of which were those commonly made by well-known telephone manufacturers, while the remaining nineteen were experimental coils constructed for the purpose of trial. These coils were tested by selecting one (No. 21 of Table No. 4) as a standard and comparing all of the other coils

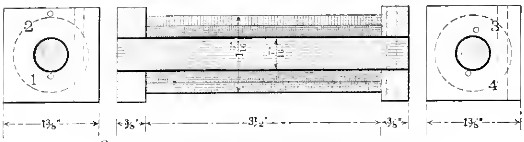


FIG. 8.—INDUCTION COIL FOR COMMON BATTERY NO. 4.

SPECIFICATIONS FOR FIG. 8.

Core: Bundle of No. 24 soft iron wire.
 Diameter of core, 7/16 in.
 Length of core, 4¼ in.
 Winding space, 3½ in.
 Paper insulation around core 1/32 in. thick.
 End blocks ⅜ in. thick, 1⅜ io. square.
Winding: Inside winding.
 Resistance, 28 ohms.
 1000 turns No. 33 single silk covered wire, wound in three layers from end to end of core.
 Two layers of common paper insulation around it.
 Outside winding.
 Resistance, 51 ohms.
 2500 turns of No. 28 single cotton covered wire wound from end to end of core.
Terminals: 1 and 2 outside winding.
 3 and 4 inside winding.
 1 to receiver.
 2 to hook.
 3 to condenser.
 4 to hook.

therewith, first over a line of six miles in length, and then over a line 106 miles. The results of these tests are shown in Table No. 4. The left-hand half of the table gives the electrical properties of each coil. The right-hand half is divided into two parts, one of which

TABLE IV.—TESTS ON INDUCTION COILS, IOWA STATE UNIVERSITY.

	Properties of Coils Tested. Primary.				Secondary.								Tests on 6 Mile Line. Transmitter.				Tests on 106 Mile Line. Transmitter.				
Designation of coil.	Number of turns.	Size of wire, B. & S.	Resistance ohms.	Inductance henrys.	Number of turns.	Size of wire, B. & S.	Resistance ohms.	Inductance henrys.	Ratio of turns.	Diameter of core.	Length of core.	Size of iron core wire. No.	Volts at terminals.	Current, amperes.	Per cent volume.	Per cent clearness.	Volts at terminals.	Current, amperes.	Per cent volume.	Per cent clearness.	Relative average efficiency per cent.
1	111	22	.392	.0061	5139	32	157	1.264	46.3	½"	4 "	18	2.83	.155	62.5	72	3.00	.140	163	86	106.7
2	44	22	.14	.0012	2246	32	70.7	.218	51.5	½"	2 "	18	2.80	.172	47.5	67	3.00	.135	77	59	70.35
3	198	22	.62	.0021	2164	32	87.9	.315	10.9	½"	2 "	18	2.83	.159	100	81	2.80	.155	110	80	104.5
4	80	22	.274	.0034	2413	32	76.3	.29	30.16	½"	3 "	18	2.80	.157	27.5	67	2.95	.130	95	81	76
5	44	22	.099	.0012	2688	32	79	.268	61	⅜"	2 "	18	2.85	.158	40	72	3.00	.115	30	28	48.25
7	132	22	.364	00086	2354	32	82.25	.208	17.8	⅜"	2 "	18	2.80	.165	90	77	2.90	.120	105	80	99
8	124	22	.24	.00074	1240	32	43	.079	10	½"	3 "	20	2.90	.163	90	81	2.95	.118	92.5	88	99.15
9	2640	32	73.5	.365	4000	30	134.3	.854	1.5	½"	4 "	18	.95	.040	35	64	1.05	.040	50	40	53.37
10	208	22	.54	.00225	1400	36x32	34.8	.739	6.73	½"	4 "	18	3.00	.113	100	85	2.95	.120	1025	84	103.6
11	400	26	2.08	.00574	1506	28	13.4	.0812	3.76	⅜"	4 "	18	2.85	.105	100	75	2.85	.125	72.5	79	92.25
12	228	22	.52	.00174	900	36	58.4	.0345	4	⅜"	4 "	18	3.00	.105	80	85	3.00	.122	65	79	87.3
13	400	26	2.07	.00497	1241	28	16.3	.0475	3.1	⅜"	4 "	20	2.95	.100	105	73	2.85	.115	825	81	96.25
14	220	22	.481.	.0025	5500	36	420	1.124	25	⅜"	4 "	20	2.97	.120	87.5	68	3.00	.120	105	80	95.5
15	262	18	.29	.003	420	22	1.91	.0079	1.6	½"	4 "	20	2.97	.107	82.5	79	3.00	.127	73	75	87.2
16	400	26	2.07	.00525	1700	28	21	.0962	4.25	⅜"	4 "	18	2.85	.105	110	76	2.8	.125	105	66	100.5
17	1409	22	25.8	.04	1800	26	13.36	.0895	1.27	⅜"	6½"	20	1.70	.060	85	67	1.50	.070	48	49	70.6
18	113	22	.393	.0006	554	22	1.71	.014	5	½"	4 "	18	3.00	.113	45	62	3.05	.115	48	67	62.5
19	371	28	3.5	.0054	2503	32	74	.208	6.7	⅜"	2 "	18	2.75	.103	100	77	2.85	.095	105	84	102.7
20	170	22	.56	.0011	2800	26	26	.399	16	¼"	2½"	20	3.00	.108	32.5	63	3.05	.085	63	62	62
21 standard	270	20	.35	.0015	2139	32	32	.0978	7.8	¼"	3½"	23	3.10	.110	100	74	3.2	.110	100	81	100
5G	275	18	.88	.0021	2934	30	84	.278	10.7	⅜"	3½"	23	3.00	.110	100	75	3.05	.110	107	69	99
5H	275	18	.88	.0022	3910	30	217	.463	14.2	⅜"	3½"	23	3.00	.112	102	67	3.05	.110	115	77	101.8

gives the results of the tests with the 6-mile line, and the other those obtained from the 106-mile circuit. The opinions of the investigators making these experiments is expressed in the columns headed volume and clearness. The figures therein contained show the idea which was formed as to relative intensity and clearness of articulation of each coil as compared with No. 21.

Unfortunately the results shown in Tables 4 and 5 do not lead to the formulation of any rules as to the best proportions to be observed in the design of induction coils. On the contrary, these experiments seem to teach that coils of quite widely varying properties yield fairly satisfactory results. Theory indicates that to secure the very highest efficiency the coil should be proportioned to the particular transmitter, receiver and line with which it is to be connected. In commercial operation this is impossible, so it is perhaps fortunate that practice shows it to be feasible to work over widely differing lines, with coils of many designs and obtain sensibly the

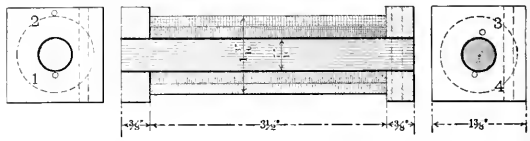


FIG. 9.—INDUCTION COIL FOR COMMON BATTERY SOLID-BACK TRANSMITTER NO. 5.

SPECIFICATIONS FOR FIG. 9.

Core: Bundle of No. 24 soft iron wire.
 Diameter of core, 7/16 in.
 Length of core, 4¼ in.
 Winding space, 3½ in.
 Paper insulation around core 1/32 in. thick.
 End blocks ⅜ in. thick, 1⅜ in. square.
Windiog: Inside winding.
 Resistance, 28 ohms.
 1404 turns No. 31 single cotton covered wire wound from end to end of core.
 Two layers common paper insulation around it.
 Outside winding.
 Resistance, 17 ohms.
 1705 turns No. 26 single cotton covered wire wound from end to end of core.
Terminals: 1 and 2 to outside wiring.
 3 and 4 to inside wiring.
 1 to line.
 2 to hook.
 3 to condenser.
 4 to hook including receiver.

same results. Probably, therefore, the best guide to the plan of an induction coil is to be found by dissecting a number of coils, that have survived the test of time and experience, and building along the lines thus indicated. As an aid to the designer the proportions used by half a dozen or more of the principal manufacturers, will be found in Table V, while the succeeding drawings and accompanying specifications, still further exemplify the building of induction coils.

Considering the importance of the induction coil, too much pains cannot be taken in its design, or too great liberality allowed in its proportions. In its construction and assemblage, the very best material and the highest standard of workmanship should be used. Under increasing competition there is a great and mistaken tendency to skimp both in quality and quantity. The general aim of design should be to produce a coil of the least possible impedance and the greatest mutual inductance. To this end the primary should be of large wire, the core ample in size and long enough to accommodate the necessary turns of the primary, which should not be less than 300 in two layers. The ratio of transformation between the primary and secondary should be from 8 to 10, and the size wire employed in the secondary such as to enable the requisite number of turns to be obtained in not to exceed five layers. For both primary and secondary white single silk-covered copper wire should be used, and it is desirable that each coil should be wound with a single piece without splices. In the winding care should be taken to wind evenly and uniformly without piling or crossing any of the turns. Between the primary and the secondary an insulation of at least four thicknesses of paraffined paper should be provided, and it is well to interpose two thicknesses of paper insulation in the middle of the secondary. The terminals of both primary and secondary should be reinforced by means of stranded wire extended from the inside of the winding through holes drilled in the heads and soldered to clips secured either upon the head or upon the base. The stranded terminal wire should be heavily insulated with a silk or cotton wick. The core should be composed of the very best and softest Swedish iron wire, thoroughly annealed. The wire should not be over a No. 20 B. & S. gauge and preferably No. 26 or 28. It should be thoroughly varnished, cut to proper length and packed into the core tube, and each piece of wire composing the core should be the full length of the tube. Short pieces or spliced pieces should not be allowed.

For the coil frame fibre heads about ¼ in. in thickness and from 1 in. to 1¼ in. square, mounted upon a fibre tube ½ in. in diameter and from 4 to 6 ins. in length is preferable. While many makers use paper tubes and wooden heads, fibre is much more desirable.

TABLE V.—INDUCTION DATA FROM PRACTICE.

Maker.	Secondary Coil. Wire. Gauge: B. & S.	Insulation.	Weight, oz.	Length, ft.	Resistance, ohms.	Turns per layer.	Number of layer.	Total turns.	Insulation between layer.	Tube. Diameter, ins.	Material.	Core. Size of wire: B. & S.	Length, ins.	Number of pieces.	Weight, oz.
Erickson	30	Bare wire Varley coil	1.25	516	60	200	17	3300	Paper	5/16	Fibre	20	3¼	73	.63
Kellogg	29	White silk	1.50	300	20	240	9	2200	Paper	¼	Paper	24	3 11/16	96	.50
Manhattan	34	Cotton	1.37	1045	250	280	19	5350	Paper	7/16	Paper	25	3 7/16	206	.75
Western Tel. Con. Co.	29	Cotton	1.75	350	30	230	7	1650	None	7/16	Paper	20	4	148	2.00
American Electric	28	Green silk	1.125	152	20	215	3	700	None	½	Paper	20	3⅞	176	2.125
Stromberg-Carlson	30	Green silk	2.37	525	50	260	9	2400	Paper	7/16	Paper	20	4¼	128	1.75
Century Tel. Co.	34	Green silk	1.37	900	230	460	10	5000	None	5/16	Paper	23	4½	120	.88
Swedish American	34	Green silk	.875	450	115	336	6	2200	Paper	5/16	Fibre	20	3¾	120	.70

Maker.	General Specification. Length, ins. Over all.	Between heads.	Body. Corimeter, ins.	Covered with	Material.	Heads. Length, ins.	Width, ins.	Thickness.	Primary Coil. Wire. Gauge, B. & S.	Insulation.	Weight, oz.	Length, ft.	Resistance, ohms.	Turns per layer.	No. of layers.	Total turns.	Insulation between layers.
Erickson	3¼	2¾	13/16	Pebble paper	Rubber	⅞	⅞	¼	27	White silk	.25	32	1.75	175	2	350	Paper
Kellogg	3 11/16	3	11/16	Black cloth	Wood	1.00	1.00	⅜	20	White silk	1.00	27	9.10	90	3	300	None
Manhattan	3 7/16	2⅞	1.00	Black paper	Wood	1.00	1.00	¼	22	Cotton	1.00	36	.53	90	3⅓	295	None
Western Tel. Con. Co.	4	3½	⅞	Black cloth	Fibre	1.00	1.00	¼	27	Cotton	2.36	300	15.50	200	8⅓	1650	None
American Electric	3⅞	3⅛	1.00	Green cloth	Fibre	1.¼	1.¼	⅜	28	Cotton	2.25	360	9.10	215	9	200	None
Stromberg-Carlson	3⅞	3 11/16	1.00	Black paper	Fibre	1⅛	1⅛	3/16	20	Green silk	1.88	50	.50	110	3	350	None
Century Tel. Co.	4½	3 11/16	¾	Green paper	Fibre	1⅛	1⅛	⅜	23	Cotton	1.63	65	1.50	125	4	500	Paper
Swedish American	3¾	3	1.00	Black cloth	Fibre	1.00	1.00	⅜	22	Cotton	2.25	82	1.30	96	6	550	Paper

Production of Artificial Gas.

A report just issued from Washington, by Mr. Edward W. Parker, gives the following figures of gas production that are of interest. The table shows the total quantity of gas made from coal by the 533 companies distributed over 44 States and Territories. Prices for artificial gas are low in States where natural gas is used largely in the principal cities, as in Illinois, Indiana, Kentucky, Ohio, Pennsylvania, West Virginia and also Massachusetts, where a large portion of the gas made is a by-product from coke-making in retort ovens:

TABLE I. PRODUCTION OF GAS AT GAS-WORKS AND COKE-OVEN PLANTS IN 1902.

Number of plants reporting	533
Coal carbonized, short tons	5,015,511
Gas made, cubic feet	30,764,625,332
Gas sold, illuminating purposes:	
Cubic feet	23,401,318,526
Value	$23,688,963
Average price per 1,000 cubic feet	$1.012
Gas sold, fuel purposes:	
Cubic feet	5,677,755,029
Value	$5,653,918
Average price per 1,000 cubic feet	$0.996
Gas sold, total:	
Cubic feet	29,079,073,555
Value	$29,342,881
Average price per 1,000 cubic feet	$1.009
Gas unaccounted for, cubic feet	1,685,551,777

TABLE II. PRODUCTION OF GAS AT GAS-WORKS IN 1898.

Number of companies reporting	433
Coal carbonized, short tons	2,042,698
Gas made, cubic feet	19,469,464,957
Gas made per ton of coal, cubic feet	9,465
Gas sold, illuminating purposes:	
Cubic feet	15,955,149,507
Value	$18,953,114
Average price per 1,000 cubic feet	$1.188
Gas sold, fuel purposes:	
Cubic feet	2,476,051,907
Value	$2,549,181
Average price per 1,000 cubic feet	$1.0295
Gas sold, total:	
Cubic feet	18,431,201,414
Value	$21,502,295
Average price per 1,000 cubic feet	$1.1666
Gas unaccounted for	1,038,263,543

Of the total amount of gas produced in the United States in 1902, 1,685,551,777 cubic feet, or 5.48 per cent., were lost by leakage or accident. The marketed product amounted to 29,079,073,555 cubic feet, of which 23,401,318,526 cubic feet, or 80.45 per cent., were sold for illuminating purposes and 5,677,755,029, or 19.55 per cent., for fuel. As a usual thing the gas sold for illuminating purposes brought higher prices than the fuel gas, but there were a few instances where fuel gas was sold at high enough figures to make the average price for this gas in the State higher than illuminating gas. The price of illuminating gas varied from 65.2 cents per 1,000 cubic feet in Massachusetts to $2.13 in Montana, Nevada and New Mexico. Fuel gas ranged from 29.2 cents in West Virginia to $1.98 in Oregon. The average prices of fuel and illuminating gas in 1902 for the country as a whole show a difference of only 1.6 cents per 1,000 cubic feet, the former being 99.6 cents and the latter $1.012.

An Electrical Engineer in Thibet.

Mr. Oscar T. Crosby, the well-known electrical engineer, who, during the past few years has devoted a great deal of his time to exploration in the remote regions of the world, including Abyssinia, Somaliland, the Blue Nile, etc., has just returned to this country after a most interesting expedition through Turkestan and Thibet. While in England on his way home he addressed the Royal Geographical Society on the subject, and a number of his friends in this country having invited him to redeliver this lecture, he appeared last week at the American Institute before a gathering of some 400 or 500 people under the auspices of the New York Electrical Society and of fellow-members in the American Institute of Electrical Engineers. The lecture made a most agreeable diversion from the usual programme of the Society and was a delightful and fascinating narrative of adventure and peril in the mysterious region beyond the snowy ranges of the Himalayas, and in a land upon which Russian and British political intrigue is now said to be focussed, the Indian government having recently sent an expedition to Lhassa. For over two hours Mr. Crosby, who has keen powers of observation, a splendid command of language, and a fine sense of humor, held his audience entranced while he detailed the successive stages of his long journey, during the last 50 days of which, spent about 15,000 ft. above sea level, he did not take his clothes off; and during the last five days of which his party was on the very verge of starvation. Although he did not succeed in reaching the capital of the Grand Llama, Mr. Crosby was able to see a great deal of the life and scenery of Turkestan and Thibet and secured a number of interesting photographs, many of which were shown on the screen by lantern. He also brought back with him ancient manuscripts from some of the sand-buried cities of central Asia, whose history still remains in such impenetrable gloom. Before starting on his trip, Mr. Crosby provided himself with a phonograph, upon the cylinder of which his credentials and attributes were set forth in the choicest Chinese dialect of the region visited; but this vocal passport he had to leave behind him with a great deal of other baggage which succumbed to the rigors of the expedition. At the close of the lecture, on motion of Vice-President Mullin and Mr. Frank J. Sprague, an enthusiastic vote of thanks was passed to the lecturer for the great pleasure he had afforded the Society and so many of his old friends. During the evening it was announced that immediately upon the Union Engineering Building becoming an accomplished fact, President Carty had filed with the conference committee, on behalf of the Society, a request that it might be given accommodation and facilities within the building: and that this request had been favorably acted upon. This news was received with great enthusiasm.

Recent Electrochemical Developments.

MANUFACTURE OF SULPHURIC ACID FROM SULPHURETED HYDROGEN GAS.

The Salom process for the reduction of lead from galena consists in the use of a cathode of galena (lead sulphide) in sulphuric acid as electrolyte. The cathodic reaction is the reduction of lead sulphide to metallic lead with a simultaneous evolution of hydrogen sulphide gas. While the main object of the process is the production of lead, yet the hydrogen sulphide is a valuable by-product and something must be done with it. In a patent granted to Mr. P. G. Salom on March 22 a method is described for using it for the manufacture of sulphuric acid.

The hydrogen sulphide gas is first burned, to form sulphur dioxide. The sulphurous-acid gas is then oxidized in the presence of water by means of electrolytic action, the current of gas being subjected to progressive anodic treatment in a series of divided receptacles through which it travels. The process is so conducted as to permit the progressive transfer from time to time of the contents of each receptacle into the next one of the series, and the discharge of the contents of the ultimate receptacle (in which the action has proceeded to the fullest extent) into a receiving tank, the gravel of the liquid contents being in the inverse direction to the flow of the gas through the same. The apparatus used by Mr. Salom is very similar to that employed by him formerly for lead reduction and consists of a stack of trays placed one upon the other.

EXTRACTION OF COPPER FROM COMMINUTED MINERAL MIXTURES.

In a patent, granted on March 22, Mr. E. A. Le Sueur, who is best known by his early pioneer work in the development of the diaphragm cell for the electrolysis of sodium chloride, describes a process for obtaining the copper from mineral mixtures containing only a very small amount of copper, as, for instance, the waste sands from stamp mills. Mr. Le Sueur proposes to treat them by a wet process and his process consists, therefore, of two steps: The first using the solution of the copper, the second its precipitation.

For solution he uses an ammoniacal solution of cupric hydroxide, with the addition of certain apparently inert salts, like ammonium sulphate. If there is no access of air, the reaction is a reduction of the cupric ions, already in the solution, to the cuprous state, while the metallic copper passes simultaneously into solution, also in the cuprous state. While in the sense of the ionic theory this is an electrochemical phenomenon, this step is purely chemical from the practical point of view, since no current is passed from the outside through the solution.

For the second step—the precipitation of the copper from the solution—either chemical or electrochemical means may be employed. In the latter case the author suggests the following cycle, the whole process being conducted in the form of a cycle, as follows: Copper is first dissolved, as described before, in cuprous form, about the same weight of copper going into solution as is contained in it in the cupric state at the start of the operation. Then electrolysis begins with an insoluble anode and as much copper is now deposited upon the cathode as had gone before into solution, while the other part is oxidized from the cuprous to the cupric form at the anode. Then the solution is again in its original condition and may again be used for leaching out other ore.

STORAGE BATTERY INVENTION.

A patent, granted to Mr. S. Lake, of Bridgeport, Conn., relates to mechanical details of the connection of the battery plates of common size to the bus-bar in such a way that individual plates may be easily removed. In a patent, granted to Mr. M. C. Burt, of Chicago, a cooling device is described which is intended to counteract the heating of the solution by Joulean heat.

Mr. C. B. Askew, of Chicago, refers, in a recent patent, to details of construction of a grid for pasted storage battery plates. The grid is made of sheet lead transversely sawed from opposite sides in planes at right angles to the medium plane of the sheet, so that each side of the sheet is provided with parallel grooves. The grid is also provided with perforations.

CURRENT NEWS AND NOTES.

TURBINES FOR CUNARDERS.—Great interest has been aroused in marine engineering and electrical circles by the announcement that the Cunard Steamship Company has decided to adopt steam turbines in the new fast steamers which are to be built under an agreement with the British Government, which will have a gross tonnage of 28,000, which are expected to travel at a speed of 25 knots an hour and will cross the Atlantic in about five days.

WIRELESS AT THE ISTHMUS.—A cable dispatch from Panama of March 26 says: "The postmaster at Panama to-day received official cable advices from Minor Keith, who is in Costa Rica, stating that a system of wireless telegraphy was successfully inaugurated last Thursday between Port Limon, Costa Rica, and Bocas del Toro, Panama. The convention recently held here authorized the President of the Republic of Panama to sign a contract for the installation of this system. Mr. Keith will also establish a wireless station at Colon."

UNDERGROUND CONSTRUCTION.—President Edgar, of the National Electric Light Association, has asked Dr. S. S. Wheeler to act as chairman of the committee to examine the papers of those competing for the gold medal offered by Past President Doherty for the best paper on underground construction, to be presented at the twenty-seventh convention of the association. Dr. Wheeler has consented to serve, and the other members of the committee will be Mr. Louis A. Ferguson and Mr. H. G. Stott. All of these gentlemen are excellent authorities on the subject, and it is hoped that the papers—which are to be handed in before April 21—will be of a character to make their work a most interesting one. Dr. Wheeler, it may be noted, was at one time electrical engineer for the New York Board of Electrical Control, in the early days of its subway work for underground wires.

MUNICIPAL ELECTRICIANS.—There will be a meeting of the executive committee of the International Association of Municipal Electricians on Saturday, April 2, at 10 A. M. at the Astor House, New York City.

POSTPONEMENT OF IOWA ELECTRICAL CONVENTION.—The Iowa Electrical Association convention which was to have been held at Des Moines April 13 and 14 has been postponed one week to April 20 and 21. Headquarters will be at the Hotel Savery.

WIRELESS IN CHINA.—It is stated that the Italian legation at Pekin has been provided with a Marconi wireless telegraphy station which enables direct communication to be maintained with the vessels of the Italian fleet in Chinese waters. Thus the Italian legation will be able to communicate with its ships at Taku and Tien-tsin without recourse to the lines of the Chinese Government.

WESTINGHOUSE RUSSIAN GIFT.—The text of the acknowledgment by the Empress of the gift of $5,000 by the Russian Westinghouse Company to her fund for the relief of the sick and wounded is as follows. It is signed by Count Rostovtsoff: "It has been a pleasure to her Majesty, the Empress Alexandra Feodorovna, to express her sincere thanks to the stockholders of the Westinghouse Company, consisting chiefly of citizens of the United States, who have placed $5,000 at her Imperial Majesty's disposal for the purpose of aiding the sick and wounded soldiers in the Far East, as well as for their expression of sympathy with Russia, which at the present time will have peculiar value. It is my pleasant duty to inform you of this by her Majesty's order."

THE YORK HAVEN POWER PLANT.—The officers and promoters of the York Haven Power Company are determined not to allow the damage which the recent freshet wrought to the extensive plant at York Haven to interfere with their original plan which was to have the plant in operation and supplying current to York and other towns by next May. At a meeting just held by the officers and the largest stockholders the reports of the damage were received. Plans were at once developed for the immediate repair of the plant. A temporary power house of wood is to be built over the machinery and a permanent brick structure will be reared over this. Repairs to the machinery can be made quickly and by the use of a temporary switchboard and the quick clearing away of the debris in the big race it will be possible to have the plant in operation within the next sixty days. The experts estimate that $10,000 will cover the cost of repair.

NEW YORK POOL ROOMS.—The Western Union Telegraph Company has been co-operating vigorously with the city authorities to stop business in the gambling pool rooms. It is said that Mayor McClellan's attention was directed to the controversy between the Western Union Telegraph Company and the several hundred pool rooms in this city—all of which the police declare are closed—the telegraph company having declared its ability, by withholding its service from the pool rooms, to put them all out of business, if certain leaks were not stopped. The Mayor was asked if it had occurred to his administration that by bringing pressure to bear on the telegraph company and compelling it to stop serving pool rooms it might do what the police admit they have great trouble in doing. "Do you mean," replied the Mayor, "that we should indict the officials of the Western Union Telegraph Company as accessories to the fact?" A moment later the Mayor, still thinking it over, said: "If the telegraph company carries out its threat to close the pool rooms, I guess the pool rooms will have to go to see brother Marconi."

TEXAS ELECTRICAL ASSOCIATIONS.—The Southwestern Gas, Electric and Street Railway Association and the Southwestern Electrical Association will hold a joint convention at Dallas, Texas, on April 25, 26 and 27. This will be the fifth annual convention of the former association, and the second convention of the latter. It is proposed to consolidate the two associations and the proposition will be voted upon at that time. Among the subjects to be discussed at the meetings will be: "Advantages of the Combination of Gas and Electric Light Plants"; "The Operation of Single-Phase Motors from the Central Station Standpoint"; "Framing of City Franchises for Public Service Corporations"; "Combination of Public Utilities in Small Cities"; "Economics of the Meter"; "Benefits and Evils of Telephone Competition"; "Accidents on Street Railways and Damage Suits"; "Central Station Accounting"; "Electricity and Risks"; "Requirements of the National Board of Underwriters in the Southwest," and "Developments of Interurban Railways in the Southwest." Mr. F. E. Scovill is secretary of the Southwestern Gas, Electric and Street Railway Association with headquarters at Austin, Texas.

THE NAME OF EDISON.—An article in *Cassier's Magazine* for April states that when Mr. J. Ricalton returned, in 1889, from a year's exploration tour in foreign climes, made in Edison's behalf in search of a suitable bamboo for filaments, he told how he had learned to regard Edison as the most widely known man in the world at that time. In all his journeyings in the Far East he had been astonished many times to find his name so familiar; even the unlettered natives of half-civilized countries had learned to associate it with the electric light. His donkey boy in the streets of Cairo was endeavoring, in broken English, to tell him something about the Khedive, when Mr. Ricalton asked him the name of the American Khedive. The boy shook his head to indicate that he did not know. Mr. Ricalton mentioned the name Harrison, who at that time was President of the United States, but the boy did not recognize it. Then Mr. Ricalton mentioned Edison's name: the boy smiled cognizantly and drawled the name, "Ed-ee-sone," while pointing to an electric light in front of the hotel. A few weeks later Mr. Ricalton mentioned the name to his courier in Morocco, whereupon the latter quickly proceeded to offer his knowledge of the man. Edison's name truly, Mr. Ricalton concluded, was a household word even at the ends of the world.

TEST OF COMMERCIAL AUTOMOBILES.—At the present time eighteen entries have been received by the Automobile Club of America for the service test of commercial motor vehicles which is to be held under the auspices of the club next week. There are eight classes according to the weight-carrying capacity. In the first class, including vehicles carrying 1,000 pounds or under, there are three entries, all being light gasoline delivery wagons. The second class has the largest number, nine vehicles, their carrying capacity limit being between 1,000 and 2,000 pounds. Of these nine the electrics are most numerous, five of the nine wagons being equipped with electric motors. Four of them are delivery wagons and one an express wagon. Of the other four, three are gasoline delivery wagons and one a steam delivery wagon. The third class, between 2,000 and 3,000 pounds, has two cars entered, both gasoline delivery wagons. The fourth class, between 3,000 and 4,000 pounds, has one, a gasoline truck. The fifth class, between 4,000 and 5,000 pounds, has one, an electric truck. No entries were made for the sixth and seventh classes, but in the eighth class, for vehicles carrying from 8,000 to 10,000 pounds, two heavy trucks are entered, one being a gasoline-electric truck and the other a steam truck. With the exception of the last class all the vehicles will perform the regular daily service of two local express companies, while the two big trucks will do the regular work required of the wagons in use by a large brewery. The club has engaged the services of a number of observers to assist in checking results.

LETTER TO THE EDITORS.

Cheap Current From Municipal Plants.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of March 19 Mr. C. W. Koiner, superintendent and chief electrician of the Madison County Gas & Electric Company, of Oneida, N. Y., takes exception to a statement made in my descriptive article relating to the South Norwalk municipal plant, published in your issue of February 20, regarding the rate of 1.9 cents per hp-hour by meter as charged by this plant for a consumption of say 50 hp-hours for 26 10-hour working days per month. I said in the article that there is no place known with the exception as given where power can be obtained so cheaply.

Mr. Koiner says that this statement is "erroneous" and "misleading," and that he "knows of cities and towns in his neighborhood that sell current for less than 1.9 cents per hp-hour." Assuming that the gentleman is familiar with his subject, I am willing to acknowledge my ignorance in the presence of superior knowledge and humbly ask him to make good his assertion, by giving the names of the "cities and towns in his neighborhood" that make a business of selling electric power under the conditions and below the rate to which he takes exception. I believe that this information will be relished by the consumers of power in the places in mind, and further, that, as it is undoubtedly the aim of all good central station managers to give the greatest value possible, with due regard for profit, for the least cost of the consumer, such information would awaken a certain degree of professional curiosity as to the economies that make a lower rate possible.

The gentleman takes the opportunity, before concluding his remarks, with some seeming loss of dignity, to say disagreeable things about those who operate or advocate municipal central stations, from which it might be inferred that he is addicted to making extravagant assertions. I think that most of those who have to do with central stations (private or municipal) are a pretty good lot of people, and am glad to believe that I have many friends on both sides, among whom I would like to add the name of Mr. Koiner.

When visiting my old home not a great way from Oneida, it will be my pleasure to run in on Mr. Koiner, for a friendly call. I am thoroughly in accord with his sentiments regarding misstatements, only I would go a little further and say that "every misleading statement emanating from agitators" for or against "municipal ownership should be called to account." Both sides should be fair to each other and justice will follow. Private and municipal plants each have their place, and where one does right the other is not needed.

I see that my friend is faithful to his trust. I try to be the same to mine, and the question is not that I happen to be in charge of South Norwalk's municipal plant, but that I am here for results, without regard to who owns the plant, and incidentally I can look upon the good and bad of both private and municipal ownership with regret for the bad and joy for the good in each.

South Norwalk, Conn. A. E. Winchester.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Speed of Direct-Current and Induction Motors.—Hobart.—An illustrated paper read before the (Brit.) Inst. Elec. Engs. on the rated speed of electric motors as affecting the type to be employed. High speed is a very favorable condition for the continuous-current motor, but up to certain limits conduces to improve results for induction motors. The author gives a great many details on the design and behavior of direct-current and induction motors for varying speeds, and gives two comparative tables with all the dimensions, efficiencies, weights and costs for 150-hp continuous-current motors running at speeds between 68 and 1,224 and for 150-hp induction motors, operated at 21 cycles per second at synchronous speeds of 70, 210 and 630, or at a frequency of 63 cycles at synchronous speeds of 630, 940, 1,260 r.p.m. The principal conclusions at which he arrives are: Induction motors are for all capacities, considerably cheaper than continuous-current motors of equivalent ratings. The general performance and the mechanical construction of induction motors improve rapidly with increasing rated speeds. The general performance and the mechanical construction of continuous-current motors improve rapidly with decreasing rated speeds. The use of very low-speed induction motors and very high-speed continuous-current motors ought to be avoided whenever this is commercially practicable.—Lond. *Elec.*, March 11.

References.

Magnetic Dispersion in Induction Motors.—Behn-Eschenburg.—A continuation of his paper. He shows that in the ordinary constructions of motors with open slots the part relatively contributed by the peripheral dispersion to the total values of the dispersion coefficient plays a very subordinate part. For closed slots, in which the iron bridge is made thin enough, this dispersion coefficient may be estimated about four times greater than for slots with slits. He then begins a general discussion of the winding coefficient. The paper is to be continued.—Lond. *Elec.*, March 11.

Alternators in Parallel.—Koehler.—An elementary article, illustrated by diagrams, in which the author discusses the fundamental principles of the operation of alternators in parallel, and describes the working of phase indicators.—*Elek. Anz.*, March 6.

Lights and Lighting.

Candle-Power and Temperature.—Eisler.—A paper in which the author refers to Lummer and Kurlbaum's determinations of the light given out by incandescent platinum at varying temperatures. They have developed an empirical formula which shows the rapid increase of candle-power with the increase of absolute temperature. This relation may also be found indirectly by means of calculation on the basis of Langley's figures for the sensibility of the eye in the different portions of the spectrum, and on the basis of the distribution of energy in the spectrum of an incandescent body. The author carries out this calculation and shows that the measurements of Langley and those of Lummer and Kurlbaum confirm each other, and that the following conclusions may be drawn with a certain degree of probability. The physiological action of combined light (that is, light of different wave lengths) equals the sum of the single actions of the light of the different wave lengths in it. The radiation of the theoretically "black" body differs from that of platinum in the visible part of the spectrum in absolute value, but both depend in exactly the same way upon the temperature. For both the black body and platinum there is the same relation in candle-power and temperature. The author criticises former attempts to give figures for the mechanical equivalent of light. Tumlirz, basing his conclusions on tests of the Hefner lamp, had stated that the visible radiation has the energy value of about 1,900,000 ergs per second. From this figure it follows that with no type of illumination would it be possible to get more than 5.2 cp per watt. The author shows that this conclusion is wrong since the physiological value of the visible radiation depends greatly on the temperature of the light. For about 4000° absolute temperature (arc light) this value is 3.5 times greater than for 1800° absolute temperature (Hefner candle). It would, therefore, follow that light corresponding to the composition of the spectrum of the black body at 4000° would give 18.7 candles per watt, if the efficiency was 100 per cent. If one desires to give a figure for the most ideal case of the generation of light, one might assume a process in which the energy is completely transformed into radiation of light of that wave length for which the human eye has the highest sensibility. For this special wave length one would get 65 candles per watt with an efficiency of 100 per cent. But such a light would not be practical, since a practical source of light should be of the same color composition as sunlight. For this case he gets a figure of 27 candles per watt for an efficiency of 100 per cent. In practice we will never attain this value, if some parts of the energy are transformed into invisible radiation and into other forms of energy which are not wanted. But even if by the use of phenomena of luminescence we should succeed in transforming the energy completely into visible radiation, there would be, nevertheless, a difference in the value of different sources of light according to the degree in which such "perfect" luminescent lights approach the spectrum of the sun.—*Elek. Zeit.*, March 10.

Photometric Tests of Street Lamps.—A table giving the results of comparative tests of street lamps extending over a period of 18 months. The tests were made by Bradley. The total cost per candle-power per year was found to be 21.5 cents and 17.46 cents for two sets of electric arcs with opalescent globes; 34.4 cents for electric arcs with muranese globes, 56.6 cents for refuge lanterns (4 mantels), 15.3 cents for Sugg's high-pressure gas lamps, 40 cents and 36.6 cents for two different sets of incandescent gas mantels, and 59.8 and 96.4 cents for two sets of triple flat-flame lamps. In the case of incandescent mantels, including high-pressure lamps, great variations in candle-power are found to be due to the condition of the mantels—what appears to the naked eye as a slight diminution in intensity, resulting in an enormous loss of candle-power. A slight defect in any of the incandescent mantels in high-pressure lamps causes a great loss of candle-power.—Lond. *Elec.*, March 11.

TRACTION.

Mersey Railway.—KIRKER.—A paper read before the Manchester Section of the (British) Inst. Elec. Engs. Electric traction was inaugurated on May 3, 1903, arrangements having been made for an instantaneous and complete transformation. The steam traffic ceased on May 2, and electric traction, with a complete train service, began on the succeeding morning. The three-minute schedule has been successfully maintained from the beginning. The trains vary in size from two to five cars. In the three, four and five-car trains there are two motor cars, situated at the extremities. Multiple-unit control is used. The average electric load is 22,000 kw-hours per day. Concerning ventilation (which is important since the road is a tunnel road) he says that under steam conditions the average cost per half year exceeded $12,000; with electric traction it falls below $1,000 for a corresponding period. As to the schedule speed, the rate was 15 miles per hour for the steam trains and electric traction was laid out on the basis of 20 miles per hour, which is attained. With the steam locomotives the train mileage was less than 6,000 per week. During the last quarter of 1903 the electric trains lacked but 40 miles on an average of 15,000 miles per week. Concerning the coal consumption, it was estimated that the average would not exceed 4 pounds per kw-hour at the switchboard, and the average for the last quarter of 1903 and the first six week of this year is below 4 pounds. The consumption of energy for a loaded three-car train was estimated not to exceed 9.25 kw-hours per train mile; for the last quarter of 1903 the actual figure was less than 9. The cost of operation per train mile (including the power house expenses, the cost of power for operating and lighting trains, the maintenance of electrical equipments, cars and collector rails) was below 13.5 cents per train mile for an average train 230 ft. long, and weighing 105 tons, including motors. The corresponding cost per steam train, 200 ft. long and weighing 77 tons, exclusive of locomotive, but working at a schedule speed of 15 miles per hour instead of 20, exceeded 22 cents per train mile. The total power station cost did not exceed 0.7 cents per kw-hour during the last quarter of 1903.—Lond. *Elec. Rev.*, March 11.

Capacity of Traction Motors.—MÜLLER.—An article in which the author describes a method for determining the size of a traction motor by calculation on the basis of tests of the heating of kindred motors. When used on the road, the motor assumes a certain end temperature which it maintains nearly constant throughout service. Under these conditions the heat which it gives out by radiation is equal to the heat produced by the electric current in the motor. This end temperature is required to be not over 75° C. over that of the surrounding air (in Germany). The total heat which is produced in the armature conductors is the sum of i^2t, where i is the current in the conductors at any time and t is a time element. The average iron loss is the sum of $Wt \div T$, where W represents the different iron losses during the different time elements, t and T, is the total time of a trip and return trip. If both the field and armature coils of a traction motor are tested at a series of voltages, for instance, 200, 300, 400, 500 volts, for continuous running at a temperature of 75° C. over the temperature of the surrounding air, then the watt represents that heat which the motor is able to give off at the iron losses which correspond to these voltages. One is, therefore, enabled to plot the capacity for continuous running as a function of the iron losses. A curve is thus obtained which, when once determined for the type of motor, is sufficient to determine the size of the motor for given conditions of service. Since a certain voltage corresponds to the determined average iron losses, one may say that the variations of load in the traction service may be represented by a continuous load, the current of which is given by the sum of $i^2t \div T$ and the voltage by the sum of $W t \div T$.—*Elek. Zeit.*, March 11.

Monorail.—A description of the model of Behr's monorail for the St. Louis Exposition. It is built on a scale of ¾ in. to the foot and comprises a circular track and a motor car running on it. Current is led to the car by means of two miniature rails running along each side of the track. This itself consists of a single running rail which is carried—in actual practice—a few feet above the ground, and of four guide rails which serve to steady the car in case it should tend to oscillate from any cause. The five track rails are carried by triangular supports of metal, the running rail being placed at the apex and the guide rails at the sides of the triangle. Owing to the mechanical difficulty of reducing the motors to scale, somewhat larger motors had to be installed and they are placed in the passenger compartment of the car. This in conjunction with the very sharp curves of the model track is said to account for the somewhat jerky and unsteady running.—Lond. *Elec.*, March 11.

REFERENCES.

Electric Railways in Italy.—A note stating that on the Milan-Varese Railroad several trains have recently been equipped with the multiple-unit system and the results have been satisfactory. The continuation of this road from Varese to Luino, which is now operated by steam, will also be equipped for electric traction and three-phase motors will be used in this case. The line from Castle Raimonda to Camerino in central Italy is now being equipped electrically with the direct-current system. The road from Turin to Torre Pellice, of about 50 km. length, is to be changed to electric traction, and it is intended to use a single-phase system.—*Elek. Zeit.*, March 10.

Tramway Traffic.—UPTON.—The first part of an article on through booking and conveyance of passengers, parcels and merchandise on tramways and light railways.—Lond. *Elec. Rev.*, March 11.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Hackney Station.—The first part of an illustrated description of the Electricity Works and Destructor Plant of the Metropolitan Borough of Hackney. The supply is on the direct-current system at 40 volts, and from the commencement flat rates of 8 cents for lighting and 4 cents for power have been charged for electrical energy. The plant began working in 1901 with a capacity of 1,800 kw, which has already been increased to 3,372 kw. The refuse destructor consists of 12 cells, each group of four cells being designed to deal with 60 tons of refuse per day. The generating plant consists of two 250-kw sets, two 300-kw sets and one 1,500-kw generator, all driven by vertical triple-expansion enclosed high-speed engines, provided with condensing plant. In addition there is a booster of 50 kw driven by a motor.—Lond. *Elec. Rev.*, March 11.

REFERENCE.

1,000-kw Double-Current Turbine Generator.—An abstract of a specification for a 1,000-kw, double-current generator for the Stepney Electricity Works. It consists of a steam turbine coupled to two 500-kw double-current generators in tandem on an extension of the turbine shaft. Each machine is shunt wound and multipolar and provided with a commutator and three slip rings, the frequency of the three-phase currents being 40 to 60 periods per second.—Lond. *Elec.*, March 11.

ELECTRO-PHYSICS AND MAGNETISM.

N-Rays.—In order to disprove the assertion that the effect of N-rays is purely subjective, Blondlot has made experiments in photographic registration of the effect of these rays upon a small electric spark. In all the 40 experiments made only one was unsuccessful, while all others showed a distinct effect of the N-rays. Ballet has used N-rays successfully in order to diagnose some diseases of the nervous system; there is a diminution in the emission of N-rays in paralyzed or atrophied muscles in myopathic and other cases. Charpentier and Meyer have found that the intoxication and curarization of certain nerves produces a perceptible effect upon the radiation of N-rays by the muscles which they control. Jegou has found that any wire carrying an electric current emits N-rays; a simple means of obtaining N-rays is to take a Leclanche cell and to close the circuit for some time. The N-rays are stored in the liquid, which becomes a powerful source of the same.—*Comptes Rendus*, February 22; Lond. *Elec.*, March 11.

N-Rays.—BLONDLOT.—An account of an experimental investigation of the dispersion of N-rays and a measurement of their wave lengths. A beam of N-rays, when subjected to dispersion by means of an aluminum prism, is dissolved into several beams corresponding to different indices of refraction. The wave lengths of the N-rays were found to be much shorter than those of light.—*Comptes Rendus*, January 18; translated in Lond. *Elec.*, March 11.

Stresses in a Magnetostatic Field.—WALKER.—A (Brit.) Physical Society paper referring to the observation made by Quincke that when a glass bulb containing a solution of ferric chloride was placed between the poles of a strong electromagnet, the level of the liquid in a capillary attached to the bulb, fell. This has generally been held to require for its explanation a system of stress which differs from the magnetic stresses of electrical type. The present author endeavors to show that the experiments can be quite well explained by the stresses of the electrical type.—Lond. *Elec.*, March 11.

REFERENCES.

Resistance and Temperature.—KÖNIG.—An article giving the simple formulas for calculating the change of electric resistance with temperature. He also gives a simple diagram which enables one to quickly read of the temperature variations of copper resistances. —*Elek. Anz.*, March 3.

Radium.—DANNE.—The first of a series of articles on radium salts; the present portion deals with their preparation and properties, some interesting illustrations being given.—*La Nature*, March 5.

ELECTRO-CHEMISTRY AND BATTERIES.

Ferro-Nickel from Pyrrhotite.—SJOESTEDT.—An illustrated account of experiments made at Sault Ste. Marie on the production of ferro-nickel direct from the Sudbury nickeliferous pyrrhotite. Experiments were made to subject the roasted fines to electric smelting and an electric furnace was erected for this purpose, in which a ferro-nickel pig iron was made from a poor roasted pyrrhotite, with about 3 per cent. sulphur and 53 per cent. iron, at the rate of 60 pounds per hour, with an electrical energy of 108 kw. This is equivalent to 225 gross tons per year, corresponding to an expenditure of 230 hp per ton-day. With a furnace of 300 to 500 hp, which would be more economical, 180 to 200 hp would probably suffice for obtaining a gross ton of metal. But even at that rate the intended plant for the manufacture of 50 tons of ferro-nickel pig per day would have required an electric installation of 10,000 hp, which meant more time and expenditure than were considered necessary. It was, therefore, decided to dead roast the ore, briquette the roasted fines and convert the briquettes, together with an addition of non-nickeliferous iron ores, by the ordinary blast furnace process, into a pig of desired nickel contents.—*Iron Age*, February 13.

Electro-Analysis.—HOLLARD.—A Faraday Society paper on some applications of the theory of electrolysis to the separation of metals from one another. He discusses three different principles and gives examples of their particular application. The first is to reduce the resistance of the bath by suppressing the formation of gas at the anode, either by introducing a reducing agent at the anode or by the use of a soluble anode. As an application the separation of zinc from nickel is discussed. The second method is based on the use of a metal for the cathode which prevents the liberation of hydrogen since it has a higher overvoltage for the production of hydrogen than other metals. The third method consists in preventing a certain number of metals from precipitating themselves upon the cathode by bringing them into the state of complex salts, the separation of antimony and tin in a concentrated solution of sodium hydrogen sulphide being an example of this principle.—Lond. *Elec.*, March 11.

Electrochemical Developments.—BLOUNT.—The first of the series of Cantor lectures. He stated that the electrochemical industries appear at present to pass through a transition stage. Of those processes which are already of practical utility, copper refining is the most important. Competition between chemical and electrochemical manufacturers is extremely beneficial, since it tends to stimulate workers in both fields to further exertion. As a result, any electrochemical process for using substances which can also be produced chemically is in a more flourishing condition than one which forms the sole basis of manufacture. Pure carbonates can only be produced electrolytically and, therefore, this particular branch is not in quite so healthy a condition as it might be. For copper refining, he believes the multiple system to be better than the series system, although much depends upon convenience. To make a process commercially successful it is necessary to employ a high rate of deposition. In the Dolphin plant good circulation is effected together with the free admixtures of air with the electrolyte, and a current density of 25 amp. per square foot is used. For producing zinc electrolytically, he considers the prospects of obtaining it from a fused salt as good. "The electrolytic winning of lead he considers as absolutely hopeless; while the winning of zinc might be large, but the refining, never."—Lond. *Elec.*, March 11.

REFERENCE.

Concentrated Solutions.—JONES AND GETMAN.—A long account of an experimental study of the molecular lowering of the freezing point of water produced by concentrated solutions of electrolytes. The authors find that, with but few exceptions, electrolytes in general give abnormal molecular depressions of the freezing point in concentrated solutions. They conclude that in concentrated solutions there is combination between the molecules of the dissolved substance and the molecules of the solvent, thus removing a part of the solvent, as far as freezing point lowering is concerned. To explain the conductivity result it is also necessary to assume that there is a certain amount of electrolytic dissociation, together with the hydration, existing in these solutions.—*Phys. Rev.*, March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determining the Coefficient of Mutual Induction.—TROWBRIDGE.—A description of a very simple method of determining the coefficient of mutual induction. It is based on the following principle: Two coils of mutual inductance, M, and of self-inductances, L_1 and L_2, when joined in series with the windings in the same direction are equivalent to a single coil of a self-inductance, $L' = L_1 + L_2 + 2M$. When the coils are joined in series so that the lines of force from one oppose the lines from the other, the system is equivalent to a single self-inductance, $L'' = L_1 + L_2 - 2M$. The two coils (provided with a commutator for reversing the direction of the current through one of them) may be put in one branch of a Wheatstone bridge, the other branches of which consist of two non-inductive resistances and a variable standard of self-induction. A balance for steady currents and for variable currents being obtained when the currents are in the same direction through the two-coil gives L'. Repeating the balancing, when the currents are in opposite direction, gives L''. Thus we get M directly as one-fourth the difference between L' and L''. This method, which is very exact, depends on the availability of a variable standard of self-induction. If such a standard is not available, the determination of M may be effected as follows. A coil of a self-inductance L (preferably intermediate between L' and L'') is prepared and by the bridge method the ratios of L' to L and of L'' to L may be found—calling these p and q, respectively, M becomes $\frac{1}{4} L (p - q)$. If L be determined by balancing against electrostatic capacity, then M may be calculated, since p and q are numerical expressions obtained by the use of the bridge. —*Phys. Rev.*, March.

Magnetograph.—WATSON.—A (Brit.) Physical Society paper in which he describes an instrument resembling in principle the Threlfall quartz-thread gravity balance. The principle is to have a magnet suspended on a horizontal quartz fibre kept stretched by means of a spring. The center of gravity of the magnet and the torsion of the fibre are so adjusted that the axis of the magnet is always horizontal. Any variation of the vertical force produces a rotation of the magnet about the fibre, which can be suitably recorded by means of a mirror attached to the magnet. The temperature compensation is effected by weighing the magnet on the same side of the axis of the fibre as the south pole, so that the magnetic couple and the couple due to the torsion of the fibre act in the same direction. Hence, since an increase in temperature causes one of these doubles to decrease and the other to increase, by suitably adjusting the weight and, therefore, the magnitude of the torsion couple, complete compensation can be obtained.—Lond. *Elec.*, March 11.

Electro-Thermometer.—CALLENDAR.—An account of his second lecture on electrical methods of measuring temperatures, the first lecture having been abstracted in the Digest last week. One of the physical problems which can be solved by the application of the electric thermometer is the determination of the absolute expansion of mercury; although this has been done previously, the results require verification, and the author intends to carry out investigations in this direction, using a mercury column 60 ft. long in conjunction with a platinum resistance thermometer. For determining the expansion of various other materials with the temperature, the electrical methods are likewise very convenient; also for determining the latent heat of solutions, for measuring the specific heat of water and steam, for observing the lowering of the freezing point of ice under pressure, and for determining the temperature of steam at different pressures, etc.—Lond. *Elec.*, March 11. A very complete illustrated account of the first lecture of Callendar is given in Lond. *Eng'ing*, March 4.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Type-Printing Telegraph.—SIEMENS.—A very long illustrated paper read before the Berlin Electrical Society on the new high-speed type-printing telegraph of the Siemens & Halske Company. The type printing is done by a photographic method, as shown in Fig. 1. On the rim of the type wheel the 45 different letters and types are cut out at uniform distances on the periphery. This type wheel revolves between an electric spark-gap, *F*, and a sensible strip of paper, *P*. If a certain letter is between the spark-gap and the sensible paper, the arc will send its light through the letter, which

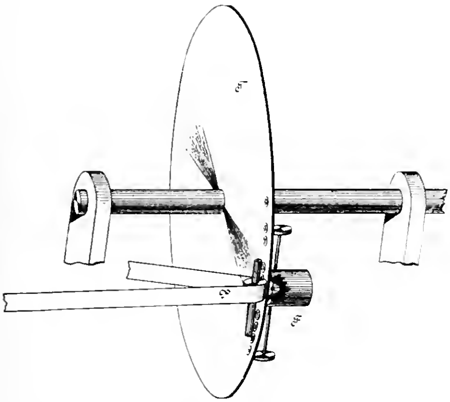
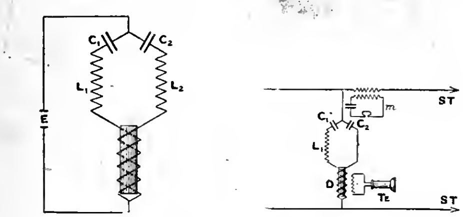


FIG. 1.—TYPE PRINTING TELEGRAPH.

is cut out in the wheel, and the letter will be printed on the paper strip. Since the time of the electric spark is smaller than one-millionth second, the paper strip can be moved at practically any speed without distorting the letter. The receiver and transmitter are operated as two apparatus always revolving in exact synchronism at a speed up to 2,000 r.p.m., or even more. In every revolution one letter may be printed so that 2,000 letters can be transmitted per minute. For every letter transmitted, the transmitter has to send out two current impulses, one positive and one negative, which act on a relay in the receiving station. By the negative impulses one of nine group condensers of the receiving apparatus is charged, while by the positive impulses the condenser is discharged at that place which corresponds to the desired letter. The apparatus is described in detail and profusely illustrated.—*Elek. Zeit.*, March 10.

Simultaneous Telegraphy and Telephony.—Brune and Turchi.—A description of an instrument called a separator, by means of which any existing telephone circuit, whether using earth return or metallic return, can be utilized for simultaneous telegraphic and telephonic messages. The separator is constructed on the principle illustrated in Fig. 2, where *E* is the source of alternating current



FIGS. 2 AND 3.—SIMULTANEOUS TELEGRAPHY AND TELEPHONY.

and the circuit divides itself into two branches of inductances, *R*, and capacities, *C*. If this circuit is traversed simultaneously by two superimposed sine currents of different frequencies and the constants of the circuit are so regulated that there exists a certain relation between the one frequency and the inductances and capacities, then only the current of the other frequency will give rise in the core to a resultant flux, differing from zero, and the effects of the two currents are thus separated. Fig. 3 illustrates the manner in which this system would be utilized for sending one telephonic and two telegraphic communications simultaneously over the same metallic telephone line, *m* being the microphone, *Te* the telephone and *St* the telegraphic station.—*Nuovo Cimento*, October, 1903; abstracted in Lond. *Elec.*, March 11.

Telephony in Great Britain.—A long editorial stating that there are indications that the telephone industry in Great Britain is approaching a crisis. There are at present governmental, municipal and private company telephone systems, but up to the present telephony has not been one of the most successful industries in England; some of those who are carrying it on are doing so at a loss, while others are just making it pay its way. The reason is thought to be that those connected with telephony feel that its present basis is not sufficiently firm. The position of competing telephone concerns must necessarily be insecure, for telephony is, in the nature of things, a business in which competition cannot continue to exist.—Lond. *Elec.*, March 11.

REFERENCE.

Wireless Telegraphy.—Mees.—An elementary and very clear description of the fundamental principles on which wireless telegraphy is based. The action of electric waves is explained by means of the analogy with a tuning fork.—*Rose Technic*, March.

New Books.

Cours D'Electricité. By H. Pellat. Paris: Gauthier-Villars. 2 volumes. Vol. I, 329 pages, 145 illustrations; price, 10 francs. Vol. II, 522 pages, 221 illustrations; price, 28 francs.

These volumes treat successively of most of the essential subjects in an academic course of electricity; the outstanding matters of electrolysis, electro-capillarity and kindred phenomena will be dealt with in a forthcoming volume. It is evident that M. Pellat's audience at the Sorbonne consisted more of men already familiar with the subject and anxious to hear it expounded by a recognized authority, rather than of ordinary college students looking for the usual sequence of subjects with its strict didactic form and goodly array of mathematical symbols.

M. Pellat is always very lucid in his exposition even of the more recondite phenomena: he also makes a good defence of his somewhat radical departure from the time-honored orthodox mode of treatment. Thus, at the very outset, he admits the importance of Coulomb's law, but declines to use it as the basis of his treatise on electrostatics because of its inapplicability to heterogeneous media. As usually written, the law of force is $F = \frac{1}{K} q_1 q_2$. The constant, *K*, shows that the medium must be homogeneous; for, if not, the force may not act along the line joining the two point charges and may not vary as the inverse square of the distance.

Again, we find the opening chapter of Vol. II devoted to electrodynamics, whilst permanent magnets, electromagnetism and electromagnetic induction follow later on. The reasons assigned for this inversion of customary order are that it tends to simplify calculations, leads to a shorter mode of treatment, and, above all, shows up the real meaning of what is called "quantity of magnetism," which the author emphatically holds to be a mere mathematical concept corresponding to nothing real in nature.

One likes such passages as: "The idea of a force existing between two bodies at a distance from each other without an intermediary is too repugnant to common sense to be admitted." "Newton did not say that the heavenly bodies attract each other, but that "everything takes place as though they do." Gilbert's *De Magnete* is spoken of as "a remarkable work on the mutual action of magnets." Boyle is credited with the introduction into scientific nomenclature of the term *electricity*, whereas it was first used by Charleton in his *Ternary of Paradoxes*[1], page 97, published in 1650, when Boyle was in his 24th year. Previous to the coinage of the term by Charleton, the adjective form was in use; thus, we had a *motus electricus*, *vis electrica*, *corpora electrica*, and the like.

Our author attributes the discovery of the Leyden jar to Dean von Kleist and takes care to note that it was due to a mere accident; further on he adds that it was rediscovered in a similar haphazard way by young Cunæus while working in the laboratory of Van Musschenbroeck in the University of Leyden. Though this is by no means improbable, yet the good luck of Cunæus has often been discredited.

The principle of the electrophorus is ascribed to Wilcke, of Stock-

[1] See Wheeler Collection in the Library of the American Institute of Electrical Engineers.

holm, in 1762; but the apparatus, as we have it to-day, is unquestionably Volta's, belonging to the year 1775.[2]

A few omissions occur in the development of the old frictional machine, which, if supplied, the following would be the main points in its evolution: The original globe of sulphur of Von Guericke was replaced by one of glass by Hauksbee. In turn, this was changed for a glass cylinder by Gordon, a Scotch Benedictine monk, then professor at Erfurt, Germany, while Winckler, of Leipsig, substituted a leather cushion as a rubber in lieu of the hand of the operator. Canton improved the action of the rubber by covering it with an amalgam of tin and mercury. Sigaud de la Fond had a plate machine constructed in 1756, which was greatly improved some years later by Ramsden, of London.

Much space is given to the theory and operation of the Holtz machine, a few paragraphs only being devoted to the Wimshurst, which, invented in 1881, is now rapidly replacing its famous prototype.[3]

The Wimshurst machine is rightly said to be practically independent of all atmospheric conditions, to which priceless advantage the author might have added two others, viz.: that it is always self-exciting when the contacts are clean, as they ought always to be; and that it never indulges in the provoking idiosyncrasy of changing its polarity during a lecture.

As to its reversibility, the late Mr. Wimshurst was in the habit of illustrating this essential feature of influence machines to his friends in his laboratory on Clapham Common, London, by sending the current from one of the larger machines into a very small one, which then acted as a motor and did so very satisfactorily. It would be interesting to know if the statement one sometimes hears is really true, viz.: that the current from, say, a 20-in. Holtz or Wimshurst machine will drive one of similar dimensions as a motor.

Electrical readers are aware that M. Pellat has done excellent work in determining the dielectric constant (K) of paraffine and ebonite; Vol. I, Chapter IX, contains an account of his method and of the apparatus which he used.

In Vol. II we notice with pleasure a description of the elegant method introduced by our own Steinmetz for determining the intensity of the current in alternating circuits; it is a well-deserved tribute to American talent and originality.

Only brief reference is made to the discoveries in radioactivity by Becquerel and the Curies. The fractionization of the atom by J. J. Thomson and the electronic theory of Lodge are not even mentioned; such reticence may, however, be overlooked in view of the author's eloquent insistence throughout on the grand, fruitful work of Clerk Maxwell.

"Annuaire" for the year 1904. Published by the Bureau des Longitudes. Paris: Gauthier-Villars. 850 pages, illustrated. Price, 1.50 francs.

This little volume appears for the first time in divided form. Hitherto it has contained not only astronomical, physical and chemical tables, but also geographical and statistical tables. The yearly increasing matter in every department has rendered it necessary to publish these two divisions of tables on alternate years. This year the astronomical, physical and chemical tables appear.

It is wonderful how much matter is condensed into so small a volume. The first hundred pages relate to calendars. The Gregorian, Russian, Jewish, Mussulman, Roman, Chinese and French Republican calendars are all given. Then follow a number of astronomical tables, occupying 250 pages. More than 300 pages are devoted to condensed tables of densities, specific heats, elasticities and other physical and chemical data.

At the end of the book are two interesting special chapters. They relate respectively to the results of the International Geodetic Conference, held at Copenhagen in August, 1903, and to an elementary explanation of the phenomena of the tides. Electric units receive a special chapter from M. Cornu. The terrestrial magnetic elements for a number of towns and cities in France are also tabularly stated. At Paris, for example, on the 1st of January, 1904, the horizontal intensity is given as 0.1984 gauss, the dip 64° 44′ and the declination as 14° 36′ W.

The tables of the book are very valuable, not merely because they are in clear and compact form, but also because they are official, and represent the data accepted by the French Government. An official value of a quantity is often a very useful one, altogether apart from the question of relative accuracy.

The book is naturally not free from errors of oversight. For example, in defining longitudinal extension, an area is expressed in millimeters, where clearly square millimeters is understood. But the authors are to be congratulated upon the great compactness and extensiveness of the data set forth.

BOOKS RECEIVED.

La Telegraphie Sans Fil. By E Guarini. Bruxelles: Ranlot. 64 pages, 88 illustrations. Price, 2.50 francs.

Electric Toy Making. By T. O'Conor Sloane. New York: Norman W. Henley & Co. 183 pages, illustrated. Price, $1.00.

Electrochimica. Soda Caustica, Eloro e Clorati Alcalini per Elettrolisi. Ing. F. Villani. Milan: Ulrico Hoepli. Price, 3.50 lire.

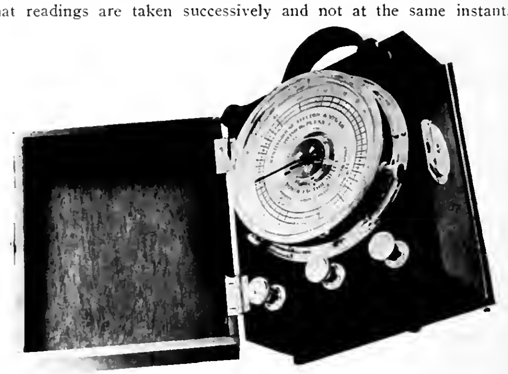
Die Elektrometallurgie der Alkalimetalle. By H. Becker. Halle: Wilhelm Knapp. 128 pages, 83 illustrations. Price, 6 marks.

Electric Lighting and Power Distribution. Vol. II. By W. Perren Maycock. London: Whittaker & Co. 690 pages, 407 illustrations. Price, 7s. 6d.

Dizionario Tecnico in Quattro Lingue. II. Tedesco, Italiano, Francese, Inglese. 2 Edizione. Ing., Edoardo Webber. Milan: Ulrico Hoepli. 611 pages. Price, 6 lire.

New Portable Power-Factor Meter.

The ordinary method of ascertaining the power factor of a polyphase circuit by means of a comparison of the output in watts with the indicated volt-amperes—a quantity obtained by the multiplication of the indicated voltage by the indicated ampere output—is open to serious criticism. In addition to the tedium and inconvenience involved in making three observations, a multiplication and a division, there is an evident liability to error caused by the number of operations required to obtain the result, which is increased by the fact that readings are taken successively and not at the same instant.



PORTABLE POWER-FACTOR METER.

The inaccuracy of such a method is demonstrated by the fact that by its use there may be shown a power factor of over 100 per cent.

It has been found possible to avoid errors and to simplify the process of determining the power factor of a polyphase circuit by employing a single instrument which indicates directly upon a scale the power factor of a circuit, which reproduces on the dial by the position of a pointer, the angle of phase difference, and gives the actual power in percentage of the apparent power. Such an instrument made in suitable form for testing purposes is shown in the accompanying illustration of a new portable power factor meter made by the Westinghouse Electric & Manufacturing Company. It operates with equal facility and accuracy on either a leading or lagging current, and indicates whether the current leads or lags, whether power is delivered to or by the circuit, and the power factor.

In principle it consists of two sets of coils, one of which contains a separate series winding for each of the phases in the circuit, and the other a potential winding which is connected across one phase of the circuit. The series coils are so arranged as to produce a resultant rotating field. A small iron vane passing through the poten-

[2] Volta's condensing electroscope was destroyed in the fire at Como in 1899; one of his "piles" was saved.

[3] James Wimshurst was born in London in 1832, where he died on January 3, 1903. In 1898 he was elected Fellow of the Royal Society.

tial winding forms movable pole pieces for this winding, which take up a position in the rotating field depending upon the phase relation of the currents producing this field and the voltage impressed upon the potential winding. The pointer attached to the shaft carrying the movable vane indicates on a scale the angle between the current and the voltage, the scale being so graduated as to read directly in power factor. Should the power factor of the different phases differ from each other, the instrument will indicate the average power factor.

Different instruments are provided for two and three-phase circuits. They are made with the same care and accuracy that is employed in the manufacture of the other Westinghouse testing instruments, are finely finished and provided with covers which are made removable for convenience in use.

Another Large Concern to Build Steam Turbines.

Another large engine building concern is entering the turbine field, the Hooven-Owens-Renschler Company, makers of the Hamilton Corliss engine at Hamilton, Ohio, having so decided. A 1500-kw horizontal turbine is now under construction at the company's extensive shops. It is intended to exhibit this machine at the St. Louis World's Fair.

A 600-hp compound condensing Hamilton Corliss engine has been ordered by the Bayshore Terminal Company of Norfolk, Va. It will be direct connected to a direct-current Westinghouse generator of 400-kw capacity. An engine of similar capacity is also to be installed on the New York and Hudson River Railway and Ferry Company at Edgewater, N. J. The generator will also be of Westinghouse build. A 300-hp engine has been requisitioned by the Chambersburg and Gettysburg Electric Railway Company, of Chambersburg, Pa. This will be a belted machine.

Electromagnetic Track Brake.

A new electromagnetic brake has been developed by the British Thomson-Houston Company, which we illustrate herewith. The brake consists of a cast-steel shoe suspended from a bracket fastened to the side of the car truck. This bracket is well ribbed and braced, and provided with heavy lugs, which take the thrust of the brake through cast-steel links in compression. The bracket is formed to act as the seat for two compression springs, which support the brake proper by wrought-iron eye-bolts. These springs keep the brake-shoe free from the track when it is not in operation.

The brake-shoe itself consists of a heavy steel casting with a cored recess, into which the magnetizing coil, which is energized by current from the motors acting as generators, is placed. A brass cap or cover is placed over this coil, and so fitted as to form a water-tight protection to the coil. A steel core extends through the coil providing magnetic circuits, which are completed by sections of rail under the end of the coil.

The terminals of the magnetizing coil consist of insulated flexible wires, brought out through bushed holes in the top of the cast-steel frame of the shoe. They consist of two wires in duplicate, and are

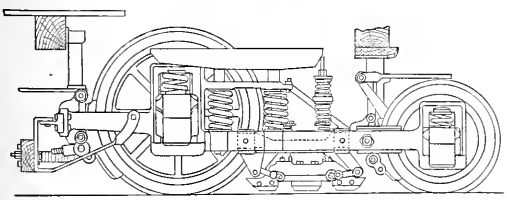


FIG. 1.—DIAGRAM OF TRACK BRAKE.

of sufficient length to extend from the end of the coil winding to the car underframing without a joint.

Each shoe is provided with wearing plates for contact with the rails. These plates are steel castings, held in place by machined bolts, so placed that the plates may be renewed without removing the brake-shoe from the truck.

The brake has been developed in two different forms. The first consists of a large shoe with a bracket designed to suit the various types of single trucks. Two shoes of this type constitute a set, the windings being connected in parallel. This insures protection against failure due to an open circuit. The second is designed for double-truck cars, four shoes per car constituting a set, one shoe being attached to each side frame of each truck. The operating coils of the two shoes on one bogie truck are placed in series, and these are placed in parallel with the two on the other bogie truck. Thus in case of injury to any one shoe or coil only half of the braking effort of the car would be rendered inoperative.

Following are the results of some tests made with the brake, which were carried out under actual working conditions on one of the

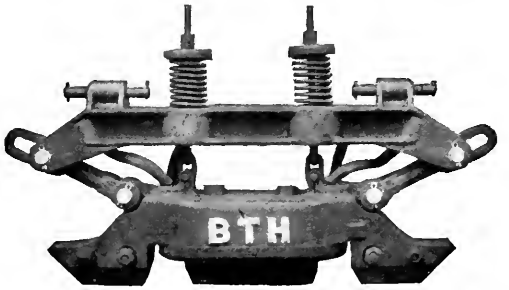


FIG. 2.—TRACK BRAKE.

heaviest routes in England. A four-wheel, double-deck car, with two motors, was used, with the following results on emergency stops:

Speed on applying brake.	Time to stop.	Distance to stop.	Grade Down.
25 m. p. h.	4 seconds	25 yards	1 in 13
14 m. p. h.	1.6 "	5.3 " Level	1 in 14

The first test represents extreme conditions, such as a car running down a steep incline, and considering the grade and the high speed the stop was very rapid, being made in about two and one-half car lengths. The second test would correspond to the case of a car traveling at a moderate speed and obliged to pull up suddenly; it will be seen that such a stop can be made in less than a car length.

SPEED REGULATION DESCENDING GRADES.

Speed maintained.	Grade.	Current per motor.
5 m. p. h.	1 in 13	4 amps.
	1 in 14	
5 m. p. h.	1 in 17	3.5 "
5 m. p. h.	1 in 45	2 "

The second table is interesting inasmuch as it shows that a low and even speed can be maintained when the car is coasting down the steepest grades, so that it is always under perfect control. If necessary the car can be brought to a stop by further movement of the controller handle and held at rest by the wheel brake.

Hauling-in Heavy Cables.

The Knickerbocker Construction Company, 15 Cortlandt Street, New York, has acquired the right to use the Grinnell patent hauling machine and all the devices connected with it. The principal feature of this machine is a chute or guide for the hauling rope, which is connected with the hauling machine extending to the opening at the duct. The rope coming from this guide goes around sheaves on the machine, which insures a perfectly uniform pull entirely regulated by the man operating and without any of the surge usual on capstan and windlass work.

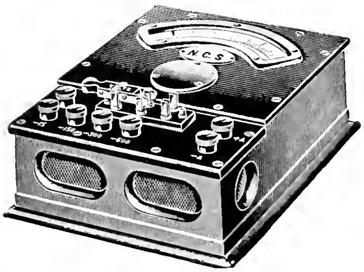
By this arrangement any obstruction in the duct can be felt by the man operating as readily as if he was pulling directly by hand. When the end of the cable reaches the manhole, pulling is continued around the chute without making a separate hitch on the cable until sufficient is in the manhole for splicing purposes. The pull while perfectly uniform can be instantly regulated from nothing to a speed of 40 ft. per minute on the ordinary heavy cables.

By the use of this machine the work can be accomplished rapidly without any chance of injury to the cable. By the continuation of the method of hauling into the manhole and carrying the cable up around the large sheaves of the machine, cables can be hauled out without injury to them and placed on the reels ready for hauling in elsewhere. On the smaller machines gasoline engines are used, and on the larger ones steam engines.

English Portable Testing Set.

The demand for a testing set suitable for use in an engine room and one that can be placed anywhere and be free from the danger of erroneous readings resulting from stray fields, led Nalder Bros. & Thompson, Limited, of London, to produce the instrument illustrated herewith. The instrument is of the moving coil type, and is dead beat. It is fitted with a white enamelled metal scale and a metal mirror. The screening of the instrument has received very careful attention, and is stated to be so efficacious that it is almost impossible for the reading to be affected, even if it be placed quite close to a dynamo or motor.

The voltmeter resistances are carried in the instrument itself, and



PORTABLE TESTING SET.

the current shunts in a separate case. Measurements up to 1,500 amp. and 600 volts can be made, and, as a double-pole change-over switch is provided, resistances can be measured by the practically simultaneous observation of current potential difference. The pressure required to deflect the pointer to the top of the scale on the ammeter side (terminals *AA*) is .12 volts, and, as the scale is divided into 120 divisions, each division corresponds to .001 volt, so that the fall of volts on rail joints, etc., can be tested conveniently. The current shunts are of a new design, and very convenient for connecting, in addition to which they are light. A complete set up to 600 amp. can be carried in quite a small box.

Oil Circuit Breakers.

The use of circuit-breakers as a means of protecting the car equipment from dangerous overloads has become quite general and has led to the development of several different types of breakers designed especially for this class of service. The oil car circuit-breaker shown in the accompanying cut, manufactured by the Hartman Circuit-Breaker Company, of Mansfield, Ohio, is designed to take the place of the fuse block and hood switch on the car. It automatically opens the circuit in case of overload or short-circuit and it can be operated by hand as readily as the usual hood switch.

The switch and current-carrying parts are immersed in oil within a tight cast-iron case. The feature of oil insulation permits of more compact and simple construction than is possible with the usual magnetic blow-out type. The distinctive feature of the circuit-breaker, however, is the use of a series break, consisting of five double-break plug contacts connected in such manner as to give ten breaks in series. The circuit is broken simultaneously at ten distinct points, and the break taking place in oil there is absolutely no destructive arcing, and the circuit-breaker will open quickly and safely on the severest overloads.

The operating mechanism is very simple and consists of a vertical rod, to the lower end of which are attached the movable bridging contacts. The rod operates in a brass bearing and is controlled by a toggle. A slight turn of the handle will cause the toggle to straighten out, thus raising the contact rod and effecting the closing and locking of the switch. The tripping coil is immersed in oil within the case, and, when an overload occurs, the plunger or core operating within the brass tube of the solenoid delivers a strong hammer blow against an extension of the lower joint of the toggle, throwing the toggle out of center and effecting the opening of the switch. Ample space is provided between the live parts of the switch and the cast-iron case, and, as an additional precaution against grounding, the case is lined with insulating cement. Connection to the outside circuit is made within the case by means of insulated cables.

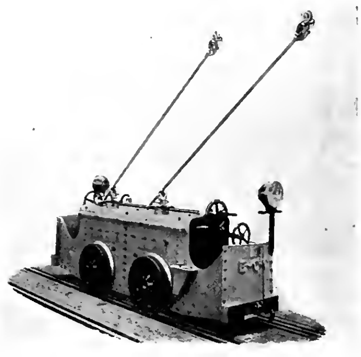
While the circuit-breaker was primarily designed for car service it is also well adapted for switchboard use. It is usually placed on the back of the panel with the handle rod projecting through

CIRCUIT BREAKER.

the board, and the circuit-breaker is opened or closed by hand from the front of the board. The circuit-breaker is also especially well adapted for the protection of motors in mills and factories, for the reason that it is not affected by damp and dirty locations, and there being no exposed current-carrying parts, the circuit-breaker is never a source of danger to those who may be working in the vicinity.

Mine Locomotive.

The accompanying illustration shows an electric locomotive for mine and tunnel work recently designed by the Electric Construction Company, of London, and Wolverhampton, England. Owing to the space limitations in this class of work machines to be adapted to the conditions must be small and compact. In this particular instance



MINE LOCOMOTIVE.

the locomotives were specified not to exceed 3 ft. in width, 3 ft. 4 in. in height, as the tunnel is only 6 ft. high at its maximum point.

The total weight of a complete locomotive of this type is about 4½ tons. It is capable of hauling a load of 35 tons at a speed of 5 miles to 6 miles an hour, but when running light it can attain 10 miles an hour. It is fitted with two motors, each having a normal capacity of about 12½ hp. They can be controlled from either end. Ordinary hand brakes and also emergency brakes are provided.

Power is conveyed to and from the locomotive by two overhead wires.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was considerable activity in the stock market and strength in prices on the announcements regarding the practical winding up of the Northern Securities Company. This naturally affected the rest of the list to a greater or less extent. Later in the week some uncertainty seemed to prevail as to the distribution of the Northern Securities' assets so far as its holdings in Northern Pacific and Great Northern were concerned, the effect of which was to cause a rather sharp decline in prices throughout the list. On Friday, however, the market recovered its tone and there was a renewed advance. Excepting these stocks there were no important developments. There was more or less renewed bullish manipulation in Amalgamated Copper. Among the industrial stocks the most important change was that in Allis-Chalmers preferred, the result of the week's trading being a net loss of 10½ points, the closing quotation being also the lowest, namely, 39½. This stock touched 48 during the week. The common stock closed at the highest figure of the week—8⅜—this being a net gain of ⅜ point. General Electric made a net gain of two points, closing at 166, ex-div., while Westinghouse common lost 1½ points, closing at 161½, which was also the lowest price of the week, the highest being 166. In the traction list there was considerable activity in trading in Brooklyn Rapid Transit, the total number of shares dealt in being 142,360. This stock fluctuated between 42¾ and 44¾, closing at 43¼, this being a net loss of ⅝ point. Metropolitan Street Railway was also active as to trading, 35,475 shares being sold at prices ranging between 110 and 113¼, the closing quotation being 111, ex-div., this being a net gain of one point. Western Union kept quite steady throughout the week, closing at 88¼, this being a gain of ⅛ point. On the curb there was a fair demand for investment issues, with generally higher prices for the entire list. Following are the closing quotations of March 29:

NEW YORK.

	Mar. 22	Mar. 29		Mar. 15	Mar. 29
Allis-Chalmers Co.	6⅛	7½	Electric Vehicle	7	6½
Allis-Chalmers Co. pfd.	39¾	40	Electric Vehicle pfd.	10	10
American Tel. & Cable	84	84	General Electric	168	165
American Tel. & Tel.	124	124	Hudson River Tel.	..	..
American Dist. Tel	22	23	Metropolitan St. Ry.	112⅛	111¾
Brooklyn Rapid Transit	43	43⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	176	173	Marconi Tel.	..	..
Electric Boat	20	21	Western Union Tel.	88	88⅛
Electric Boat pfd.	50	52	Westinghouse com.	163	159
Electric Lead Reduction	¾	¾	Westinghouse pfd.	175	175

BOSTON.

	Mar. 22	Mar. 29		Mar. 15	Mar. 29
American Tel. & Tel	124	125¼	Western Tel. & Tel. pfd.	75	75
Cumberland Telephone	*115	114	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	233	234	New England Telephone	117	120½
General Electric	168	166	Mass. Elec. Ry.	19	18½
Western Tel. & Tel.	8½	8¼	Mass. Elec. Ry. pfd.	72	72½

PHILADELPHIA.

	Mar. 22	Mar. 29		Mar. 15	Mar. 29
American Railways	43	43	Phila. Traction	95½	95½
Elec. Storage Battery	57	56	Phila. Electric	6	5⅞
Elec. Storage Battery pfd.	57	56	Phila. Rapid Trans.	14	14
Elec. Co. of America	8	8			

CHICAGO.

	Mar. 22	Mar. 29		Mar. 15	Mar. 2
Central Union Tel.	..	..	National Carbon pfd.	99⅞	100
Chicago Edison	150	..	Metropolitan Elev. com.	16½	16
Chicago City Ry.	155	165	Union Traction	5	5
Chicago Tel. Co		..	Union Traction pfd.		30
National Carbon	28	29			

*Asked

ST. LOUIS BELL STOCK.—In order to provide additional capital for the removal in St. Louis of overhead wires, the connection of Southwest Missouri lines, extension of toll service, completion of its systems in the southwestern portion of the State, and the betterment of its urban properties, the shareholders of the Bell Telephone Company of Missouri will, on May 17, vote to increase the capital stock from $4,000,000 to $10,000,000. Treasurer Fritz Nisbet states that the directors will be given power to issue this stock from time to time. The right will be offered present holders of the stock to subscribe to the new issue at par.

NEW GENERAL ELECTRIC STOCK.—The $3,325,000 of new stock, the issue of which General Electric stockholders will be asked to approve at a special meeting on May 10, will leave approximately $4,387,600 stock available for sale to present holders. The authorized capitalization of General Electric is $45,000,000, of which $43,937,400 was outstanding in February, 1903, leaving $1,062,600 in the treasury. This balance, with the $3,325,000 now to be authorized, will make $4,387,600, or practically 10 per cent. of the outstanding capitalization, as it was reported a year ago.

ELECTRIC STORAGE BATTERY REPORT.—The Electric Storage Battery Company reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.	1900.
Gross	$1,761,058	....	....	$1,447,519
Expenses	352,048	....	....	297,779
Net	$1,409,010	....	....	$1,149,140
Other income	92,581	....	....	168,105
Total income	$1,501,591	$1,113,199	$900,243	$1,317,845
Dividends	812,435	812,427	812,413	....
Surplus	$689,156	$300,772	$87,830	....

The condensed balance sheet of the Electric Storage Battery Company as of December 31, 1903, is as follows:

Assets:	1903.	1902.
Plant investment	$283,482	$241,279
Treasury stock	1,750,575	1,750,575
Stocks and bonds in other corpor.	2,839,831	2,845,482
Patents, agreements and franchises	13,564,866	13,523,796
Mortgages	71,000	15,000
Cash	357,495	521,503
Accounts receivable	1,500,820	1,004,568
Notes receivable	240,528	47,065
Inv. accts., nat., stk., etc.	707,829	574,329
Total	$21,316,429	$20,532,601
Liabilities:		
Preferred stock	$453,700	$5,000,000
Common stock	17,546,300	13,000,000
Accounts payable	107,011	94,292
Unpaid dividend scrip	1,737	1,737
Sundry liabilities	4,523	4,523
Profit and loss surplus	2,972,632	2,323,354
Res. for plant deprec., bad debts and unfinished contracts	230,522	104,216
Total	$21,316,429	$20,532,601

AMERICAN MARCONI REPORT.—The Marconi Wireless Telegraph Company, of America, issues the following statement as of January 31, 1904:

Assets:	1904.	1903.
Patent rights, good will, etc.	$5,318,494	$5,286,494
Cost of stations, etc.	175,606	139,939
Stock on hand	14,770	31,224
Accounts receivable	31,088	18,382
Cash	22,115	15,432
Furniture and fixtures	1,216	1,204
Treasury stock	582,760	700,000
Organization expenses, salaries, office and station expenses, etc.	85,183	35,468
Total	$6,231,232	$6,228,166
Liabilities:		
Capital stock	$6,190,000	$6,190,000
Accounts payable	17,232	38,166
Notes payable	24,000	....
Total	$6,231,232	$6,228,166

The annual meeting will be held on April 18.

DIVIDENDS.—The New England Telephone and Telegraph Company directors have declared the regular quarterly dividend of 1½ per cent., payable May 16. The directors of the Hall Signal Company have declared a regular quarterly dividend of 1½ per cent. on its common stock and a dividend of 6 per cent. on its preferred stock, payable April 1. The directors of the Cincinnati, Newport and Covington Light and Traction Company have declared the regular quarterly dividend on the preferred stock of 1¼ per cent., payable April 15.

MICHIGAN TELEPHONE BONDS.—A deed conveying all the property of the Michigan Telephone Company to the Michigan State Telephone Company, as the assignee of N. W. Harris, the purchaser under foreclosure, has been filed. There was filed at the same time a first mortgage executed by the Michigan State Telephone Company to the Old Colony Trust Company, of Boston, for $10,000,000 to secure an issue of a like amount of 5 per cent. thirty-year gold bonds.

BOSTON AND WORCESTER TROLLEY.—The Boston and Worcester Street Railway Company has petitioned the Massachusetts Railroad Commissioners for permission to issue $100,000 additional capital stock and also $200,000 twenty-year 4½ per cent. bonds, the proceeds to be used to pay for expenses and new equipment.

KEYSTONE TELEPHONE BONDS.—It is stated that as soon as market conditions will permit, the Keystone Telephone Company, of Philadelphia, Pa., will ask authorization to issue $5,000,000 bonds, of which $3,500,000 will be sold at once.

BRITISH MARCONI WIRELESS.—The report of the Marconi Company for the year ended September 30 last, to be submitted to the annual meeting, shows receipts for the year of £36,376, £10,607 in excess of the general charges.

CUMBERLAND TELEPHONE reports February gross $319,591, as compared with $277,769 last year, with a net gain in surplus of $31,121, the total February surplus being $118,556.

Commercial Intelligence.

THE WEEK IN TRADE.—Retail business has improved somewhat under the stimulus of better weather, and the tone of wholesale and jobbing trade is thereby strengthened. On the whole, however, distribution is not equal to that of a year ago. Other favorable features are the better winter wheat condition, and evidences of further activity and strength in the iron and steel trades. There is more doing in building, but threatened disturbances in labor circles constitute a drawback at several large centers. Country roads are in poor condition and collections are a source of complaint. Railway earnings tend to improve as transportation difficulties are surmounted, and the outlook is that gross receipts for March will show a slight increase over those of the corresponding month last year. There is still complaint of lack of cars, particularly in the coke producing districts. The decisions of the bituminous coal miners not to strike has been a decided element of strength to general business throughout the West. The industrial situation is quite satisfactory, although unrest tends to increase as spring advances. Reports from the Northwest indicate that the lumber cut in that section is much smaller than that of a year ago. In Maine, however, the cut is a good one. It is reported that Minneapolis flour mills have shut down, owing to the decreased demand for flour. Export trade from San Francisco is good with all parts of the world except Hawaii. Recent rains in the lower Mississippi Valley have helped the farmers, who are now actively engaged in planting. Cotton is coming up in Texas, where the winter wheat crop is in good condition. The situation in the metal markets generally is a very satisfactory one. Finished products have improved. Sales of steel rails are more numerous, and transportation companies are buying shop and track materials, an order for 8,000 cars having been placed with Chicago manufacturers. The market at Pittsburg for steel billets and sheet bars is very firm, with a heavy demand. The country's iron furnaces are pretty well supplied with orders up to July 1, and finishing mills have fully three months' production booked. Other metals have been stronger, copper notably so on an increased foreign and domestic demand. Domestic consumers are showing rather more interest, but orders from home sources are still below the average. The lack is, however, off-set by the very large export business which amounts to 15,500 tons so far this month and is expected to reach 20,000 to 21,000 tons for the entire month of March. The closing prices of the week were 12¾ @ 13 c. for Lake: 12⅝ @ 12⅞ c. for electrolytic, and 12½ @ 12¾ c. for casting stock. During the week ending March 24 there were 215 business failures, according to *Bradstreet's* compilation, against 193 the week previous and 175 the corresponding week last year.

INCANDESCENT LAMPS.—It is understood that incandescent lamp makers have been holding convention in Cleveland and New York the last week or two, but the intention and results have not been disclosed. A great many rumors are afloat as to the object and "plan of campaign." One definite statement that is warranted, however, by the conditions known as we go to press is that the Sawyer-Man Company, which is controlled by the Westinghouse Electric interests, has declined to enter the pool, or combination, or whatever it may be, as to policy and prices. Pending authoritative announcements on the general subject, the following from a Cleveland newspaper will fairly serve the same purpose: "Electric lamp manufacturers all over the country have formed an agreement by which prices will be maintained at a uniform rate. The agreement was reached at a meeting of representative manufacturers last week at The Hollenden. There was no suggestion of combination and competition will be as active as before, but by uniting on uniform rates cutting will be eliminated and competition will be determined by quality of products, thereby greatly benefiting the consumer, it is said. The meeting was called to make adjustment of the differences existing between the various companies because of the universal use of patents controlled by the General Electric Company. This concern owned a number of patents for incandescent lamps, but the patents had been in general use by all the manufacturers. The General Electric Company was finally forced to press its claims in self-defense and suits were begun against manufacturers and dealers who had been using the patents. The latter concluded that they had better pay royalties and be sure of their ground, rather than bear the expense of litigation, and such arrangements were made with every lamp company in the country. These companies, in taking the license, agreed to maintain the scale of prices which had been observed by the best established companies for a number of years. This action will not raise the price above that formerly charged for first-class lamps, but will take off the market lamps of unrecognized makes for which, it was claimed, was charged any price the purchaser would pay. The result will be that the purchaser will pay no higher price than formerly and will be sure to incur no liability for damages for infringement of the patents, dealers claim. All suits against the licensees and customers are withdrawn and the arrangements do not affect the identities or the managements of the various companies concerned in the least. The prices are those under which the Edison lamp has been sold. All existing contracts will be filled at the prices prevailing at the time of contract."

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty Street, New York, has secured an order for a 300-kw, three-bearing belted generator from the Electric Company of America, Philadelphia. The machine will be used for both light and power purposes in the company's central station plant at Atlantic City, N. J. The Aetna (Ind.) Power Company has ordered one 180-kw and one 40-kw two-bearing generator for light and power use. A 100-kw, direct-connected generator has been called for by the Citizens' Electric Light & Power Company, of Altoona, Pa. The engine will be a 150-hp one, built by the Erie City Iron Works. This outfit is intended for lighting. A generator of 100-kw capacity has been ordered by the National Meter Company for direct connection to a Nash gas engine. This equipment is to be used for lighting the Steeplechase Park at Coney Island. A similar outfit has been ordered for shipment to St. Louis, Mo. Two 40-kw and one 25-kw direct-connected generators have been ordered for the Mechanics' laboratory, University of Pennsylvania, Philadelphia. The engines will be of Westinghouse manufacture. A 12½-kw, also an 18-kw generator, have been ordered by the National Meter Company for direct connection to 20-hp and 30-hp Nash gas engines for the St. Louis exhibition. The Roberts Chemical Company, of Niagara Falls, is to be shipped a 100-kw special generator for direct coupling to an alternating-current motor already installed. This equipment will be used for electrolytic purposes. A 125-kw engine type generator is to be installed in the plant of the Brylgon Steel Casting Company, at New Castle, Del. The engine will be of Harrisburg build. The C. & C. people also report receipt of an order for a number of motors to be used for driving machine tools in the Boston Navy Yard. Three motors have also been ordered through Feer & Clarkson, of Lebanon, Pa., for operating hoists at the Brooklyn Navy Yard.

LAUNCH WORK AT BAYONNE, N. J.—The Electric Launch Company is very busy with a great many orders for various types of pleasure launches and yachts. W. B. Dinsmore, Jr., of New York, has placed an order for a 21-foot electric launch for use on Tuxedo Lake. The success of the electrics at Tuxedo during the past two years has very much interested society, and boating is expected to become very popular during the coming season. Mr. A. Montgomery Ward, of Chicago, has ordered a 30-foot electric launch for use at Oconomowoc, Wis., one of Chicago's most attractive summer resorts. The launch will be of special design so that it can be taken from one lake to the other over an incline railway built by the cottagers, connecting two lakes. Mr. C. A. Grippin, of Bridgeport, has ordered a large electric cabin launch for use at Lake George. The launch will be used for pleasure purposes and also for conveying guests from the railroad station to Mr. Grippin's camp on Cull Bay Point, where for two years he has been building his summer home. A private electric light plant for lighting the residence and charging the launch has been installed. By an ingenious arrangement the residence can be lighted by the electricity in the launch if the electric plant is not running. Mr. Moritz Walther, of New York has purchased a large electric cabin launch for use on Upper Saranac Lake in the Adirondacks. This boat will join a large fleet of electric boats now in use on this lake. A powerful electric searchlight will be furnished the launch, enabling the boat to navigate at all hours of the night.

LORAIN SPECIAL WORK FOR MANILA.—The Lorain Steel Company branch of the United States Steel Corporation has captured the contract for the special work for the Manila electric traction system, in face of severe British competition. The contract, which is valued at about $30,000, calls for delivery of the material May—June. As previously noted in these columns, J. G. White & Co. have the contract for the construction of the system, which is also to light the Philippine capital. An American syndicate composed of Charles F. Swift, of Detroit, Mich.; Ex-President Frank H. Buhl, of the Sharon (Pa.) Steel Company; F. Kimberley, of Sharon; J. G. White, President Smith, of the Pittsburg Securities Company, and other Westinghouse interests, will operate the lines, etc. Westinghouse equipment will be installed in the power station. A contract will be awarded next week for 100 cars.

HUGE CONTRACT FOR ANDERSON SWITCHES.—The Albert & J. M. Anderson Manufacturing Company have secured what is said to be the largest contract for switches ever awarded. The contract was allotted by the New York Edison Co. and calls for special type edgewise switches in the manufacturing of which no less than 58 tons of copper will be used. Delivery is called for in six months. The Metropolitan Street Railway Company of New York has ordered a substantial lot of big service switches. Eccles & Smith, of San Francisco, have sent in a requisition for 3,000 straight line hangers, ears, pull-offs, etc., for use on the new 30-mile Huntington road. The Interborough Rapid Transit Company of New York has ordered 700 heater switches with magnetic blowout. An elaborate switchboard outfit has been ordered for the purpose of testing different kinds of current in the Lamp Testing Bureau, New York. The Anderson people have also got a number of fair-sized orders in hand for their various specialties to be shipped to the British electrical engineering and contracting concern, Robert W. Blackwell & Co., Limited.

THE BALL ENGINE COMPANY, Erie, Pa., has made the following recent shipments: National Tube Works, Pittsburg, Pa., one 800-hp cross compound Corliss engine, direct connected to alternator. United States Coal Company, Dillonvale, Ohio, one 500-hp Corliss direct-connected engine. Whiting Foundry Equipment Company, Harvey, Ill., one 400-hp Corliss direct-connected engine. Continental Coal Company, Jacksonville, Ohio, one 400-hp engine. Steamer "City of Buffalo," Detroit, Mich., one 80-hp direct-connected engine. J. M. Denholm Bros. & Co., Ltd., East Liberty, Pa., one 150-hp direct-connected engine. Leyden Coal Co., Leyden, Colo., one 175-hp engine. Forest Park Highlands Amusement Company, St. Louis, Mo., two 175-hp direct-connected engines. Semet-Solvay Co., Syracuse, N. Y., two 150-hp direct-connected engines. Dilworth, Porter & Co., Ltd., Pittsburg, Pa., three 50-hp engines. Union Ice Company, Bakersfield, Cal., one 350-hp engine. Soldiers and Sailors' Home, Grand Island, Neb., one 75-hp direct-connected engine.

TRANSMISSION IN OREGON.—The Rock Creek Power and Transmission Company of Baker City, Oregon, is installing a plant near that place, consisting of two 400-kw three-phase, 60 cycle General Electric generators, directly coupled to 900-hp water wheels, running at 450 r.p.m. The latter were furnished by the Pelton Water Wheel Company, of San Francisco, and operate under a head of 960 ft. Three 300-kw three-phase transformers raise the voltage to 22,500—at which pressure it is transmitted 27 miles to Baker City, and 17 miles in another direction to adjoining mining properties. A mixed light and motor load has been secured up to capacity of the two generators. The latter will operate during the greater portion of the time in parallel, but a single governor of the hydraulic pattern will control both units. This plant is the most important of its kind in eastern Oregon, and is expected to be in commercial operation the latter part of this coming May.

EQUIPMENT FOR MEXICAN CAR SHOPS.—Now that the Mexican Car & Foundry Company, S. A., has been organized under the concession granted to Isaac M. Hutchison, of Mexico City, contracts for machine tools, which are to be electrically operated, will be let practically immediately for installation in the company's plant to be built about four miles north of the Mexican capital. The initial capacity of the factory will be five cars daily. Later on it is intended to build trolley cars. M. Hutchison is president and general manager of the company. He has represented the Mexican interests of the St. Louis Car Company for some time past. He also looks after the business of the Niles-Bement-Pond Company and A. L. Ide & Sons. About $100,000 gold will be expended for equipment in the first instance. The works will be electrically lighted.

LIGHTING EQUIPMENTS FOR NEW YORK.—The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, has secured within the past few days several orders for Harrisburg engines to be installed in New York. The Women's Hospital, One Hundred and Tenth Street, is to be equipped with two 150-hp engines to be direct connected to 100-kw Western Electric Company generators, for lighting purposes. Luchow's Restaurant, Fourteenth Street, is to be provided with a 90-hp engine for direct connection to a Western Electric generator of 60-kw capacity, also for lighting use. The Hanover Fire Insurance Company, 34 Pine Street, has ordered a 75-hp engine to be direct connected to a 50-kw General Electric generator. This outfit will be utilized for additional lighting purposes.

AMERICAN BRIDGE COMPANY.—A number of changes are announced in connection with the American Bridge Company. The Eastern and Pittsburgh divisions of the company's business have been abolished, and the plants now embraced in them have been put in charge of Mr. R. J. Davis, as operating manager, with headquarters in the Frick Building, Pittsburg. President Alfred J. Major gives the schedule below for the removal of the general offices of this company from Philadelphia to Frick Building, Pittsburg: March 26, president, assistant to president and operating manager, March 31, auditing department; April 9, treasury department. Notable gains and economies are expected to attend this concentration of effort and management.

EQUIPMENT FOR FLORIDA PLANT.—The Manatee Light and Power Company of Bradentown, Fla., is about to extend considerably its plant, and has just awarded contracts for additional generators and engines. The new machinery to be installed will have a capacity of 700 kw. The generators have been ordered from the Bullock Electric Manufacturing Company. There will be three machines, a 300 kw alternating-current engine type, 60-cycle, 200 r.p.m. generator; one 300-kw 550-volt, 200 r.p.m engine type railway generator, and a 550-volt belted railway generator of 100 kw capacity. The 300-kw generators will be direct connected to engines to be built by the Harrisburg, Pa., Foundry and Machine Works.

EQUIPMENT FOR MEXICAN MINES.—The United Mining and Development Company of America, 66 Broadway, has just let contracts through E. Gybbon Spilsbury, of the E. G. Spilsbury Engineering Company, 45 Broadway, for considerable electrical equipment to be installed in its Mexican property. A water power plant is to be built for the purpose of operating the company's mines. The initial equipment will be about 400 hp. The generator will be of Westinghouse build. A Pelton water wheel will be used. A large lot of machine tools to be electrically operated, have been ordered through Mexican concerns, who represent American manufacturers in the Southern republic.

GILMORE GENERATORS FOR ENGLAND.—The Gilmore Electric Co., of Boston, and Postal Telegraph Building, New York, recently secured a contract for four generators of 80-kw capacity each for lighting an asylum in the vicinity of Liverpool. The generators will be direct connected to Scotch engines. An order for six machines of similar capacity has just been received for shipment to London, where the generators will be used for both light and power purposes.

THOMAS INSULATORS FOR MEXICO.—Thomas & Son, of East Liverpool, Ohio, have been awarded a contract for 40,000 insulators by the Mexican Light & Power Company, Limited, for use in the construction of the Mecaxa-Mexico City transmission system. Various other interesting contracts will be let shortly by the Mexican company, whose New York offices are at 29 Broadway, and of which F. S. Pearson is the consulting engineer.

LIGHTING FOR BLOOMINGDALE STORE.—The Bullock Electric Manufacturing Company, through its New York office, has secured a contract for lighting equipment to be installed in Bloomingdale Brothers Department Store, East Fifty-ninth Street. A 150-kw three-bearing slow-speed belted generator and a 200-r.p.m. engine of 100-kw capacity direct-connected to a Watertown engine have been ordered.

CHICAGO, ILL.—Articles of incorporation will be filed at Springfield, Ill., by the United States Telegraph and Telephone Company. The plan, it is said, is to absorb the National Telegraph News Company of Chicago, the Sempire Clock Company of St. Louis, and the Chicago and Milwaukee Telegraph Company, of Milwaukee.

EQUIPMENT FOR TWENTY-THIRD STREET FERRY HOUSES.—It is proposed to install a plant of about 400-kw capacity for the purpose of generating current to light the new Central, Erie and Lackawanna ferry houses, West Twenty-third Street. Kenneth M. Murchison, Jr., 5 West Thirty-first Street, is now drawing up the plans.

ELECTRIC PUMPS FOR PHILIPPINE DRY DOCK.—The International Steam Pump Company, 114 Liberty Street, New York, has secured the contract for the large electrically operated Blake pumps to be used on the steel dry dock now under construction at Sparrow's Point by the Maryland Steel Company for use in the Cavite Naval Station, Philippine Islands.

WAGNER MOTORS ADOPTED.—The Wagner Electric Manufacturing Company, St. Paul Building, will fill all future power motor requirements for the Public Service Corporation of New Jersey. Under 35-hp the machines will be of single phase type. Above that size the motors will be polyphase.

ROBB ENGINE FOR SCOTCH LIGHTING PLANT.—J. G White & Co., Ltd., of London, has placed an order for a 300-hp Robb engine which is to be installed in the municipal lighting plant at Perth, Scotland.

ELECTRIC ROCK DRILLS FOR NEW ZEALAND.—The Denver (Col.) Engineering Works have secured a substantial contract for electrically operated rock drills for installation in New Zealand mines.

THE PERKINS MACHINE COMPANY, South Boston, Mass., has purchased the Slater Engine Works at Warren, Mass. The Perkins Company manufactures presses, punches, shears, etc.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. General meeting, Washington, D. C., April 7, 8 and 9, 1904.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, New York City and Portland, Ore.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., June, 1904.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, D. Fleming, Harrisburg, Pa.

United Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, H. E. Chubbuck, LaSalle, Ill.

Indiana Public Utilities Association. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

Independent Telephone Association of the United States of America. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Pichardt, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

Iowa Electrical Association. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Des Moines, April 20 and 21, 1904.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Ia.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ind.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

National Electric Light Association. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May 24, 25 and 26, 1904.

New England Street Railway Club. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept., 1904.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, Canton, Ohio. Next meeting, Columbus, O., May 13, 1904.

Pacific Coast Electric Transmission Association. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal.

Southwestern Electrical Association. Secretary, J. L. Ellis, Oklahoma City, Okla. Next meeting, Dallas, April 25, 26 and 27, 1904.

Southwestern Gas, Electric & Street Railway Association. Secretary, Frank E. Scovill, Austin, Texas. Next meeting, Dallas, April 25, 26 and 27, 1904.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, August, 1904.

Western Society of Engineers, Electrical Section, Chicago, Ill.

General News.

THE TELEPHONE.

JACKSONVILLE, ARK.—The Jacksonville Telephone Company has been incorporated with a capital stock of $1000. The incorporators are S. W. Murtishaw, W. G. Graham, E. J. McBride, E. C. Stone and Mrs. Emma C. Martin.

ROGERS, ARK.—The Tri-State Independent Telephone Association has been organized, Mr. W. T. Stahl, of Siloam Springs, being president; S. H. Slaughter, of Lafayetteville, vice-president; K. J. Comfort, of Westville, secretary, and W. D. Wasson, of Gentry, treasurer. The association represents independent lines in southwest Missouri, northwest Arkansas and northeast Indian Territory, and its object is the betterment of local and long distance service. A farmers' line service will be encouraged. A meeting of the association will be held in June.

WASHINGTON, D. C.—The District Telephone Company has been incorporated with a capital stock of $1,000,000. The directors are C. S. Walton and J. H. Ralston.

LEWISTON, IDAHO.—A franchise has been granted to the Nez Perce Co-operative Telephone Company to operate and maintain a telephone line in this city.

WYOMING, ILL.—The Fidelity Telephone Company has been incorporated with a capital stock of $25,000. The directors are A. L. Johnston, A. B. Hoff and others.

TREMONT, ILL.—The Tremont Independent Telephone Company has been incorporated with a capital stock of $20,000. The directors are A. J. Davis and W. H. Ames.

WILLIAMSVILLE, ILL.—The Sangamon Telephone Company has been incorporated with a capital stock of $2500. The directors are J. P. Telfer, R. U. Richardson and others.

EAST LYNN, ILL.—The Fountain Creek Telephone Company has been incorporated with a capital stock of $34,000. The directors are W. A. Yeasel, G. H. Wiel and others.

HEBRON, ILL.—The Farmers' New Era Telephone Company has been incorporated with a capital stock of $5000. The directors are George Hunt, L. A. Nichols and others.

JOHNSON CITY, ILL.—The Good Service Telephone Company of Johnson City has been incorporated with a capital stock of $2500. The incorporators are J. E. Poindexter, D. H. Penson and Calvin Dillon.

TROY, ILL.—A license has been issued by the Secretary of State for the incorporation of the Troy Telephone Company, of Troy, Ill. The capital stock is $10,000. Incorporators: J. H. Steinhaus, J. W. Gornett and C. Busse, Jr.

CHICAGO, ILL.—The United States Telegraph and Telephone Company has filed articles of incorporation in this State. Among the incorporators are Col. G. Watson French, of Davenport, Iowa; Henry E. Weaver, H. L. Turner and H. D. Critchfield, of Chicago; Max R. Ortvine and A. B. Hulit, of St. Louis. This probably means the entrance of independent telephone toll lines to Chicago. H. D. Critchfield, one of the incorporators, is general manager of the Automatic Electric Company and closely identified with the Illinois Tunnel Company. It is rumored that the Chicago & Milwaukee Telegraph Company's line will be taken over by the new company.

HANCOCK, IND.—The Coffman-Heller Telephone Company has been incorporated with a capital stock of $120. The directors are G. W. Coffman and others.

FORT WAYNE, IND.—The annual meeting of the stockholders of the National Telephone & Telegraph Company was held here recently and officers were elected as follows: President, Henry C. Paul; vice-president, Charles S. Bash; secretary, William L. Moellering, and treasurer, William A. Bohn. The company operates exchanges in several towns in this part of the State. The financial statement showed that the earnings were satisfactory and exceeded those of last year by several thousand dollars.

RUSHVILLE, IND.—The Rushville Telephone Company held a meeting on March 18 to devise a plan to raise additional capital necessary to extending the lines and purchasing a new and modern switchboard. The company's plant has proven a paying investment, and the 200 stockholders voted that each shareholder increase the amount of his stock. By this plan $32,000 was raised and extensive improvements are now assured. L. C. Lambert, a local capitalist, offered to buy the plant and said he would agree to expend $100,000 on it for betterments during the next ten years.

TAMA, IA.—The Tama Telephone Company has been incorporated with $15,000 capital stock.

STUART, IA.—The Lincoln & Stuart Telephone Company proposes to establish a local exchange.

POCAHONTAS, IA.—The Pomeroy-Palmer Telephone Company has been formed to build a rural line.

PORTLAND, ME.—The Northeastern Telephone Company is preparing to extend its lines to South Windham and Raymond. This company operates an automatic system.

AMBOY, MICH.—The Clear Fork Telephone Company has been organized here.

MILLIKIN, MICH.—The Michigan Bell Telephone Company will build an exchange here.

RED WING, MINN.—D. M. Neill and others contemplate establishing a local telephone exchange.

ST. CLOUD, MINN.—The Clearwater Telephone Company has increased its capital from $10,000 to $25,000.

SLAYTON, MINN.—The Enterprise Telephone Company has been granted a franchise for a telephone exchange.

ST. PAUL, MINN.—The Armstrong Telephone Company will increase its capital stock from $25,000 to $100,000.

MAZEPPA, MINN.—A farmers' telephone line is to be built from Mazeppa covering Bear Valley and Zumbro Falls.

WILLMAR, MINN.—The Lake Andrew & Dover Telephone Company has been formed here by farmers. A 30-mile line will be built.

ST. PAUL, MINN.—The Armstrong Telephone Exchange Company of Truman has increased its capital stock from $25,000 to $100,000.

OVANDO, MONT.—Articles of incorporation of the Big Blackfoot Telephone Company, which will operate between this city and Drummond, have been filed with the Secretary of State.

HANNIBAL, MO.—The Missouri & Kansas Telephone Company is seeking a franchise here for an exchange.

ST. LOUIS, MO.—The Kinloch Telephone Company, of this city, announces that its lines to Carthage and Joplin will be completed by June 1. In the "zinc belt" the independent companies show great increase in earnings.

JEFFERSON CITY, MO.—The Laddonia, Rush Hill & Mexico Union Telephone Company has been granted a certificate of incorporation. The capital stock is $1000. The incorporators are: J. N. Rosser, E. A. Featz, C. L. Stewart, J. C. Maxwell and T. J. Roberts.

ST. JOSEPH, MO.—The Missouri River Telephone Company, with a capital stock of $150,000, has filed articles of incorporation. The company is composed of J. E. Zeluff and Walter S. Dickey, of Kansas City; W. T. Rankin, Frank S. Travis and John R. Stafford, of Tarkio, and Ralph O. Stauber, of St. Joseph.

LINCOLN, NEB.—The Hay Springs Alcova Telephone Company has been incorporated with a capital stock of $25,000.

NEWARK, N. J.—The Newark Telephone Exchange has been incorporated; capital, $25,000. Directors: E. A. Smith, J. E. Pulver, E. P. Thatcher, Newark.

WOLCOTT, N. Y.—The Farmers' Co-operative Telephone Company has been organized here by J. P. Fowler, Fred Brown, S. Sears and others.

ALBANY, N. Y.—The Sherburne Telephone Company has been incorporated with a capital stock of $10,000. The directors are: Jesse H. Shepard, F. G. Shepard, H. A. Shepard, Estella A. Shepard, Charles A. Fuller and Frank C. Cashman.

TROY, N. Y.—The Commercial Union Telephone Company has been organized here for the purpose of merging the Rensselaer Telephone Company of this city, the Saratoga Telephone & Telegraph Company of Saratoga Springs and the new Union Telephone Company of Glens Falls. The new company elected J. T. Christie, president; W. Levis Burke, secretary, and Peter McCarthy, treasurer. It will extend its lines.

BISMARCK, N. D.—The Milton Telephone Company has been incorporated with a capital stock of $10,000.

BOWBELLS, N. D.—A telephone exchange is proposed in this place, Mr. G. L. Bickford being one of those interested in the enterprise.

BORDEN, OHIO.—The Laurel Telephone Company of Borden has been incorporated with a capital stock of $1000 by William R. Jackson, Edwin Packwood, F. M. Vance and E. Ross.

ALLIANCE, OHIO.—The Stark County Telephone Company will establish an exchange at Louisville and will give toll connection with farmers in Harrisburg, Fairport, Pairs and other villages.

GETAWAY, OHIO.—The Getaway Telephone Company, of Getaway, Lawrence County, has been incorporated with a capital stock of $5000, by J. E. Schneider, John W. Gerlach, W. W. Poindexter, W. T. Cox and G. W. Thader.

CINCINNATI, OHIO.—The Council of Norwood has granted a 25-year franchise to the Norwood Citizens' Telephone Company, which is an independent concern. This is regarded as an entering wedge in favor of the admission of independent service in this city.

TOLEDO, OHIO.—What is said to be the largest single extension to a telephone switchboard in America has just been completed at the exchange of the Home Telephone Company in this city. The extension has a capacity of 1000 connections, which bring the total capacity of the exchange up to 7000 lines. The new work was done by the Sterling Electric Company, of Lafayette, Ind., and cost about $29,000, making the total expenditure on account of the switchboard $148,000.

TITUSVILLE, PA.—The Pennsylvania Railroad Company is installing a telephone line on its Chautauqua Division.

EMERY, S. D.—The Tri-County Mutual Telephone Company is seeking a local franchise.

MITCHELL, S. D.—The Dakota Central Telephone Company will build a line from Aberdeen to Mitchell.

GARRETSON, S. D.—A telephone company has been organized to build a local and rural system. A. J. Berdahl is interested.

FORT SUPPLY, TEX.—The Fort Supply Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are: J. T. Brewer, J. P. Gandy, Robert Simis, M. W. Phillips and J. S. Peterson.

CHARLESTON, W. VA.—A charter has been granted here to the Wheeling & Pittsburg Telephone Company, of Wheeling, W. Va., which has been incorporated with a capital stock of $100,000. The incorporators are: J. A. Howard, J. P. Young and F. C. Handlan, of Wheeling; R. C. Hall and J. G. Plant, of Pittsburg.

DALLAS, WIS.—J. A. Anderson is seeking a franchise for a telephone exchange.

GRANTSBURG, WIS.—A telephone company has been formed at Swiss to build a line from Gordon to Grantsburg.

ELECTRIC LIGHT AND POWER.

GURDON, ARK.—The City Council has granted S. Scott Harris and T. L. Hodges a franchise for an electric light and power plant.

WASHINGTON, D. C.—It is reported that certain officials of the government are considering a plan to establish in the vicinity of the west end of the Mall an immense power house from which heat, light and electric power will be supplied to all government buildings in the northwest and southwest sections of the city. The plan at this time has not assumed definite form, but the proposition is being discussed among a number of government officials who seem to favor the project.

ALBANY, GA.—The city of Albany has contracted with the Albany Power & Manufacturing Company for 300 horse-power to be delivered at the city electric light plant at $8000 annually. The power company is developing a big power on Muckafoonee Creek near the city. The matter will be submitted to a vote. The saving to the city is estimated at $3000 or more per annum.

DUQUOIN, ILL.—The City Councils of Duquoin and Pinckneyville have in contemplation the construction of an electric light plant to give service to both places.

RIDGEFARM, ILL.—The matter of issuing $10,000 bonds for a municipal lighting plant is under consideration.

MOROCCO, IND.—H. D. Hallett, of Aurora, is preparing plans for water works and an electric light plant, to cost $26,000.

JEFFERSON, IND.—Local capitalists, headed by Hon. Louis Schneck and George H. Voight, have employed hydraulic engineers to examine Fourteen Mile Creek and the Tunnel Mill property with a view to utilizing the falls for developing power. A company will be formed to establish a power house for generating electricity by water power. The experts say that sufficient fall can be had to furnish 10,000 hp. It is the intention to operate an electric railway connecting this city and New Washington by this power.

CLARION, IA.—The City Council has decided to expend about $6000 in improving the electric light plant.

HOUGHTON, MICH.—The Portage Lake Gas & Coke Company has petitioned for a franchise to establish electric and gas lighting.

KALAMAZOO, MICH.—Application has been made by H. C. Hoagland for a receiver for the Kalamazoo Valley Electric Company. The Kalamazoo Company furnishes power to many factories in Kalamazoo and Battle Creek, and also supplies the power for the operation of the electric railways between Allegan and Jackson.

DULUTH, MINN.—Bids will be received April 11 by the Common Council for $50,000 bonds to be used for extending and improving water and light plant. H. W. Cheadle is City Clerk.

MINNEAPOLIS, MINN.—The effort of the Retail Dealers' Association to bring the Minneapolis General Electric Company and the city council to an agreement on a franchise has come to naught.

CARTHAGE, MO.—The Carthage Heat, Light & Power Company has been incorporated with a capital stock of $100,000, all paid. The incorporators are S. A. Stucky, I. C. Hudson and D. C. Brainard.

HARVARD, NEB.—J. J. Keefe, of York, Neb., has secured the franchise for an electric light plant.

OMAHA, NEB.—The Omaha Electric Light & Power Co. is planning to expend $75,000 in improvements on its plant this spring.

VALATIE, N. Y.—The City Clerk writes that it was voted March 15 to construct an electric light plant.

LOCKPORT, N. Y.—The Lockport Light, Heat & Power Company has been incorporated, with a capital of $75,000.

ALBANY, N. Y.—The Nassau Light & Power Company, which was recently incorporated, has increased its capital stock from $500,000 to $1,500,000.

FT. EDWARD, N. Y.—The Village Trustees have granted a franchise to the Hudson River Electric Company to furnish electricity for power, heat, fuel and lighting purposes.

ALBANY, N. Y.—The Heat, Light & Power Improvement Company of America, of New York, has been incorporated; capital, $600,000. Directors: James P. Lowery, Andrew Ritchie and Charles T. Eldridge, New York.

SYRACUSE, N. Y.—The Syracuse syndicate which owns the controlling stock of the Wayne County Electric Light & Power Company, is anxious to dispose of its interests in the same to business men of Lyons and Clyde.

AMSTERDAM, N. Y.—The Citizens' Electric Company, of Amsterdam, has been incorporated with a capital stock of $50,000. The directors are: William W. Dickson, Frank W. La Chapelle, Maurice G. Walsh, George C. Stuart and W. Fenton Myers, of Amsterdam.

NEW YORK, N. Y.—Bids will be received April 23 by Mordecai T. Endicott, chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., for installing a turbo-alternator with exciter set, 5 induction motors, 1 motor generator, 2 switchboards and accessories at the navy yard here. Estimated cost, $44,000.

CONCORD, N. C.—The town of Concord has voted to purchase the electric light plant at $8500.

SALISBURY, N. C.—The Salisbury and Spencer Railway & Electric Company has bought the Salisbury Gas & Electric Lighting Company.

WAYNESVILLE, N. C.—B. J. Sloan has contracted to furnish the city of Waynesville with power for light for 10 years, the power to be generated at a falls on Pigeon River, by the erection of a dam. The capacity of the plant will be 1500 horsepower. The city will take at least 125 horsepower at $20 per horsepower per annum.

HAMILTON, OHIO.—The city will issue $5000 in bonds for the purpose of improving its lighting system. Walton S. Powers is secretary.

MARYSVILLE, OHIO.—Mr. McKibben, of Van Wert, is preparing estimate of cost, etc., for an electric light plant. The contract for lighting expires this spring.

CAMERON, OHIO.—The Cameron Pottery Company has made a proposition to the town council to light the streets. The company has recently completed its plant and has more power than it requires.

BEDFORD, OHIO.—Philadelphia, Pa., capitalists represented by E. A. Mandeville and Edw. Roberts, are stated to have purchased the plant of the People's Electric Light Company. It is proposed to enlarge the plant, and install some new machinery.

ZANESVILLE, OHIO.—Hon. C. U. Shryock, of Zanesville, has obtained a franchise from the village of Philo for the construction of an electric lighting plant and water works system. A plant will be erected at Taylorsville Dam where excellent water power will be obtained. The villages of Duncan's Falls and Taylorsville will also be supplied.

MT. VERNON, OHIO.—The city council has passed an ordinance granting a franchise to H. C. Hubbell, C. C. Hubbell and John W. Hawk for an electric light, power and hot water heating system. The rate of current shall not exceed 15 cents per kilowatt and arc lights are to be furnished at $65 per year on moonlight schedule. The plant is to be built at once.

BEAVERDALE, PA.—A charter has been issued to the Beaverdale Electric Light Company, of Beaverdale; capital, $5000. Directors: W. L. Hicks and C. O. Templeton, of Tyrone; C. F. Fraser, of Altoona, and T. J. Gates, of Tyrone.

BUSHKILL, PA.—A charter has been granted to the Bushkill Water Power Company, with a capital of $5000. The company intends using the water to furnish electric power for commercial purposes, and also for a cement mill which the company will erect in the near future.

KNOXVILLE, TENN.—At a meeting of the City Council an ordinance was passed on first reading to put all wires underground. The Council also reported at this meeting favorably on the city owning a lighting plant.

HEMPSTEAD, TEX.—W. P. Lipscomb is reported interested in the construction of an electric light plant.

BARTLETT, TEX.—Plans are being considered for the construction of an electric light plant, to light Bartlett, Granger and Holland.

RICHFIELD, UTAH.—The Clark Power Company has in view a project for establishing a large power plant near here which will supply sufficient power for all the towns in the county. The plant also includes the construction of electric railways.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Shoshone Falls Power & Lighting Company have been filed at Boise. The company is organized with a capital stock of $2,500,000, and bonds of a like amount will be issued. The main promoters are McDonald & McCoy, of Chicago, although Utah and Idaho capitalists are largely interested in the project. The plan is to establish three power plants on the Snake River, where from 80,000 to 100,000 horse-power will be generated, the first plant to be installed at Shoshone Falls. The Utah Light & Railway Company expects to receive, for distribution, about 8000 horse-power, which will relieve it of the criticism it is now undergoing as a result of its inferior lighting service.

RICHMOND, VA.—Governor Montague has signed the bill appropriating $25,000 for the construction of a heat, light and power plant on the Capitol Square.

RICHMOND, VA.—The State Legislature of Virginia has refused to take up the matter of the city of Newport News issuing $100,000 bonds to establish a municipal electric light plant.

TOLEDO, WASH.—The City Council has granted W. A. Gray a franchise for an electric light plant.

BERKELEY SPRINGS, W. VA.—The Cacapon Power Company, of Berkeley Springs, has been incorporated, with a capital of $100,000, to use water power of Cacapon River, in Morgan County, to generate electric power for industrial plants. The company proposes to light both Hancock, Md., and Berkeley Springs with electricity. Incorporators: Morrison Barclay and Thos. Barclay, of Greensburg, Pa., and F. R. Reed and J. H. Siler, of Berkeley Springs.

NEW LONDON, WIS.—The city has purchased the local electric light plant and will make improvements.

MONTICELLO, WIS.—E. W. Van Norman, Village Clerk, writes that it was voted March 11 to issue $8000 bonds for an electric light plant.

QUEBEC, QUE.—Another electric company for the city of Quebec is likely to be formed soon under the name of the Quebec Electric Company. The idea of the new company is to install a hydraulic electric plant at Seven Falls, on the River Ste. Anne, in the county of Montmorency. The company will seek incorporation at the next session of the legislature for power to construct an electric railway from these falls to the city of Quebec by way of St. Paul, St. Joachim, Ste. Anne de Beaupre, Chateau Diver, L'Ange Gardien, Montmorency Falls, Beauport and Limpilpu, and to sell in these places electricity, heat and power.

QUEBEC, QUE.—The amalgamation of the two Quebec electrical companies, the Jacques Cartier Electric Light & Power Company and the Quebec Railway, Light & Power Company, which entered into a secret agreement some months ago, has been publicly announced. The latter company has just issued a circular to its clients, informing them of an increase in the rate of charges for the electric light service. Heretofore, ten cents per kilowatt, with a cash discount of 10 per cent., was charged consumers, and now they are called on to pay 15 cents per kilowatt with a 20 per cent. cash discount, which means a practical increase in the rates of 40 per cent. The result of this increase is that many of the consumers are returning to the use of gas and coal oil.

THE ELECTRIC RAILWAY

BESSEMER, ALA.—Local interests have raised funds for making a survey for an electric railway to extend from Bessemer to Blue Creek, Brookwood and Blockton. The move is at present purely a local one, with the end in view of including outsiders to lend aid if a favorable report is made on the project. S. E. Jones and W. J. Parkes are members of the committee which has the matter in charge.

SAN JOSE, CAL.—Articles incorporating the Santa Clara Valley Transit Company have been filed. The capital stock is placed at $1,000,000, of which $25,000 has been subscribed. The directors are: F. M. Lockwood, J. A. Mehling, V. A. Scheller, W. C. Andrews and A. D. Cutler.

PUEBLO, COL.—Leading citizens of Bessemer are the promoters of a plan to establish an electric railway here.

STONINGTON, CONN.—The Westerly Railway & Lighting Company, of Stonington, has filed a certificate of organization. The authorized capital stock is $400,000. The company will begin business with $20,000 capital. It is organized to construct and operate railroads, street railways, electric light plants, power plants, gas works and ferries. The directors are: James O. Sweet, Jewett City, Conn.; Francello G. Jilson and Frank P. Sheldon, of Providence; Nathan B. Lewis, of West Kingston, R. I.; Joseph M. Kingelsmith, of Stonington, and H. Hobart Babcock, George W. Mansfield and William Hoxsey, of Westerly. Subsequently, the directors elected Frank P. Sheldon president; George W. Mansfield, vice-president; Nathan B. Lewis, secretary, and Joseph M. Kingelsmith, treasurer.

WATERBURY, CONN.—The local municipal authorities have granted to the Cheshire Street Railway Company the necessary rights to construct the Waterbury end of the proposed line between this city and Cheshire. The Cheshire Company is an underlying corporation of the Connecticut Railway & Lighting Company.

HILLSBORO, ILL.—The Hillsboro Electric Railroad Company has been organized, with a capital stock of $15,000. The incorporators are: Isaac Hill, T. M. Jett and L. V. Hill.

EAST CHICAGO, IND.—The Hammond, Whiting & East Chicago Electric Railway Company has increased its capital stock from $300,000 to $1,000,000.

ANDERSON, IND.—The Indiana Union Traction Company will begin the construction of its new shops here this summer. The company has set aside $150,000 for this work.

CRAWFORDSVILLE, IND.—It is anounced that the Consolidated Traction Company will, in a few days, receive bids for the construction of a large power house in this city. Edward Hawkins is president of the company.

RICHMOND, IND.—The Richmond & Northwestern Electric Railway Company has been incorporated. The capital is $50,000, and the directors are: George M. Hodges, G. G. Bambach, W. D. Riddel and L. I. Lowman, of Dayton.

EVANSVILLE, IND.—The Evansville, Boonville & Rockport Traction Company has completed its survey to Rockport, a distance of 37 miles, and has contracted for private right of way from Evansville to Boonville, a distance of 17 miles.

INDIANAPOLIS, IND.—The Jackson & Fort Wayne Interurban Railway Company has filed articles of incorporation with the Secretary of State. The object of the corporation is to construct and operate an electric railway from Indianapolis to Jackson, Mich. The line will be 130 miles long. The capital stock of the company in Indiana is $50,000. The incorporators and stockholders are: John H. Roberts, Joseph McKee, Charles W. Wadkins, of Grand Rapids; Will H. Mann, of Muskegon; William Sullivan, of Mackinac Island, Mich.; Stephen H. Powers, of Angolia, Ind.

MARSHALLTOWN, IA.—It is reported that a contract has been closed with J. G. White & Company, of New York, for the construction of the Marshalltown Electric Street & Interurban Railway. The road will be built from Marshalltown to Grundy Center, 30 miles, and then, if feasible, will be extended to Parkersburg and ultimately to Charles City, on the north, and to Ferguson, south of Marshalltown. The power house will be built at Marshalltown.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company has been granted a franchise to enter the city.

PADUCAH, KY.—Articles of incorporation for the Kentucky & Ohio River Interurban Railroad Company have been filed here. The company is capitalized at $250,000, and the incorporators are: J. J. Freundlich, C. E. Whitesides, O. B. Williams, of Paducah; O. B. Pettit, of Wabash, Ind.; L. B. Whitesides, of Franklin, Ind., and C. T. Crump, of Columbus, Ind.

LAKE CHARLES, LA.—W. C. Easterling and W. C. Pfeiffer have applied to the City Council of this town for a franchise for constructing and operating an electric street railway system here. They represent a syndicate of Pennsylvania capitalists.

ANNAPOLIS, MD.—A bill will be introduced in the Legislature to grant a charter to the Baltimore, Westminster & Union Mills Railway Company. The incorporators of the company named are Charles E. Fink, Joseph Friedenwald, W. A. Jackson and others. The capital stock is to be $20,000.

ANNAPOLIS, MD.—A bill has been introduced in the Senate to incorporate the Roland Park Electric & Water Company. The capital stock is $25,000, and the company is to operate in Baltimore city. The incorporators are Edward H. Bouton, George Miller, Robert J. W. Hamill, Richard W. Marchant, Jr., and Osborn I. Yellott.

BOSTON, MASS.—The Nahant Selectmen have granted the franchise for the new electric railway between that town and Lynn to the Nahant Street Railway Company, which includes among its incorporators Senator Henry Cabot Lodge, George Abbot James and others. Frand Ridlon & Company will finance the road and supervise its construction.

WORCESTER, MASS.—Representatives of the Worcester & Northern Street Railway Company have been at work, so it announced in Worcester, buying up stock of the Gardner, Westminster & Fitchburg Street Railway, which operates a line to the base of Mt. Wachusett. The Worcester & Northern proposes to run a line to the top of the mountain, using a cable road, and wants the line from Gardner and Fitchburg as a feeder.

ATTLEBORO, MASS.—Preliminary plans for a new street railway to connect the Milford, Attleboro & Woonsocket Street Railway with the Boston & Worcester road are well under way, and the legal papers have been drawn up and submitted to Boston capitalists, who will finance the new company. The company proposes to purchase the Caryville branch line from the Milford, Attleboro & Woonsocket Company.

WORCESTER, MASS.—It is announced that a company to be known as the Worcester, Southbridge & Sturbridge Street Railway Company is about to be formed, to acquire the Worcester & Southbridge Street Railway after that road has passed out of the hands of the receivers, and to acquire also the Southbridge & Sturbridge Street Railway, which has been operated under the Worcester & Southbridge management. The company is said to have a capital stock of $700,000. It is said that William E. Rice, who has been prominent in the settlement of the troubles of the Worcester & Southbridge Company, will be president of the new corporation. The two roads will be put up for sale at auction as soon as the claims have been adjusted, and it is the purpose of the new company to bid them in.

MONROE, MICH.—The Detroit, Monroe & Toledo Short Line is making extensive improvements at its power house in order to provide better facilities for handling the new extension to Detroit, which is now nearing completion. A new engine, generator and additional boilers are being installed.

GRAND RAPIDS, MICH.—The Grand Rapids, Holland & Lake Michigan Interurban Railway Company has elected members of the board of directors for the ensuing year. Directors organized as follows: Benjamin S. Hanchett, president; John P. Crozier, vice-president; Willard Kingsley, secretary; Strathearn Hendrie, treasurer and general manager.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company proposes to extend its present White Bear line from Mahtomedi to White Bear village, passing through Dellwood and White Bear Beach.

LEXINGTON, MO.—The citizens of Lexington are considering the proposition of building an electric railway from Nigginsville to Lexington Junction. Gustave Maerie is the promoter.

KANSAS CITY, MO.—A sub-station is to be built at Twelfth Street and Cleveland Avenue by the Metropolitan Street Railway Company. Two rotaries will be installed, and from them power will be supplied to the car lines on the East Side. When the new station is in commission the stations at Eighth Street and Woodland Avenue and Eighteenth and Olive Streets will be shut down. The sub-station at Fifteenth and Walnut Streets will also be equipped with two rotaries. One will be transferred from the Kaw River power plant, the other is now on the way from the east. The equipment at the power station at Thirty-first and Holmes Streets will also be improved. Two engines at the new plant at Second Street and Grand Avenue are now in commission, and a third engine will be ready for service by June 1.

NEWARK, N. J.—President Thomas N. McCarter, of the Public Service Corporation, has made formal application to the Board of Public Works of Newark for permission to construct five extensions to the trolley system.

SUMMIT, N. J.—An agreement has been reached between the Springfield Township Committee and the Morris County Traction Company, whereby the company will be given a franchise through the township for its proposed electric railway from Summit to Elizabeth.

BATH, N. Y.—The Bath Town Board has granted a franchise to John Tuerk to construct the proposed electric railway from Branchport to Hornellsville.

LOCKPORT, N. Y.—It is announced that all the finances have been arranged for the completion this summer of the electric railway between Lock port and Rochester, via Albion.

ROCHESTER, N. Y.—The entire proceeds of the $100,000 of new stock recently authorized to be issued by the stockholders of the Rochester Railway Company will be used for improvements.

EAST AURORA, N. Y.—The Buffalo & Southeastern Electric Company has been granted a franchise to operate an electric railway here. John H. Boyle, of Utica, is promoting the company. The plan is to connect with Buffalo.

GREENSBORO, N. C.—The Greensboro Electric Company has decided to make many improvements to its system. It is said that a new steam turbine wheel will be installed at the power house. The boiler capacity of the plant will be increased and improvements will be made in the rolling stock.

TOLEDO, OHIO.—Stockholders of the Toledo & Indiana Railway Company will meet April 5 to discuss plans for extending the road westward and for the erection of a large power house.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company will build a new line from Euclid Heights to Warrensville, which will provide a new route into the city for the cars of the Garrettsville division of the road.

COLUMBUS, OHIO.—The Marion, Bucyrus & Tiffin Railway & Light Company has been incorporated, with $10,000 capital stock, by M. B. Earnhart, J. B. DeWitt, S. S. Thorn, O. M. Blake and W. H. Davidson. The company proposes to build an interurban line between Marion, Bucyrus and Tiffin. This is one of the most important projected lines in Ohio, as its completion will make possible, through electric travel between Cincinnati and Toledo and Cincinnati and Cleveland. The Municipal Bonding & Securities Company, of New York, is financing the road.

GUTHRIE, O. T.—A territorial charter has been granted to the Oklahoma City, Lexington & Sulphur Springs Electric Railway Company, with headquarters at Lexington, with $1,000,000 capital. The incorporators are: Charles Stewart, of Parkersburg, W. Va.; H. A. Hawk, J. S. Little, H. L. Forehead and others.

FRANKLIN, PA.—Application has been made to the State Department at Harrisburg for a charter for a company to construct an electric railway from Franklin to Butler, a distance of 53 miles. The company is to be capitalized at $400,000.

ALLIANCE, PA.—An ordinance has been introduced in Council granting a franchise to the Blue Ridge Electric Passenger Railway Company. The line will run from Walnutport, along the Lehigh River, to Alliance, crossing over to Bath and Nazareth.

WILKINSBURG, PA.—A charter has been issued by the State Department to the Wilkinsburg & Braddock Electric Street Railway Company to construct a line from Turtle Creek to Wilkinsburg. The capital is $21,000. Hawley McKinney, of Pittsburg, is president.

PROVIDENCE, R. I.—The act authorizing the Pascoag & Providence Street Railroad Company to increase its capital stock to $300,000 has been passed by the Senate in concurrence with the House of Representatives.

CHATTANOOGA, TENN.—The stockholders of the Chattanooga Electric Railway Company have decided to build a line to Chickamauga Park.

OGDEN, UTAH.—The City Council has granted a franchise to the Ogden Rapid Transit Company to extend its system into the suburbs of the city. The equipment required will be ordered at an early date.

ST. ALBANS, VT.—The St. Albans Street Railway has suspended operations, and rumor has it that the company is financially embarrassed.

RICHMOND, VA.—It is stated that the Richmond Passenger & Power Company has under consideration the extension of its lines to Washington by way of Ashland and Fredericksburg.

COLFAX, WASH.—The Board of County Commissioners has granted a franchise to the Palouse & Spokane Electric Railway Company for an electric railway from Spokane to Colfax.

HAMILTON, ONT.—The Hamilton, Grimsby & Beamsville Electric Railway Company will make additions and improvements to its plant.

WOODSTOCK, ONT.—Wallace & Little, of this city, will apply for a charter for an electric railway between Crantford and Hamilton. David Brennan, of Detroit, and other American capitalists are interested.

New Industrial Companies.

THE EASTERN ELECTRIC COMPANY, of Newport News, Va., has been chartered, with A. L. Powell president.

THE MICHIGAN AUXILIARY FIRE ALARM COMPANY has been incorporated at East Orange, N. J.; capital, $30,000. Incorporators: Paul Muntur, Joseph Genwardt and Charles A. Green.

THE GUSTAVE S. NEU COMPANY of New York has been incorporated to deal in electrical supplies. The capital stock is $10,000, and the directors are G. S. Neu, Marion Neu and W. L. Frank, New York.

THE SHEDD ELECTRIC COMPANY, of Elizabeth, N. J., has been incorporated; capital, $250,000. Incorporators: William H. Peck, J. Foster Symes, C. A. Matthews, H. C. Henshaw and H. Richmond Palmer.

THE FIELD MULTIPLEX TELEGRAPH INSULATION COMPANY has been incorporated at Jersey City, N. J., with a capital stock of $20,000. The incorporators are James D. Campbell, R. W. Ashcroft and Kenneth K. McLaren.

THE INTERNATIONAL ACCUMULATOR COMPANY has been incorporated at Portland, Me., with a capital stock of $1,000,000, of which $50 has been put in. The officers are: President, Ardon W. Coombs, Portland; treasurer, Winfield S. Carpenter, Boston.

Legal.

NEW ORLEANS FRANCHISES.—At New Orleans, on March 26, Attorney-General Guion brought suit in the District Court to have the New Orleans Railways Company, a company chartered under the laws of New Jersey, declared unconstitutionally incorporated, and therefore unable to do business in Louisiana. The company has a capital of $80,000,000, most of the bonds being held in New York. It controls all the street car and suburban lines of New Orleans, besides owning the gas works and electric light plant of the city and furnishing all light—gas and electricity—for public and private lighting.

Obituary.

MR. H. H. CARPENTER.—Mr. Hiram H. Carpenter, an inventor of electrical devices, died on March 28 at Bellevue Hospital, New York City. He had recently returned from a European tour. He was born in Williamstown, Mass., sixty-four years ago, and was a cousin of the late United States Senator Matthew Carpenter of Wisconsin. He invented and improved some storage batteries, and lately had been engaged upon a wireless telephone. He was an officer in the Iron Brigade of Wisconsin in the Civil War, and commanded the Twentieth New York Cavalry during the latter part of the war.

MR. C. D. CRANDALL.—It is with deep regret that we note that Mr. Chester D. Crandall, manager of the Western Electric Company, died at his home in Edgewater, Chicago, March 22, 1904. He had been a prominent figure in the Bell telephone field for many years. Soon after he graduated from the University of Rochester in 1879, he became connected with the Western Electric Company. At one time he was associated with the Missouri & Kansas Telephone Company at Kansas City, but returned to the Western Electric Company. He was a member of the Union League Club and other prominent clubs in Chicago. He had been an associate member of the American Institute of Electrical Engineers for several years. He leaves a wife and daughter.

PERSONAL.

ASA M. MATTICE.

MR ASA M. MATTICE has accepted the appointment of chief engineer of the Allis-Chalmers Company. Mr. Mattice was graduated from United States Naval Academy, Annapolis, Md., at the head of the class of Cadet Engineers of 1874, and remained in the naval service until 1889. During his 17 years' service, he was attached to the Naval Academy for three years as instructor in engineering, and acted three years as assistant to the Engineer-in-Chief of the Navy at Washington, D. C. The remainder of his duty was on board ship and at navy yards. While serving as assistant to the Engineer-in-Chief, he had direct charge of the designs for the machinery of the first vessels of the new navy, and the great success of the several new types originated led to their rapid adoption in the navies of the world. From the time of Mr. Mattice's resignation from the Navy until the end of 1899, he was the principal assistant to Mr. E. D. Leavitt, consulting engineer, Cambridgeport, Mass., where his work was principally in connection with large mining machinery, pumping engines, mill plants and power plants, along with a great deal of miscellaneous engineering. In 1900 he resigned to engage in independent engineering, but in December of that year accepted an appointment as chief engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. In June, 1903, he was appointed chief engineer of the Westinghouse Machine Company, East Pittsburgh, Pa., and consulting engineer of the Westinghouse Electric & Manufacturing Company, which positions he held up to the present date. Mr. Mattice took up his new duties on April 1 with headquarters at the central works of the Allis-Chalmers Company, Milwaukee.

F. H. BETHELL.

MR. FRANK HOPKINS BETHELL has been appointed general manager of the Chesapeake & Potomac Telephone Company, with headquarters at Washington, D. C. He is one of the youngest managers in the present Bell telephone system to hold so prominent and responsible a position. Mr. Bethell began his telephonic career in that excellent school, the New York & New Jersey Telephone Company, and was connected with its Brooklyn office. He went thence to the New York Telephone Company, and for the past three years has been its contract agent. His work in this arduous position has been of a really brilliant character and has attracted considerable notice. During the three years of his incumbency the company has doubled the number of telephones in use in Manhattan and the Bronx, so that at the time this is written there are not less than 140,000 telephone stations installed or under contract in the district named, this being by far the largest telephonic network in the world. Mr. Bethell's success in New York has been due to his own efforts. He has a clever diplomatic way of handling men, and the high *esprit de corps* in the contract department is due to his methods, while at the same time he has made friends with the great New York public, so that complaints are rarely heard. Mr. Bethell has developed business in many ways, and is a great believer in advertising. His work in the New York newspapers, as well as in the booklets he has constantly sent out, has been attended with the splendid results as noted above. Great regret is felt by the officers of the New York Telephone Company as well as by Mr. Bethell's own immediate staff at his departure, but they realize that the move is strictly in the line of promotion and wish him abundant success. He begins his new labors on April 1. The principal points covered by the Chesapeake & Potomac Company are Washington, Baltimore, Annapolis, Belair, Cumberland, Frederick, Hagerstown, Westminster, Md., and Martinsburg, W. Va. Comprising as it does the national capital, this field involves at once great opportunities and great responsibilities, while at the present time the work is complicated by the heavy restorations necessary in Baltimore after the great fire.

MR. H. W. POTTER, of the export department of the Westinghouse interests, sailed March 29 for Panama. He expects to be absent about a month.

MR. B. E. SALISBURY, secretary and general manager of Pass & Seymour, Inc., of Solvay, N. Y., was in New York City last week on important business for that concern.

MR. CLINTON L. ROSSITER, president of Rossiter, MacGovern & Co., has gone to Mexico in connection with the Toluca Light & Power Company, in which he is interested.

MAJOR W. A. GLASSFORD, U. S. Signal Corps, upon his return to this country from service abroad shortly, will proceed to Atlanta, Ga., and report for duty there as signal officer.

MR. FRANCK Z. MAGUIRE, of London, has just arrived in this country by the "St. Louis," and will be here for two or three weeks, going first to Washington.

MR. S. B. FORTENBAUGH, electrical engineer of the Underground Electric Railways Company of London (Yerkes syndicate), is now in this country on a flying trip, and has been visiting Schenectady, etc.

MR. JOHN McDOUGALL, of Montreal, Can., who represents the interests of the International Steam Pump Company, 114 Liberty Street, in that part of the world, is now on a visit to New York.

MR. A. M. BARRON has moved from Indianapolis, Ind., to South Bend, Ind., where he will continue his engineering work. Mr. Barron is secretary of the Indiana Public Utilities Association, which will hold its next meeting at Indianapolis in October.

PRESIDENT CHARLES SUMNER HOWE is to be installed as head of the Case School of Applied Science, Cleveland, Ohio, on May 11. Considerable preparations are now being made for the inauguration exercises, and official invitations are being sent out.

MR. G. W. FRANK, of J. G. White & Co., 49 Exchange Place, New York, has gone to Mexico for the purpose of supervising the remodeling of the Monterey Electric Light & Power Company's plant, the contract for which is being carried out by J. G. White & Co.

MR. W. K. PALMER, consulting engineer, 402 Lyceum Building, Kansas City, Mo., is engineer for the municipal lighting plant for Versailles, Mo. Plans and specifications will be ready in about two weeks. Bids will be required on boilers, engines, generators, switchboard, poles, etc., together with the building.

MR. MARTIN MOLONEY.—A cable dispatch from Rome of March 26 says: "Marquis Martin Maloney, of Philadelphia, and Miss Maloney were to-day received in private audience by the Pope, who conversed with them at considerable length in the most cordial manner. They were presented to His Holiness by Cardinal Satolli."

MR. LOUIS F. MAHLER, formerly western manager of the De Laval Steam Turbine Company, and St. Louis manager for the Bullock Electric Manufacturing Company, is now representing the Buckeye Engine Company, of Salem, O.; the International Steam Engineering Company, of Atlanta, Ga., and New York, and the Chase-Shawmut Company, of Newburyport, Mass., at Suite 1008-9 Chemical Building, St. Louis.

DR. A. C. CREHORE, of Yonkers, N. Y., has issued in neat pamphlet form a recent article of his in *Country Life in America*, describing a new sun-dial that tells standard time all the time the sun shines and indicates the time of sunrise and sunset throughout the year. The gnomon of an ordinary dial is represented in this form by a phosphor bronze wire carrying a small metal head.

MR. F. W. BENNETT, chief engineer of the Cienfuegos, Palmira & Cruces Electric Power & Railway Company, is expected to arrive from Cuba very shortly. The company is to build a large hydraulic plant for the purpose of generating power for light and traction use in the Santa Clara province. The consulting expert of the company is Mr. Cornelius C. Vermeule, 203 Broadway, New York.

MR. EDWARD BENNETT has resigned from the Nernst Lamp Company and with Mr. Murray C. Beebe will engage in engineering and expert work with offices in the Farmers' Bank Building, Pittsburg. Mr. Bennett became associated with the development of the Nernst lamp shortly after the inception of the work in this country, and for the past fifteen months has served as chief electrician of the Nernst Lamp Company.

MR. HUGH L. COOPER, at one time hydraulic engineer of the Stilwell-Bierce & Smith-Vaile Company, and who later on acted as expert in charge of the large water power plant on the Rio Tiete, Brazil, operated by the Sao Paulo Tramway, Light & Power Company, is now in charge of the construction of the Mexican Light & Power Company's extensive system. He has sailed for Mexico after a short visit to the States.

MR. EDWARD GUINLE, of the electrical engineering and contracting firm of Aschoff & Guinle, of Rio Janeiro, Brazil, will arrive very shortly on a somewhat extended visit to the United States. The firm represent the Brazilian interests of several large American electrical and mechanical concerns. Mr. Guinle will make his headquarters in the offices of G. Amsinck & Co., 6-9 Hanover Street. He is expected to place some large contracts.

MR. S. M. CONANT, now representing the Crocker-Wheeler Company of Ampere, N. J., in Atlanta, Ga., is to be married at Holy Trinity Church, Church Road, Richmond, Va., Tuesday, April 5, to Miss Helen Temple Southall, daughter of John H. Southall, treasurer of the Virginia Trust Company of Richmond. The ceremony will be performed by the Rev. C. M. Conant, M. D., father of the bridegroom, assisted by the Rev. Dr. Gravatt, rector of Holy Trinity.

MR. F. S. PEARSON, 29 Broadway, New York, has gone on a trip to Mexico for the purpose of inspecting the progress made in the construction of the Mexican Light & Power Company's Mecaxa plant, which is to generate initially no less than 45,000 hp for transmission to Mexico City, etc. Mr. Pearson is vice-president and consulting engineer of the company, which is controlled by Canadian capitalists. He expects to be back in about ten days.

MR. JAMES MITCHELL, general manager at Sao Paulo, Brazil, of the Sao Paulo Tramway, Light & Power Company, is expected to arrive in New York next week. Mr. Mitchell was formerly one of the partners of the recently dissolved firm of James Mitchell & Co., of Rio de Janeiro and Sao Paulo, which represented the interests of some of the leading United States electrical concerns. While in New York he will make his headquarters in the Sao Paulo Company's office, 29 Broadway.

MR. MURRAY C. BEEBE has resigned from the Nernst Lamp Company, and in association with Mr. Edward Bennett, has opened an office in the Farmers' Bank Building, Pittsburg, to engage in the practice of electrical and mechanical engineering and in expert work. Mr. Beebe was for several years an instructor in electrical engineering in the University of Wisconsin, which position he left to take up work on the development of the Nernst lamp, and when the Nernst Lamp Company was later formed, became its chemist and technical superintendent.

MR. GEORGE J. GOULD on his recent trip through the Southwest was so pleased, it is said, with the performance of the engine which drew his train over 5000 miles without a break that he presented the engineer and fireman who handled it with purses each containing $100 in gold. The locomotive plowed its way through snow, ran through the heart of the Salt River Valley, was fed with forty different kinds of coal, and used water of every known analysis in its boiler, yet the only repairs it needed were such as were made en route by the crew. His Manhattan Elevated electric locomotives have also been doing about as well.

MR. W. MARCONI has had the misfortune to lose his father, Mr. Giuseppe Marconi, at the age of 82, at Bologna, Italy. Mr. Giuseppe Marconi was born in 1823. The mother of William Marconi, of wireless telegraph fame, was his second wife. She was Miss Anna Jameson, daughter of the founder of the well-known Dublin firm. She was a beautiful girl and was sent to Italy to complete her education. She met in that country the elder Marconi, a dashing young Italian, who was of good family, in possession of a large estate near Bologna, their mutual liking arising out of a common taste for outdoor sports. Their elder son, Alfonso, was born in 1865 and William in 1874, at the family house, the Villa Grifone, near Pontecchio. Signor Marconi took great pride in his son's achievements.

MR. FRANK W. FRUEAUFF, auditor of the Denver Gas & Electric Company, has been asked by President Edgar to report on office methods and accounting at the 27th convention of the National Electric Light Association, to be held in Boston May 24-27. Mr. Frueauff is a very progressive young man, and as he is familiar with the up-to-date methods of keeping central-station accounts, including modern devices for saving time and insuring accuracy in office work, the report, which he has promised to prepare, is sure to be a valuable addition to the programme of the meeting.

PROF. F. G. BAUM, formerly assistant professor in the department of electrical engineering at Stanford University, California, has been appointed electrical engineer and general superintendent of the California Gas & Electric Corporation, which recently absorbed the Standard Electric Company and now controls all the local distributing companies around the bay. Prof. Baum will have entire charge of all construction and operation of the water systems, power houses, transmission lines and sub-stations of the company. Prof. Baum graduated from Stanford in 1898, taking the degree of electrical engineer a year later. He then became connected with the department as instructor and assistant professor. He resigned a year ago on his appointment as assistant electrical engineer of the corporation of which he becomes chief engineer and general superintendent.

MR. ANDREW CARNEGIE.—The reason for Mr. Andrew Carnegie's gift of $50,000 to Kenyon College, at Gambier, Ohio, announced just as he sailed for Scotland, is that it is an expression of Mr. Carnegie's grateful remembrance of kindness shown to him years ago by Edwin M. Stanton, who, when secretary of war in President Lincoln's cabinet, made Mr. Carnegie assistant manager of posts and telegraphs. Mr. Carnegie's gift will be used to establish what is to be known as the Edwin M. Stanton chair of economics. Mr. Carnegie gave the money on learning that Mr. Stanton's early education had been secured at Kenyon College. The gift was partly due also to a suggestion from the late Senator Hanna, who had himself given $50,000 to the college to found a dormitory. Mr. Carnegie has always welcomed such opportunities to emphasize his various close relationships with the telegraphic field.

MR. WINSLOW H. HERSCHEL, who has been stationed at the Jerome Park Reservoir, Aqueduct Department of New York City, has sailed for Europe on behalf of the Allis-Chalmers Company. He will remain on the other side for a year, making his headquarters at Zurich, where he will act as local agent and technical correspondent for the company. The works of Escher, Wyss & Co. are located at Zurich. As previously mentioned in these columns, the Allis-Chalmers Company has acquired the American rights for the Swiss concern's water turbines. Mr. Clemens Herschel, M. Am. Soc. C. E., formerly hydraulic engineer of the Holyoke, Mass., Water Power Company, also consulting hydraulic engineer from time to time during the past score of years for several Niagara water power companies, has charge of the new water turbine and other hydraulic machinery department of the Allis-Chalmers Company.

MESSRS. KEMPSTER B. MILLER AND S. G. McMEEN, two of the best known telephone engineers of Chicago, have become associated as consulting engineers, experts and solicitors in patent causes, and will open offices at 1442 and 1443 Monadnock Block, Chicago, about May 1, 1904. As consulting engineers in the telephone field they will fill a place hitherto unoccupied even in such an important independent telephone center as Chicago. Mr. Miller needs no introduction as a telephone engineer. He is a graduate of Cornell. After several years in the U. S. Patent Office as examiner of telephone patents he left to become one of the pioneer independent telephone manufacturing company engineers with the Western Telephone Construction Company of Chicago. He left that company to accept a much higher salary as instructor in telephony for the International Correspondence Schools, where he remained a year. About four years ago when the Kellogg Switchboard and Supply Company was started he took an important engineering position with that company which he has held ever since. His book on "American Telephone Practice" is recognized as the standard work on telephone circuits and switching, being the only comprehensive book of the kind in the field. Mr. S. G. McMeen is best known through his long connection with the Central Union Telephone Company as chief engineer and assistant engineer. Graduating from Purdue in 1895, he went at once into field work for the Central Union Telephone Company. In 1893 he became assistant chief engineer, and later chief engineer, until 1902, when he took charge of the telephone central office and exchange equipment work for the Western Electric Company, where he has been for the two years just past. It would be hard to find two engineers better fitted by all around experience and personal acquaintance to enter the telephone consulting field than Messrs. McMeen and Miller, and the industry is to be congratulated on having available such talent outside of the manufacturing companies. It is a good thing for the business.

Trade Notes.

OIL FILTERS.—The American Ship Building Company has given a second order for Cross oil filters for its yards at Lorain, Ohio.

THE BOSSERT ELECTRICAL CONSTRUCTION COMPANY, of Utica, N. Y., has increased its capital stock from $75,000 to $100,000.

THE BUFFALO STRIKE.—The strike of electrical workers at Buffalo, N. Y., has been settled by a complete backdown of Local Union I. B. E. W., in regard to all the vital points at stake.

AUTOMOBILE MOTORS.—The Elwell-Parker Electric Company, Cleveland, O., has recently closed a contract for a large number of automobile motors, and the company is building a number of 200-hp heavy-duty hoisting motors.

SALUS COMPOUND.—The Electric Appliance Company, Chicago, is anxious to tell the world about "Salus Compound," which is the insulation that it claims makes the Packard transformer so effective. It has literature on the subject and will be glad to send it to any address.

MILLING MACHINES.—The Hess Machine Company, Fifteenth and Chestnut Streets, Philadelphia, in a pamphlet just issued describes and illustrates its line of milling machines and cutters for large output. The company furnishes electric motor drive, designed to suit each individual case, and the company has on hand designs suited for direct, alternating and multivolt motors, low and high speed.

DINKEY VENTILATED CONTROLLERS.—A very handsome and complete illustrated catalogue has been issued by the manufacturers of the Dinkey ventilated controllers, the Electric Controller & Supply Company, of Cleveland, O. The construction is shown complete and in detail of this apparatus for cranes, the original type of which was brought out at the Homestead Steel Works of the Carnegie Steel Company to meet the special requirements of steel works. The catalogue is known as Bulletin No. 9.

HAND PORTABLE ELECTRIC DRILLS.—E. H. Cadiot & Company, 12, Rue St. Georges, Paris, France, have made hand portable electric drills a specialty since 1896. They have sent us a new catalogue of these machines, whose object is to enable small drill holes to be made in any kind of material or machinery which cannot be easily transported to large electric drilling machines. These small drills have met a steady and increasing sale. Messrs. Cadiot have recently introduced some powerful machines of this class, which, however, retain all their portable features and are in every way up to date.

THE NERNST LAMP COMPANY has recently established district offices at St. Louis, Mo., and Denver, Col. The St. Louis office, embracing the southwest territory, is located at 908 Pine Street, with Mr. H. M. Reed as district sales manager. The Denver office, covering the middle western territory, is at 1619 Glenarm Street, with Mr. F. D. Marthens as district sales manager. These offices will carry a complete stock of Nernst lamps and supplies, and will be provided with an attractive exhibition room, in which will be shown the different types of Nernst lamps in actual operation and in comparative tests with other illuminants.

REMODELING OF POWER PLANT.—The Canadian Rubber Company of Montreal recently remodeled its power plant and found that the tall brick chimney, 110 feet high, would not give the proper amount of draft necessary in connection with the four new Stirling boilers it was to install. Mechanical draft was necessary, and for this purpose a large Sturtevant horizontal engine was installed, and now the proper amount of draft is easily attained and regulated at will regardless of the weather conditions. This installation is another illustration of the necessity of mechanical draft, especially in connection with the remodelling of old boiler plants.

HOW TO MAKE INDICATORS, reducing wheels and planimeters and how to use them intelligently from the first lesson to the last, is a line of instruction which any progressive engineer should be interested in. Such a course is being offered by the Indicator Instruction Company, No. 19 Franklin Avenue, Scranton, Pa. This is a concise, practical course of instruction, as it covers the subject in twenty-four pages from the making of the patterns to the construction and testing of an indicator spring. The company is making a special offer for enrollments received prior to April 15 and offers to send prospectus and all particulars free to those interested. Mr. A. C. Lippincott is the instructor.

THE NATIONAL-ACME MANUFACTURING COMPANY, Cleveland, O., manufacturer of the Acme automatic multiple spindle screw machine and parts produced on this machine, has recently found it necessary to add a night shift in its products department. The speed and accuracy of its Acme machine enables it to rapidly produce special milled work from steel, iron and brass, and the company has been particularly successful in securing business of this class from telephone, battery and electrical instrument manufacturers. Its business in the machine tool line is fully up to that of last year. An interesting machine recently shipped by this company was a multiple spindle screw machine for producing caulks for cavalry horses for the Japanese army—an instance of the careful attention which the "Yankees of the East" are giving to the most minute details in the care of their army equipment.

THE ROSSITER, MACGOVERN Electrical Company, western agents of Rossiter, MacGovern & Co., has found it necessary, owing to the very large increase in its office staff, to move its offices from the Missouri Trust Building to its factory, corner Papin Street and Compton Avenue, St. Louis. The business under the active management of Mr. J. A. Peirce has increased immensely since the company was first organized, less than two years ago. Among recent contracts taken by this company is the complete installation of the power house of the Kokomo, Marion & Western Traction Company, Kokomo, Ind., calling for the complete installation of a power station of 1000 kilowatts. Everything is furnished, including engines, boilers, generators, pumps, etc., and two 150-kw motor-generator sets. The company is also installing one 500-kw direct-connected, direct-current 600-volt unit in the station of the Louisville Lighting Company, Louisville, Ky., besides having in hand a large number of the electrical exhibit installations at the Louisiana Purchase Exposition.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 22, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

754,969. STORAGE BATTERY; Martin C. Burt, Chicago, Ill. App. filed Aug. 13, 1903. (See page 658.)

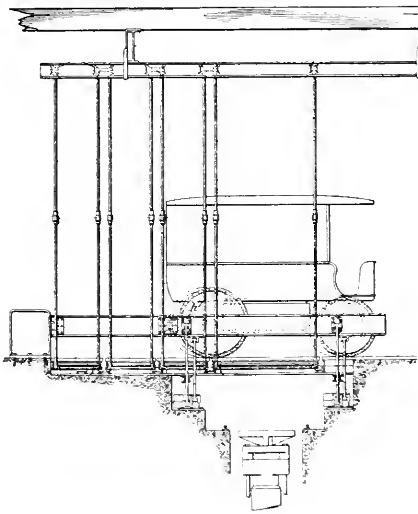
754,980. SYSTEM OF SPEED REGULATION FOR MOTOR-DRIVEN MACHINERY; Gano S. Dunn, East Orange, N. J. App. filed Aug. 20, 1903. A variable speed motor is combined with a number of trains of gears, the velocity ratio of the gear trains being proportioned so that the entire range of speed obtained with each successive train covers a portion of the range obtainable with the next succeeding train.

754,997. METHOD OF PROVIDING CABLES OR OTHER FLEXIBLE BODIES WITH SOLID ENDS; George G. M. Hardingham, London, England. App. filed Mar. 21, 1903. The cable is inserted in an opening in the head and a tool driven into another opening to force the metal into intimate contact with the cable.

755,029. ARMATURE WINDING OR COIL; Frank A. Merrick, Johnstown, Pa. App. filed Nov. 9, 1899. A form of coil intended to occupy small space at the heads of the armature.

755,032. APPARATUS FOR WIRELESS TRANSMISSION OF ENERGY; Daniel M. Moore, Newark, N. J. App. filed Apr. 18, 1903. The current is broken in a vacuum, the object being to create the waves or vibrations of radiant energy in a more economical and effective manner.

755,048. AUTOMATIC CIRCUIT CLOSER; James L. Russell, Boston, Mass. App. filed Nov. 2, 1903. A tubular walking-beam containing an expansible liquid is arranged near two lamps and controls the circuit of the lamps by oscillating from one position to the other by reason of the heating effect of the lamp upon the liquid contents of the beam.



755,087.—Positioning Apparatus for Vehicles.

755,087. POSITIONING APPARATUS FOR VEHICLES; George A. Ward, New York, N. Y. App. filed Dec. 23, 1902. The sections of a platform upon which the vehicle runs to receive its battery are movable by power devices so as to position the vehicle accurately with respect to the platform upon which the battery is deposited.

755,092. LINE WIRE CLAMP; Herman C. Willitz, Janesville, Wis. App. filed Oct. 17, 1903. A U-shaped spring plate adapted to clamp the wire and a link embracing and confining the ends of the clamp.

755,121. ELECTRICAL APPARATUS FOR THERAPEUTIC PURPOSES; Frederick C. Fisher, Bristol, Eng. App. filed Sept. 21, 1903. Details.

755,125. ALARM DEVICE; William Friedberg, New York, N. Y. App. filed Nov. 11, 1903. Details of a door knob circuit closer.

755,140. ELECTRIC RAILWAY SIGNAL; Bertram M. Kershner, Pittsburg, Pa. App. filed June 21, 1902. A signal wire extends over a block and is normally grounded at each end; the car automatically disconnects one end from the ground and connects it to a source of current supply to actuate the signal.

755,141. ELECTRICAL SWITCH MECHANISM; Hubert Krantz, Brooklyn, N. Y. App. filed June 29, 1903. A special arrangement of the cross-bars and bus-bars of a switchboard affording a saving in material in the construction.

755,142. STORAGE-BATTERY CONSTRUCTION; Simon Lake, Bridgeport, Conn. App. filed Dec. 17, 1903. (See page 658.)

755,165. ELECTRIC SWITCH; Ashley P. Peck, Milwaukee, Wis. App. filed Sept. 21, 1903. A switch having insulating barriers so arranged that when the ends of the movable contact leave the stationary contacts, they are practically inclosed in insulating material.

755,173. ELECTROPNEUMATIC SYSTEM OF DRIVING; Johann Sahulka, Vienna, Austria. App. filed Apr. 18, 1903. A compressor driven from the motor shaft charges an air tank, which supplies an air engine also connected to the axle. The electric motor acts as the main working motor, the air engine being used in starting going over sections of the track where there are no line conductors and in cases where an extra amount of power is required. A controlling device common to both motors enables one or the other motor to be thrown in or out.

755,203. ELECTROMAGNETIC RAIL BRAKE; Karl A. Wilde, Hamburg, Germany. App. filed Dec. 1, 1903. A plurality of pole pieces carrying brake shoes and having tubular extensions, detachably connected together for convenience in assembling and replacing the parts.

755,229. COIL FOR ELECTROMAGNETS OR OTHER PURPOSES; Friedrich Klingelfuss, Basle, Switzerland. App. filed Sept. 28, 1900. The wire layers are in discs perpendicular to the axis of the coil; the insulation being arranged so that its value between every two turns is proportional to the potential difference.

755,247. MANUFACTURE OF SULPHURIC ACID; Pedro G. Salom, Philadelphia, Pa. App. filed June 17, 1902. (See page 658.)

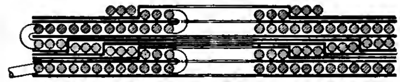
755,282. ELECTROMAGNETIC SEPARATOR; Myron Dings, Milwaukee, Wis. App. filed May 23, 1903. Details.

755,297. AUTOMATIC CIRCUIT BREAKER FOR ELECTRIC TIME OR OTHER SWITCHES; Arthur W. Hutchins, Providence, R. I. App. filed May 15, 1903. Details.

755,302. EXTRACTION OF COPPER FROM COMMINUTED MINERAL MIXTURES; Ernest A. LeSueur, Ottawa, Can. App. filed May 27, 1899. (See page 658.)

755,305. PEAKED WAVE WIRELESS TRANSMISSION; Daniel M. Moore, Newark, N. J. App. filed June 14, 1902. A method of setting up waves of radiant electric energy by producing changes of primary exciting electric potential which, if graphically described as a series of waves, would show waves of highly peaked form.

755,306. ELECTRIC TUBE LIGHTING; Daniel M. Moore, Newark, N. J.



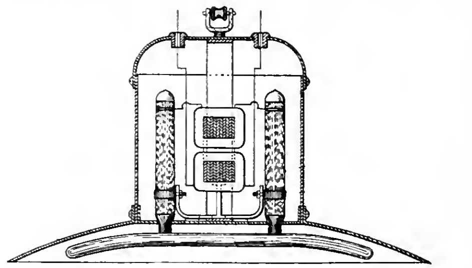
755,229.—Coil for Electromagnet or other Purposes.

App. filed Jan. 19, 1903. The leading-in wires of the tube are in direct connection with the terminals of the secondary of the transformer, the connection being made within a casing inclosing the transformer.

755,307. ELECTRIC TUBE LAMP; Daniel M. Moore, Newark, N. J. App. filed Feb. 6, 1903. A casing containing a transformer and the tubular lamp terminals, that portion of the tube used for lighting, extending through the walls of the casing.

755,320. APPARATUS FOR HEATING AIR; Walter K. Seelye, Dubuque, Iowa. App. filed June 13, 1902. Details of a resistance and valve apparatus for instantaneously heating air on its passage through a dental or other tool.

755,358. RETARDING DEVICE FOR ELECTRIC CIRCUIT BREAKERS; Algernon R. Cheyney, Philadelphia, Pa. App. filed Dec. 2, 1903. An



755,307.—Electric Tube Lamp.

automatic valve controlling the inlet of liquid to a chamber in which the core of the solenoid moves.

755,367. STATIC ELECTRIC MACHINE; Ernest E. Fewkes, Newton, Mass. App. filed June 1, 1903. One or more revolving non-charging generating plates and a revolving charging plate, equalizing combs for all the plates, and electrical connections between the equalizing combs of the charging plate and those of the generating plates.

755,382. DEVICE FOR TESTING ELECTRIC CURRENTS; Charles Oliver, Woolwich, England. App. filed Nov. 29, 1902. A low conductive pencil to be held in the band is fitted with a sliding metallic cap adjustable in position to alter the resistance of the pencil.

755,391. ELECTRIC RAILWAY SHOE; Henry Rosenfeld, New York, N. Y. App. filed Aug. 19, 1903. The contact surface of the shoe has a V-shaped rib and is weighted to remove snow and ice from the rail.

755,393. ELECTRIC CONNECTION; Frank J. Russell, New York, N. Y. App. filed Nov. 6, 1903. Reversible bracket angle-plates are used to compensate for incorrect settings of terminal boxes in a wall.

755,468. RHEOSTAT; Arthur C. Eastwood, Cleveland, O. App. filed Dec. 21, 1903. Wiring connections of a controller are avoided by mechanically fastening the contact fingers to a metal frame to which the resistance circuit is applied and connected.

755,514. FIRING MECHANISM FOR BREECH-LOADING GUNS; John F. Meigs and Sigard A. S. Hammar, South Bethlehem, Pa. App. filed Feb. 2, 1901. Details.

755,537. COIL FOR DYNAMO ELECTRIC MACHINES; Ferdinand Porsche and Ludwig Lohner, Vienna, Austria-Hungary. App. filed July 11, 1902. A coil wound of band conductors and having opposite sides or ends cut away to give it a concave-convex form to fit against the ring of a field magnet.

755,563. AUTOMATIC CONTROLLING DEVICE; Jacob S. Cole, Allegheny, Pa. App. filed July 15, 1903. An automatic switch adapted for electric cranes.

755,577. ELECTRIC VIBRATOR; William MacMillan, New York, N. Y. App. filed July 29, 1902. A circuit changer for vibrating bells in which the contacts are located in a closed box.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, APRIL 9, 1904. No. 15.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

NEW YORK, SATURDAY, APRIL 9, 1904.

CONTENTS.

ELECTRIFYING STEAM ROADS.

We have already called attention to the electrification of the Lancashire and Yorkshire steam railroad in England, and last week gave some further interesting data about this work. It is not to be forgotten that outside the Manhattan Elevated this is virtually the largest third rail system in the world, but of course the main interest lies in the change from steam to electricity. This is the first notable example of the kind in England, a country where a great deal more of the same development may be expected, even before it is attempted in this country. Indeed it is striking to note the elaborate figures made by Mr. F. F. Bennett in his recent paper before the British Institution of Electrical Engineers on the electrification of the steam railroads of England. He estimates a total annual expenditure of £13,939,646 or about $65,500,000, and a cost per train mile of 10.0479 penny, with a kilowatt cost of 1.2121 penny. This, he says, shows only an extra profit of 0.29 per cent., which he does not regard as sufficient temptation for making the change. But on the other hand he points to the great increase in traffic, sometimes fourfold, that follows the adoption of electricity, and claims that with an ultimate increase of capital of £300,000,000 to make the change up to its feasible limit of increase, the proportion of net receipts would be raised from the 3.279 per cent of 1901 to 5.1, or an increase in the profits of 1.831 per cent. This would represent an additional profit of £23,558,421 per annum. The complete paper is well worth close study and criticism.

BOOSTER CALCULATIONS.

In dealing with a long trolley feeder that is overloaded, we find that the pressure is unduly low at the distant end, where the feeder connects with the mains. Under these conditions one of two expedients must be resorted to for amelioration: Either more copper must be used or else a higher generating pressure. In the case of a trolley station, it may be impracticable to raise the pressure at the generators. In that event, there must either be more copper or a booster. There must be more conductance in the feeder, or an e.m.f. must be inserted in it. In many cases it is cheaper to put in the booster, and to increase thereby the drop and waste more power in transmission, than to sink investment in the copper and continue to lose the interest on the same. The article on page 687, by Mr. W. A. Del Mar, considers the various conditions controlling the installation and use of boosters.

There are two ways in which boosters may be applied to a trolley system. One is the ordinary way of raising the pressure at feeding points, or increasing the positive pressure. The other is in the application of boosters to the return circuit, in order to keep down the pressure more nearly to that of the ground. Such negative boosters, or depressors, are sometimes called "crushers." The difference, however, between a booster and a crusher is a mere matter of detail, and if instead of a ground return circuit, the return were entirely insulated, the difference would disappear. The value of a crusher is not merely for reducing the apparent drop of pressure in the ground return conductor system, but also for reducing or eliminating the dangers of electrolysis. The computations described for arriving at the most economical booster plant are very interesting. The cost per kilowatt of boosters is manifestly considerably in excess of the cost of generators, since boosters are of relatively small capacity, and require motive power as well as generator power. Boosters also add to the switchboard expense, and the general complexity of a system. Consequently, although boosters have proved a great boon to the electric street railway, they should not be installed without carefully counting the economies of the situation.

SYNCHRONOUS CONVERTERS.

The modern converter is a wonderful machine from the standpoint of efficiency and convenience. It is in very extensive use, particularly in America, and it gives, as a rule, excellent service. It is a very compact machine and very light. That is to say, its output in watts per pound, or per kilogramme, is high relatively to that of the ordinary motor or generator. The reasons for this large output are that the machine is to a great extent a mere revolving commutator, and that during an appreciable part of the time in any alternating-current cycle, the alternating current is directly delivered from the collector rings on one side to the commutator, brushes and direct-current circuit on the other side. Moreover, in the polyphase converter, there is no appreciable absorption of mechanical power. The alternating-current power arriving on one side is converted into direct-current power delivered on the other side, without assuming the form of mechanical power as an intermediary step. In other words, neglecting frictions, the converter is devoid of mechanical torque. In this respect it approaches the conditions of the alternating-current transformer, which is stationary and devoid of torque, but which is, nevertheless, subjected to electromechanical forces of appreciable magnitude. These forces are rendered apparent when the coils are capable of moving relatively to each other, as in "tub transformers." It is surprising how large a proportion of our direct-current supply in large cities comes from alternating-current generators through the medium of converters. The theory of operation of converters thus assumes considerable importance. Part of this theory is covered by the article of Prof. F. G. Baum, appearing on page 691.

The relations between the voltages between collector rings on one side and commutator brushes on the other, are readily capable of being elucidated and apprehended. The heating of the armature winding under the differential action of the alternating and direct currents is, however, a complex matter. It has been worked out by Steinmetz, Child and others. A resumé of the computation is given in Prof. Baum's article, and shows the relative advantage of the six-phase converter. The article also gives the characteristic regulation curves of a particular small polyphase converter when employed as a shunt machine, and when compounded. It is shown that when compounded by the use of a series winding, the pressure at brushes is sustained much better under load than when the machine only employs a shunt field; but that, in order to make the pressure rise, reactance has to be inserted in the external alternating-current circuit. The manner in which the compound winding of the converter can cause the alternating current entering the machine to lead as the load comes on, and thereby force the pressure up at collector rings owing to the negative drop of the leading current in the reactances, is a very interesting well-known proposition.

STROBOSCOPIC METHODS OF OBSERVING AND RECORDING PERIODICALLY AND RAPIDLY VARYING PHENOMENA.

In the January number of the *Journal* of the British Institution of Electrical Engineers is an excellent paper by M. E. Hospitalier on stroboscopic methods of observation and recording. Instruments for stroboscopic observation are called stroboscopes, and instruments which record stroboscopically are called strobographs. The ondograph of the author pertains to the latter class. A commutator is driven, with a definite small amount of asynchronism, by a small electric motor, and the commutator alternately charges a condenser from the periodically varying e.m.f. under test, and discharges the same through a measuring instrument. The latter moves a pen over a rotating cylinder, and, after about 1,000 cycles of the alternating e.m.f. completes a curve that practically represents every detail of variation in the wave.

There are several ingenious mechanical details in the apparatus. One is the avoidance of curvilinear co-ordinates in the traced diagram. When a D'Arsonval galvanometer is fitted with a lever arm and pen, the pen moves on the arc of a circle having for radius the length of the lever. A long arm makes a heavy and unwieldy lever. On the other hand, a short and manageable lever gives markedly curvilinear co-ordinates. In the ondograph, a long balanced pen-holding lever is operated by a short arm on the D'Arsonval galvanometer by a pin-and-slot connection. By this means the rectilinear diagram of co-ordinates is very nearly secured without encountering the mechanical difficulty referred to. By employing an electrodynamometer of the Thomson watt-hour-meter type for the recording instrument, the apparatus may also be made to record the cyclic curve of varying power in an alternating-current circuit, in addition to the curves of cyclically varying pressure and current.

THE ELECTRIC RIGIDITY OF THE ATMOSPHERE.

By far the cheapest and best insulator for high pressures in transmission circuits is air. It costs nothing more than the land beneath. It insulates alike the high-pressure, long-distance systems with many kilovolts, and the telephone wires that throb to vocally responsive voltages of but a volt or two. Of course, air insulation means practically air-and-glass, or air-and-porcelain, insulation, and at the glass or porcelain usually lies the rub. The race for high voltages in recent years has set even the atmosphere at its wit's ends to insulate the wires. Up to forty kilovolts, the spark-leaking distance of which is but a few centimeters, the air gives no trouble at reasonable distances between the wires; but above that limit the air is apt to take alarm and to coruscate with a cylindrical halo or corona that is very expensive to the station manager. The halo of a saint is always assumed by artists to be wattless, but the halo of a high-pressure wire may absorb many watts per foot. Consequently, as sixty kilowatts is already the existing commercial limit of pressure and there is talk of raising this yet further in the not-far-distant future, it becomes necessary to reckon with the air god as well as with the controlling spirits of glass and glazed earthenware. According to our modern views of electrolysis, air insulates like pure water, because it is in a stable molecular condition. There are no atomic valencies to satisfy in ordinary air or water. All the atoms are satisfied. But a disrupted molecule or a chipped atom thirsts for satisfaction and is subject to forces in electrostatic fields.

There are, however, limits to the stability of molecules. Jostle air molecules violently enough and they break up, or ionize. At the same time ozone is produced. At ordinary temperatures, and in the absence of energetic radiations, air molecules are supposed to jostle about with velocities of kilometers per second, but their collisions do not break up more than a few molecules per billion per second. Add, however, an electrostatic field, and the stability under collision is reduced. Lower the atmospheric density, so as to lengthen the mean free path, and give the electric flux more room to act between collisions; also increase the temperature of the air, and its mean velocity of molecular swing and the stability may be overcome. The air ionizes rapidly when the critical limits are reached, and the indicate that the critical voltage of brush discharge descends with from the wires. The recently published researches of Prof. Ryan indicate that the critical voltages of brush discharge descends with the air pressure, so that on transmission lines passing over high mountains the voltages that may be carried are markedly less than that which the same construction would admit of at sea level. Moreover, the danger of brush discharge diminishes with the size of the conductor, a large wire permitting of a higher voltage. This fact favors aluminum wires. After all, at sea level, 100 kilovolts can apparently be carried with wires four feet apart, when the area of each of the wires is 40,000 circular mils. Since it is the top of the wave that counts, for producing halo, a flat-topped wave of voltage is less addicted to brush than a sine-wave or a peaked-wave, for the same effective voltage. On the other hand, the peaked-wave favors the reduction of hysteresis loss in transformers, while the sine-wave favors the elimination of resonant effects by harmonics.

The Question of Fire Risk.

The Institute discussion at the March meeting took a turn which most forcefully impresses the importance of precautions against fire. Modern electrical generators have been so far perfected as to make down-right breaking down of their functions extremely unusual. But it is not unusual for stations to be wholly or partly shut down by accidents, and fire is no unusual cause or concomitant of such occurrences. In fact, the fire risk, while enormously less than it was a few years ago, is still a consideration of much importance. It ought to be, and in fact is, no difficult matter to build a fire-proof station, but in practice fire-proof stations in any proper sense of the term are rare. As a rule, either the designing engineer is thinking of something else or somebody steps in with the blundering notion of making the station pretty and the result is a fire trap at some point. If there is any place in which the Socratic criterion of beauty should be rigidly applied, that place is an electric power station. But when it comes to fire-proof construction, somebody generally protests with serious results. Let us consider seriously the design for a station with especial reference to fire risks and see what safe construction implies. In the first place, the general shell of the plant is an easy task. Whether it be for a water power plant or a great steam-driven station, walls of stone, brick or concrete, with iron roof and floor beams, if there be more than one story, give a construction as safe from fire as anything yet devised by man. Next comes the serious question of floors. Wood which is commonly used implies a grave fire risk, particularly as it is certain sooner or later to become saturated with oil. Tile and concrete make good floors, but are not entirely free from fire risk when oil soaked.

Perhaps the best combination is as follows: For all floor not so situated as to be exposed to oil from the machinery, tile or concrete, and near and around the machinery, metal or glazed tile covered by removable grids of fire-proofed wood. It is a question to what extent fire-proofed wood can be advantageously used, but it is certainly safe enough if not used in large amounts, and there is no need of covering large areas with it. Starting with radical fire-proof construction of such sort, danger to the building as a whole is pretty well eliminated. But in station work continuity of service is of the first importance and precautions must be directed next at the apparatus so that fire shall not be able, even if in the form of an electric arc, to do damage of serious character. For convenience, we may divide the whole equipment into four parts—generators, transformers, leads and switchboard, each of which should be considered with reference to the prevention of fire risk. As to the generators, they are fairly safe except in the case of a prolonged short-circuit, and when internal damage occurs it is generally not very extensive. They are not likely to be injured seriously by external causes if the generator room floor is fairly non-combustible. In a modern large station there is often danger, more or less acute, of getting a short-circuit inside the protecting switches on the board and it is a good rule to get a safety switch cut in as near the generator as practicable. The use of revolving-field generators has greatly reduced the danger of disastrous short-circuits, and such machines form the most reliable part of the plant.

The transformers are far more exposed to danger of fire external and internal than are the generators. The discussion of Mr. Rice's excellent paper brought out the facts in the case very forcibly. The general consensus of opinion was that upon the whole oil transformers were decidedly less severe fire risk than air-blast transformers. The oil, as Mr. Townley in particular forcibly pointed out, is very far from being oil in the ordinary sense of the term. It is inflammable only with great difficulty and will put out an arc started in it under ordinary circumstances without the slightest danger of fire. It is practically merely a liquid insulator, upon the whole less inflammable and less seriously affected by heat than most solid insulators. Still it can be set on fire and then burns fiercely enough. The danger of giving off explosive vapors, to which frequent reference was made in the discussion, does not seem to us considerable owing to the very high boiling point of the oil and the density of the vapor, which makes it far from easy to get air enough for an explosion. For this reason the suggestion of oil tanks strong enough to stand [illegible]00 pounds per square inch internal pressure seems unnecessary, a relief valve in the top of a thin case appearing to us adequate protection. Provision for drainage of the oil in case of serious trouble seems highly desirable, and if the transformers be slightly raised above the floor, and the latter be sloped to drain outside the building into a sand pit no great harm can be done. It might not be a bad idea to put a plug of fusible metal in the base of the case to let out the oil into the scuppers before the flashing point could be reached, but with proper drainage the value of the oil in protecting the coils is so considerable as to make one think twice before letting it out so long as the case holds together. It makes no particular difference whether the transformers are in the generator room or a separate room, so long as oil from the transformers cannot run freely about.

Trouble with insulating the leads from the generator room to a separate transformer room must be taken into consideration. They may be, and in many stations are, a graver fire risk than the transformers themselves. They are usually of fairly high voltage and are very apt to be crowded together in a needless straining after compactness. We have a good deal of sympathy with Mr. Mershon's preference for bare conductors and his lament that our modern oil switches are so bulky to install. Oil switches are by far the best thing to use with even moderately high-voltage circuits, owing to their comparative safety in the matter of setting up surging, but they certainly are clumsy, as in fact any switch for very powerful circuits must be. In large sizes they add considerable difficulty to planning the switchboard, but they are necessary. They are, however, free from the danger of appalling leaps of the current such as are produced by air switches, and which in many plants render the switchboard by far the severest fire risk in the building. We have seen stations in which the switchboards were a constant peril both to life and to property. The commonest fault is a foolish effort at compactness, resulting in crowding the board with apparatus and incurring great risk of short-circuits or of arcs formed fierce enough to ruin the board and shut down the plant. The safest rule is to take plenty of space and to put the board where it is well lighted and fully accessible. The modern electrically or pneumatically-operated switches aid immensely in safe design, but full advantage should be taken of the facilities thus acquired for avoidance of crowding. A plant is as weak as its weakest point and a fire on the board may put it out of service for days. One of the most encouraging features of the papers and discussions under notice is the general unquestioning acceptance of these high voltages as an essential part of the modern programme, susceptible of proper engineering treatment, with a steady tendency towards improvement and the minimization of danger and damage.

A. I. E. E. International Electrical Congress Reception Committee.

The first meeting of the International Electrical Congress Reception Committee of the American Institute of Electrical Engineers was held at 12 West Thirty-first Street, N. Y., Thursday evening, March 24. A large representation of the committee was present; also Mr. George G. Ward, local honorary secretary of the Institution of Electrical Engineers, members of the board of directors, and members of the transportation committee, who had been invited to attend. Chairman Lieb proposed the following itinerary:

The foreign guests of the Institute are expected to arrive in New York previous to September 3, 1904. After that date the itinerary will be as follows:

Sunday, September 4, 1904, New York City.—This day will be spent in a steamer ride up the Hudson River, possibly as far as West Point.

Monday.—The visitors will be entertained by the corporations representing the electrical industries of New York City, including a visit to the power houses of the Rapid Transit Subway Company, the Manhattan Railway Company, the Metropolitan Street Railway Company, the New York Edison Company, the exchanges of the New York Telephone Company, and other points of engineering interest. In the evening there will be a formal reception to the foreign visitors under the auspices of the Institute.

Tuesday, Schenectady, N. Y.—The party will leave New York on Tuesday morning for Schenectady, where they will be received and entertained by the General Electric Company, leaving for Albany in the afternoon. P. M., Albany, N. Y.—Leave Albany in the evening for all-night trip to Montreal.

Wednesday and Thursday, Montreal, Canada.—Reception at McGill University, Montreal, and visits to the important power transmission plants in the vicinity, leaving Montreal Thursday evening by boat or train for Niagara Falls.

Friday, Niagara Falls, N. Y.—Visit to the Falls and the important power houses and electrical industries of the locality. Leave Niagara Falls Friday evening for Chicago, arriving Saturday morning.

Saturday, Chicago, Ill.—Visits to important power houses and local points of interest. Leave Chicago Saturday evening for St. Louis, traveling all night.

Sunday, September 11, St. Louis, Mo.—To be spent in St. Louis.

Monday.—Opening of the International Electrical Congress at 10 o'clock A.M., with joint sessions of all of the sections.

Wednesday.—Special joint session between the American Institute of Electrical Engineers and the British Institution of Electrical Engineers, to which all foreign guests are invited.

September 13, 14, 15 and 16.—Sessions of the various sections of the Congress, with sessions each day from 9 to 12 A.M., and from 1.30 to 4.30 P.M.

Saturday, September 17 (Afternoon).—Closing general sessions of all sections of the International Electrical Congress. (Night.)—Leave St. Louis for Pittsburg, arriving late Sunday afternoon.

Monday, September 19, Pittsburg, Pa.—Reception and entertainment by the Westinghouse Company, and visits to important and interesting local industries. Leave Pittsburg Monday night and arrive at Washington Tuesday morning.

Tuesday, Washington, D. C.—Inauguration of the National Bureau of Standards at Washington and visits to places of local interest.

Wednesday, Philadelphia, Pa.—Visits to important power houses and points of interest. Leave Philadelphia for Boston in the afternoon via boat—Fall River Line.

Thursday, Boston, Mass.—Visits to power houses Harvard University, Massachusetts Institute of Technology and places of local interest. Leave Boston Thursday night for New York by boat.

Friday.—Unassigned.

Saturday, September 24.—Return home by some of the party. Ladies are expected and special arrangements will be made to insure their comfort.

The details of the tour as suggested were thoroughly discussed, and while there was a feeling that it would be a severe tax upon the visitors, it was difficult to see how the trip could be curtailed without omitting some desirable and important features. It was voted that the committee be thanked for the programme as outlined, and that it be accepted with the recommendation that if possible, the chairman of the transportation committee should arrange that there be some plan adopted by which as many sleeping cars as might be necessary would be provided for the special train on the return trip; and that such persons as desired, have the privilege of alternative return routes on regular trains. In case this cannot be arranged, the plan to be adopted as presented.

The following executive committee was appointed: John W. Lieb, Jr., chairman; F. J. Sprague, vice-chairman; J. C. Barclay, J. J. Carty, F. W. Jones, H. Ward Leonard, E. H. Mullin, L. B. Stillwell, H. G. Stott, Calvert Townley, Geo. G. Ward, J. B. White. Local committees at the various points to be visited will be subsequently announced by the chairman.

Incandescent Lamp Combination.

Note was made in these columns last week of the meetings held by the incandescent lamp manufacturers in this city and Cleveland in regard to patents, prices, policy, etc. There is not a great deal to be added to what was then outlined. Under the guidance of Mr. F. S. Terry, of the National Lamp Company, the manufacturers remained in session at the Manhattan Hotel in this city until the end of the week, when important results were reached. Some thirty infringement suits under the Malignani, Howell and Edison patents had been brought against manufacturers, jobbers and others, and these may be regarded as amongst the moving causes for the combination, although there had of late been considerable discussion on the subject also from the standpoint of ruinous rate-cutting. Be the reasons what they may, the following lamp manufacturers have now taken out licenses dating from April 1, granted by the Edison Electric Light Company and the General Electric Company, and all suits against licensees or their representatives have been discontinued. The list of licensees is as follows: Downward Light Electric Company, New York; the Sterling Electrical Manufacturing Company, Warren, Ohio; the Brilliant Electric Company, Cleveland, Ohio; the Banner Electric Company, Warren, Ohio; the Franklin Electric Manufacturing Company, Hartford, Conn.; the United States Incandescent Lamp Company, St. Louis, Mo.; the Standard Electrical Manufacturing Company, Niles, Ohio; Capital Electric Company, Denver, Colo.; Gilmore Electric Company, Boston, Mass.; Liberty Electric Company, Pittsburg, Pa.; Warren Electric & Specialty Company, Warren, Ohio; the Colonial Electric Company, Ravenna, Ohio; Shelby Electric Company, Shelby, Ohio; Bryan-Marsh Company, Marlboro, Mass.; the Buckeye Electric Company, Cleveland, Ohio; Munder Electric Company, Springfield, Mass.; Sunbeam Incandescent Lamp Company, Chicago, Ill.; Columbia Incandescent Lamp Company, St. Louis, Mo.; Independent Incandescent Lamp Company, Cleveland, Ohio; New York & Ohio Company, Warren, Ohio; Fostoria Incandescent Lamp Company, Fostoria, Ohio; General Incandescent Lamp Company, Cleveland, Ohio; National Electric Lamp Company, Cleveland, Ohio.

It will be noted that the Sawyer-Man Electric Company is not in the combination and that company has already issued a statement to the public to that effect. Four other concerns are not included, although it is intimated that some of them may still come in. It is claimed that over 99 per cent. of the lamp production of the country is represented by the capacity of the "pool" licensees. The present annual consumption of lamps is put at 45,000,000. The total productive capacity of the existing factories is placed at about 65,000,000.

With regard to concerns not yet included the statement is made that all in the business on April 1 have the option to come in on taking out a license, agreeing to the scale of prices, and consenting to pay the royalty. No information is vouchsafed as to the royalty, but it is rumored to be a gross charge of ½ cent per lamp, and an actual ¼ cent net. There is also a report that all members of the combination as licensees agree to bind themselves to sell their product at a certain flat price—say 16 cents—and not below; and it is also reported that with this and territory as a basis a certain scale is to apply to central stations, jobbers, isolated plants, etc. The question is raised as to what would be the course adopted toward a new manufacturer coming into the field after April 1 and willing to be licensed, pay the royalty and maintain rates; or, on the other hand, one who would be willing to take out a license, but objected to maintaining the proposed schedule of prices. Extremists urge that an illegal condition "in restraint of trade" might easily arise under the operation of this new license and contract. Meantime the present manufacturers appear to be very well satisfied with the close of the rate war and the protection and immunity which their license affords them. It is understood that they may form an association among themselves for the cultivation of intimacy and closer intercourse.

Steam Turbine and Other Features of the Port Huron Light and Power Company's Station.

By James E. Davidson.

THE Port Huron Light & Power Company was one of the first central station companies to contract for a Curtis steam turbine, a 1,500-kw turbo-generator having been ordered in October, 1902, which has been in operation several months. On account of the interest in the steam turbine at the present time, a description of this company's installation may not be without interest. Before going into the details of the steam turbine outfit, however, a review will be made of the general conditions in the station in which it is installed.

Port Huron is a city of about 20,000 inhabitants, situated at the southern end of Lake Huron on the St. Clair River. It is generally known to the outside world as the "Tunnel City," on account of the great international tunnel of the Grand Trunk Railway from Port Huron on the American side to Sarnia, on the Canadian side of the river. Among other industries is a shipbuilding yard, employing about 500 men. The whole yard is operated by electric motors, some sixteen in number, with current supplied by the Port Huron Light & Power Company. A traction engine and farm machine factory, together with a malleable iron factory, and a saw factory, employing 600 men, operate their plants with three-phase induction motors, ranging from 7½ to 75 hp. There are a number of other important industries, including the locomotive and car building shops of the Grand Trunk Railway. Gratiot, Huronia, La Salle and Keewahdin Beaches are large summer resorts just beyond the city limits, where many Southern people make their homes during the summer months. This company furnishes light to about 100 cottages on these beaches. Then, too, Port Huron has a very fine railway system, having cars run from one end of the city, at which point is located the principal railroad depot, on the south, to the beaches above mentioned on the north, covering a territory of about seven miles in length. During the summer months ten-minute car service is given over this territory. This is also the northern terminal of the Rapid Railway system, which runs cars hourly from Detroit, Mich. These cars are interurban type with 300 hp in motors installed under them. The Port Huron Light & Power Company furnishes power to the city railway, which operates in the neighborhood of twelve to fifteen cars per day, and also furnishes power for the Rapid Railway system in the city and about one-half mile outside of the city limits. Taken altogether, the company is covering the light and power field very fully, as can be judged from the foregoing.

The light and power business in Port Huron was started by the Excelsior Electric Company in 1885. The old plant of this company was burned twice, as a result of which experience the present station is entirely fire-proof. In June, 1901, the company was reorganized under the name of the Port Huron Light & Power Company, at which time a thirty-year franchise was obtained from the city. The officers of the old and new companies, which have remained unchanged from the beginning are: Henry McMorran, president; Charles F. Harrington, vice-president, and W. F. Davidson, secretary and treasurer.

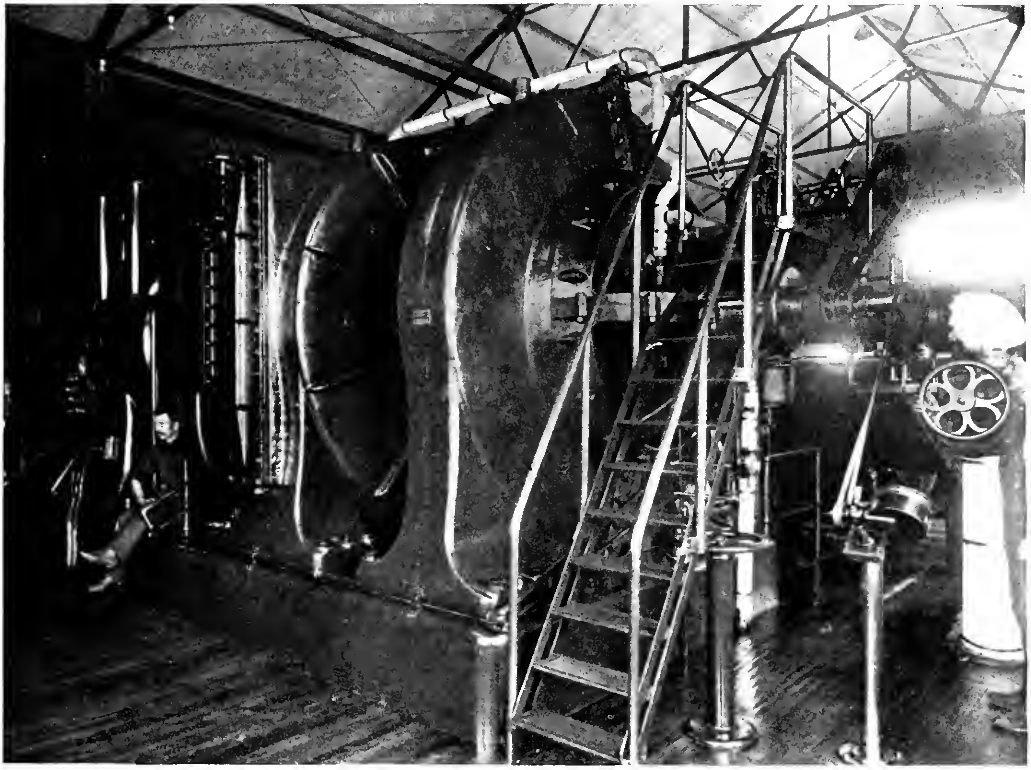


Fig. 1.—General View of Curtis Horizontal Turbine, Port Huron, Mich.

The property at the time of the reorganization consisted of a fireproof building 125 ft. x 138 ft., built about five years prior to this time. This building contains two compound condensing 500-hp engines, and one tandem compound condensing 1,200-hp engine; also three 500-hp and one 250-hp Stirling boilers, two Worthington feed pumps, one Cochrane heater and a Worthington jet injector. On the top of each of these boilers there are installed Crane automatic valves which close automatically in case the pressure changes in any of the different boilers. For example, if a tube is blown out, this boiler is immediately cut out from the others so there will be no interruption to the plant by other boilers losing their steam and water. The generating equipment is driven mainly by Hill's system of pulleys from line shafting, and consists partly of direct constant-current arc dynamos, partly of 500-volt railway and power generators, and partly of 60-cycle, 1,150-volt, three-phase generators. Since the 1,500-kw turbo-generator was installed, a series alternating-current arc system has been planned to do away entirely with the direct-current arc dynamos.

Direct current at 550 volts is sold for the operation of the street railway system and for commercial power within one mile radius of the plant. For factories situated some distance from the power house in a factory district called "South Park," power is transmitted at 10,000 volts, which is stepped down by transformers to 230 volts for

FIG. 2.—GENERAL VIEW OF PORT HURON PLANT.

the operation of three-phase induction motors. At different localities on the 10,000-volt transmission line are four brick transformer houses, in which the step-down transformers are installed as well as lightning arresters, and marble primary and secondary switchboards. The three-phase generators in the station are all wound for a voltage of 1,150, which is that of the primary distributing system of the general lighting and power business of the city. The lighting secondaries are 115-volt. For street lighting and commercial arc lighting, the 6.6-amp. series enclosed arc has been adopted.

To accommodate the new turbine unit, an entirely new portion of the plant adjoining the old plant was built. This is 40 x 80 ft., with a 9-ft. basement. The interior finish of this building is as follows: Maple hardwood floor, wainscotted with dark green terra vitra tile, and the rest of the side wall is finished with terra cotta pressed brick. All the machinery and iron work is painted deep blue green with vermilion and white trimmings. The machinery in the old building is also painted in the same manner. This addition is shown in the foreground in the general view of the plant, Fig. 2, and its position is shown on the plan, Fig. 3.

In adding to the plant, an ingenious plan has been worked out whereby the new turbo-generator outfit may operate both the old and new portion of the plant as long as the load is not too great. By this plan the turbo-generator operates certain three-phase generators as synchronous motors in the old plant, which motors, in turn, drive through a line shaft the necessary direct-current machinery to keep up the service. If necessary, in order to carry peak loads, or if the turbo-alternator is stopped, the engines in the old plant are started up so as to drive the line shaft and drive the synchronous motors as generators as well as the direct-current apparatus. The load can be thrown from either plant to the other without the slightest interruption to service.

The 1,500-kw turbo-generator consists of a Curtis turbine driving an alternating-current generator, the latter being a three-phase, 60-cycle, 1,150-volt machine. The unit runs at 720 r.p.m. An Alberger surface condenser guaranteed to maintain 28 in. of vacuum has been installed. This Curtis turbine unit, as can be seen from Fig. 1 and Figs. 4 to 6, is of the horizontal shaft type. The piping plant is shown in Fig. 8. Steam enters the turbine through an 8-in. pipe. The governing is accomplished at five ports, the number of ports opened depending on the load. Descriptions of the detailed construction of the Curtis turbine have appeared from time to time in these columns. There are two stages in this turbine, with four revolving discs in each stage. The bearings are sealed against air by a pocket of steam and carbon collars. To lubricate the machine, an oil pump is operated by a leather belt from a pulley on the turbine shaft between the generator and the second stage. The oil is pumped to the bearing through a 5/8-in. brass pipe and returned through a 1½-in. pipe. Before returning to the pump, the oil passes through a water cooler. This cooler consists simply of a water tank with a coil of copper pipe in it through which the oil circulates. There has not been the slightest trouble from heated bearings. The oil at the pump has a temperature of 120 to 130° F.

The turbine is equipped with a mechanical and also an electrical governor. The mechanical governor, which is the emergency governor, is set to operate a butterfly valve when the speed reaches 800 r.p.m., or 50 revolutions above normal, when the governor trips a weight which closes the butterfly valve. This emergency valve can also be operated by hand. The electric governor is the one used for the ordinary governing. The governor shaft of the electric governor is run by a 3-in. leather belt from the turbine shaft. The governor shaft runs about 200 r.p.m. and is equipped with the regular fly-ball governor. When the shaft is above normal speed, the sleeve of the fly-ball governor makes an electrical contact. When it is below speed, another electrical contact is made. Supposing that the turbine is above normal speed and the "high-speed contact" is made, a circuit is established through a magnetic clutch which connects the governor shaft with the port valves, and which runs the governor valves down so as to close some of the row of ports. When the speed is below normal, the "low-speed contact" on the governor operates another magnetic clutch, which causes the governor shaft to operate the valves to open the ports.

This arrangement is, of course, radically different from the balanced solenoid valves very recently used on large Curtis turbine units. The steam ports open into nozzles, and closing of steam ports effects the shutting off of nozzles. There is thus no throttling action, as a nozzle is either wide open or closed, hence there is no such loss of efficiency as would occur if the steam supplying a nozzle were to

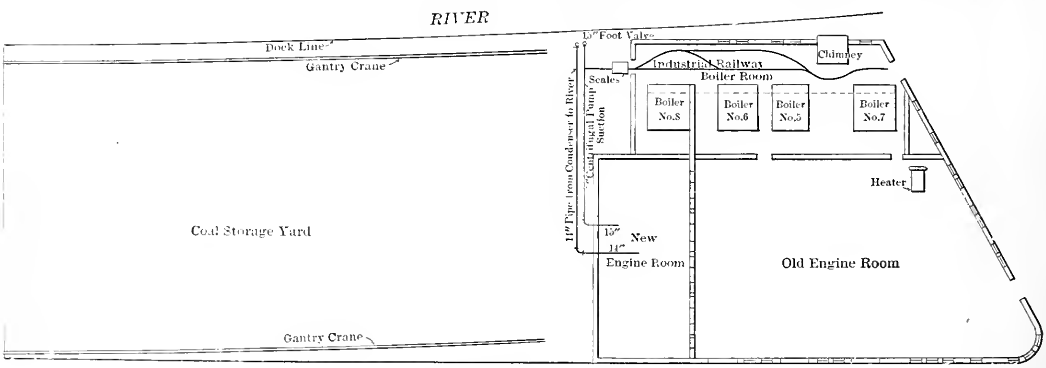


FIG. 3.—GENERAL PLAN OF BUILDINGS.

be throttled so as to lower its velocity at the nozzle. The regulation of speed with this governor with a street railway load varying from 150 to 500 kw, operated together with the other services given by the company, consisting of 500-volt power service, incandescent lighting and induction motors, is within 1.4 per cent. This excellent regulation holds its own during the heavy snow storms that they have had to contend with in their street railway work, and the turbine kept its regulation while the big interurban cars bucked heavy snowbanks, as well as the city line. At times the load would vary from zero to 1,500 amp., and the turbine would take care of this load without any perceptible change in speed. In the second stage of the turbine there are two sets of ports with governor valves instead of one set as in the first stage. The current for the operation of the governor magnets is taken from the exciter circuit.

As the high vacuum which it is considered expedient to maintain in connection with a steam turbine is a matter upon which some steam engineers have had doubts, it is interesting to note that with a load of 1,000 kw, and intake water at 72°, 28 in. of vacuum has been maintained continuously. With the same load and cooling water temperature at 58°, $28\frac{5}{8}$ in. of vacuum has been maintained with

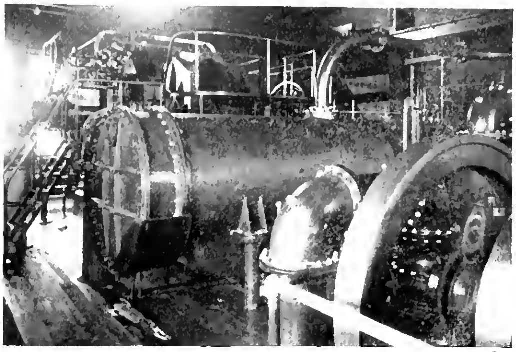


FIG. 6.—CONDENSER.

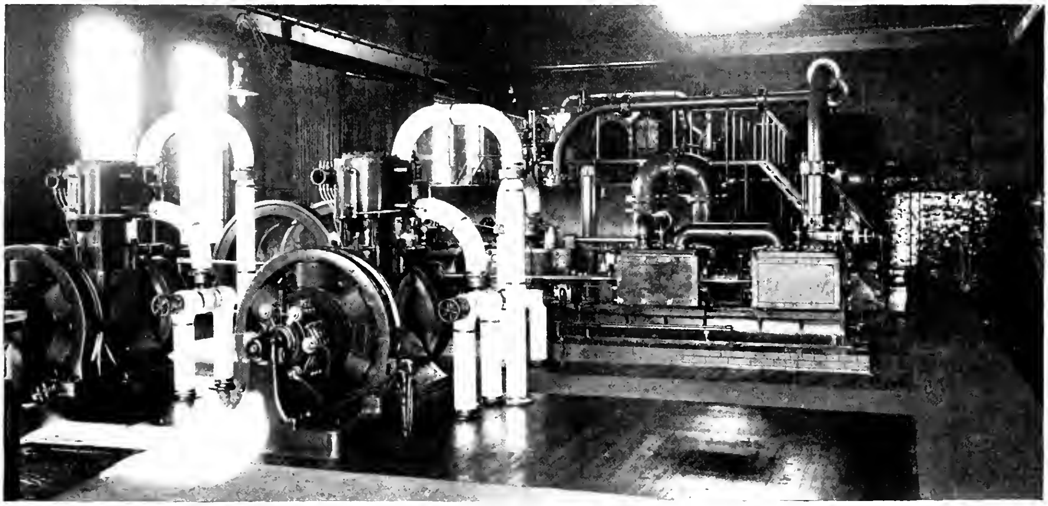


FIG. 4.—GENERAL VIEW OF ENGINE ROOM, SHOWING TURBINE WITH CONDENSER AT REAR AND EXCITERS.

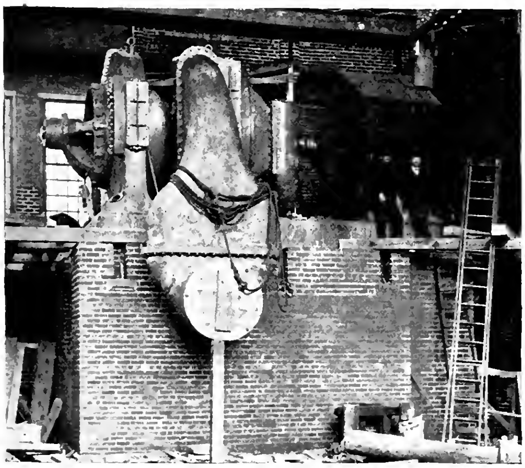


FIG. 5.—TURBINE UNIT IN PROCESS OF INSTALLATION.

the barometer reading $29\frac{3}{4}$ in. During the winter months the vacuum has been maintained with but very few exceptions above 29 in., and fluctuates only with the barometer. Readings within one-quarter to one-half inch of the United States Government barometer readings are obtained at all times. This, of course, is with the cooling water in the neighborhood of 40° F. By closing the valve between the condenser and the vacuum pump, a vacuum within $\frac{1}{4}$ in. of barometer pressure has been obtained. A vacuum of $28\frac{1}{2}$ in. has been recorded with the exhaust from both exciting engines going into the condenser, and the vacuum pump discharging into the condenser, and with the exhaust from the circulating pump engine going into the heater. A mercury tube and not a gauge was used in all these tests.

The Alberger surface condenser (shown in Figs. 3 and 5) with which the turbine unit is equipped is supplied by a 15-in. centrifugal pump made by the same company. This centrifugal pump is driven by a standard Westinghouse $8\frac{1}{2}$ x 8 engine direct-connected to the pump. The water is pumped from the hot well to the heater by a duplex pump. Circulating water is taken from a well open to the river. This well has cement walls 12 in. thick. The water is let in from the river through a 16-in. cast-iron pipe. The well is divided by a screen partition with $\frac{3}{8}$-in. mesh, the inflow from the river being on one side of the screen and the suction from the circulating pump on the other side. The circulating pump suction is a 16-in. cast-iron pipe. A 16-in. free exhaust to the atmosphere is provided so that the turbine can be run non-condensing. An automatic relief valve is provided in the turbine exhaust which automatically opens the exhaust when the vacuum is lost. The exhaust of the auxiliary engines can either be condensed or sent to the feed water heater. Condensed steam from the turbine is usd as far as it will go for feed water. The air cylinders of the vacuum pump are water jacketed. The jacket water is also run into the feed water supply, and furnishes sufficient extra feed water. The steam pressure carried on the turbine unit is 150 pounds. Standard extra heavy pipe is employed, with brass corrugated gaskets. A receiver 5 ft. long and 3 ft. in diameter, made by the Jenks Ship Building Company, which erected the piping, is placed just before the live steam pipe enters the turbine. The drip is taken from the bottom of this receiver. The steam from the boilers enters near its top and the pipe to the turbine leaves directly at the top. A Kiley standard trap is used on the receiver. Crane valves are used throughout except the throttle valve on the turbine, which is a Chapman gate valve. The six-inch air discharge on the vacuum pump is outside the building.

In the operation of the turbine there has been no trouble from the so-called end play after once setting the intermediate stationary vanes. A tachometer is located on the shaft near the throttle and is in operation all the time. Should anything happen to the governor, fair regulation can be obtained by pulling the switch to the governor and operating the valves by a hand wheel, using the indications of the tachometer as a guide. An iron platform with steps leading to it and with a brass guard rail around it, has been built so that the engineer can easily get at the governor, this being about the only part of the apparatus that needs attention, as the rest comes very near taking care of itself.

The steam pressure is reduced for the exciting engines and air pumps. The object of this is to make it possible, in cases of emergency, when the boiler pressure falls, to open a by-pass valve so as to increase the pressure on the exciter unit and keep the exciting current up to its normal value, even though the speed of the generator is decreased. The same thing can be done with the vacuum and circulating pumps so that the vacuum will not be reduced.

The expense for oil has been reduced over 50 per cent. by the running of the turbine as compared with the engines in spite of the fact that at all times three auxiliary engines are operated. As to long runs, two of the hardest months in the year, November and December, the turbine was operated almost 1,500 hours without stopping. It was then stopped to clean out the surface condenser.

Another advantage this company has noticed in its turbine over engines, and a point that has not been usually considered, is that the turbine will maintain its speed and run at one-half its capacity with steam pressure at the boilers as low as eighty pounds.

The exciter sets (seen in the foreground, Fig. 3) are two 30-kw. General Electric standard direct-connected, high-speed marine sets, giving 240 amp. at 125 volts. The engine is 11 in. x 8 in. and runs at 305 r.p.m. Either one of these is sufficient to excite all the alternators in the plant. A Tirrill regulator made by the General Electric Company, which regulates the generator voltage by interrupting the exciting current, maintains the voltage within a variation of 1/4 volt in spite of the fluctuating load on the turbine. The turbine speed can be reduced to about 33 per cent. without any decrease in the voltage, as the Tirrill regulator will increase the exciting current to take care of this decrease in speed.

The turbine is operated somewhat after the following manner in every-day work: Supposing the turbine to be at rest, the condensing apparatus and exciter are put in operation. The by-pass valve around the throttle valve on the turbine is opened enough to admit live steam for warming it up for a period of about twenty minutes. At the end of that time the machine turns over slowly and in five minutes more is brought up to speed. The steam seal for the bearings is next admitted.

In the old portion of the plant a Russell engine is driving a 300-kw, alternating-current generator and three 500-volt, direct-current generators. A Ball engine is driving a 550-kw railway generator. Both engines transmit their power first to a line shaft. A switchboard attendant puts in the synchronizing plug for synchronizing the 300-kw alternator with the 1,500-kw turbo-generator. The engineer is at the throttle of the Russell engine, and an oiler is at the clutch that connects this engine with the line shaft. A Lincoln synchronizer is used to indicate when synchronism is obtained between the two alternators, and they are then thrown together. After they are thrown together a clutch connecting the Russell engine with the line shaft is opened, so that the engine can be stopped. The line shaft runs through the driven pulley of this engine in a quill. The 300-kw alternator which was a moment before running as a generator is now running as a synchronous motor driving the line shaft. That portion of the shaft being run by the Ball engine is now connected by a clutch to that portion of the shaft which is being run by the 300-kw synchronous motor. The clutch on the Ball engine is then thrown out and the Ball engine stopped. The line shaft is then being driven by the 300-kw synchronous motor, which in turn is supplied with power from the 1,500-kw turbo-alternator. The line shaft is running the generators for 500-volt power service and street railway service.

In the afternoon, when the direct-current series arc service is to be started, a 100-kw synchronous motor is started with a compensator, and this drives two Brush arc machines. A second 300-kw alternator is started by throwing in a clutch connecting the section of shaft to which it is belted to the section of shafting being driven by the 300-kw synchronous motor. The second 300-kw machine, when up to speed, is thrown in parallel with the turbo-alternator and then becomes driven also as a synchronous motor and supplies power to drive five 50-light Thomson-Houston and one Brush arc machines. The two 300-kw alternating generators or motors are located at opposite ends of the line shaft, and when they are in operation most of the line shaft can be cut out on account of the position of the driven machines near the ends. Under these conditions of operation, of course the three-phase power circuits as well as the incandescent lighting circuits are taken from the 1,500-kw turbo-alternator. The power factor of the alternator is kept up by giving the synchronous motors a leading current by heavily exciting their fields. It is easy to determine when the adjustment of the synchronous motor fields is such as to bring the power factor of the turbo-alternator close to 100. The excitation of the fields is raised gradually, and as the power factor approaches 100, the ammeter indicates less and less until, when the power factor passes 100 the ammeter needle will again rise. In other words, the synchronous motor fields are adjusted at the point which will give the lowest indications on the ammeter of the turbo-alternator.

A 325-kw motor-generator set which has been in operation two months does away with the operation of considerable line shafting

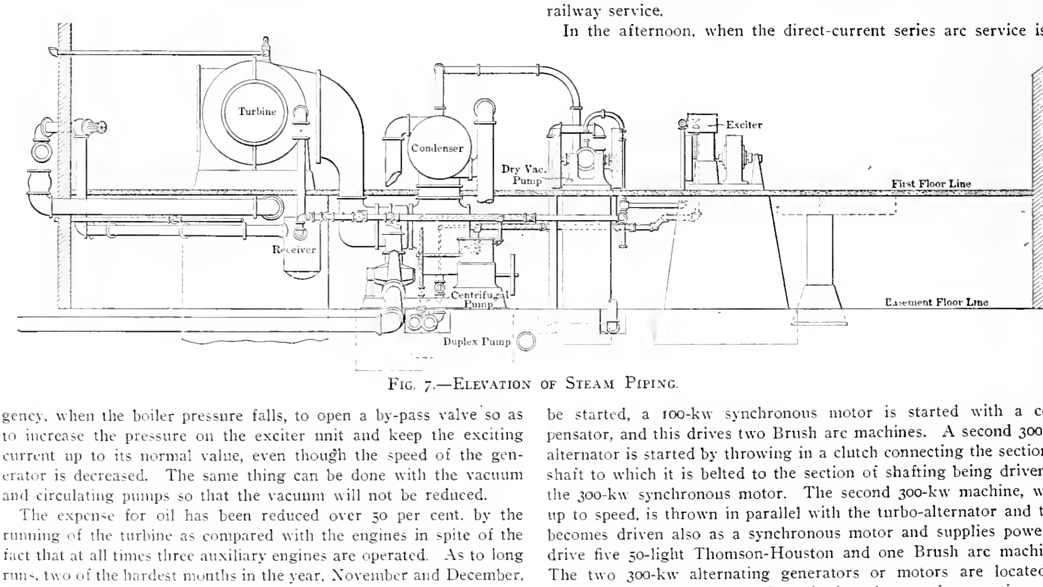


FIG. 7.—ELEVATION OF STEAM PIPING.

formerly used to drive 500-volt, direct-current generators. This consists of a 325-kw synchronous motor of 60 cycles driving a 550-volt, direct-current generator. By operating this set during most of the day, the line shaft can be entirely stopped, and by stopping the line shaft results have been obtained that have been astonishing; that is, in saving at the coal pile. The company never realized the power that it took to operate this line shaft.

The switchboard, Fig. 8, which is in the old portion of the plant, is mounted on an iron framework, which reaches the entire width of the building, and the floor of the switchboard gallery is on a level with the turbine room. Three sets of stairs lead to the switchboard gallery. The gallery floor is of maple. The posts on the platform are of oxidized copper, and the railing is of two-inch polished brass. The switchboard panels, twenty-one in number, are of marble. The board is 49 ft. 8 in. long with panels 90 in. high.

Beginning at the right, Fig. 8, are two direct-current, ten circuit arc panels. One of these is a positive board and the other a negative. At the left of these are two single-phase lighting circuit panels, 24 in. wide, with fuses, I. T. E. circuit-breakers and double-pole, single-throw, 300-amp., quick-break switches, controlling four circuits. The receptacles on these panels were for connecting different circuits to various machines when the generators in the station were single-

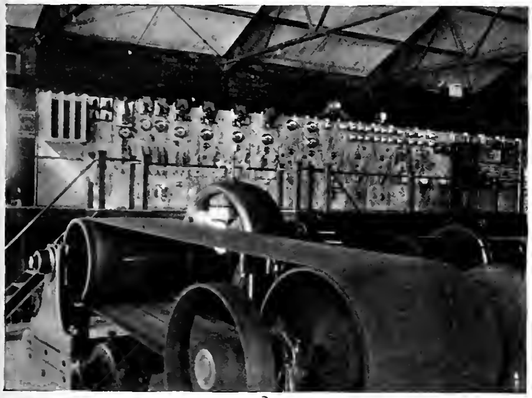


FIG. 8.—VIEW OF SWITCHBOARD.

phase and not operated in parallel. Now, all single-phase lighting is taken from one of the three phases, thus obviating the trouble from unbalancing the phases. It will be remembered that this company has a large induction motor load and that further a large per cent. of the capacity of the three-phase generator can be obtained from one of the phases.

The next panel is for controlling the secondary side of the step-up transformers. It contains one triple-pole switch and two polyphase recording wattmeters. One of these wattmeters records the energy on the high-tension transmission line to the South Park factory district, and the other measures that supplied to the 300-kw synchronous motor which drives the arc machines.

The next two panels (6th and 7th from the end) are generator panels for the 300-kw alternators, which are operated either as generators or motors. Each of these panels contains three 300-amp. horizontal edgewise ammeters, one voltmeter, 1,150-volt ground detector, synchronizing receptacle, synchronizing lamps, 200-amp., double-pole, double-throw exciter switch, and a 500-amp., 2,500-volt, three-pole, single-throw oil brake switch.

The eighth panel, which is for the 1,500-kw turbo-alternator, is 22 in. wide. On top are mounted a Lincoln synchronizer and synchronizing lamps. Mounted on the panel are three 1,500-amp. ammeters, two 1,500-kw indicating wattmeters, one 175-volt voltmeter, a synchronizing receptacle, a 200-amp., single-pole, single-throw exciter switch, one 2,500-volt, 1,200-amp., three-pole, automatic oil switch. On the sub-base is located a relay for operating the automatic device on the oil switch.

The next (9th) panel is to control the alternating-current side of the 325-kw motor-generator. It has upon it three 300-amp. ammeters, two 300-kw indicating wattmeters, one 175-volt voltmeter, a synchronizing receptacle, a 100-amp., single-throw, single-pole exciter switch, a 2,500-volt, 300-amp., three-pole automatic oil switch and one relay for the automatic oil switch. The compensators for both the 300-kw synchronous motor and 100-kw synchronous motor are located under the switchboard platform.

Next to this is the panel for operating the 100-kw synchronous motor. This has a 100-amp. ammeter, to show the primary current, one 35-amp. ammeter to show the exciting current, one 2,500-volt, 300-amp., three-pole automatic oil switch with relay. There are two panels for the exciter and each panel has an ammeter. On one is a voltmeter, which can be used on either machine with the aid of a voltmeter plug. Each exciter has two three-pole, single-throw switches. The other generator panels are for direct-current apparatus and contain the usual switches and instruments customary on 500-volt railway and power generator panels.

Recording wattmeters are placed on all outgoing light, power and railway circuits except the series arc circuits; the power supplied to the meters driving the series arc machines is measured, so that really the entire output is measured by recording wattmeters.

In connection with this plant there is a very complete system for unloading, conveying and storing coal. There is a Gantry crane operating on tracks running parallel with the dock front and spanning the coal yard.

The surface equipment for hauling coal from the coal storage to the boiler room consists of a system of industrial railway and charging cars, designed and constructed by the Russell Wheel & Foundry Company, of Detroit, Mich. The outdoor tracks are laid 18 ft. 6 in. between centers, covering the coal-storage space between the legs of the Gantry crane, and connect by means of curves and switches to a track leading to the boiler room. All cars must pass over a two-ton capacity track scale of special design.

The outer tracks, 20½ in. gauge, are made up of 16-pound rail, spiked to oak ties. The curves are of special design, 12 ft. radius to center of track, and made of cast steel. The tracks, curves and switches within the boiler room are of cast iron, cast in plates, and arranged so that the full charging cars may stand in front of the boilers and the empties may be passed around them.

The charging cars are of malleable iron and steel, of 1½ tons capacity. The running gears are so designed that the cars run around the curves of 12 ft. radius easily. The doors of the cars when lowered form an apron from which the coal is shoveled into the boilers. The ashes are removed, by means of a 12-cu. ft. tip car, to vacant property across the street.

The Gantry crane which operates on the track along the dock front is designed to unload coal from the holds of vessels and automatically convey it to a coal storage pile on the dock, the coal pile being 100 ft. wide by 250 ft. long and 20 ft. high. To accomplish this the crane spans the coal dock, running on tracks on the ground level, 110 ft. center to center, and the bottom chord of the bridge is 27 ft. clear of the dock level, giving ample clearance for a coal bucket over the coal pile.

The crane consists of a bridge with a moveable apron, a back pier that supports the end of the bridge away from the water, and a front pier carrying the hoisting and traveling mechanisms and the operator's house. Both piers are carried on wheels and a power-driven squaring shaft running across the bridge is connected by means of sprocket chains to the driving wheels on each pier.

The bridge and its hinged extension, the 35-ft. apron, carry a runway for a trolley, and supported from the trolley by means of the hoist rope is the hoist block to which is attached the coal bucket. On the front pier there is a platform upon which stands the operator's house, where controllers and levers are placed so that one operator can control all motion of hoisting, lowering, trolley traveling and bridge traveling. The hoisting and bridge traveling mechanism with its motor is also located in the operator's house. The trolley traveling mechanism with its motor is located on top of the pier, but its controller, as before stated, is below in the house. On the platform a scale is placed where the bucket can be landed so that each bucket of coal can be weighed before being stocked, if so desired. The operator's stand is so located that a clear view may be obtained of the vessel on the one hand and the stock pile on the other.

When the crane has been placed opposite a hatch from which coal is to be unloaded, the apron is lowered, giving a 35-ft. extension over the vessel's deck. The trolley carrying a clam shell bucket is run out over the hatch and the bucket is lowered into the coal. The attendant in the hold pulls the lever and gives the operator the signal. The hoist block rises, pulling on the closing chain until the bucket jaws close together. Then the hoist block lowers and rises again, carrying with it the closed clam shell and 2,000 pounds of coal. When the trolley is reached the operator throws in his trolley traveling mechanism, running the trolley with its load back along the bridge to the dumping point, where the bucket is opened as it passes under the dumping trigger, the coal falling to the stock pile below.

About 70 per cent. of the coal in the vessel can be removed with the clam shell bucket, but the remainder must be shoveled into the ordinary coal buckets. Three of these buckets are furnished with the machine, and are dumped by the same triggers that operate the clam shell.

In rehandling the coal from the stock pile to the cars that carry it to the boiler house, the crane is used in connection with a moveable bin. This bin stands on a track of wide gauge and has a capacity of 40 tons, being sufficient to supply the power house needs for twenty-four hours. The small coal cars run under it on a narrow-gauge track and are filled by opening a valve in the bottom. In the morning the bin is filled from the stock pile with the clam shell.

In unloading the vessels the motions of hoisting and trolley traveling occur every time a bucketful of coal is handled, while movements of the entire crane are necessary only when the crane moves from a hatch that it has just emptied to a full hatch. For this reason the machine has been given a hoisting speed of 100 ft. per minute, a trolley travel speed of 600 ft. per minute, and a crane travel of only 60 ft. per minute. These speeds will enable a skilful operator to handle the buckets at the rate of one trip per minute from the hold of the vessel to the stock pile and return, and while the clam shell is in operation, only one man should be necessary in the hold of the vessel. When hand shoveling is resorted to the machine will keep three buckets in continuous operation, two of which will always be in the hold of the vessel at the disposal of the shoveling gangs. On the machine itself one man controls all the motions of the crane.

The coal yard being 250 ft. long, it is not deemed advisable to rehandle the coal into a stationary bin, as this would make the operation a slow one, and as traveling the whole crane 250 ft. to deposit one ton of coal in the bin would be too much like sending an elephant to pick up a peanut, the movable bin has, therefore, been adopted. The first work in rehandling consists in clearing up that portion of the yard nearest the river, the clam shell being used and the crane making side travels of not to exceed 30 ft. with each load. After this the crane can remain in position with the movable bin under the end near the river, and all movements can be confined to trolley traveling and hoisting, the crane being moved only when a whole section of the yard has been cleaned up. One hour's work with one man in the operator's house and one man on the coal pile

It will be readily seen that it would be dangerous to attempt to run a crane of this span with tracks separated by a great coal pile and nothing provided to inspire perfect alignment unless there were some provisions for automatic adjustment. If the crane were rigidly constructed, 1½ in. misalignment of the tracks would bring the flanges of the wheels against the tracks and strain the structure. Furthermore, when the crane is moved along the tracks, if one end started a little ahead of the other owing to the slipping of a wheel or the necessary lost motion in the driving chains leading from the squaring shaft to the wheels, the crane structure would again become strained and the wheel flanges bound on the tracks.

To overcome these difficulties, the crane has been built in three separate pieces; the front pier, the back pier and the bridge. At the front pier the bridge is suspended in such a manner as to allow it a limited motion in a horizontal plane about a king pin. At the back pier the bridge is allowed universal motion, this pier simply supporting the load. This form of construction permits the crane to automatically adjust itself to any reasonable track variations, and one pier can, if necessary, travel 4 ft. in advance of the other before the wheel flanges will bind. The crane is designed and built by Whitehead & Kales Iron Works, of Detroit, Mich., and is unique in being flexibly constructed and yet having but two tracks. Fig. 9 shows the arrangement of wires leaving the station.

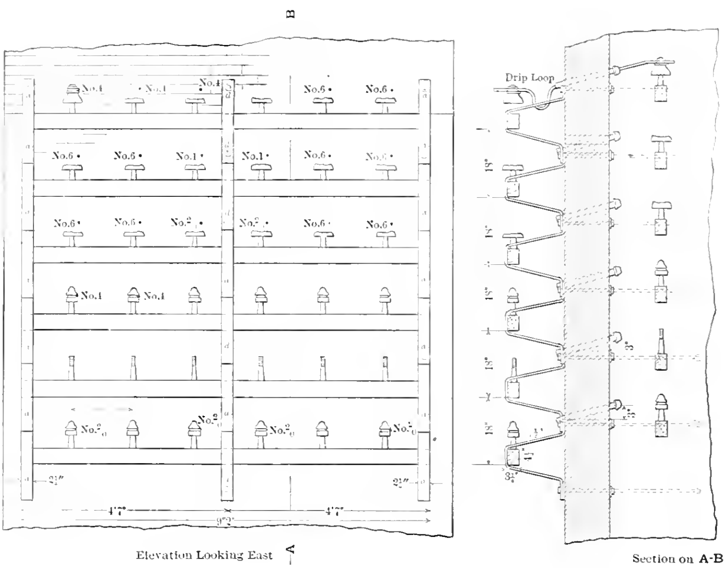


FIG. 9.—LINE DETAIL.

An Important Trolley System for New Jersey.

New Jersey is the center just now of a great deal of important work in trolley extension, some of which has apparently a bearing upon other plans. Articles of incorporation for the New Jersey Short Line Railroad Company were filed last week at Trenton and deserves attention. The object of the company is to extend the electric line of the Trenton & New Brunswick Railroad Company from their present terminus at Milltown to Elizabeth. The company is a plan of the Public Service Corporation to shorten the route from Philadelphia to Jersey City by fourteen miles. It is rumored at Trenton that the line is part of the Gould system of railroads, which is trying to get to New York. The capital stock of the company is $3,000,000. The route is to cross the Raritan River, near Weston's Mills, and to go to Metuchen and Rahway and Elizabeth, where the line will connect with the present line of the Public Service Corporation.

The entire length of the road is to be fifteen and five-tenths miles, and the road is to be built in Middlesex and Union Counties. The terminus at Eliabeth will be near the western boundary of the city. The company was incorporated under the Railroad Act of 1903. The incorporators and the amount of capital subscribed as set forth in the articles of incorporation are as follows: Richard I. D. Ashbridge, of East Bowington, Pa., $19,500; Thomas S. Phillips, of Philadelphia, $19,500; Thomas B. Courley, George H. B. Martin, John H. Switzer, of Camden; Abraham A. Moyer and Thomas Heller, of Philadelphia, $200 each. The company paid to the State $37,000 as an incorporation fee.

The immediate intention of the road is to form a continuous trolley line from Philadelphia to New York, and cut off the time now lost by going from this city to Bound Brook and Plainfield to get to Newark. This road will shorten the trolley distance fourteen miles. An agreement has already been entered into between the promoters of the new company and the Public Service Corporation by which the cars of the Public Service Corporation will use the road as soon as it is built. The trolley excursion fare from Trenton to Newark is to be $1.50, and the single fare 80 cents.

Ohio Electric Light Association.

This association will hold its next annual convention at Sandusky, Ohio, on August 16, 17 and 18 next.

Booster Calculations.

By WM. A. DEL MAR.

THE booster is a generator placed in series with a conductor for the purpose of neutralizing the drop of potential in the latter. The e.m.f. of the generator is made to act in opposition to the drop in the line so as to neutralize it partially or entirely, thereby causing the combination to act as a conductor of lower resistance. If the e.m.f. of the generator were exactly equal and opposite to the drop of potential in the conductor, the two would neutralize one another, and the combination would act as a perfect conductor. It is in railway work that the booster has found its principal application. The powerful currents required in this service cause the potential of

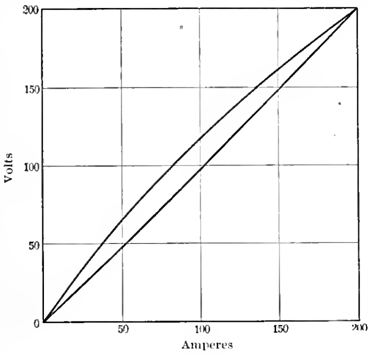


FIG. I.

feeders to fall very much at points distant from the generators. It may therefore occur that at some points the line voltage will be so low as to cause the lights to dim and the cars to run at less than their normal speed. This trouble might be remedied by the use of extra feeder cables, but it often occurs in practice that the cost of these is so enormous as to be quite prohibitive. It is in such cases that the booster finds it application. A small amount of cable and a booster will reduce the drop of potential as effectually as a system of cables that would cost perhaps several times as much.

The booster is probably most useful in reducing the potential drop

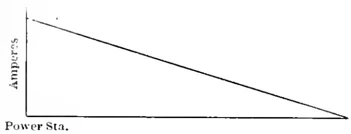


FIG. 2.

in grounded return feeders. Here a drop of potential that would not appreciably affect the operation of the car lights and motors, might be the cause of serious electrolytic damage to underground pipes and cable sheaths. This is a subject that is scarcely given the consideration it deserves, but it is gradually forcing the attention of railroad officials who have to decide whether it is better to install efficient return feeder systems or to run the chances of having to pay for the destruction of cable sheaths and pipes.

The booster is usually a series wound generator having a fairly straight characteristic, in order that its voltage may be approximately proportional to the load it carries. The characteristic of such a generator is shown in Fig. 1, with a straight line next to it for comparison. The deviation from the straight line is principally affected by the saturation of the magnetic circuit so that the smaller the allowable deviation the more expensive the generator. As, however, the curve is always above the straight line at partial loads, the booster will act better with partial than with the full load. Hence if calculations be made for the full load the booster will more than do its work at partial loads. For this reason all booster calculations should be made for full-load current. A booster may be either steam-driven if in a power station or motor-driven if in a sub-station. The method of connecting up a booster to a feeder system as well as other details, will be considered later.

In railway feeder work it is usual to assume the load to be uniformly distributed along the line, so that going towards the power station the current in the feeders gradually increases. The current flowing in the feeders to the bus-bars will thus be represented by a straight line diagram, as shown in Fig. 2. This occurs where all the feeders are connected together so as virtually to form one conductor. When, however, a booster cable is connected to the feeders

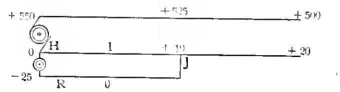


FIG. 3.

at a certain point, as shown in Fig. 3, the booster cable being insulated from the other feeders, except at that point, the current will take a course different from that shown in Fig. 2. In this case some of the current will be drawn from the line into the booster cables and the current diagram will take one of the forms shown in Fig. 4.

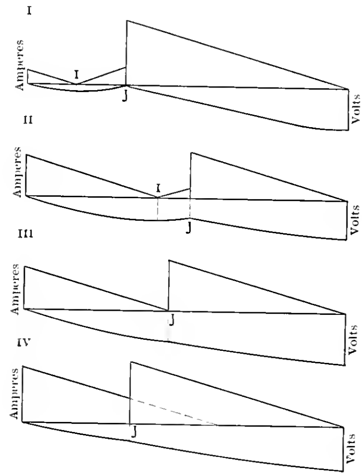


FIG. 4.

There are four typical cases to be considered, differing in the various possible distributions of current and potential Case I shows a booster which entirely neutralizes the drop in the booster cables and reduces the point of connection, J, to the same potential as the bus-bar. In this case current is drawn into the booster cables from both sides of the point of connection, the current dividing at a point I from which the resistance to the bus equals the resistance to the point J. In Case II, the booster only partially neutralizes the drop in its cables, but nevertheless draws current from both sides of the point of connection. Case III shows a booster drawing current only from beyond the point of connection, the whole of the current on the other side returning to the bus by the line feeders. In Case IV, the booster only draws part of the current from beyond the point of connection, the remainder returning to the bus through the line feeders with the current from between the station and that point.

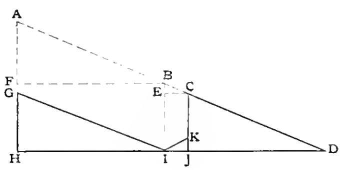


FIG. 5.

These four cases are represented with their respective curves of current and drop in Fig. 3. A fifth case might be added to these, which placed in its proper position should precede Case I. It is only useful when the permissible drop is extremely small. In this case the point of connection, I, is maintained at a lower potential than the negative bus itself.

The first two cases resemble one another in their current diagrams, and may, to a certain extent, be considered together. The distribution of current in the feeder system, *H I J D* (Fig. 5), is given by *G I K C D*. The current with no booster is indicated by the broken line, *A B C D*. When, however, a booster cable is connected at *I*, it will, in the case under consideration, take all of the current from beyond it and some of the current from between it and the power station. How to determine the position of the point *I* where the current divides will be seen later. It suffices to say here that *I* and *J* being known, the current "curve" may be drawn by making $IJK = CEB$ and $IHG = BFA$. A curve of drop for Case II is shown

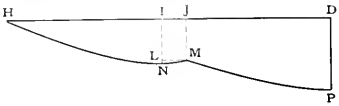


FIG. 6.

in Fig. 6, in which the letters *H I J D* refer to the same points as in Fig. 5. In this diagram the drop *I N* is due to the current *H G I*; *L N* to the current *I J K*; *M P* to the current *D J C*, and *J M* to the current in the booster cable. The drop *M P* is given for every

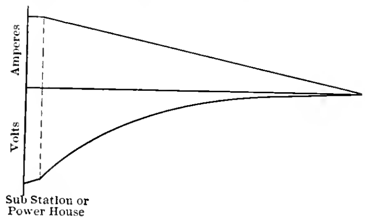


FIG. 7.

point *J*, in Fig. 7. The method of obtaining this curve is indicated in Fig. 8, in which the drop curve without booster is given by the curve *R*, and the ordinates, *R S*, are the same as the ordinates of the volt curve in Fig. 7. The drop *H N* is given in Fig. *I*; currents originating at various points, I_1, I_2, I_3, etc., and increasing the same number of amperes per foot, are assumed, and the drop from *H* to

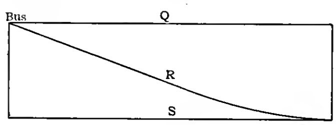


FIG. 8.

I_1, I_2, I_3, etc., are calculated and plotted as the ordinates of the curve. Thus the ordinate $I_4\ T_4$ is the drop between *H* and I_4, with a current "curve" $I_4\ G_4$.

A simple way to obtain the curve shown in Fig. 9 is worthy of notice.

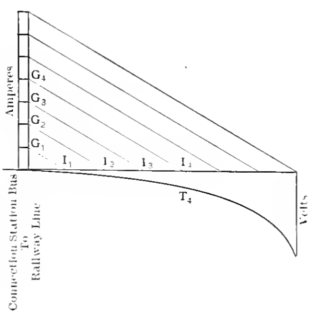


FIG. 9.

Fig. 10 gives two curves of potential drop produced respectively by currents originating at *D* and *S*. It should be observed that the difference between the two currents, which is indicated by *U V*, is equal to *H T*, and that *H U* is equal to *T V*. The drop, $S V_2$, may be regarded as the sum of the drops produced by the tapering current *T V*, and the uniform current *H T*. Now $HU = TV$, and SV_1 is the drop produced by *H U*, so that $SV_2 = SV_1 + HT \times$ (resistance of *H S*) or $SV_1 = SV_2 - HT$ (resistance of *H S*).

When the curves of Figs. 7 and 9 are plotted for the line in question, it will be easy to make the calculations for a booster to give any desired drop of potential. As stated above, these curves should be constructed for the maximum current that will last for any appreciable length of time, and liberal provision should be made for an increase of load.

It is necessary to establish a formula which will give the voltage required for the booster. In any closed circuit the sum of the differences of potential taken around the whole circuit is zero. Hence, referring to Fig. 3, consider the variations of potential around the closed circuit *R J I H*, taking the drop towards the bus as positive and away from it as negative, so that if the booster voltage be represented by *V*, the following equation is obtained:

Drop in IH + drop in RJ — drop in $IJ - V = O$.

From this it follows that—

V = drop in RJ + drop in IH — drop in IJ.

The drops in *IH* and *IJ* are given respectively in Fig. 6, as *IN* and *LN*, so that the above formula may be written, V = drop in booster cables $+ IN - LN$. Now, in Fig. 6, $JM = DP - MP$ and $LN = IN - JM$, so that $LN = IN - DP + MP$, and, therefore, V = drop in booster cables $+ DP - MP$. From the two last formulas

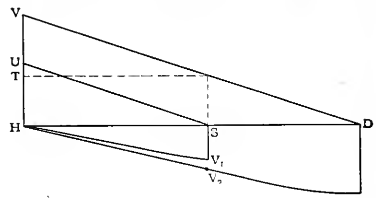


FIG. 10.

two important conclusions may be drawn, namely, that the points *I* and *J* must be so related that $LN = IN + MP - DP$, and that in order to get a total drop of *DP* with the booster cables connected at *J*, the booster voltage must be equal to the sum of the drop in the booster cables and the total drop *DP* in the line feeders, less the drop *MP*.

Referring to Figs. 6 and 9, it should be observed that if a certain drop *DP* be required, the point *I* cannot be farther away from the bus than the point in Fig. 9, having the ordinate equal to *DP*, and the

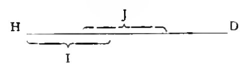


FIG. 11.

most distant location for the point *J* is midway (along the resistance —not along the length) between *I* and *D* when *I* is at its most distant position. Referring now to Figs. 6 and 7, it will be observed that *J* cannot be nearer to the bus than the point in Fig. 7, having the ordinate equal to *DP*. As *I* can be as near to the station as is desired, the possible positions of the points *I* and *J* are limited, as indicated in Fig. 11.

It is now necessary to find the most economical point *I* and its corresponding point *J* by trial. In order to find the point *J* for any point *I*, a table should be constructed on the plan given below:

1	2	3	4	5	6
Length *H J* feet.	Volts *L N* =IN (MP-DP)	Length *I J* feet	Amperes *J K*	Resistance *I J* ohms	Drop in *I J* = ½ *J K* x resist of *I J*

Different values of *H J* are chosen between the limits given in Fig.

11, and $I\,J$ being known, column 2 can be constructed. The current $J\,K$ (column 4) is the product of the amperes per foot, and the length $I\,J$ in feet. The correct value of HJ is that which causes the quantities in columns 2 and 6 to be equal. A number of points I should be tried, and their corresponding points J found according to the above directions. It is obviously wrong to choose $H\,J$ so that $IN < (MP - OP)$ as IN must have the same algebraic sign as MP and DP, and DP cannot be less than MP. Hence it is useless to assume $HJ < HI$. This narrows the limits between which to try HJ, so that very often the correct point J for a given point I will be found after three or four trials.

For any particular value of I, the cost of the booster installation is calculated in the following way. Knowing the points I and J, the currents $J\,C$ and $J\,K$ (Fig. 5) are known. The current carried by the booster cables is the sum of these. The size of cable and their number are determined by the current they carry so that their resistance and the drop in them can be calculated. The voltage of the booster is given by the formula $V =$ drop in booster cables $+ DP - MP$ (Fig. 6). From the current and voltage the kilowatts of the booster may be obtained. The cost of boosters is taken at a certain number of dollars (say, $75) per kilowatt, and the cost of the switchboard panel and wiring (say, $500 to $1,500) added to this.

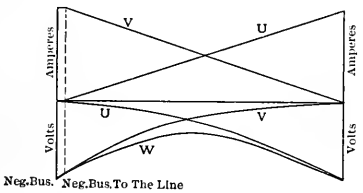


FIG. 12.

The value thus obtained added to the cost of the cable, including installation, gives the total cost of the booster system.

It is now necessary to return to some general considerations of the four cases illustrated in Fig. 4. The third case will be considered first as it is the simplest. In this case there are two completed drop curves, each of which becomes horizontal where the current is zero. Each of these curves may be derived from those given in Figs. 7 and 9. The drop from the bus to J is given by Fig. 9, and that from J to the end of the line by Fig. 7. The total drop from the bus to the end of the line, whatever the position of J may be, is the sum of the ordinates of these two curves. Fig. 12 gives the curves of Figs. 7 and 9, and one obtained by adding their ordinates. This curve W shows that Case III is not always applicable, as it fails for drops less than the minimum ordinate. For any drop greater than this minimum, there are two possible positions for the point J. An example of this is shown in Fig. 13, where the broken lines represent one case

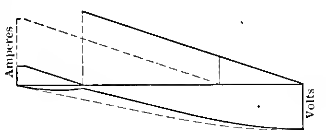


FIG. 13.

and the full lines another, each giving the same drop of potential. In Case IV, for a given position of J, the drop is greater than in Case III, because the current on the line is greater. Hence a smaller drop than is shown by the curve W (Fig. 12) is not attainable by this case.

It is now convenient to consider Case II in connection with the curve W. For a given position of J, the total drop will be a maximum when J and I are coincident, so that Case III is the limiting condition of Case II. Hence the total drop cannot exceed the ordinates of the curve W. Referring to Fig. 14, it will be seen that in order to get any given drop HQ, the point J must be chosen to the right of where QE intersects the curve V, for otherwise the drop to the end will be greater than HQ. This combined with the condition that the point J cannot be where the line QE is below the curve W, shows that J must be between A and B, or between C and E. If J be chosen in AB, the booster will have to carry a very large current, but must generate but a small voltage. This is not a practical machine, so that J will generally be in CE. When HQ is less than the minimum of the W curve, the possible positions of the point of connection, J, lie between A and E. Furthermore, the point I cannot be to the right of where QE intersects the curve U, or the drop between J and the power station will be greater than HQ. These considerations should serve to simplify the calculations by reducing the number of trials for the correct positions of I and J.

From these considerations it appears that if the desired drop be

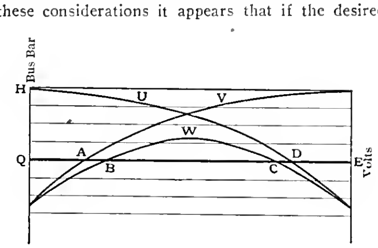


FIG. 14.

below a certain amount, Cases III and IV may be left out of consideration, and that the best way by Cases I and II must be found by trial. There are two ways of getting a given drop by Case I. One is to get the maximum permissible drop between H and J, and the other to get it between J and D.

When the cost for a number of positions of I has been calculated in the way described, a curve like that shown in Fig. 15 may be plotted, in which the total cost of the system for different positions of I or J is given. The point where the curve reaches a minimum indicates the most economical booster scheme that will give the required drop.

The apparatus required for a "negative booster" panel is shown

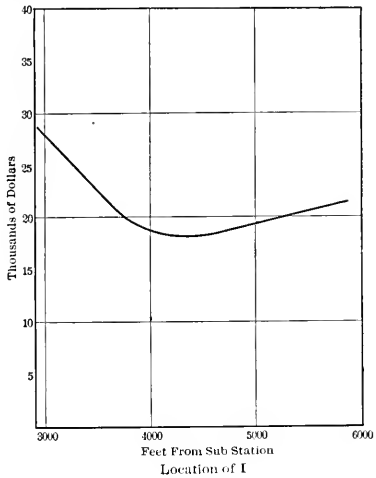


FIG. 15.

in the diagram, Fig. 16, where the booster is represented as a series dynamo driven by a three-phase induction motor. In series with this generator are a circuit breaker and switch. This switch has a single pole, but double throw, so that at times of light load the booster cables may be connected directly to the bus without requiring the use of the booster itself. In the case of a booster for the positive or non-grounded feeders, a single-pole single-throw switch is required between the bus and booster.

The following guarantees should be required of a booster. After a run of twenty-four hours at full rated amperes and volts, the temperature of no part of the machine should exceed 40 degs. C. by thermometer, above the surrounding air, provided this latter is not over 25 degs. C. The booster must also be capable of giving 25 per cent overload in amperes or 50 per cent overload in kilowatts for one-half hour, and must be able to stand a momentary overload of 100 per cent in kilowatts. The voltage regulation depends on the amount of iron in the field magnets, so that the best regulation is only attainable in expensive machines. The actual voltage at any load should not differ from the voltage given by the straight line characteristic (Fig. 1), by more than 20 per cent.

In order to calculate the current that will flow through the booster cables when there is no booster, one may proceed in the following way: Let I be the total current taken by the section of line under consideration; i, the current in the booster cables; R, the resistance

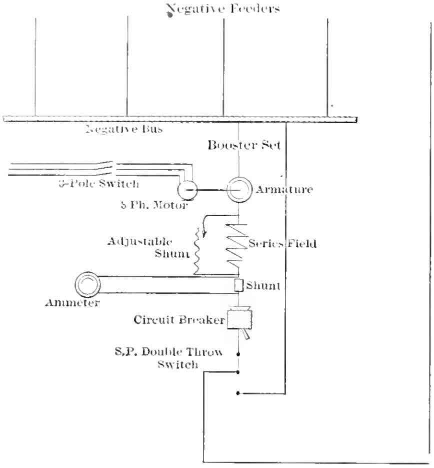


FIG. 16.

of the feeders between H and J; and r the resistance of the booster cables. Then the drop in the feeders between H and J is $R \times \frac{1}{2} (I - i)$, and the drop in the booster cables between the same points is $r - i$. These two must be equal, so that

$$ri = \tfrac{1}{2} R (I - i)$$

$$\therefore i = \frac{RI}{2r \times R}$$

This is an important calculation, as it enables the influence of the booster cables on the drop to be calculated.

In any feeder system whether or not boosters are employed, the value of the energy lost is an important item. The power lost in the line is equal to the product of the amperes per foot, and the area of

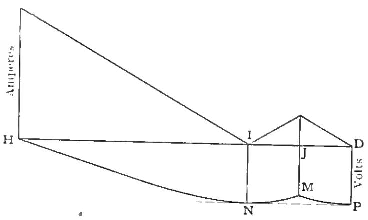


FIG. 17.—PARTICULAR CONDITION IN CASE II, THAT IS OFTEN THE MOST ECONOMICAL, NAMELY, WHEN IN = DP.

the drop curve expressed in volt feet, so that the number of watts lost in either the positive or negative system can be easily computed with the aid of a planimeter. When, however, there is a booster, the watts lost in the booster cables must be added. This may be calculated for full load and the kilowatt-hours per day obtained on this basis. In order to get the true kilowatt-hours per day this should be multiplied by the load factor. This latter quantity is obtained in the following way. As the power lost in a conductor is proportional to the square of the current in it, if the current be variable, the mean power lost will be proportional to the mean of the squares of the currents. The load factor mentioned above is the ratio of the mean of the currents squared to the maximum current squared. The mean of the currents squared may be found by squaring the ordinates of a load diagram and taking their mean.

In comparing the costs of feeder and booster systems, the value of the energy lost per annum may be capitalized and added to the initial expenditure.

When a line is supplied with current from two power houses or sub-stations, the feeder systems from these two must have about equal resistance, or one of the stations will "pull" a greater load than the

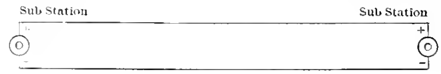


FIG. 18.

other. Hence putting a booster in one station will cause that station to carry a greater load unless the other be similarly equipped. This will not occur if the positive feeders are broken at the central point, as shown in Fig. 18. Hence there may be the choice of two booster sets against one booster set, and the cable, etc., for the break. Other problems are likely to arise in connection with booster calculations, but the foregoing considerations should be sufficient for most purposes.

High Tension Discussion in Chicago.

The Chicago branch of the American Institute of Electrical Engineers held a meeting on March 29 to discuss the general subject of high-tension work inside the station, high-tension being defined by the chairman, P. Junkersfeld, to be 5,000 volts and over.

The Institute paper of Mr. E. W. Rice, Jr., on the relative fire risk of oil and air-blast transformers was abstracted by James Lyman.

W. A. Blanck thought 30,000 volts was the upper limit of air-cooled transformers, and the lower limit for water-cooled oil transformers. Mr. Junkersfeld mentioned the awkwardness of making the connections in an oil-cooled transformer of 5,000 to 12,000 volts and large amperage. He also stated that the air-blast type is usually the cheapest, the difference depending on the temperature rise allowed. Mr. Thomas had an insulated water and oil system frozen up last winter. Mr. D. W. Roper mentioned an oil fire caused by the heat from hysteresis. Mr. G. H. Lukes thought the air diaphragm as a fire preventive both good and inexpensive. He suggested a tank of carbon dioxide on top, to smother the blaze by injection into the air duct.

The paper on the use of group switches in large plants by Mr. L. B. Stillwell was presented by Mr. F. Woodmansee. It being impracticable to discuss this in the abstract, concrete examples were suggested by various members, with the conclusion that local operating conditions entirely determine the question of installing such switches. The operation of these group switches with feeder switches under various combinations of time limits was brought up, and Mr. W. G. Carlton stated that a ground or short-circuit would shut down everything on that bus-bar before the time limit would operate if such device were used.

Oil switches for high voltages were introduced by an abstract of Mr. E. M. Hewlett's paper, and provoked a free discussion of the form of cover best adapted for oil switch boxes. Mr. Junkersfeld advocated an iron lid containing a glass panel, to reveal what the condition of the switch is after opening the switch on a short-circuit. A defective switch, if not detected before closing under such circumstances, would cause a much more serious shut-down. Mr. Sessions considered the glass unnecessary, and would so mount the iron door as to allow two inches free air space under its edges, providing the iron door with a counterweight and trip, so that it could be quickly opened.

Long Telephone Circuit.

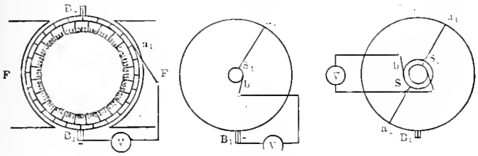
The New York Central Railroad system will soon own what it is claimed will be the longest private telephone direct wire in the world. It will be a No. 8 copper wire along the tracks of the Central all the way to Chicago. It will touch every important city on the lines of the system, and will, therefore, extend a distance exceeding 1,000 miles. West of Buffalo the wire will follow the tracks of the Lake Shore Railroad, and east of that city it will run along the New York Central tracks, coming into Weehawken along the West Shore line. The wire will cross the river in cable and will end in the Grand Central Station.

Synchronous Converters.

BY F. G. BAUM.

IT would be presumptuous for the writer to try to improve on the very excellent theory of the synchronous converter given by Mr. C. P. Steinmetz, in his book, "Elements of Electrical Engineering." However, I find that students and engineers have considerable difficulty in understanding his theory without some explanations, and I have found that the following way of approaching the subject gives good results.

If we rotate a continuous-current armature (Fig. 1.) so that we get a difference of potential between the brushes, and then connect a voltmeter to one brush and move the other terminal connected to the voltmeter around the commutator so as to get the potential of



FIGS. 1, 3 AND 4.—SINGLE-PHASE CONVERTER.

the commutator bars as they pass different parts of the field, we obtain a curve like that shown by the full line in Fig. 2.

Instead of drawing the commutator bars and winding as in Fig. 1, we shall represent the winding by the circular line as in Fig. 3.

If we connect one point of the armature winding a_1, Fig. 3, to a slide ring and connect an instrument, V, such as the oscillograph, which will measure instantaneous values of potential between the slide rings and one brush, it is evident that the curve traced will be the same as that shown in Fig. 2. That is, the potential of the slide

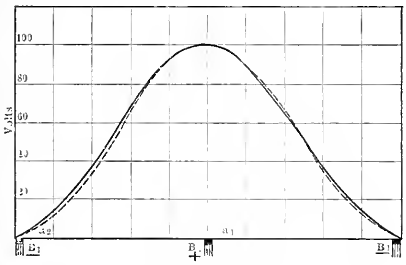


FIG. 2.—DISTRIBUTION OF POTENTIAL AROUND COMMUTATOR.

ring, counting the potential of the negative brush as zero, is measured by the ordinates in Fig. 2.

Suppose now we connect a second point, diametrically opposite to the first, to a second slide ring, S_2, Fig. 4, and connect our instruments for measuring the instantaneous potential between the two slide rings as shown. It is evident now that the difference in potential between the slide rings is the same as the difference in potential between the points a_1 and a_2, Fig. 2. But the difference in potential between a_1 and a_2 may be obtained from the curve by subtracting ordinate a_2 from a_1. In the position shown a_1 is at a higher potential than a_2. An instant before the position shown a_1 was under brush B_2, and a_2 was under brush B_1, in which position there was maximum voltage between the slide rings. This maximum voltage is, of course, equal to the potential between the brushes of the direct-current machine. As rotation goes on a_1 decreases in potential and a_2 increases, until the points are opposite the center of the pole faces, when the difference in potential becomes zero. Then a_2 increases, and a_1 decreases, until a_2 is under B_2 and a_1 under B_1, when we again have maximum voltage but the reverse of before. That is, for each revolution of the armature the potential difference between the slide rings passes through a cycle as shown in Fig. 5.

We, therefore, obtain an alternating e.m.f wave from a direct-current machine, by connecting two diametrically opposite points to two slide rings. (In a two-pole machine we connect diametrically opposite points to the slide rings; in a multipolar machine we must connect one point opposite each N pole to one ring and one point opposite each S pole to the other) to two slide rings.

We may supply direct-current to such a machine driving it as a direct-current motor, and take off alternating-current. Or we may supply alternating-current driving it as an alternating-current motor and take off direct-current. Such a machine is called a rotary converter, and is most generally used for converting from alternating to direct current. We may also drive the machine mechanically and take off alternating and direct current simultaneously.

FREQUENCY OF ALTERNATING CURRENT.

It is evident from the above explanation that the frequency of the alternating potential in a two-pole machine is equal to the revolutions per second of the armature. For an alternating current having frequency of 60 cycles the armature would have to make 60 revolutions per second, or 3,600 r.p.m. This speed is too high even for small machines, and therefore rotary converters are made multipolar. Even then it is a difficult matter to build rotary converters of large capacity

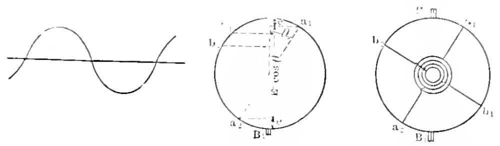


FIG. 5.—SINE WAVE OF PRESSURE. FIGS. 6 AND 7.—TWO-PHASE CONVERTER.

for as high a frequency as 60 cycles. For, as we increase the number of poles to reduce the speed, the diameter of the commutator must be increased to keep the voltage between the commutator bars within safe limits. This is a difficult matter, and, except for small capacities, rotary converters are generally not recommended for a greater frequency than 30 or 40.

If, instead of bringing taps from a_1, a_2, Fig. 4, to the collector rings, it were possible to rotate the alternating-current brushes directly on the commutator we could obtain an e.m.f of any frequency from any direct-current machine, no matter what its speed, by merely revolving the brushes at the frequency desired. To carry this out practically would mean building a commutator outside the bearing of the machine and then rotate the brushes by a small synchronous motor. It is very probable that the difficulties are insurmountable in a practical way, especially the sparking which would occur at the brushes.

WAVE FORM AND RATIO OF CONVERSION.

It is generally considered best, for general purposes, that the curve shown in Fig. 5 should be a sine wave. Now, what is the necessary condition that we get a sign wave of e.m.f. from the converter?

The maximum e.m.f. obtained is when a_1 and a_2 are directly under the direct-current brushes. Suppose the diameter of the circle in Fig. 6 represents this maximum potential, E. Then when the armature has rotated through the angle, Θ, the potential between the slide rings should be $E \cos \Theta$, which is represented by the projection of $a_1 a_2$ on the vertical diameter. This means that the potential difference between brush B_1 and a_2 must be represented by the projection of the arc of the circle from B_1 up to a_2 on the vertical diameter, and represented by e. Similarly, the potential between B_2 and a_1 must be e. This means, further, that the potential between any two points of the armature $b_1 b_2$ is represented by the projection of the length of the arc on the vertical diameter. The equation of the curve in Fig. 2 is

$$\text{ordinate} = \frac{E + E \cos \Theta}{2},$$

Θ being measured from the brush B_2 as shown.

In Fig. 2 the heavy line represents the curve obtained in an ordinary direct-current machine not built for converter work. The dotted line shows the curve as it should be to give a true sine wave. As we see, the curves differ very little, and it is generally found that any armature completely overwound gives a close approximation to a sine wave, with the ordinary design of pole pieces. However we find occasionally machines with distorted waves, and it is difficult to operate these as synchronous converters, owing to "hunting," caused by a difference in wave between generator and converter.

With two diametrically opposite points we obtain practically a sine wave from any direct-current machine; but it is easy to see that if we connect two points very near together to two slide rings we will not obtain a sine wave, unless the potential of distribution around the commutator is as shown by the dotted line in Fig. 2. With two points very close together we would obtain from an ordinary direct-current machine the curve of magnetic distribution, since owing to the small and equal air gap the angularity of the coil may be neglected. We will therefore not get the same e.m.f. curve from a three-phase converter as from a single-phase, because for the three-phase the armature is tapped every 120° instead of 180°, as in the single-phase or two-phase.

We may obtain a two-phase converter by tapping the armature as in Fig. 7, the phase b_1b_2 being taken midway between a_1a_2. A three-phase converter may be obtained by tapping the armature as in Fig. 8.

RATIO OF ELECTROMOTIVE FORCES.

Since in a single-phase or two-phase converter the maximum alter-

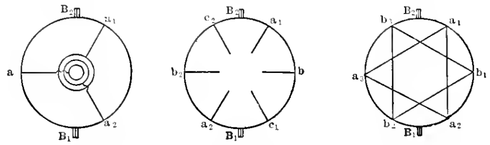


FIG. 8.—THREE-PHASE CONVERTER. FIG. 9.—SIX-PHASE DIAMETRICAL CONNECTION. FIG. 10.—SIX-PHASE DELTA.

nating-current potential is equal to the direct-current brush potential, the effective value of the alternating e.m.f., assuming a sine wave, is

$$E_1 = E/\sqrt{2} = .707\ E. \qquad (1)$$

In a three-phase converter the maximum potential between a_1 and a_2 would be when the arc, $a_1\,a_2$, has a maximum projection on the diameter, B_1B_2. This length will be the length of the cord a_1a_2. This may be easily found as follows: The length of the radius of the circle, Oa_1, is $E/2$, and the length of the cord, a_1a_2, is therefore $\dfrac{E\sqrt{3}}{2}$. The effective value of the potential is

$$E_1 = \frac{E\sqrt{3}}{2\sqrt{2}} = .615\ E. \qquad (2)$$

The only other converter used to any practical extent is the six-phase converter. This may be obtained by tapping the armature at six points as shown in Fig. 9. Evidently we may connect one phase across the diameter as shown in Fig. 9 or across 120° as in Fig. 10. The first is the diametrical connection which has the advantage of a higher voltage between slide rings over the "delta" ( ) shown in Fig. 10.

FIG. 10. SIX-PHASE, DELTA CONNECTION.

If there are n collector rings the voltage between adjacent collector rings will be

$$E_1 = \frac{E \sin \pi/n}{\sqrt{2}}, \qquad (3)$$

as may be easily proved.

RATIO OF CURRENTS.

Consider again the converter as transforming from direct to alternating. Suppose I amperes direct current is consumed by the converter, what will be the output in alternating current? Take first a single-phase converter. Since for a complete cycle the direct-current input must be equal to the alternating output, neglecting losses, we must have, assuming the alternating current to be in phase with the pressure,

$$E\,I = E_1I_1 \qquad (4)$$

in which E_1 and I_1 are the effective values of alternating pressure and current. But we have $E_1 = E/\sqrt{2}$; substituting above we obtain

$$I_1 = I\sqrt{2}$$

That is, the effective value of the alternating current is the $\sqrt{2}$ times the direct current. Now the maximum value of the alternating current is $\sqrt{2}$ times the effective, and hence the maximum value of alternating current

$$I_1\ max = 2I \qquad (5)$$

Hence, in a single-phase converter the maximum value of alternating current is twice the direct current. At the instant then when the alternating current is a maximum, that is, when points a_1a_2 pass under the direct-current brushes, twice as much power is given out on the alternating side as comes in on the direct. When, on the other hand, the alternating current is zero, power is being taken from the direct-current mains at the same constant rate as before.

Referring to Fig. 6, when a_1a_2 are in the position shown the alternating-current pressure is $E \cos \Theta$, and if the current is in phase with the pressure, its value is $2I \cos \Theta$. The instantaneous power going out on the alternating side then $2\,E\,I \cos^2 \Theta$. The instantaneous direct-current power taken by the armature is $E\,I$. The difference between these must be the power given to or taken from the armature.

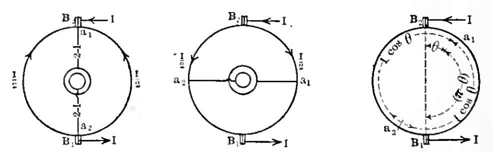
$$\text{Power given to armature} = 2E\,I \cos^2\Theta - E\,I$$
$$= E\,I\,(2 \cos^2 \Theta - 1) = E\,I \cos 2\Theta \qquad (6)$$

In a single-phase converter, therefore, when a_1a_2 pass under the brushes, a direct current, I, flows to the converter but an alternating current, $2I$, flows to the collector ring (Fig. 11). We may regard the direct current, I, as flowing direct from the direct-current mains to the alternating slide rings without going into the armature. The source of the other current, I, necessary to make up the difference between the alternating and the direct-current is, in this position, the armature, the inertia of the armature supplying the power, $E\,I$. When a_1a_2 have moved through 90 degrees to the position shown in Fig. 12 the alternating current is zero, but the direct current is still I. The direct current, I, flows then from brush to brush, giving back the power, $E\,I$, to the armature rotating mass. In a single-phase converter then the armature acts alternately as a motor and as a generator twice per cycle. As we shall see, because of this fact the single-phase converter does not commutate as well as the polyphase converter, in which the flow of power to and from the converter is at every instant the same, neglecting "hunting" and losses.

In a two-phase converter the power, $E\,I$, is flowing to the armature from the direct-current mains. The outgoing energy on the alternating side for a complete cycle must equal the incoming energy for the same time. Since we have two phases we have

$$E\,I = 2E_1I_1 \qquad (7)$$
$$\text{But } E_1 = E/\sqrt{2}$$
$$\text{Therefore } I_1 = I/\sqrt{2} \text{ or}$$
$$I_1\ max = I \qquad (8)$$

That is, the maximum value of the alternating current is equal to the direct current. Here we see that in a two-phase converter when a_1a_2 are directly under the brushes all the incoming direct current flows



FIGS. 11, 12 AND 13.—RATIO OF CURRENTS.

directly to the alternating slide ring, and there is no current in the armature (this assumes no losses). When b_1b_2 are on the brushes the same thing will occur in the direct-current passing direct to the slide ring without entering the armature.

We can easily see from the above that there will be less heating in a two-phase converter than a single-phase, because four times per revolution the armature current is zero—that is, the direct current passes directly from the direct-current mains to the alternating-current circuit without going through the armature—and for a considerable time the armature current is nearly zero. In a six-phase converter, diametrically connected there will be no armature current six times per revolution. In a three-phase converter three times per revolution the current flows over only a part of the armature.

HEATING OF ROTARY CONVERTERS.

With the above as an introduction, to give some idea of what occurs, let us calculate in as simple a manner as possible the heating of a single-phase and a two-phase converter. First, consider a single-phase converter, Fig. 13. It is simpler here to consider the direct current flowing from brush to brush just as though it were a direct-current machine, a current, $I/2$, flowing down each side of the armature. The alternating current, $2I \cos \Theta$, flows from a_2 to a_1, $I \cos \Theta$ flowing over each half of the armature, as shown in Fig. 13. We need only consider the heating of one side of the armature from brush to brush, as the other side will be the same.

The actual value of the current in that part of the armature between B_2 and a_1 will be the sum of the alternating and direct current; that is, equal to $I/2 + I \cos \Theta$; and the current in that part of the armature between a_1 and b_1 will be the difference between the alternating and direct current, and hence, equal to $I/2 - I \cos \Theta$. The resistance between B_2 and a_1 is proportional to Θ, and the resistance between a_1 and B_1 is proportional to $(\pi - \Theta)$. The instantaneous heating in the position shown is therefore proportional to

Instantaneous heating $= (I/2 + I \cos \Theta)^2 \Theta + (I/2 - I \cos \Theta)^2 (\pi - \Theta)$.

$= (I/2)^2 [(1 + 2 \cos \Theta)^2 \Theta + (1 - 2 \cos \Theta)^2 (\pi - \Theta)]$

$= (I/2)^2 [\pi + 8 \Theta \cos \Theta + 4\pi \cos^2 \Theta - 4\pi \cos \Theta]$,

and the average heating is the average value of this between the limits of Θ and π.

Average heating

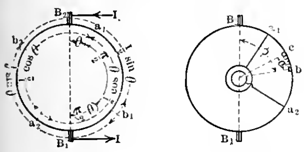
$$\frac{I}{\pi} (I/2)^2 \int_0^{\pi} (\pi + 8 \Theta \cos \Theta + 4 \pi \cos^2 \Theta - 4 \pi \cos \Theta)\, d\Theta$$

$$= \frac{(I/2)^2 (\pi^2 + 2\pi^2 - 16)}{\pi}$$

$$= (I/2)^2 \pi (3 - 16/\pi)^2 = (I/2)^2 \pi (1.37) \qquad (9)$$

The factor π comes in because the resistance of one side of the armature has been assumed to be equal to π.

If this machine were acting as a direct-current generator, delivering the current, I, the heating of each side of the armature would be proportional to $(I/2)^2 \pi$, and hence we see that the I^2R loss in the single-phase converter is 37 per cent. greater for the same output than the same machine as a direct-current generator. To give the same heating the output of the rotary must be decreased. The rating of a



FIGS. 14 AND 15.—RATIOS OF CURRENTS.

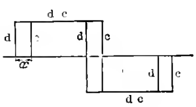


FIG. 16.—RECTANGULAR CURRENTS IN COILS D & C.

direct-current machine must be $1/\sqrt{1.37} = .85$ x rating as direct-current generator, for the same heating.

In the two-phase converter, Fig. 14, we must consider the current in three parts of the armature. These currents are as follows:

Current between B_2 and $a_1 = I/2\ (1 + \cos \Theta - \sin \Theta)$

Current between a_1 and $b_1 = I/2\ (1 - \cos \Theta - \sin \Theta)$

Current between b_1 and $B_1 = I/2\ (1 - \cos \Theta + \sin \Theta)$

To get the average heating we integrate between the limits of O and $\pi/2$, because from $\Theta = 0$ to $\Theta = \pi/2$ the armature current passes through all possible values. We get, then, by proceeding as before,

Average heating

$$= 2/\pi\ (I/2)^2 \int_0^{\pi/2} (2 \pi + 4 \Theta \cos \Theta - 2 \pi \cos \Theta - 4 \Theta \sin \Theta)\, d\Theta$$

$$= (I/2)^2 \pi\ (2 - 16/\pi^2) = (I/2)^2 \pi\ (.37) \qquad (10)$$

Here we see that the heating of a two-phase converter is only 37 per cent. of that of a direct-current generator for the same output. In order to get the same heating the output may be increased to $1/\sqrt{.37} = 1.64$ times output of direct-current machine. The capacity of the two-phase converters is $\frac{1.64}{.85} = 1.93$ times that of the single-phase.

While the above method gives us a good insight into the real reason for the decreased heating of polyphase converters it becomes laborious to work out each case separately. A general method due to Mr. Steinmetz will now be given. No clearer piece of mathematical reasoning has ever been given.

In a converter having n collector rings tapping the armature at n equal spaces around the commutator the voltage between adjacent collector rings will be:

$$E^1 = \frac{E \sin (\pi/n)}{\sqrt{2}} \qquad 3(b)$$

(In a single-phase converter $n = 2$, in a two-phase converter $n = 4$, etc.)

The current between two collector rings may be obtained by the equation (assuming no lag of alternating current):

$$n E' I' = E I \qquad (11)$$

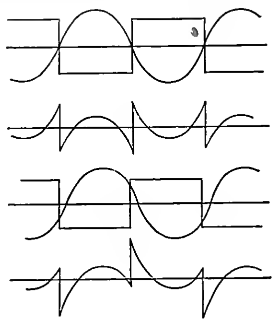
By substituting the value of E' we obtain

$$I' = \frac{I\sqrt{2}}{n \sin \pi/n} \qquad (12)$$

Now consider a coil, c, of the armature at an angular distance a from the position midway between two adjacent collector rings, as in Fig. 15. The alternating e.m.f., and therefore the current between a_1a_2 will reach a maximum value when the angle ϕ is 90°. Now it is evident that the direct current in every armature coil reverses when the coil passes under brush B_1 or B_2. The alternating current, however, in any armature coil between a_1 and a_2 is the same. If we plot the rectangular direct current in the coil, d, counting time when the coil passes from one side of the brush to the other we obtain the curve, d, shown in Fig. 16. In successive armature coils the rectangular currents are displaced in phase. That is, for example, the current in the coil c is as shown by the curve, c, in Fig. 16. The alternating current being the same throughout the section between a_1 and a_2 the direct and alternating currents are thrown more and more out of phase as we pass from d to a_1 or a_2, as shown in Figs. 17, 18, 19 and 20. At the alternating leads, a_1 and a_2, the alternating and direct currents are out of phase by the angle π/n.

FIGS. 17, 18, 19 AND 20.

The direct current, then, in the coil, c, is $I/2$ for half a period; that is, from the time the coil passes from B_2 to B_1. The current in coil d is $\sqrt{2}I' \sin \phi$, I' being taken from equation (12). The alter-



FIGS. 17, 18, 19 AND 20.—PHASE RELATIONS.

nating current in coil c is $\sqrt{2}\ I' \sin (\phi - a)$. By substituting the value of I' from equation (12) we obtain

$$\text{Alternating current} = \frac{2I \sin (\phi - a)}{n \sin \pi/n} \qquad (13)$$

The actual current in the armature coil, c, is the difference between the alternating and direct current, and is therefore equal to

$$i_0 = \frac{2I \sin (\phi - a) - I/2}{n \sin \pi/n}$$

$$= I/2 \left[\frac{4 \sin (\phi - a)}{n \sin \pi/n.} - 1 \right]$$

The effective value of this current is

$$I_0 = \sqrt{1/\pi \int_0^\pi i_0^2 d\phi} = I/2 \sqrt{1/\pi \int_0^\pi \frac{(4 \sin (\phi - a) - 1)\, d\phi}{n \sin \pi/n}}$$

$$= I/2 \sqrt{\frac{8}{n^2 \sin^2 \pi/n} + 1 - \frac{16 \cos a}{n \pi \sin \pi/n}} \qquad (14)$$

$I/2$ is the armature current of a direct-current generator, and hence for the same output the ratio of the heating of the coil, *c*, of the converter to the heating when used as a direct-current generator is

$$Y\,a = \left(\frac{I_0}{I/2}\right)^2 = \frac{8}{n^2 \sin^2 \pi/n} + 1 - \frac{16 \cos a}{n \pi \sin \pi/n} \qquad (15)$$

This ratio is a maximum at the alternating leads a_1 and a_2, where $a = \pi/n$, and is a minimum for the coil, *d*, midway between a_1 and a_2. The value of Ym and Yo, the maximum and minimum values of $Y\,a$ may be obtained from equation (15) by substituting $a = O$ and $a = \pi/n$.

The average heating of the armature is obtained by integrating $Y\,a$ over the width of the coil between a_1 and a_2. Doing this we obtain

$$\text{Average heating} = Y\,a = n/\pi \int_0^{\pi/n} Y\,a\, d\,a$$

$$= \frac{8}{n^2 \sin^2 \pi/n} + 1 - 16/\pi^2 \qquad (16)$$

By substituting $n = 2$ and $n = 4$ we verify equations (9) and (10). The rating of the converter will be

$$\text{Rating} = 1/\sqrt{Y a} \qquad (17)$$

The following table, given by Steinmetz, may be worked out by substituting different values of n:

Type.	Dir.-Cur. Gen.	Single Phase.	3 Phase.	4 Phase.	6 Phase.	12 Phase.	∞ Phase.
n		2	3	4	6	12	
Yo	1.00	.45	.225	.20	.19	.187	.187
Ym	1.00	3.00	1.20	.73	.42	.24	
Ya	1.00	1.37	.555	.37	.26	.20	
Rating (by mean arm. heating)	1.00	.85	1.34	1.64	1.96	2.24	2.31

For tables of capacities taking into account mechanical losses or wattless currents the reader is referred to Steinmetz's "Elements of Electrical Engineering."

ARMATURE REACTION.

Consider the single-phase converter. The direct current may be considered as flowing down each side of the armature from brush to brush as though the alternating current were not present. With the brushes in the neutral position this would give us a magnetomotive force which may be represented by the line *s o*, Fig. 21, the point *o* being the centre of the larger circle. When a_1 and a_2 are directly under the brushes; the alternating current is double the direct current, but opposite in direction. The M.M.F. of the

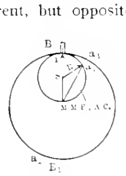


FIG. 21.—ARMATURE REACTION OF SINGLE-PHASE CONVERTER.

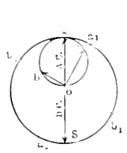


FIG. 22.—ARMATURE REACTION OF TWO-PHASE CONVERTER.

alternating current when a_1 and a_2 are under the brushes will then be represented in magnitude and direction by *O T*, the diameter of the small circle in Fig. 21. This gives the resultant M.M.F. of *s T*.

When a_1a_2 have moved to the position shown in Fig. 21, the M.M.F. of the alternating current will be represented by the line *o a'*. The locus of the alternating M.M.F. may be easily seen to be the circle *o T a'*. In whatever position the alternating leads are, the resultant M.M.F. of direct and alternating current gives a vector of constant magnitude and the direction is the line giving the two alternating-current taps (this in a two-pole machine) *s T*. *s T* is a vector rotating with twice the frequency of the alternating current. The armature reaction of a single-phase converter, therefore, passes from a generator reaction to a motor reaction twice the revolution. On account of this the commutation of the direct-current converter is not as good as that of the polyphase converter.

In the polyphase converter the armature reaction is practically absent, as may be easily shown. The demonstration will be given for a two-phase converter.

In Fig. 22 the line *o s* represents the direct-current M.M.F. (for the same current intake *o s*, Fig. 22, and *s o*, Fig 21, will be the same

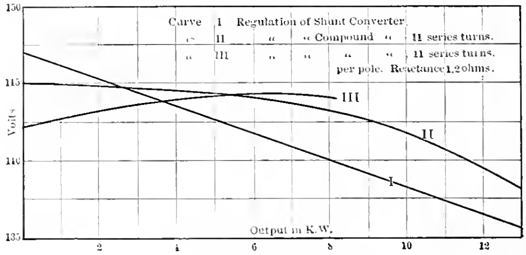


FIG. 23.—REGULATION OF CONVERTER.

magnitude, but to give a simple result in each case a different scale is taken). The M.M.F. of phase a_1a_2 will be again *o a'*, and the M.M.F. of phase b_1b_2 will be *ob'*. The resultant of *oa'* and *ob'* gives the length *o T*, which is equal and opposite to the M.M.F. of the direct current: Hence the alternating and direct current M.M.F. are balanced, giving little reaction for a balanced polyphase converter.

COMPOUNDING OF CONVERTER.

At constant impressed alternating potential the direct current voltage will be practically constant also. Varying the field excitation of the converter will not materially affect the ratio of conversion. The regulation of a converter is better than that of a direct-current, shunt-wound generator on account of the absence of armature reaction. In Fig. 23, curve I shows the regulation of a shunt-wound converter, and curve, II, the regulation when the converter was compounded with 11 turns per pole. The only way to compound the rotary is to automatically vary the pressure at the alternating-terminals. This can be done by introducing reactances into the line and then compound-winding the rotary, so that as the load comes on the rotary the leading alternating current drawn by the machine will cause a rise in pressure through the reactance. This problem then is the same as that of compounding a synchronous motor[1] so the changes of load will affect the pressure at the machine terminals in a desired way. Curve III, Fig. 23, gives the regulation of a converter with external reactances.

Trolley to Haul Logs.

It is stated from Bangor, Maine, that a trolley system is in successful operation in the Maine woods, hauling heavy loads of logs. It is the invention of A. O. Lombard, of Waterville, and is somewhat like the flat construction cars used on street railways. It is twenty feet long and six feet wide, and its wheels, like those of the steam hauler, run on an endless lag bed, supported on roller bearings, while the framework of the bed is so constructed that the machine accommodates itself to all knolls and other irregularities in the road. The cog gears which do the driving are so constructed that no matter what the position of the machine they always turn within each other. The machine is fitted with two twenty-five horse-power motors and a Westinghouse controller, and is geared to run about four miles an hour. Over the axle of the machine a rocker is pivoted, and on this is rested one end of the load of logs to be hauled, the rear end of the load being supported by a common logging sled. Other sled loads of logs may be attached in tow. The hauling capacity of the machine has been tested as high as 58,280 ft. at a trip.

The electric machine runs over a road seven miles long, the usual trolley system being used, current being generated at a water power plant with steam reserve. Illuminating current is also supplied by the plant, and the logging roads and landings are brilliantly lighted with electricity.

[1] Synchronous Motor Calculations, by F. G. Baum, ELECTRICAL WORLD AND ENGINEER, May 17, 1902.

The Telephone Substation.—III.

By ARTHUR V. ABBOTT, C.E.

The mounting of an induction coil usually depends on the place where it is to be used. Coils which accompany a wall or cabinet set are merely wound on a spool and placed in a chamber made by expanding the base of the transmitter arm, as illustrated in Fig. 14. For switchboards and desk sets when the coil is to be attached to neighboring woodwork it is usually mounted on a wooden base, *a*, as in Figs. 10, 12 and 13. Fig. 15 is from a photograph of the group of coil dissected to form Table 5.

As an aid in designing the winding of induction and other coils Table 6 is appended, collected from experimental data gained in the winding of many coils with various kinds of insulation.

Owing to the scarcity of data upon induction coil construction, the design of a new coil is more or less a matter of experiment, and for this purpose it is well after roughly designing the windings to construct experimental coils which shall enable the design to be tested.

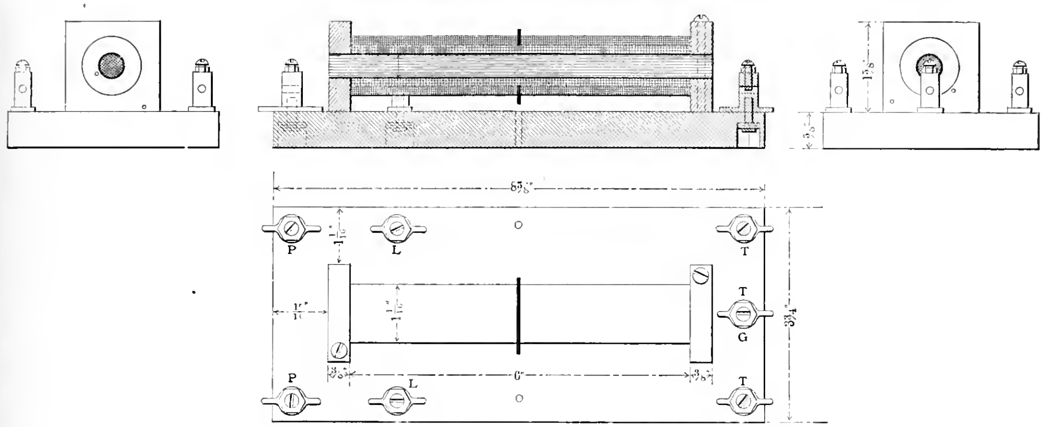


FIG. 10.—INDUCTION COIL FOR OPERATOR'S SWITCHBOARD TRANSMITTER, LOCAL BATTERY.

TABLE VI.—DATA FOR WINDING COILS.

Size of wire: B. & S.	Resistance Ohms per Cubic Inch. Single cotton.	Double cotton.	Single silk.	Double silk.	Inches per Turn or Layer. Single cotton.	Double cotton.	Single silk.	Double silk.	Feet of Wire per Cubic Inch. Single cotton.	Double cotton.	Single silk.	Double silk.
0000	.0000111	.0000086	....	....	.6418	.7309	......	......	.2025	.1559	......	......
000	.0000155	.0000119	....	....	.6231	.7112	......	......	.2145	.1647	......	......
00	.0000233	.0000166	....	....	.5510	.6536	......	......	.2745	.1950	......	......
0	.0000412	.0000360	....	....	.3521	.3731	......	......	.3824	.3275	......	......
1	.000114	.000108	....	....	.3155	.3236	......	......	.8389	.7950	......	......
2	.000177	.000163	....	....	.2924	.2895	......	......	1.0460	.9630	......	......
3	.000268	.000253	....	....	.2519	.2597	......	......	1.222	1.1510	......	......
4	.000514	.000423	....	....	.2222	.2326	......	......	1.875	1.5410	......	......
5	.000760	.000692	....	....	.1965	.2044	......	......	2.159	1.9930	......	......
6	.001175	.001080	....	....	.1762	.1842	......	......	2.670	2.4580	......	......
7	.001760	.001650	....	....	.1613	.1653	......	......	3.205	3.0500	......	......
8	.00290	.00264	....	....	.1418	.1490	......	......	4.140	3.7680	......	......
9	.00413	.00396	....	....	.1340	.1357	......	......	4.875	4.5260	......	......
10	.00662	.00638	....	....	.1171	.1198	......	......	6.072	5.8120	......	......
11	.01065	.01006	....	....	1031	.1068	......	......	7.830	7.4000	......	......
12	.01830	.01585	....	....	.0893	.09624	......	......	10.450	8.9820	......	......
13	.02665	.02425	....	....	.0833	.08772	......	......	12.000	10.8300	......	......
14	.03860	.03585	....	....	.0769	.08000	......	......	14.070	13.0200	......	......
15	.06980	.05572	....	....	.0651	.07262	......	......	16.680	15.7000	......	......
16	.1035	.09250	....	....	.0597	.06579	......	......	23.330	20.8100	......	......
17	.1491	.1320	....	....	.0564	.05988	......	......	26.220	23.2500	......	......
18	.2655	.2055	....	....	.0513	.05452	......	......	31.710	27.9900	......	......
19	.3415	.2665	....	....	.0439	.04965	......	......	43.200	33.7400	......	......
20	.6100	.4799	.7190	.5580	.0389	.04444	.03610	.03814	54.200	42.6000	63.90	58.50
21	.9150	.7110	1.104	1.010	.0353	.04082	.03228	.03440	65.170	50.8000	78.90	72.10
22	1.345	1.000	1.541	1.442	.0322	.03745	.03978	.03114	80.100	59.3100	91.80	85.90
23	2.218	1.600	2.760	2.367	.0291	.03552	.02618	.02814	98.300	70.9000	122.3	105.2
24	3.241	2.339	4.280	3.625	.0271	.03190	.02360	.02555	113.300	81.7800	149.6	126.7
25	4.361	3.415	6.620	5.530	.0263	.02984	.02127	.02328	121.200	95.0100	184.1	153.6
26	6.666	5.003	10.400	8.382	.0240	.02726	.01921	.02136	147.000	109.6000	225.9	182.5
27	11.01	7.250	15.79	12.73	.0208	.02567	.01734	.01938	192.000	126.3000	277.1	221.8
28	17.04	10.50	24.30	19.40	.0184	.02403	.01578	.01772	234.000	144.2000	334.5	266.2
29	23.11	14.26	37.00	28.60	.0177	.02259	.01426	.01624	255.200	163.2000	409.5	315.8
30	34.42	21.21	56.21	43.12	.0168	.02131	.01296	.01497	296.600	183.5000	486.9	373.3
31	49.85	30.10	85.98	63.60	.0156	.02009	.01182	.01381	342.600	206.3000	597.2	436.6
32	70.58	41.00	128.90	91.55	.0146	.01911	.01078	.01279	392.000	228.0000	716.0	500.2
33	102.00	57.90	197.00	127.00	.0137	.01815	.009842	.01188	444.500	253.0000	860.0	545.0
34	147.60	81.30	307.00	201.10	.0128	.01737	.008921	.01106	502.800	276.1000	1046	682.0
35	209.10	100.4	434.80	287.5	.0121	.01666	.008354	.01032	569.100	300.5000	1182	782.0
36	294.00	150.4	506.0	410.0	.0115	.01600	.007686	.009662	632.000	326.0000	1410	890.2
37	445.00	201.0	943.0	533.0	.0109	.01546	.007112	.009074	703.000	348.5000	1640	926.5
38	544.00	268.0	1385.0	823.0	.0105	.01497	.006622	.008561	770.000	371.8000	1910	1137
39	762.00	364.0	2060.0	1145.0	.00993	.01475	.006120	.008163	844.500	394.5000	2225	1251
40	1085.00	488.5	3050.0	1611.0	.00943	.01404	.005630	.007740	935.000	421.0000	2630	1340

For this purpose it is advantageous to arrange the primary and secondary to be separable so that the combination of various primaries with other secondaries may be tested. For example: Assume that a coil having 300 turns in the primary and 2,500 turns in the secondary be considered desirable. Assume the core to be from ½ in. in diameter and provide a winding space of 5 ins., construct five such cores; wind one with two layers of No. 24 wire. This will give approximately 300 turns. Wind one other core with No. 13 wire, obtaining 100 turns and one with No. 19 wire, giving 200 turns; also one with No. 27 wire, obtaining 400 turns and one with No. 32 wire, giving 500 turns. Construct in a similar manner five secondaries, each wound upon a paper tube so that they may be slipped over any one of the primaries. One secondary should be wound of No. 33 wire, giving 2,500 turns in five layers; one with No. 24, giving 1,000 turns; one with No. 28, giving 1,500; one with No. 36, giving 3,000, and one with No. 35, giving 4,000 turns. As each secondary may be tested with

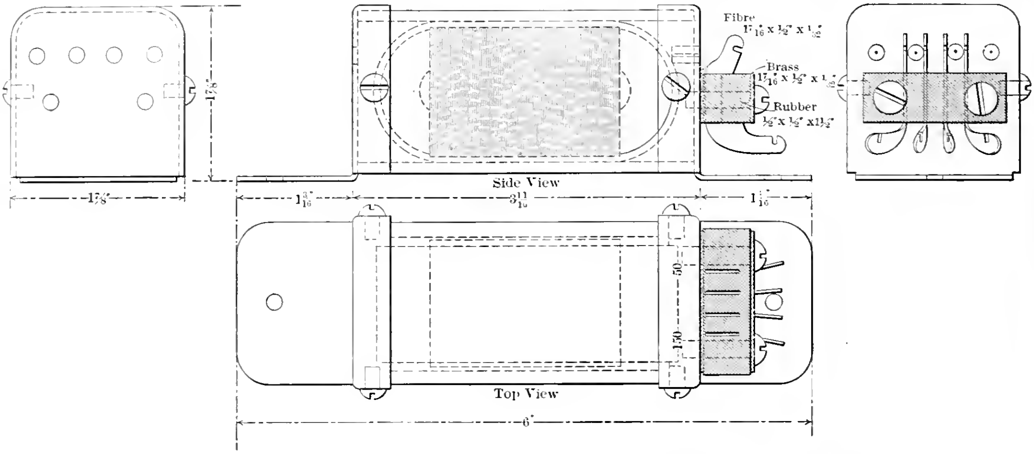


Fig. 11.—Iron-Clad Induction Coil for Switchboard Operator's Common Battery Transmitter.

TABLE VI.—DATA FOR WINDING COILS.

Size of wire: B. & S.	Bare wire.	Diameter in Mils. Over Insulation. Single cotton.	Double cotton.	Single silk.	Double silk.	Turns per Linear Inch. Single cotton.	Double cotton.	Single silk.	Double silk.	Turns per Square Inch. Single cotton.	Double cotton.	Single silk.	Double silk.
0000	460.000	610.000	697.000	.....	.....	1.558	1.368	.....	.....	2.4285	1.8714	....	....
000	409.640	590.000	677.000	.....	.....	1.605	1.406	.....	.....	2.5760	1.9768	....	....
00	364.800	525.000	622.000	.....	.....	1.815	1.530	.....	.....	3.2942	2.3409	....	....
0	324.950	475.000	572.000	.....	.....	2.140	1.980	.....	.....	4.5070	3.9300	....	....
1	289.300	299.300	311.300	.....	.....	3.170	3.090	.....	.....	10.0489	9.5481	....	....
2	257.630	267.630	277.600	.....	.....	3.540	3.400	.....	.....	12.5400	11.55000	....	....
3	229.420	239.420	240.400	.....	.....	3.970	3.850	.....	.....	14.7609	13.8125	....	....
4	204.310	214.310	222.300	.....	.....	4.500	4.300	.....	.....	20.2500	18.4900	....	....
5	181.940	189.940	106.440	.....	.....	5.090	4.890	.....	.....	25.9081	23.9121	....	....
6	162.020	170.020	176.520	.....	.....	5.660	5.430	.....	.....	32.0350	29.4849	....	....
7	144.280	152.280	158.780	.....	.....	6.200	6.050	.....	.....	38.4400	36.6025	....	....
8	128.490	136.490	142.990	.....	.....	7.050	6.710	.....	.....	49.7025	45.0241	....	....
9	114.430	122.430	128.930	.....	.....	7.460	7.370	.....	.....	54.6516	54.3169	....	....
10	101.890	108.190	113.590	.....	.....	8.540	8.350	.....	.....	72.9216	69.7225	....	....
11	90.742	97.042	102.442	.....	.....	9.700	9.360	.....	.....	94.0900	87.6096	....	....
12	80.808	87.108	92.508	.....	.....	11.200	10.390	.....	.....	125.4400	107.9521	....	....
13	71.961	78.261	83.661	.....	.....	12.000	11.400	.....	.....	144.0000	129.9600	....	....
14	64.084	70.384	75.784	.....	.....	13.000	12.500	.....	.....	169.0000	156.2500	....	....
15	57.068	63.368	68.768	.....	......	15.370	13.770	.....	.....	236.2369	189.6129	....	....
16	50.820	57.120	62.520	.....	.....	16.740	15.200	.....	.....	280.2276	251.0400	....	....
17	45.257	51.557	56.957	.....	.....	17.740	16.700	.....	.....	314.7076	278.8900	....	....
18	40.303	46.603	52.003	.....	.....	19.500	18.340	.....	.....	380.2500	336.3556	....	....
19	35.390	41.690	47.090	.....	.....	22.770	20.140	.....	.....	518.4729	405.6196	....	....
20	31.961	37.861	42.161	34.261	36.161	25.700	22.500	27.70	26.22	650.4900	506.2500	767.2900	687.4884
21	28.462	34.362	38.662	30.762	32.662	28.300	24.500	30.97	29.07	800.8900	610.2500	959.1400	845.0649
22	25.347	31.247	35.547	27.647	29.547	31.000	26.700	34.39	32.11	961.0000	712.8900	1182.6721	1031.0521
23	22.571	28.471	32.771	24.871	26.771	34.400	28.970	38.19	35.53	1183.3600	839.2609	1468.4761	1262.3809
24	20.100	26.000	30.300	22.401	24.300	36.900	31.350	42.37	39.14	1361.6100	982.8225	1795.2169	1532.9396
25	17.000	23.800	28.100	20.200	22.100	38.000	33.920	47.02	42.94	1454.0000	1150.5664	2210.8804	1843.8436
26	15.940	21.840	26.140	18.240	20.140	42.000	36.290	52.06	46.81	1764.0000	1316.9641	2710.2436	2191.1761
27	14.195	20.095	24.395	16.495	18.395	48.000	38.950	57.67	51.59	2304.0000	1517.0925	3326.8289	2661.5281
28	12.641	18.541	22.841	14.941	16.841	53.000	41.610	63.36	56.43	2809.0000	1731.3920	4014.4896	3184.3449
29	11.257	17.157	21.457	13.557	15.457	56.500	44.270	70.11	61.56	3062.2500	1959.8329	4915.4121	3789.6336
30	10.025	15.025	20.255	12.325	14.225	59.660	46.930	77.14	66.79	3559.3156	2202.4249	5841.4796	4460.9041
31	8.928	14.828	19.128	11.228	13.128	64.125	49.780	84.64	72.39	4112.01562	2478.0484	7163.9296	5240.3121
32	7.950	13.850	18 150	10.250	12.150	68.600	52.340	92.72	78.19	4705.9600	2739.4756	8595.9984	6113.6761
33	7.080	12.980	17.280	9.380	11.280	73.050	55.100	101.65	84.17	5336.3025	3036.0100	10332.7225	7084.5889
34	6.304	12.204	16 504	8.504	10.504	77.900	57.570	112.11	90.44	6068.4100	3314.3049	12568.6521	8179.3936
35	5.614	11.514	15.814	7.014	9.814	82.600	60.040	119.70	96.90	6822.7600	3604.8016	14328.0900	9389.6100
36	5.000	10.900	15.200	7.300	9.200	87.100	62.510	130.15	103.55	7586.4100	3912.5001	16939.0225	10722.6025
37	4.453	10.353	14.653	6.753	8.653	91.870	64.700	140.60	110.20	8440.0969	4186.0900	19768.3600	11144.0400
38	3.965	9.865	14.165	6.265	8.165	95.000	66.800	151.05	116.85	9025.0000	4462.2400	22816.1025	13653.9225
39	3.531	9.431	13.731	5.831	7.731	100.700	68.800	163.40	122.55	10140.4900	4733.4400	26669.5600	15018.5025
40	3.144	9.044	13 344	5.344	7.344	106.000	71.200	177.65	129.20	11236.0000	5059.4400	31578.5225	16602.6400

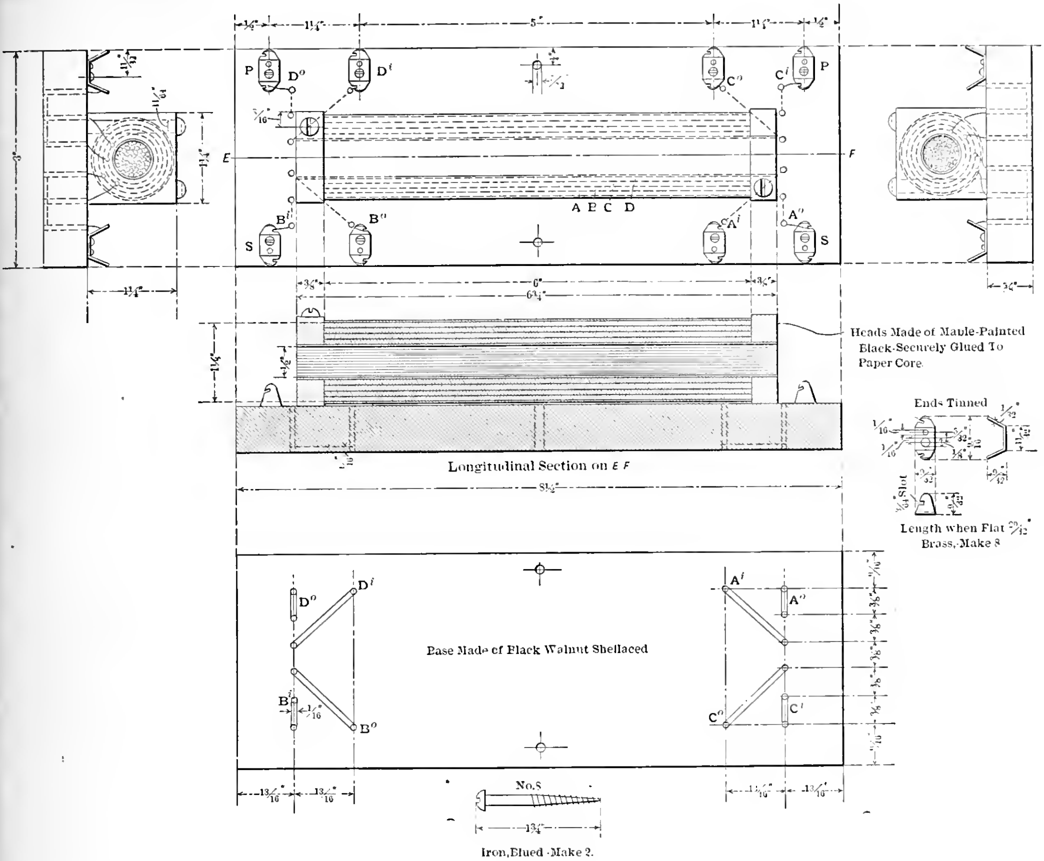


FIG. 12.—DOUBLE-WOUND COIL.

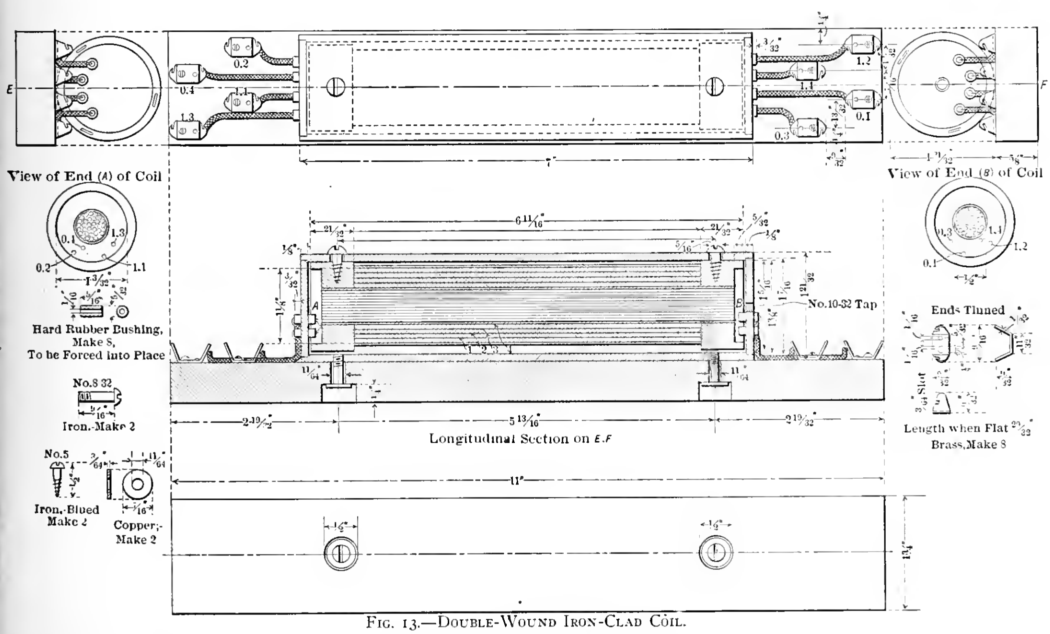


FIG. 13.—DOUBLE-WOUND IRON-CLAD COIL.

any one of the previous primaries, the construction of five coils will give twenty-five combinations. A trial with each of these will show which combination gives, on the whole, the best results under the particular circumstances the coil is to be used, and from a prelimi-

SPECIFICATIONS FOR FIG. 10.

Core: Bundle of No. 24 soft iron wire.
- Diameter of core, ½ in.
- Length of core, 6¾ in.
- Winding space, 6 in.
- Paper insulation around core 1/32 in. thick.

Winding: Inside winding.
- Resistance, .5 ohms.
- 380 turns No. 18 single covered wire wound from end to end of core in three layers. Cotton covered.
- Two layers of common paper insulation around it.

Outside winding:
- Resistance, 84 ohms on each side = 168 ohms total.
- 2500 turns on each side = 5000 turns total.
- Wound from end to center and from center to end of core.
- Secondary. Two coils separated by hard rubber ring 1/16 in. thick.

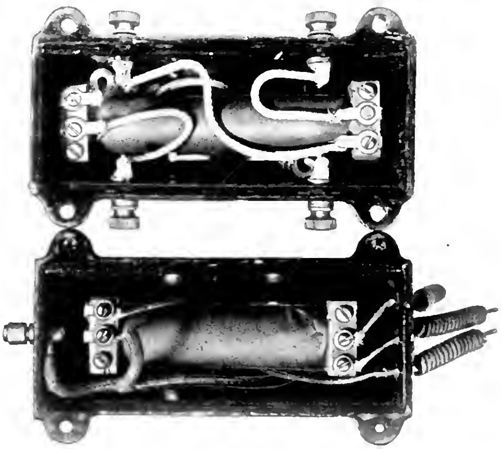


FIG. 14.—INDUCTION COIL IN BASE OF TRANSMITTER.

Terminals: Primaries to operator's telephone.
- L. L. to keyboard.
- T. T. to telephone.
- G. to center of telephone or ground.

German silver winding wound differentially, insulated by a covering of heavy wrapping paper to prevent contact with the iron casing of the coil.

Terminals: The winding which includes the 50 ohms of copper and the 100 ohms of German silver is the primary and will be stamped 150 ohms at the terminals.
- The 50-ohm winding is the secondary and will be stamped 50 ohms at the terminals.

SPECIFICATIONS FOR FIG. 12.

Frame: Two heads, maple painted black ⅜ in. thick 1¼ in. by 1¼ in. Core tube, paper made of a sheet 6¾ in. wide, 9 in. long, .004 in. thick rolled around a mandrel ½ in. diameter and glued.
- Tube glued into heads.

Base: Black walnut, varnished, 11 in. long, 1¾ in. wide, ⅝ in. thick.

Core: Best annealed iron wire, varnished, cut 6¾ in. long.
- Diameter of wire, .016 in.

Primary: Single white silk covered copper wire.
- Diameter, 0.16 in., No. 28 B. & S.; to be wound in two parts, each having 1550 turns.
- Resistance, 16 ohms.
- Terminals to be reinforced with stranded wire throughout and soldered to clips as in drawings.
- Winding to be in two layers.

Secondary: Single white silk-covered copper wire diameter, .013, No. 28 B. & S.; to be wound in two parts, each having 1550 turns.
- Resistance, 23 ohms.
- Terminals to be reinforced with stranded wire and brought out and soldered to clips as in drawing.
- Winding to be in two layers.
- Coil to be wrapped with black "seal cloth."

SPECIFICATIONS FOR FIG. 13.

Frame: Two heads to be made of maple, varnished, shaped as at *A A B*, Fig 13. Heads to be 11/16 in. thick, 1 5/16 in. in diameter.

Core Turn: To be made of a sheet of paper 6⅜ in. wide, 9 in. long, .004 in. thick, rolled on a mandrel ½ in. in diameter and glued.
- Tube to be glued into heads.

Base: Black walnut, varnished, 11 in. long, 1¾ in. wide, ⅝ in. thick.

Iron Shield: Annealed wrought iron pipe, 6⅞ in. long, 1¼ in. diameter inside, recessed as shown. Two caps ⅛ in. thick cut to fit pipe.
- Heads to be secured by upsetting pipe after coil is in place. All to have two coats of black paint.

Core: Best annealed wrought iron wire, cut 6¾ in. long, varnished.
- Diameter of wire, .016 in.

Primary: To be of best white single silk covered copper wire.
- Diameter, .0142 m., No. 27 B. & S.; to be wound in two parts, each having 1565 turns and a resistance, 14 ohms. Each part to have two layers.

Secondary: To be of best white single silk covered copper wire.
- Diameter, .0142 m., No. 27 B. & S.; to be wound in two parts, each having 1565 turns; resistance to be 21 ohms. Each part to have two layers.
- Coil to be wrapped with black "seal cloth."

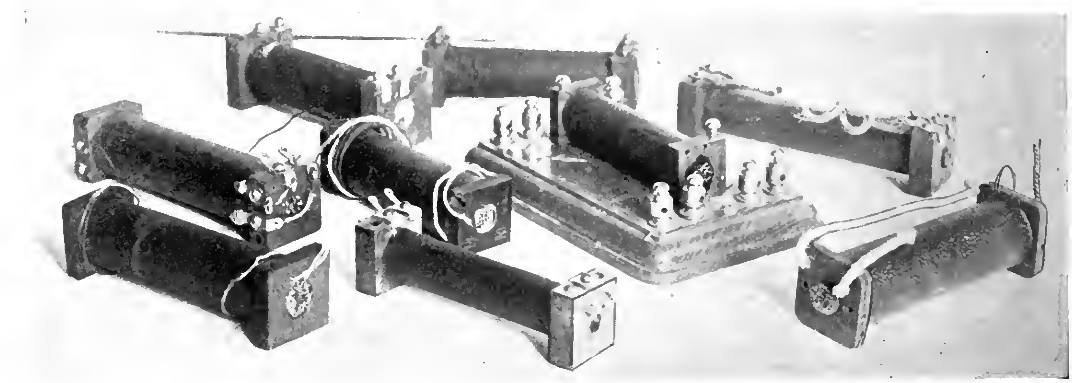


FIG. 15.—A GROUP OF INDUCTION COILS.

SPECIFICATIONS FOR FIG. 11.

Core: 200 soft iron punchings 0.12 in. thick.
- Diameter 2¼x½ in.
- Winding space, 1 1/16 in.
- Heavy parafined paper insulation.

Winding: Inside wiring.
- Resistance, 50 ohms each.
- 2 No. 30 single cotton covered copper wires wound parallel.

Outside winding:
- Resistance, 100 ohms.
- German silver wire put on and connected in series with one of the 50-ohm coils.

Terminals: The terminals shall consist of two (2) strands of wire of the same description as that herein specified for the winding of the coil. That part of the terminal which extends beyond the iron sheath shall be covered with a braided cotton covering. The terminals shall be securely soldered to their respective terminal clips without the use of acid.

Finish: The coil and its accessories shall be assembled and finished in a workmanlike manner.

Test: The fulfillment of the electrical requirements herein called for shall be determined by a comparative test for efficiency against a standard coil.

nary test of this kind the probable final proportions of the most desirable coil can be readily determined.

CURRENT NEWS AND NOTES.

NIGHT ELECTRICAL SCHOOL IN SCHENECTADY.—Several progressive employees of the General Electric Company at Schenectady, N. Y., have initiated a project having for its purpose the founding of a night electrical school.

WASHINGTON UNDERGROUND WIRES.—A bill introduced by Senator Gallinger and reported to the Senate with the recommendation for favorable action by Senator Foraker from the Senate Committee on the District of Columbia, requires all telegraph wires in the District to be put under ground under penalty of a fine of $25 per day.

GAMBLING BY TELEPHONE.—Mayor Harrison has appealed to the Chicago Telephone Company for its co-operation in suppressing pool rooms and "hand books". Warfare on tickers has resulted in substituting telephones and the company finds itself in the peculiar position of a common carrier obliged to accept and maintain the secrecy of all business offered to it in ignorance of its purport, and the operators are forbidden by the rules to listen in to determine whether gambling is being conducted. Listening or "tapping off" the line is in direct violation of the law.

DERI DIRECT-CURRENT ELECTRIC RAILWAY SYSTEM.—A patent granted March 29 to Max Deri, of Vienna, Austria, and assigned to the Stanley Electric Manufacturing Company relates to an direct-current power transmission system stated to be particularly adaptable to traction use. A railway system is divided into such a number of sections that not more than one car shall be on a given section at any time. Each section is fed by an independent generator with two windings in opposition, one being separately excited, and the other in series with the armature. With this arrangement the line voltage varies inversely with the current, and a motor can, therefore, be connected directly with the line from a state of rest or non-excited condition without the intervention of resistance.

STORAGE BATTERY PATENTS.—The only three electrochemical patents granted on March 29 refer to storage battery inventions. Two patents, granted to Mr. C. P. Elieson, of Paris, relate to details of mechanical construction of the grid, and a patent of Mr. A. Meygret, of Paris, refers to a protective envelope for the plates for the purpose of preventing the active material dropping off the plates. This envelope is produced by dipping the plate or grid, after the active material has been applied to it, in a bath consisting of castor oil, essence of turpentine, octonitric cellulose, and ordinary nitrate of cellulose. This method is stated to give an elastic coating which presses the active material against the supporting grid. In order to render it porous, it is afterwards mechanically perforated or provided with a series of fine gashes.

BRITISH STREET RAILWAYS.—The latest Board of Trade returns show that there are 296 tramway undertakings in the United Kingdom, which have cost $200,000,000. These have nearly all been created in the past twenty-five years. Of the total number 142 are owned by municipalities and 154 by private companies. The municipal undertakings, though less in number, have more mileage and cost about $120,000,000; the private, over $80,000,000. The total length of both is over 1,700 miles. Some of the municipal tramways are alleged to make handsome profits, which materially reduce local taxes. During the current year, it is estimated, Nottingham will clear $90,000 from this source, Liverpool $123,000, Leeds $300,000 and Manchester $250,000. In none of these cities do the facilities begin to compare with those afforded in like American cities under private ownership.

ELECTRICAL POLE LINES.—Mr. H. Von Schrenk, chief of the Forest Products Division of the Government Bureau of Forestry in the United States Department of Agriculture, has recently issued a letter and a circular asking for information with regard to poles, pins and cross arms used in the telephone and telegraph industry. He states that the Bureau is to issue a bulletin on the subject of such lumber. A number of questions are asked bearing upon this subject, as to standard specifications, sources of supply, seasoning, average length of life, wire capacity, etc. These questions appear to be somewhat in line with those included in the telegraph and telephone schedules issued by the United States Census Office, with regard to poles, etc., used for those branches of electrical work. The inquiry appears to be based upon the increasing difficulty of obtaining suitable timber for these purposes.

NEW USE FOR THE SEARCHLIGHT.—Prof. C. L. Cory, of the University of California, who is at the head of the electrical engineering department, recently caused a sensation at Berkeley, Cal., by adopting modern military methods to prevent a prohibited college "rush." One of the classes had planned to storm a high hill near the University and paint their class number in white on the hillside where it could be seen for miles around. Prof. Cory had an electric searchlight trained on the hill from the top of the mining building. A force of armed policemen lay in ambush until 1 A.M. when one of them gave the signal, which resulted in the capture of the luckless students, revealed by the powerful rays turned on them as they scaled the heights. About a dozen of the more determined ones were handcuffed until their names and addresses could be ascertained.

A NEW COHERER.—Prof. J. Chunder Bose, the distinguished Hindoo physicist, is represented in the patent budget of March 29 by a patent on a new form of coherer. According to the theory of Prof. Bose, the changes produced on or in the sensitive substances of the coherer are due to molecular distortion, and in order to obtain the best results with the coherer it is necessary that this distortion shall be removed before fresh radiations are received. This is usually done by resort to tapping contrivances, but Prof. Bose offers a method whereby the necessary effect is produced by subjecting the sensitive substances to torsional distortion, imparting to the tube carrying the sensitive substance either a one direction or an oscillatory or vibrational twist. He has, moreover, discovered that certain substances such as galena, tellurium, lead, tin, allotropic silver and a number of others, possess the property of rapid self-recovery from the effects of Hertzian waves. As illustrated, at the end of two pivoted arms are two contact pieces of such material, one being in the form of a plain cylinder, and the other pointed and bearing on the first mentioned. The contacts are normally held together by a spring, the pressure of which can be regulated with great delicacy by means of a micrometer screw. It is stated that this apparatus is self-recovering when the sensitive substance is of the kind enumerated, the distortion produced in the contacts by a wave radiation thereon being automatically removed upon the cessation of the wave.

CONTROLLING INDUCTION MOTORS.—A patent issued several years ago to Analto P. Zani, of Milan, Italy, described an arrangement for starting induction motors, whereby the usual large starting current could be cut down. In this arrangement the rotor had two paths for the induced current, one having a high ohmic resistance and little, if any, self-induction, and the other having an almost negligible resistance, but a comparatively high self-induction. In starting a motor with such an arrangement, a large proportion of the current generated in the rotor will at first flow through the high-resistance path, due to the high frequency of the induced current at low speed. As the speed of the motor rises the frequency of the current decreases, thus correspondingly reducing the reactance in the low-resistance path, until finally when the speed of the motor approaches normal, the impedance of this path becomes so small that nearly all the current generated will flow through it. In a patent issued March 29 it is stated that substantially the same results may be produced with but a single path in the rotor or induced circuit, consisting in effect of the primary of a transformer having a low-resistance path. As illustrated, mounted on the shaft of the rotor are three coils surrounding the same number of cores, the ends of the windings being connected with the ends of the rotor circuit. It has been found that if the members constituting the core magnetic circuit are massive in construction and unlaminated, distinct secondary windings are not required, the magnetic material offering low-resistance inductive paths for eddy currents set up, these eddy currents constituting the secondary current of the transformer. An arrangement is provided whereby when the motor arrives at normal speed the transformer magnetic circuit is opened by means of centrifugal force.

LETTERS TO THE EDITORS.

Steam Turbine Economy.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of March 5 Mr. Cyrus Robinson, referring to the results of tests of a 1,250-kw steam turbine, published in your issue of February 20, made some criticisms, to which I would ask your kind permission to reply. I quote from Mr. Robinson's letter the following paragraph:

"We have been informed so many times by the manufacturers of turbines of the necessity of high—in fact almost theoretical—vacuum, that it is somewhat of a question if the high economies claimed are not more than offset by the means adopted to obtain them; viz.: the use of large air and circulating pumps, and superheaters, etc."

It is a surprise to me to learn that any manufacturers of turbines have stated that the turbine requires a high vacuum, and I am sure that it would be interesting to your readers to learn from Mr. Robinson what manufacturers of turbines have made such a statement, and where.

It is a fact, as everyone knows who is acquainted with the theory of the steam turbine, that, as the vacuum increases, each successive increment of vacuum is of greater value in the steam turbine than in the reciprocating engine. It follows, therefore, that it is somewhat more to the advantage of the owner of the steam plant to produce a high vacuum for the turbine than for the reciprocating engine, as he gets a greater return for his outlay in the condensing plant. The desirability—not the necessity—of a high vacuum in the steam turbine, as well as in the reciprocating engine, should not be allowed such a prominent place in one's mind as to overshadow the fact that the steam turbine is highly economical with a much lower vacuum than was obtained in the tests above referred to.

In this connection it should be remembered that not only with turbines, but with reciprocating engines, steam users are appreciating more and more every day the desirability of a high vacuum as conducive to station economy. There is to be found in the market to-day condensing apparatus far superior to any which could be obtained a few years ago, and at prices but little higher than those of the less efficient apparatus which was formerly to be had. With such apparatus, at a less operating expense than with poorer apparatus, such vacua as in the tests above cited are easily obtained, either for use with the reciprocating engine or the turbine.

Incidentally I would say that some, if not all, makes of steam turbines are now so constructed that it is absolutely impossible for any air to get into the exhaust steam, except such as may have come with the steam from the boilers, whereas in the reciprocating engine more or less air enters at the low-pressure piston rod and valve stem stuffing boxes; the amount of air so admitted increasing as the packing wears. With the steam turbine, therefore, for a given amount of exhaust steam, a high vacuum is more easily obtained than with the reciprocating engine. This being the case, why should not the steam turbine fairly derive an advantage from the high vacuum which it incidentally assists to create?

Mr. Robinson says that it is unfortunate that I did not give the consumption of the auxiliaries, particularly the air and circulating pumps and superheaters. No observations of these items were made during the tests referred to, principally for the reason that these auxiliaries in our testing plant are not installed as they should be in a power station with due regard to economy, but rather with regard to the necessary flexibility of a plant which is used for testing machines of various capacities temporarily located in various parts of the testing shop. I have quite recently, however, had an opportunity to get indicator cards from the steam cylinder of the same air pump during the test of a turbine which is an exact duplicate of the one previously tested. With the turbine developing 2,120 brake hp, or considerably above rated load, with the barometer at 29.18, and carrying a vacuum of 27.89 in. by mercury column, equivalent to 28.71 in. referred to a 30-in. barometer, the indicated power of the air pump engine was 14.4, or less than seven-tenths of one per cent. of the power developed by the turbine.

A good proportion of this power would be required to maintain only such a vacuum as is found in the older and inferior forms of condensing apparatus. But, for the sake of argument, let us assume that the whole of this power was expended in increasing the vacuum from 27 to 28 in., and let us suppose that the air pump engine consumes as much as 25 pounds of steam per indicated hp-hour. This would call for an expenditure of 260 pounds of steam per hour. Now, referring to the results of turbine tests in your issue of February 20, it will be seen that, when using saturated steam, an increase from 27-in. to 28-in. vacuum decreased the steam consumption of the turbine by 0.68 pound per kw-hour. At the rated load of 1,250 kw, therefore, the steam consumption of the turbine was bettered to the extent of 850 pounds per hour by the increase in vacuum.

We therefore have a balance in favor of the better vacuum equivalent to 850-360-490 pounds of steam per hour, which is a little over 2 per cent. of the total steam consumption of the turbine. Even this 2 per cent. would be worth saving, but as a matter of fact the saving is much greater, because the power required to increase the vacuum can be nowhere near as great as that above assumed. Moreover, in this testing plant the condensing apparatus works under great disadvantage, for the reason that it is connected up to an extensive exhaust pipe system having an abnormal number of turns, offsets, etc., in order to lead to the various testing stands, and the exhaust piping is handicapped by a large number of blank flanges and other temporary joints, thus making it more difficult to maintain a vacuum than in a regular power plant.

As to the power required for working the circulating pump, any data which might be derived from the testing plant would be misleading, as the exigencies incident to a combination of testing and manufacturing operations require a plant quite different from what would be used in a regular power station. In a properly designed power station, moreover, the power required to work the circulating pump of a modern condensing apparatus is extremely small, as the pump requires to do nothing but overcome the friction of the pipes and condenser tubes, etc. With everything properly designed and installed, the entire power required to work not only the air pump, but the circulating pump could be charged to the increase of vacuum from 27 in. to 28 in. and still leave a paying margin of profit, no matter whether the condensing apparatus is used in connection with a steam turbine or with a reciprocating engine.

As to superheat, the gain to be derived from this, in a properly-designed plant, either in a steam turbine or in a reciprocating engine, is too well known to require any defense. In the above referred-to turbine tests, however, the economic results were stated both with and without superheat, and the reader is, therefore, enabled to make the necessary comparisons.

I would quote further from Mr. Robinson's criticism as follows:

"Articles of this kind are apt to be misleading, and as an illustration the operation of a compound reciprocating engine by means of the air pump may be cited, where no steam is actually consumed by the engine itself, the work being done entirely by the 'vacuum,' i. e., atmospheric pressure."

This might be said of any test of any kind of apparatus. In this case, however, as will be seen by referring to the article in your issue of February 20, we took the precaution to have all of the results of the turbine test verified and certified to by a disinterested engineer, whose reputation is above criticism, namely, Mr. Julian Kennedy, the well-known consulting engineer.

PITTSBURG, PA. A. M. MATTICE.

British Technical Education.

To the Editors of Electrical World and Engineer:

SIRS:—I beg you to allow me as an unprejudiced American educated in England, to enter a voice of protest against your editorial on English technical education, in the issue of March 26. I must first point out that your comparison of time spent in the colleges is not quite fair. Nearly all of the men at my college, the Central Technical College, of London, had spent from one to four years at either one of the universities of Oxford or Cambridge or the scientific school of Dulwich College, or at the Finsbury Technical College or some equivalent institution. It will not do to say that the time devoted to technical education in England is short, because the average time spent at the Finsbury College is, say, two years. It is necessary to follow the student to the higher college before one can accurately judge what he is doing. The matriculation examination of the Central covers the subjects treated in the Freshman year of the American college, so that a student practically enters at once into the equivalent of the American sophomore year. That is why the course at the Central Technical college extends over only three years, instead of four, as in America. An experience of four years in London technical institutions and four years acquaintance with American college graduates, leads me to the conclusion that the American college, in attempting to be very practical, neglects the fundamental knowledge that is so important to the engineer. The English professors, unlike their American brethren, do not attempt to grind out experienced engineers by the wholesale. Care is taken to give the men a good grounding in fundamentals, something that American technical graduates are usually sadly lacking in. I shall never forget my first experience with a Massachusetts Institute of Technology man. He was fresh from college, but seemed to know a great deal about practical details of machine design, wiring, railway work and so forth. We were discussing a recent paper on transformers, published by the Institute, when he asked, "Why does the reading of an ammeter in a transformer circuit include the wattless current? I cannot see how a wattless current can operate an ammeter." Probably he was not a representative M. I. T. man—I hope not—but the mere fact that a man could spend four years at college and get a degree, and then ask such an idiotic question illustrates that the college faculty considers a practical knowledge of transformers more important than a knowledge of the fundamental principles governing these apparatus. I don't think college the correct place to learn engineering practice—that can only be learned by hard work in the shops and drafting room.

Another reason why there are so many students in England who do not take the full three years' course is that men who cannot follow the work are dropped. They are either requested to leave or expelled, for the diplomas and certificates are not awarded to all as they apparently are in many of our American colleges.

Let us not rejoice too noisily over our institutions until we have learned all we can from our friends across the ocean.

NEW YORK CITY. WM. A. DEL MAR.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Voltage Variation of a Direct-Current Dynamo and a Direct-Current Voltage Transformer.—ALIAMET.—An illustrated description of a direct machine of Lanhoffer. The voltage which can be obtained at the terminals of a direct-current dynamo cannot be varied within wide limits, since an upper limit is set by the saturation of the magnetic circuit while the lower limit is determined by the conditions of good commutation. If the ratio of the highest and lowest voltage under which a dynamo can be operated successfully is called the coefficient of variation of the tension, this coefficient is generally below 1.5. The machine of Lanhoffer enables one to increase it over 5. It consists, as shown in Fig. 1, of two machines with inde-

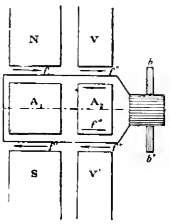


FIG. 1.—VOLTAGE VARIATION.

pendent stationary field systems while the two armature cores are mounted on the same axle. The armature winding passes over both cores. The excitation of the field $N S$ is kept constant while the exciting current of the field $V V'$ can be varied and reversed. For this reason a rheostat with a reversing switch is provided in the exciting circuit of $V V'$. The field $N S$ may be excited either by a separate source of current or a method of self-excitation may be used; in the latter case the exciting current for $N S$ is furnished from a special winding which is wound only around the core A_1 and not around A_2. If the e.m.f's induced in the common armature circuit by the field $V V'$ are of the same sign as the e.m.f's induced by the field $N S$, the machine $V A_2 V'$ acts as a booster; if the e.m.f's are of the opposite sign, this machine acts as a negative booster. The same arrangement may be used as a direct-current voltage transformer with a ratio of transformation being variable within rather wide limits. In this case, of course, a second commutator must be provided which is supplied from the external circuit at constant voltage. This commutator is connected to the armature winding of core A_1 alone. The transformed current is taken up from the brushes $b b'$. The author gives some theoretical notes on the operation of this machine with special reference to armature reaction and to commutation.—*La Revue Elec.*, February 1.

Speed and Type of Electric Motors.—An account of the discussion which followed the paper of Hobart on the comparative advantages of direct-current motors and induction motors for various speeds. This paper was abstracted in the Digest last week. Thompson said that the contrast between the designs of a number of machines of the same rated output emphasizes several very important features of design. In comparing machines of one kind with those of another, it is useful to go back to first principles and to apply a formula which is applicable to all cases. He has found the following formula very convenient for comparing all kinds of motors and generators, whether direct-current, single-phase or three-phase alternating current. It states that the output of the machine in kilovolt-amperes divided by the speed in revolutions per minute equals the magnetic flux multiplied by a coefficient which varies with the type of machine (being 1 for continuous-current machines and theoretically 1.11 for alternating-current machines), multiplied by the diameter of armature, multiplied by the amperes per inch of armature, multiplied by the number of poles, the whole divided by 1.9×10^{12}. He shows that the eleven machines analyzed by Hobart show some very curious and interesting variations. Drysdale said that Hobart's result concerning cost might well be expressed by saying that the cost is about 25 cents per square centimeter of core area for the large machines discussed by him. Drysdale has found himself that small machines from 2 to 10 hp give a surprisingly uniform value of about 60 cents per square centimeter of core area, and he thinks that this is rather a valuable basis of comparison, since, when taken into consideration with the Steinmetz coefficient, it affords a considerable help in design. Meyer expressed the opinion that all the facts brought forward by Hobart are of a theoretical nature, and discussed several details.—Lond. *Elec.*, March 18.

Operation of Alternators in Parallel.—BOHLE.—A continuation of his illustrated paper. He shows that the mass of a fly-wheel should be directly proportional to the coefficient of fluctuation of energy and the work done by the engine, and inversely proportional to the coefficient of speed variation and the square of the speed. Multi-crank engines should be given a smaller coefficient of speed variation than single-cylinder sets. There is absolutely no reason why alternators driven by single-crank prime-movers should not give first-class results when running in parallel. Where trouble occurs it is almost always due to resonance. Trouble occurring with single-crank sets and being due to resonance is made worse by interference of oscillations and can be avoided by decreasing the fly-wheel mass if the coefficient of speed variation is as low as 1/200. The fly-wheel mass will still be large enough to count for any irregular changes. The coefficient of speed regulation should, however, never be larger than 1/100. In multi-crank sets, working under similar conditions, the coefficient of speed variation should not be less than 1/150, so that, whenever there is nearly resonance, the fly-wheel mass should be increased. 1/300 should, however, be the limit in the other direction, otherwise the machines become too expensive.—Lond. *Elec.*, March 18.

REFERENCES.

Compensated Series Motor.—OSNOS.—A long theoretical article in which the author develops the diagrams for the compensated series motor and draws from them some general conclusions. While the voltage at the terminals remains constant, the voltage at the stator increases with increasing speed, but the voltage at the rotor (between the brushes connected in series with the stator) always decreases. The stray fields have an effect equivalent to an increase of the primary stator field and a decrease of the primary rotor field or like an increase of the air-gap which always results in a greater phase difference, other things being equal. Concerning the arrangement of the slots he finds that the best arrangement is the uniformly distributed one with a coil breadth equal to the pole pitch.—*Elek. Zeit.*, March 17.

Single-Phase Commutator Motors.—Sumec.—The first part of a mathematical article in which the author intends to give a simple review of the properties of single-phase commutator motors. His method is to first give for each electric circuit of the system under consideration an equation of the e.m.f's and then to represent all these equations by means of vector diagrams. He intends to combine in this way the accuracy of mathematical methods with the clearness of the graphical methods.—*Zeit. f. Elek.* (Vienna), March 20.

Sparking of Dynamo.—Mailloux.—An article with reference to a former article of Browne, in which troubles were recorded that had been experienced with a dynamo sparking on account of a weakened magnetic field in an electrolytic refinery in which a number of tanks had been disconnected. He discusses briefly the possibility of sparkless commutation with full-load current at low e.m.f's and also discusses the prevention of the reversal of the magnetic field due to the counter e.m.f. of the electrolytic vats under certain conditions of switching.—*Electrochem. Ind.*, April.

Power.

High-Tension, Direct-Current Power Transmission.—A note on experiments made on the St. Maurice-Lausanne transmission line on which the Thury system is used. The earth was first used as a return conductor in the ordinary sense, with the transmission voltage equal to the maximum pressure allowable between line and earth and then as the middle wire in a three-wire system with a voltage between the outers equal to double the voltage between earth and either of the outers. On one day, during damp and partially cloudy weather the transmission line was fed with direct current at 20,000 volts and the total leakage amounted to 0.01299 amp., which corresponds to a loss of 0.0866 watt per insulator. When the earth was substituted for one conductor during the ordinary service of the power transmission the drop of volts at the earth plates at Lausanne was observed to be 25 volts and that at St. Maurice 185 volts, the resistance of the earth being negligible.—Lond. *Elec.*, March 18.

References.

Motor-Driven Roller Tables.—Kingsbury.—A full account of tests of motor-driven roller tables at the Duquesne steel works of the Carnegie Steel Company. The object of the tests was to determine data for use in estimating the sizes of motors required in this class of service. The tests were made during the regular operation of the machinery; additional runs were made without loads on the rollers, for determining the no-load friction. The first test was made with a roller table in a 40-in. mill and the second test with a skew table for a 14-in. mill. The article is fully illustrated by diagrams and the results of the tests are given in tables, but it is impossible to abstract them briefly.—*Iron Age*, March 31.

Electric Cranes.—The first part of a fully illustrated paper read before the Vienna Electrical Society on some recent styles of electric cranes. Among them is one which is designed more with a point of view of preventing accidents during lifting or lowering the load than with an intention to get a high current efficiency. As a special feature of the crane is mentioned the use of series motors and series brake magnets which are believed to be more suitable and safer for heavy crane service, since the series motor develops a higher torque for the same current consumption than the shunt motor, while it has the great advantage of automatic speed regulation; that is light loads are lifted more quickly than heavy loads. The series brake magnet is also considered to be better for the purpose of safety. Various constructions of new cranes are illustrated. The article is to be concluded.—*Zeit. f. Elek.* (Vienna), March 20.

Indicator Diagrams.—Concerning the applicability of electrical methods for taking indicator diagrams. (See the abstract on electrical methods for measuring temperatures, under "Units, Measurements and Instruments.")

Traction.

English Electric Railways.—A long editorial review of this subject. The first electric railway in the United Kingdom between Portrush and the Giant's Causeway was opened in 1883. It was built on the third-rail system, but was altered into an ordinary overhead trolley system in 1899. Another short electric railway on the third-rail system was opened at Brighton in 1883 and this is still running. These lines were both very light railways, practically tramways. Two conduit tramway lines were built, one between Gravesend and Northfleet, the other at Blackpool; "but as in the case of many other engineering developments, England took the initiative and then paused, America worked further at the problem and the fully-developed American systems were then brought over to England." The City & South London Railway Company opened the first "tube" line in 1890; in 1893 the Liverpool overhead railway was opened; in 1898 the Waterloo City "tube," and the Central London Railway in 1900. The first steam railway to be electrified was the Mersey Railway, the second is the Liverpool-Southport section of the Lancashire & Yorkshire Railway and the third will be the Tyneside lines of the Northeastern Railway. While the Mersey Railway is self-contained the Liverpool-Southport line, although three times its length, is but one section of the large network of suburban lines owned by the main railway company serving Liverpool. The success of this section will, therefore, mean the electrical equipment of all the other suburban lines of the Lancashire & Yorkshire Railway, so that standardization of track and working voltage was important. A third-rail system was chosen with the third rail outside the running rails and 3 ft. 11½ in. from the center of the 4-ft. 8½-in. gauge. The line voltage was fixed at 600. In the Lancashire & Yorkshire system a fourth rail is employed in the center of the track, but it is not used as a contact rail, being simply bonded to the running rails to decrease the resistance of the return conductor. Three-phase generation and distribution at high pressure is used, with conversion by transformers and synchronous converters to 600-volt direct current in sub-stations. In choosing between direct control and indirect control by means of electromagnetic or electropneumatic switches for several car trains, the company has decided in favor of the former. A double unit system has been adopted with a motor car at each end of the train and two trailers in the middle. This has necessitated the use of no less than eight cable couplings from one end of the train to the other. Two main cables, from auxiliary cables for the series-parallel control, and two cables for working the reversing switches at the motors. There are thus two controller barrels worked by one handle in the cab of each motor car, each barrel controlling the four motors under one of the motor cars. By this method the "contactors" or the electropneumatic devices of the usual multiple-unit systems are dispensed with. (See also the next abstract.)—Lond. *Elec.*, March 18.

English Electric Railway.—The first part of an illustrated description of the electrical equipment of the Liverpool-Southport section of the Lancashire & Yorkshire Railway. This will be the first section of a main-line railway to be worked electrically in England. The distance between Liverpool and Southport is nearly 18½ miles, while the total length of track equipped is practically equivalent to 47 miles of single track. Under steam conditions there are about 36 trains per day in each direction, which will be increased to 65 under electric operation. The running time for local trains, which is 54 minutes with steam traction, will be reduced to 38. The train mileage will be increased from 1,900 to 3,200 per day. Electrical energy is generated as three-phase alternating currents at 7,500 volts and transmitted to sub-stations with step-down transformers and synchronous converters of 650 volts pressure, the maximum voltage at the trains being 600. In addition to some rotary converters at the main power house, the scheme embraces three sub-stations. The generating plant contains four 1,500-kw units and one 750-kw set besides the converters.—Lond. *Elec.*, March 18.

Mendel Road.—Thomann.—The conclusion of his illustrated article on the Mendel Railroad in Southern Tyrol. One part of it is ordinary adhesion road, while the last part of which has very considerable grades, is cable road, one car going always down while another goes up. The cable is operated by a direct-current motor, which is supplied from the same motor-generator which also feeds the adhesion road. This motor-generator consists of a 100-hp, 3,600-volt, 42-period, three-phase induction motor, running at 610 revolutions, and a 60-kw, 650-volt shunt-wound direct-current generator, which is connected in parallel with a storage battery of 324 cells with a capacity of 248 amp.-hours. The high-tension, three-phase currents are transmitted from a hydro-electric plant at a distance of 12 km. The motor which operates the cable is a shunt-wound, 600-volt, 90 to 110-hp, direct-current motor, running at 600 revolutions. Should the car which goes down the mountain carry more than the other one which goes up, the cable motor has a braking effect, since it then acts as generator and sends current into the network. The arrangement of the brakes is described in detail, with the results of tests.—*Eletr. Bahnen*, March, No. 5.

REFERENCE.

Single-Phase Traction.—EICHBERG.—A description, fully illustrated by diagrams and illustrations, of the single-phase traction system on the road from Nieder-Schoenweide to Spindlersfeld, where the Winter-Eichberg motor is used, has been repeatedly noticed in ELECTRICAL WORLD AND ENGINEER.—*Zeit. d. Ver. Deutscher Ing.*, February 27.

WIRES, WIRING AND CONDUITS.

Earth Connections.—MOON.—The first part of an article in which the author points out that a damp situation and a porous soil are not the only necessary conditions required for a good earth connection, but that much depends upon the nature of the soil in which the earth plate is sunk. He gives numerical data on the conductivity of various kinds of soil. He gives some notes on the determination of the conductivity of the soil in a given case. After it has been measured, the resistance of an earth connection can be calculated. He gives the formulæ for special cases and shows that the resistance under the most favorable conditions of an earth plate 2½ ft. square would be about ¾ of an ohm for a plate sunk in the sea, 3 ohms for pure clays, 10 to 15 ohms for mixtures of gravels and clays, and as high as 40 ohms for some mixtures of sands and gravels, or of porous rocks. The least resistance of an earth connection which he has yet measured is 7 ohms, and the mean resistance of a large number of measurements was between 15 and 20 ohms. He gives detailed instructions how to sink an earth plate, and shows that even under the most favorable conditions the resistance of an earth connection is inversely proportional to the dimensions of the plate, and that in many cases it would be little decreased by using a larger plate. A number of small plates, sunk some distance apart, is in any case a more efficient earth connection than one large one; and this is the more so, if the conducting layer of soil is shallow.—Lond. *Elec. Rev.*, March 18.

ELECTRO-PHYSICS AND MAGNETISM.

N-Rays.—Some notes on new properties which N-rays have been found to possess. Blondlot has found that besides the kind of N-rays already described, there exists another kind which reduces the luminosity of a feebly luminous surface instead of increasing it. Bagard has succeeded in reproducing the rotation of the plane of polarization in a magnetic field which was first produced by Faraday in the case of ordinary plane polarized light, and is usually known as the Faraday effect. Since ordinary light consists of waves about 100 times as long as those which make up N-rays, and since according to Faraday the rotation increases as the waves become smaller, it was natural to expect the Faraday effect to be very large in the latter. This has been fully verified by Bagard, who obtained rotations in aluminum and in carbon bisulphide, such as can, with ordinary light only to be obtained in quartz. Blondlot has found a probable explanation of the failure of many other physicists to repeat his observations. It lies in the fact that the emission of light is affected by N-rays in the sense of being concentrated upon the normal rather than upon the tangent plane. Thus an observer watching the surface perpendicularly sees it brighten up while if he watches it along the edge it appears to become duller. In the case of N-rays the reverse is the case.—*Comptes Rendus*, February 29; abstracted in Lond. *Elec.*, March 18.

Demonstrating the Absorption of Radium Radiations.—PASCHEN.—An illustrated note showing that the apparatus of Strutt for demonstrating the positive charge of radium enclosed in a glass tube, may be modified so as to demonstrate also the negative charge of the β radiation which penetrates the glass. As shown in Fig. 2, a glass bottle which may be evacuated contains the small glass tube, *b*, which contains a radium-barium preparation and is suspended by means of the quartz rod, *a*. Two quartz tubes, a_1 and a_{11}, hold the hollow lead vessel, *c*, of a thickness of 2 mm., which is completely insulated from *b*. Through *b* passes in spiral form the platinum wire, *f*, which is connected to the electroscope, *d*. The second electroscope, *e*, is fixed to the lead cylinder. As soon as a good vacuum is reached, both electroscopes diverge, *d* with positive electricity, *e* with negative electricity. It is also possible to demonstrate the current which flows from the interior of the glass tube to the lead cylinder, if both are

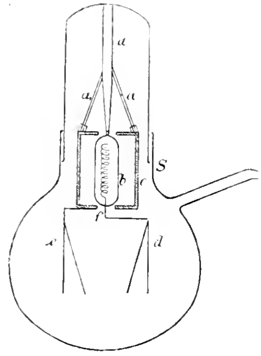


FIG. 2.—ABSORPTION OF RADIUM RADIATIONS.

connected by a wire. This current was first measured by Wien. The divergence of *e* is always smaller than that of *d*, especially on account of imperfect absorption of the β radiation in lead of 2 mm. thickness. Within an hour the electroscopes converge and the charges of their conductors are neutralized, but the neutralization is not complete, both electroscopes showing afterwards a small positive charge.—*Phys. Zeit.*, March 15.

δ-Rays.—A note describing some experiments which Eve has made with Röntgen rays of high penetrating power. Rutherford concludes that Eve's results remove the strongest objection to the view that the δ-rays given out by radioactive bodies are nothing more than an extremely penetrating type of Röntgen rays. It is thus reasonable to expect that these rays are set up as a result of the sudden expulsion of the β particle from the atom of a radioactive body.—From *Nature*, in Lond. *Elec.*, March 18.

REFERENCE.

Electroscope in Vacuum.—PASCHEN.—A note in which he confirms an observation made by Guggenheimer and Korn that two small strips of aluminum, in form of an electroscope, diverge in a vacuum under the influence of light. They believed that the aluminum strips had assumed a positive charge, while the present author thinks that the observation is not an electric phenomenon, but rather due to radiometer action.—*Phys. Zeit.*, March 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Precipitation of Gold.—HAMILTON.—A very full account of the modifications which the Siemens & Halske electrolytic process, as originally worked in South Africa for precipitating gold from cyanide solutions, has undergone in recent years in this country and in Mexico. The main changes are the use of a lead peroxide instead of an iron anode and the fact that the gold is not plated upon the cathode, but is obtained in form of slime, which falls to the bottom. The lead peroxide anodes are practicably indestructible and since there is no compound formed at the anode, like the Prussian blue with iron anodes, they are not covered with canvas. Being indestructible, they do not limit the current density employed. The cathodes are made of tin and are continually kept in the tanks. A good junction between the cathodes and the external conductors is thus rendered possible. The most favorable current density depends upon the amount of gold in solution, the rate of flow of the solution and upon the area of the electrodes. The author gives a full account of measurements which he has made.—*Electrochem. Ind.*, April.

Electroanalysis.—PERKIN AND PREBBLE.—A Faraday Society paper on the electrolytic analysis of gold. They recommend the use of solution of gold salts in ammonium thiocyanate. With a current density of 0.2 amp. per sq. dm. the deposition of 0.05 to 0.08 gram in gold solutions is complete in from 5 to 6 hours. With a current density of 0.4 to 0.5 amp. it is generally possible, even at normal temperatures, to deposit the gold in from 1½ to 2 hours. The appearance of the deposit is generally better when obtained at low current densities and from solutions containing small quantities of gold. For removing the deposited gold from the platinum cathodes, they recommend a solution containing potassium cyanide, with an oxidizing agent such as hydrogen peroxide, sodium peroxide or an alkali persulphate.—*Electrochem. & Met.*, February.

Corrosion of Aluminum.—MOTT.—An article, illustrated by diagrams, on the corrosion of aluminum and its prevention. A film forms over an aluminum anode in certain solutions, such as sodium acid phosphate, and this film greatly decreases the rate of corrosion of aluminum. The author gives results of experiments upon the special protective action of this film, which is many times thicker and chemically different from the ordinary film that form upon aluminum in air. The author thinks that utensils such as aluminum jars, cups, combs, etc., and all kinds of aluminum handles could be coated with this film to advantage. Another field of importance is the treatment of electric lines of aluminum exposed along the sea coasts to the corrosive action of sodium chloride.—*Electrochem. Ind.*, April.

Nickel Refining.—GUENTHER.—An account of successful laboratory experiments on nickel refining. He recommends the use of a sulphate or chloride solution and a somewhat elevated temperature, and a current density of 250 to 275 amp. per sq. meter. The electrolyte is kept slightly acid; the content of free acid—either sulphuric or hydrochloric acid—should be 0.03 to 0.25 per cent. At the cathode more nickel is deposited than is dissolved from the anode; the balance is to be continuously supplied to the bath in form of a concentrate salt solution.—*Metallurgie*, March 10.

REFERENCE.

Gibbs-Helmholtz Equation.—CARHART.—An article in which the author shows that while the Gibbs-Helmholtz principle has been proven to be correct beyond doubt by experiments with various cells, yet the Daniell cell should not be quoted among them, since there are no absolutely correct data for any specific solutions of this cell available.—*Electrochem. Ind.*, April.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electric Nomenclature.—HOSPITALIER.—The author proposes for discussion the following suggestions: He wants them to be taken up by the general body of members of the International Electric Congress in St. Louis, but not by the board of official delegates (which he calls the Senate of the Congress). A physical quantity defined as the quotient of two other quantities gets its name from the numerator in combination with the name of the denominator, the latter in adjective form. A physical quantity defined as the product of two other quantities gets its name by combining the two quantities together and joining them by a hyphen; thus, force-length is work. The following adjectives are proposed: linear for length, surfacic or sectional for surface, volumic for volume, massic for mass, temporic or chronic for time, poweric (puissancique) for power, ergic for energy or work. The symbols in the physical formulæ should be printed in italics, or Greek letters, while the abbreviations or units should be printed in Roman characters. The table of symbols and of abbreviations recommended by the Board of Delegates of the International Electric Congress of Chicago in 1893 and printed as a supplement to the *Proceedings* of this Congress, should be revised, completed and adopted as a table of international symbols and abbreviations for the principal physical and electrical quantities and units. For alternating currents he would suggest the following terminology: active current for what we now call the energy component of the current; imaginary current for what we now call the energy component of the current; imaginary current for what we now call the wattless component of the current; and correspondingly, active power and imaginary power.—*L'Industrie Elec.*, March 10.

Electrogoniometer.—CHAUMAT.—A paper read before the International Society of Electricians in Paris on an instrument of Routin for measuring the phase difference between e.m.f. and current in a three-phase system. The method is a zero method, one e.m.f. u_1 in phase with the current being opposed by another u_2, equal to the former and variable with one of the tensions of the three-phase system, E (Fig. 3). The angle e represents the phase difference to be determined. The principle of the method is indicated in Fig. 4. One essential part of the apparatus is a transformer, the primary of which is in series with the phase $A\,O$ of the three-phase system, while the secondary is shunted by a non-inductive resistance; the tension at its terminals is u_1. The second essential part is a device, called decaleur, which is connected on one side to the three phases of the three-phase system, and which produces at the other side the tension u_2, opposed to u_1. Two hot-wire voltmeters, V_1 and V_2,

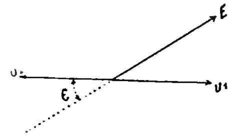


FIG. 3.—MEASURING PHASE DIFFERENCES.

of different sensitiveness, enable one to estimate one-tenth of a volt, which represents an accuracy corresponding to one-third degree for the angle of phase to be measured. The transformer has a primary

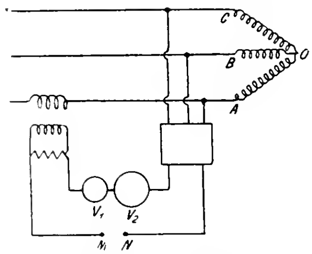


FIG. 4.—DIAGRAM OF CONNECTIONS.

with four coils, each of 25 turns, and permits the use of a current of 25 amp.; the secondary has 1,800 turns. For a phase difference smaller than 1°, the absorbed power is 1.1 watt. The principle of the "décaleur" is shown in Fig. 5, in which $O\,A$, $O\,B$ and $O\,C$ represent by their length and direction the three e.m.f's of the three-phase system. If an insulating rod, $m\,n$ (of a length equal to $O\,A$)

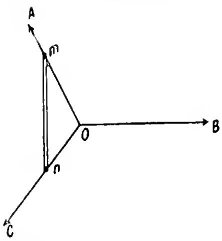


FIG. 5.—DIAGRAM SHOWING PRINCIPLE OF "DÉCALEUR."

is moved with its terminals, m, along $O\,A$ and n along $O\,C$, then the potential difference between m and n is constant, but its phase varies. In this way it is possible to make the phase of u_2 opposite to that of u_1. In practice, this rod, $m\,n$, is moved on a drum with a large number of turns.—*La Revue Elec.*, March 15.

Electrical Methods for Measuring Temperatures.—CALLENDAR.—A note on his concluding lecture on this subject. He demonstrated the applicability of electrical methods for taking indicator diagrams. For this purpose a motor scale had been rigged up in the lecture room and five thermo-couples had been screwed from the outside into the central wall of its small internal combustion engine. Since the thickness of the cylinder casing is about ⅛ of an inch, the temperature indications of the thermo-couples could be taken to represent also the internal temperatures. One couple was placed near the exhaust, another near the inlet and the remaining three were fixed near the top, the middle and the bottom of the stroke, respectively. First he determined the temperatures at these various points. He proved experimentally that the temperature at the exhaust side of the cylinder was considrably higher than at the inlet side, but that, by directing a blast of air from a small fan against the exhaust, this order of things might be reversed and the engine rendered more powerful in consequence. The measurement of the temperatures at the three points of the stroke brought out the fact that these temperatures—contrary to expectation—differed but little, the explanation being that the heat generated in the combustion chamber was rapidly transported to all points of the stroke by the piston. The indicator diagrams which were taken were perfectly continuous at the very highest speeds (about 2,000 r.p.m.) and with their aid the influence of a retarded or advanced spark and of various compositions of the gaseous mixture could be easily studied.—Lond. *Elec.*, March 18.

New Books.

DIE HERSTELLUNG VON METALLGEGENSTANDEN UND DIE ELEKTROGRAVURE. By Dr. W. Pfanhauser. Halle: Wilhelm Knapp. 146 pages. Price, 7 marks.

This volume is the fifth one of the series of monographs on applied electrochemistry, edited by Victor Engelhardt and published by the well-known electrochemical publishing house of Wilhelm Knapp. Its author, Dr. W. Pfanhauser, is a recognized authority on the subject and the author of several other books on galvanotechnics. In the present volume, after a brief historical introduction, he takes up the discussion of the composition of the copper plating bath, as being the most important representative of the galvanotechnic baths. The results obtained by different investigators are summed up, the influence of concentration currents, etc., is investigated, and the maximum current densities allowable under various conditions are given. Then follows an interesting chapter on the physical properties of the deposited copper, with data of tests for tensile strength, etc. The next chapter deals with the question of the anode copper, and in the following two chapters brief data are given on the bath constants, the deposits and the calculations of the latter, and the arrangement of electroplating establishments. Then follows a compilation of the methods used for the purpose of obtaining even deposits, especially on curved and irregular surfaces, and the methods for removing the deposits from the cathode. In the following chapters are grouped together in the order named, the methods for the manufacture of metallic powders, metallic foils, wires, vessels of various forms, parabolic mirrors and tubes. The next chapter is devoted to electrolytic etching and the last chapter contains a description of Josef Rieder's method of electroengraving. The latter method consists essentially in arranging a steel disc, serving as anode, on top of a block of gypsum, which projects above the surface of the electrolyte. The contact surface of the block is shaped in the form it is proposed to give to the lower surface of the steel disc. The electrolytic vessel is filled with a solution of ammonium chloride, and as the block of gypsum becomes saturated with the latter solution, electrolysis takes place at the contact surface of the block with the iron. As a result, the steel disc is dissolved out corresponding to the shape of the top of the gypsum block on which it rests.

The book is an interesting and valuable contribution to the literature on the subject, the numerous references to journal and patent literature being specially noteworthy. Though the treatment of the various matters dealt with is necessarily brief, the author has succeeded in bringing out clearly the important points, and he has thus been enabled to present a comprehensive review of the state of the art at the present time.

AUFGABEN AUS DER ELEKTROTECHNIK NEBST DEREN LÖSUNGEN. By Dr. Phil. E. Müllendorff. Berlin W.: Verlag von Georg Siemens. 113 pages, 14 illustrations. Price, 2.50 marks.

This small book of problems for the electrical engineer, with their solution, ostensibly attempts to cover the ground recently traversed by Prof. Atkinson in his "Electrical and Magnetic Calculations." The spirit in which Müllendorff has approached his task is indicated in his preface by the words, "It must be conceded that, for electrical engineers, the vital connections between theory and practice are difficult. The pronounced failure of the modern higher instruction in technical studies is that it leads to no practical applications. Many problems whose solution seems simple when presented in the course of instruction, develop unexpected complications and difficulties when applied in subsequent practice." Such an expression on the part of an author would lead one to surmise that he had not vitally grasped the place and significance of electrical theory, and its real relations and applications in practice; and that a lack of thoroughgoing knowledge of such subjects had led him to place an unwarranted emphasis on certain phases of theory, such as that of the transformer; and that he had perused the older academical methods, rather than the later processes of analysis which are inseparably associated with practice. These assumptions are abundantly borne out by the context. Prof. Atkinson has wisely discriminated in his book between a manual for the solution of problems and a text for the derivation of formulas. Müllendorff has confused the two, and sacrificed the unity of his book. In the selection of matter, Prof. Atkinson has broken away from the old and perhaps classical academical problems, and presented only those cases which have an actual application in engineering practice. In this later work the author seems to have gone over the ground anciently cultivated by Cumming and similar writers.

The opening chapter deals with the problems of the absolute system of units. The second chapter seems wholly out of place in a work of this character. Here the writer attempts a numerical exposition of the theory of potential, a subject which belongs properly to such a work as Webster's, intended for electrical physicists. One meets here the mechanics of the Newtonian potential theorem, whose vital application in practice is remote. In the sixth chapter, given to miscellaneous problems, a brief summary is presented of Kelvin's method in line and station economics, which might profitably have been extended to a more adequate discussion. In the chapter devoted to the technics of alternating currents, the usual academical subjects are attempted and their treatment is purely that of analysis. Here, as in general throughout the book, the differential equation is taken for the departure of the discussion and solution. The matter and method are those of the purely analytical discussion of periodical functions; these, however, are conscientiously worked out, and should prove interesting and suggestive. The concluding chapters deal with vector analysis, methods of least squares, and transcendental functions. Thus the book is a pure mathematical and academical summary of the theory of electrophysics, and its matter and treatment are very distantly related to its title and purport.

While Prof. Atkinson's book is representative of American methods of practical instruction, the book of Müllendorff cannot be accepted for German pedagogy. Though German methods of discussion are in the main more obscure and not so clearly directed as American, yet they are far in advance of those presented in this book. There is a certain humor in mathematics which should save the worker from expending pains to obtain the third decimal place, when the first is doubtful; and this humor should dispel the presumptive gravity of a formidable algebraic array of manipulations with capacity and self-induction of copper conductors in air, when their applications are so generally associated with the obscurities and uncertainties of dielectrics and iron.

Müllendorff's book lacks wholly this sense of humor; it lacks also unity of treatment and the true engineering sense, probably because we have here an academician writing for an electrical engineer. The book may prove useful and interesting as a summary of certain academical methods and processes.

BOOKS RECEIVED.

CONTROLE DES INSTALLATIONS ELECTRIQUES. By A. Monmerque. Paris: Ch. Beranger. 775 pages.

ARITHMETIC OF ELECTRICITY. By T. O'Conor Sloane. New York: Norman W. Henley & Co. (16th Edition.) 162 pages, illustrated. Price, $1.00.

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY. Vol. IV. Philadelphia: American Electrochemical Society. 192 pages. Price, $3.00.

ANWENDUNG UND ZUKUNFT DER KONDENSATOREN IN DER WECHSELSTROMTECHNIK. By W. Von Bisicz. Berlin: Julius Springer. 88 pages, 26 illustrations.

DIE ANWENDUNG DER ELEKTRIZITAT FÜR MILITARISCHE ZWECKE. By Dr. Friedrich Wachter. Leipzig: A. Hartleben. 212 pages, 66 illustrations. Price, 4 marks.

ALTERNATING CURRENTS. Their Generation, Distribution and Utilization. By George T. Hanchett, M.E. New York: John Wiley & Sons. 175 pages, illustrated. Price, $1.00.

ELECTRICAL ENGINEERING EXPERIMENTS AND TESTS ON DIRECT-CURRENT MACHINERY. By George F. Sever. New York: D. Van Nostrand Company. 64 pages, 22 illustrations. Price, $1.00.

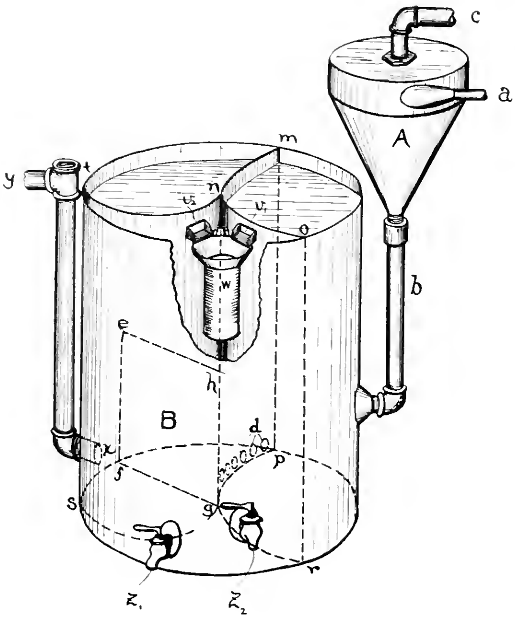
THEORETISCHE GRUNDLAGEN DER STARKSTROM-TECHNIK. By Charles Proteus Steinmetz. Braunschweig: Friedrich Vieweg & Son. 331 pages, illustrated. Price, 9 marks.

Recovery of Cylinder Oil.

By Thomas Griswold, Jr.

A successful, and so far as the writer knows, an original method for the recovery of cylinder oil is practised at the Midland (Mich.) plant of the Dow Chemical Company. A brief description of the means employed may interest central station men and others engaged in economical power production.

The recovery apparatus which we call a "skimmer" is applied to a vertical cross-compound, direct-connected generating unit of 1,600-kw capacity. The engine cylinders are provided with valves in the heads, and are connected by a large intermediate receiver drum without reheating coils. This receiver is at one side and below the cylinders, so that condensation collects in it and must be removed by a trap. Having noticed that the water discharged by the trap was yellow with oil which rose on standing, we first connected up a series of three oil barrels in cascade, letting the discharge enter the first or highest one tangentially near the bilge. This caused a cyclonic action separating the steam and water, the latter falling to the bottom, the former being led away at the top to an open feed water heater. The water was piped from the bottom of the first barrel to the middle of the third by a pipe. The third barrel had an overflow connected with the bottom. The different parts were so arranged that the second and third barrels were kept nearly full of water. We found that about 95 per cent. of the oil rose to the surface in the second barrel and that there was very little oil left in the discharge which passed the third barrel. This outfit, although successful, was not sightly, nor was it cleanly, but it served to demonstrate that by allowing the water to stand quiet for a few minutes a large percentage of oil could be recovered. After skimming a number of gallons and allowing it to further settle and clarify, we strained it and used it again in the same engine with success.



OIL SKIMMER.

The sketch herewith shows in a diagrammatic way the "skimmer" made to replace the barrels. The device consists of a steam and water separator, A, and an oil and water separator, B. The trap discharge enters A tangentially at a, where the water separates by centrifugal force and falls to the bottom, flowing to B through the pipe, b. The steam is led away to the heater through the pipe, c. B is divided into three parts by vertical cylindrically-formed partitions. The parts o, n, m, p, q, r and m, n, t, s, g, p are water compartments connected through the holes at d. The latter compartment is also partially divided by a partition, f, e, h, g, designed to cut off the water about the discharge, x, from disturbing effects due to circulation. The compartment, o, n, t, s, g, r, is for the skimmed oil, which, after it has accumulated to a certain extent on the surface of the water in the other two compartments, flows over the weirs at v_1 and v_2 into the screen or strainer, w. The height of the overflow, y, is regulated to permit the oil to accumulate to a depth of about 8 in. before it rises to the weirs. It is kept fluid by the hot water underneath, and the larger part of the water separates out before it begins to "skim." The oil compartment being bounded on two sides by hot water is also kept warm and the water still further separates there, where it may be drawn off at the faucet, Z_1. The recovered oil is finally drawn at Z_2. The skimmer is also provided with a cover, not shown, and the screen, w, is removable for cleaning.

The action of this device is quite automatic and it seems to recover practically all of the high-pressure oil fed to the engine. The recovered oil appears substantially like that originally fed, and so far seems to answer as well on refeeding. The discharge water is still somewhat yellow, and on agitation with a suitable solvent shows oil in small amount. It seems probable that this lost portion may be largely one particular constituent of the oil as originally compounded, and that eventually the repeatedly recovered oil may lose its "quality" and be fit only for low-pressure oil or for other less important purposes of lubrication where the high-pressure grade is not required.

Storage Battery Installation at Binghamton, N. Y.

An interesting storage battery installation illustrating the handiness of the storage battery for isolated plants has just been made in the power house for lighting and heating, which serves the Broome County buildings at Binghamton, N. Y. The plant as first installed was operated with live current and included a 10 x 9 Westinghouse Junior engine, direct-connected to a 37½-kw Westinghouse 110-volt, direct-current generator. As a matter of fact, however, while this plant was entirely satisfactory, it was found cheaper during the hours of limited lighting to burn gas rather than start up the plant. Under these circumstances in order to get the best possible service out of the installation, it was decided to add a storage battery and the contract was awarded to the Smith Storage Battery Company, of Binghamton, N. Y., for one of their novel and ingenious horizontal tray type batteries. The installation as it now stands equipped is shown in the cut herewith.

The addition to the plant consists as shown of 56 elements of the tray type of 280 amp.-hour capacity, together with a battery panel addition to the original switchboard, this new panel being provided with the necessary switches, voltmeters and ammeters, circuit-breaker and voltage regulator.

STORAGE BATTERY INSTALLATION, BINGHAMTON, N. Y.

The battery is arranged in two piles of 29 trays, each 22 x 48 in., entirely enclosed in glass, something after the manner of a glass showcase, so as to reduce evaporation and exclude dust. The whole presents an extremely neat, simple and workman-like appearance. The result is that no gas is now used in the buildings, and that while the engine during the winter season is only run about five hours a day, there is electric lighting service for 24 hours per day. It is estimated by the Board of Supervisors, to whom the credit is due for this change, that an investment of $10,000 is saving the county about $2,000 a year. This is but one case out of a great many where the storage battery finds a definite function and plays a very useful part.

Data on the Marconi Wireless Telegraph System.

The annual report of the British Marconi Company gives a variety of interesting data, some of which has been published: The Italian Government has been very active in the extension of wireless telegraphy throughout Italy. A number of stations have been erected during the past year which are available exclusively for the use of ships equipped with the Marconi system through the continuous support and assistance of the government of the King of Italy. The site for a high power station, near Pisa, for communicating with the Argentine Republic, and with the company's high-power stations in the United States and Canada, has been selected by Mr. Marconi, and some of the plant for this station is already on order. Arrangements have also been made for a wireless telegraph service between Italy and Montenegro, in the benefits of which the Marconi Company participates. Negotiations have for some time past been going on between the company and the board of trade for the equipment of lightships with wireless telegraph apparatus, and a contract relating to this service is in preparation.

During the year negotiations with a group of Danish financiers were entered into for the connection of Iceland with Europe by wireless telegraphy, that country being at present isolated from the world so far as telegraphic communication is concerned. The negotiations are at present temporarily suspended, partly owing to the inability to obtain from the English post office the facilities for an inland service which are necessary, and partly to other difficulties.

Fifty-four shore stations are now installed commanding the principal shipping routes, these stations being available exclusively for communication with ships equipped with the Marconi system. Among them are stations worked by the British Admiralty, the Italian Admiralty and Lloyd's. As the stations worked by the governments and Lloyds are increased, an extension of the arrangements for working exclusively with ships equipped with the Marconi system will ensue.

Launch Motors and Controllers.

One of the features of the St. Louis Exposition will be the operation of a number of electric launches upon the waterways somewhat in the same manner as at Chicago and the Buffalo Pan-American. The Hertner Electric Company, of Cleveland, Ohio, has recently

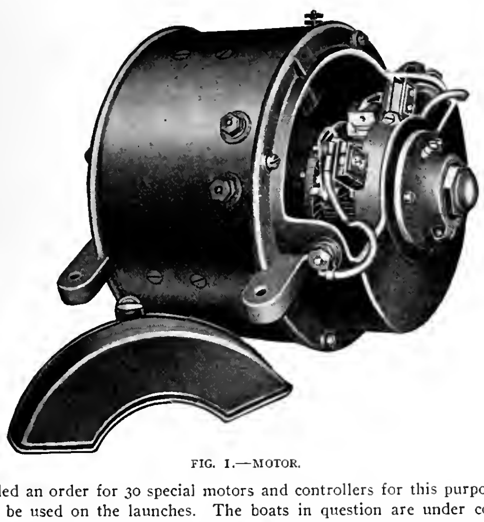


FIG. 1.—MOTOR.

filled an order for 30 special motors and controllers for this purpose, to be used on the launches. The boats in question are under construction by the Truscott Boat Manufacturing Company, of St. Joseph, Mich., and each will seat about 30 persons. Current will be furnished by storage batteries, a 140-amp.-hour, 88-volt Willard battery being furnished for each equipment. As in the case of most of the recent gasoline boats, the motors are of the automobile type and are those built ordinarily by the Hertner Company as their standard 2½-hp for automobile purposes. They are illustrated in Fig. 1 and are multi-polar with forged steel field yoke and laminated poles. Ball bearings are provided so constructed as to take care of end thrust as well as radial pressure. Special heads are used so that the motors are water-tight up to the level of the bearings; the upper half of the front head being left open so as to expose the commutator and brushes, over which a removable cover is provided. The motors are compound wound and designed for high efficiency. The controllers shown in Fig. 2 are arranged for three forward and

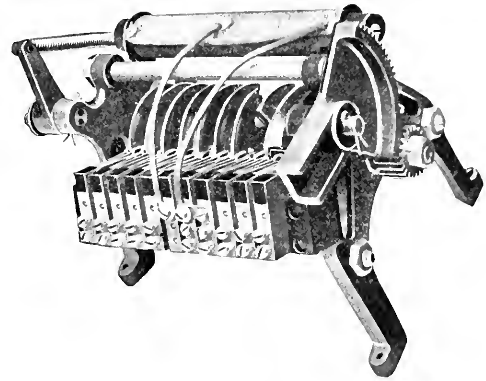


FIG. 2.—CONTROLLER.

two reverse speeds. The first speed forward is on 44 volts with a resistance in series with the armature. The second speed cuts out the resistance. This yields the ordinary rate of running at about 4½ miles per hour when the motor makes 600 r.p.m. For emergencies, the battery is thrown in series, when the motor operates on the full 88 volts and the speed of the boat is hit up to about 6½ miles. The backward speeds are on the 44 and 88 volts, corresponding to the second and third speeds forward. When the controller handle is in the off position the battery is series-connected and can be charged from a regular 110-volt circuit. Exhaustive tests have been made on these equipments, resulting in the St. Louis contract.

Rubber Compound for Electrical Purposes.

A new insulating material has recently been put upon the market by the Electric Rubber Manufacturing Company, which is intended to take the place in some degree of full rubber for the production of battery jars and other purposes. The company named has an adulterant for pure rubber which serves as a substitute for from 25 per cent. and upwards, according to the article required, and which it is said is fully as efficient, although with pure Para rubber costing from $1 to $1.40 a pound, the adulterant can be sold for 12 cents a pounds. With regard to this material, a sample of which made up in a resilient battery jar has been shown us, tests and analyses are submitted by Prof. A. F. Ganz, of the Stevens Institute of Technology, and Mr. W. J. Comly, an electrochemist of New York City. Speaking of the sample submitted to him resembling vulcanized rubber and in the form of a plate measuring 14½ x 11½ x ¼ in., Prof. Ganz states that the insulation resistance determined was greater than 50,000 megohms. Dr. W. E. Geyer, after testing insulated wire with the same compound applied to it and having a thickness of vulcanized insulation of .071 in. on a copper wire of .039 in. diameter, stated that the insulation resistance on one minute electrification at 68° F., after four days immersion in water, was 350 megohms per mile. The capacity per mile was 0.677 microfarad. The resistance to rupture in a length of about 100 ft. tested by means of alternating current was shown by a rupture occurring at 7,000 effective volts. This insulation would appear to have been vulcanized for 40 minutes at 270° F. Other tests are quoted together with the report of Mr. Comly on the resilient battery jars, which stood up under severe tests with sulphuric acid, caustic potash, etc. Some of these jars are reported to have been in use by Altman & Co., in New York City, in their automobile delivery wagons with satisfactory results.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was strong in tone but there was slackened activity. The harmonious situation in the settlement of the Northern Securities matter had a good influence, yet it did not attract any great outside public interest. The principal incident of the week was the large purchases of Union Pacific common, supposed to be by Standard Oil financiers, who are interested in the St. Paul road. The Easter holidays created dullness toward the end of the week, and trading became decidedly professional. There was an inclination to accept a cheerful view about iron and steel trade conditions and prospects, and the current belief is that the United States Steel directors will this week declare the regular 1¾ per cent. dividend on Steel preferred, even though the earnings for the March quarter fall to around $10,000,000, as compared with some $25,000,000 for the same three months last year. Steel shares and the second mortgage 5 per cent. bonds of the corporation were decidedly strong. The easy money market was a supporting element in the stock market. The electric and traction securities showed a firmer tone and better prices were secured, all closing with net gains except General Electric, which lost 1⅜ points, closing at 164⅝. Allis-Chalmers preferred was steady at 40, an advance of ½ point. The greatest gain was in American Telephone & Telegraph, which ruled at 124¼ throughout the week, this being also the closing figure and a gain of 4¾ points. Brooklyn Rapid Transit and Metropolitan Street Railway both made a net gain of ⅞ point, the former closing at 44⅛ and the latter at 111⅞. Western Union closed at 88½, thus making a net gain of ¼. Westinghouse Electric closed at 159 ex.-div. The curb market was generally firm, with a reduced volume of business. There was an active demand in Interborough Rapid Transit, which brought about a rise of several points in that stock in the anticipation of the early opening of the subway. This event, however, will not occur, according to a statement from Mr. McDonald, until August, or later, depending largely upon the attitude of the labor organizations during the summer. Below are given the closing quotations of April 5. In Boston stocks were generally quiet on account of the holidays. Massachusetts Electric lost ¼ point. The market was quite devoid of features.

NEW YORK.

	Mar. 29	Apl. 5		Mar. 29	Apl. 5
Allis-Chalmers Co.	7½	7½	Electric Vehicle	6½	7¼
Allis-Chalmers Co. pfd.	40	43	Electric Vehicle pfd.	10	10
American Tel. & Cable	84	85	General Electric	165	163
American Tel. & Tel.	124	126	Hudson River Tel.	..	..
American Dist. Tel	23	23	Metropolitan St. Ry.	111¾	113¼
Brooklyn Rapid Transit	43⅝	44¼	N. Y. & N. J. Tel.	..	..
Commercial Cable	173	170	Marconi Tel.	..	..
Electric Boat	*21	20	Western Union Tel.	88⅛	88¼
Electric Boat pfd	52	50	Westinghouse com.	159	160
Electric Lead Reduction	¾	¾	Westinghouse pfd.	175	175

BOSTON.

	Mar. 29	Apl. 5		Mar. 29	Apl. 5
American Tel. & Tel	125¼	126	Western Tel. & Tel. pfd.	75	80
Cumberland Telephone	114	113	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	234	225½	New England Telephone	120⅛	120
General Electric	166	163	Mass. Elec. Ry.	18⅛	19
Western Tel. & Tel	8¼	8	Mass. Elec. Ry. pfd.	72½	74

PHILADELPHIA.

	Mar. 29	Apl. 5		Mar. 29	Apl. 5
American Railways	43	43	Phila. Traction	95½	95⅜
Elec. Storage Battery	56	56	Phila. Electric	5⅞	5⅞
Elec. Storage Battery pfd.	56	56	Phila. Rapid Trans.	14	13¾
Elec. Co. of America	8	8			

CHICAGO.

	Mar. 29	Apl. 5		Mar. 29	Apl. 5
Central Union Tel	..	..	National Carbon pfd.	100	..
Chicago Edison		..	Metropolitan Elev. com.	16	..
Chicago City Ry.	165	..	Union Traction	5	..
Chicago Tel. Co.	..	..	Union Traction pfd.	.	..
National Carbon	29	..			

*Asked

FRANCHISE VALUATIONS.—Special franchise valuations in New York City, as computed by the State Tax Commissioners, and on which the corporation franchise tax is levied, increased $16,363,725 over the aggregate for the previous year, the grand totals being respectively $235,157,725 and $251,521,450. In a number of instances the valuations were lower than the previous year, but in the majority of cases, where changes were made the valuations show an increase. The new corporations receiving franchises in 1903 number but 10, and the total valuation of their franchises is but $16,300. This leaves the net increase in 1903 in the old companies $16,347,425. The largest increases is that of the Consolidated Gas Company, of New York, being $3,917,000, and the greatest reduction was in New York Telephone (Manhattan branch), $239,000. The larger of the increases are: New York Edison Company (Bronx), $70,000, and (Manhattan), $1,965,000; New York Mutual Gas Light Company, $251,500; United Electric Light & Power Company, $315,000; Empire Subway, $546,000; New York & New Jersey Telephone Company (Brooklyn), $428,000, and (Queens), $40,000; Brooklyn City & Newtown Railroad, $84,000; Bleecker Street & Fulton Ferry Railroad, $115,000; Christopher & Tenth Street Railroad, $100,000; Metropolitan Street Railway, $67,000; Union Railway (Bronx), $188,000; New York & Queens County Railroad, $70,000; Consolidated Telegraph & Electrical Subway, $733,000; Manhattan Railway, $2,600,000; Edison Electric Illuminating Company, Brooklyn, $1,034,000; New York Telephone Company (Bronx), $43,000; Western Union Telegraph Company, $30,000; Brooklyn City Railroad Company, $260,000. The largest of the decreases are: Brooklyn Union Elevated Railroad, $141,000; Dry Dock, East Broadway & Battery Railroad, $50,000; Forty-second Street, Manhattanville & St. Nicholas Avenue Railroad, $70,000; Long Island Railroad (Brooklyn), $55,000; Brush Electric Illuminating Company, $36,000.

THE MACKAY COMPANIES.—The Mackay Companies have declared a quarterly dividend of 1 per cent. upon the preferred stock, payable April 9 to stock of record March 31. Stockholders of the Commercial Cable Companies were given two shares of Mackay Companies preferred stock and two shares of common for each share of Commercial Cable. The Commercial Company pays 8 per cent. per annum to the Mackay Companies, which distributes it in preferred stock dividends. There were about 900 stockholders of the Commercial Cable Company. A large majority of the stock of the Cable Company has been exchanged for stock of the Mackay Companies. The time for the deposit of this stock with the Old Colony Trust Company, Boston, and Manhattan Trust Company, of New York, has been extended to and including April 18.

CHICAGO CITY RAILWAY CO. shows the following statement for the year 1903, to December 31:

	1903.	1902.	1901.
Gross	$6,435,565	$6,413,181	$5,900,000
Expenses	4,648,341	4,336,504	4,142,841
Net	$1,787,224	$2,076,677	$1,757,159
Depreciation	100,000	180,000	....
Balance	$1,687,224	$1,896,677	$1,757,159
Dividends, etc.	1,619,991	1,620,000	1,630,000
Surplus	$67,233	$276,677	$127,159

BELL DIRECTORS.—At the annual meeting the following directors of American Telephone & Telegraph Company were re-elected; Charles W. Amory, George F. Baker, Francis Blake, Charles P. Bowditch, George L. Bradley, Alexander Cochrane, T. Jefferson Coolidge, Jr., John D. Waterbury, Moses Williams, W. Murray Crane, Frederick P. Fish, Henry F. Howe, Charles Eustis Hubbard, Charles E. Perkins, Thomas Sanders, Nathaniel Thayer, Theodore M. Vail. Thomas B. Bailey was elected a director to succeed J. Malcolm Forbes.

DIVIDENDS.—The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 2½ per cent. on preferred and assenting stock payable April 11. The Electric Storage Battery Company has declared a dividend of 1¼ per cent., payable April 1. The Binghamton (N. Y.) Railway Company has declared a dividend of 2 per cent., payable April 11. The Mackay Companies have declared a quarterly dividend of 1 per cent. on the preferred stock.

SNOQUALMIE FALLS POWER.—It is stated in Seattle (Wash.) dispatches that the Snoqualmie Falls & White River Power Company, with $3,000,000 capital, has acquired the property and business of the Snoqualmie Falls Power Company, the White River Power Company, the Seattle Cataract Company, and the Tacoma Cataract Company.

SALT LAKE CITY, UTAH.—A contract has been entered into between the Salt Lake Railroad Company and the Western Union Telegraph Company, which gives the latter corporation wire privileges and the right to handle all commercial telegrams along the line of the new railroad.

HUDSON RIVER TELEPHONE.—The Hudson River Telephone Company reports a gross for the year ended December 31, 1903, of $883,885, increase $96,555; net, $269,852, increase $33,288; surplus after charges and dividends, $18,572, decrease, $19,464.

ELECTRIC LIGHTING COMPANY EARNINGS.—Messrs. Stone & Webster report the earnings of the following companies for the month of January, 1904:

TERRE HAUTE ELECTRIC CO.

	1904.	1903.	Inc.	Dec.
Jan. gross	$41,188	$33,535	$7,653	....
Net	11,321	7,971	3,350	....
Surplus	1,792	1,428	363	....

TAMPA ELECTRIC CO.

	1904.	1903.	Inc.	Dec.
Jan. gross	$24,987	$22,579	$2,408	....
Net	7,070	9,063	....	$1,993
Surplus	4,942	7,093	....	2,151

EDISON ELECTRIC ILLUMINATING CO. OF BROCKTON.

	1904.	1903.	Inc.	Dec.
Jan. gross	$11,951	$10,447	$1,504	....
Net	5,967	2,414	3,553	....
Surplus	4,898	1,613	3,285	....

LOWELL ELECTRIC LIGHT CORPORATION.

	1904.	1903.	Inc.	Dec.
Jan. gross	$22,217	$21,992	$224	....
Net	9,641	6,813	2,827	....
Surplus	8,036	5,952	2,083	....

SAVANNAH ELECTRIC CO.

	1904.	1903.	Inc.	Dec.
Jan. gross	$39,734	$38,521	$1,212	....
Net	14,787	12,990	1,797	....
Surplus	4,224	3,406	817	....

MINNEAPOLIS GENERAL ELECTRIC CO.

	1904.	1903.	Inc.	Dec.
Jan. gross	$56,084	$51,222	$4,862	....
Net	23,591	22,145	1,446	....
Surplus	13,694	13,347	347	....

SEATTLE ELECTRIC CO.

	1904.	1903.	Inc.	Dec.
Jan. gross	$189,813	$174,065	$15,747	....
Net	51,933	35,562	16,370	....
Surplus	28,745	12,120	16,625	....

Commercial Intelligence.

THE WEEK IN TRADE.—The wet weather is still throttling trade. "Low temperatures, heavy rains, bad roads and floods, the latter in the Ohio and tributary valleys," *Bradstreet's* notes, "have checked spring trade, delayed collections, discouraged Easter demand and closed a three-months' period of rather backward business in the North, East and West." While this report seems rather discouraging on its face there are some redeeming features. Agricultural implement men are doing well and have done what is probably their best season's trade on record. The railroads, too, are better off, and are gradually getting the upper hand in the transportation difficulties. In the South wholesale trade was never better than it is at present, and the feeling in the iron and steel trades is of a much more cheerful character. The agricultural situation is very satisfactory, and large yields are looked for. An enormous cotton acreage will be planted. Dry goods distribution is behind last year at all the leading markets. Textile machinery is not running full and the demand for cotton goods is backward, high prices being a bar to activity. The trade outlook on the Pacific Coast is good, notwithstanding the unfavorable weather conditions there. In the iron situation the outlook is satisfactory. Furnaces are filled up with orders for the second quarter, and prompt deliveries of pig iron and billets are being extensively demanded. There is a good call for finished products, effects of labor troubles being noted in structural material, however. Large tunnel work and pipe contracts are expected to call for an immense quantity of iron. Copper was notably strong. Lake and electrolytic are quoted at 12¾c. to 13c. and casting stock at 12½c. to 12¾c. The business failures for the week ending March 31 numbered 212, according to *Bradstreet's*, against 215 the previous week and 145 the corresponding week last year.

PRODUCTION OF MICA IN 1902.—A report on the production of mica in 1902 by Dr. Joseph A. Holmes, abstracted from the annual volume of Mineral Resources, published by the United States Geological Survey, shows that the total quantity of mica produced in the United States during the year 1902, as reported to the Survey, was as follows: Plate mica, 373,266 pounds, valued at $83,843; scrap mica, 1,028 short tons, valued at $13,081, and mica rough as mined, or unmanufactured, 372 short tons, valued at $21,925; making a total value of $118,849. The increase in the production of plate mica during the last three years is due to the increasing quantity of small-sized mica discs and rectangular sheets that have been cut for electrical purposes. During 1902 there was a large falling off in the production of scrap mica, which in 1902 amounted to 1,150 short tons, valued at $14,606, as against 2,171 short tone, valued at $19,719 in 1901. The tables which show the great increase in the importation of mica during 1902 are significant. This increase, valued at $131,278, is larger than the total value of the product of mica in the United States during 1902. It illustrates the increasing demand for mica in this country. Although mica is widely distributed in the United States, actual mining has been limited, during the last few years, to North Carolina, New Hampshire, South Dakota, New Mexico, Idaho, Virginia and Colorado. Some development work has also been carried on in California, Nevada, Maine, Alabama and Georgia.

NEW YORKERS IN CONTROL OF MONTEREY PLANT.—The firm of J. G. White & Co. and the Wall Street banking house of N. W. Halsey & Co. have acquired control of the Monterey Electric Light & Power Company, which operates an extensive plant at Monterey, Mexico, for lighting and general power purposes. The Monterey Light & Power Company has been incorporated under the laws of the State of New Jersey with a capital of $500,000. P. G. Gossler, formerly general manager of the Montreal Light, Heat & Power Company, and now head of the operating department of J. G. White & Co., has been elected president; Robert Lewis Hoguet, of the law firm of Hornblower, Byrne, Miller & Potter, is vice-president, and Harry R. Tobey, of N. W. Halsey & Co., is secretary and treasurer. The directors are Mr. Gossler, Chester Griswold, treasurer of J. G. White & Co.; Roger H. Williams, of N. W. Halsey & Co., and Morris K. Parker, of the same firm. The plant is to be remodeled and considerably enlarged. About 1,000 kw of additional equipment has been ordered. There will be a 500-kw Curtis turbine. Two 240-kw belt-driven alternators, one 125-kw engine-driven exciter generator and two 7½-kw belted exciter generators, transformers, etc., have also been ordered from the General Electric Company. One hundred and fifty General Electric fan motors will also be shipped. The boilers will be Babcock & Wilcox.

PEARSON SYNDICATE TO SUPPLY POWER TO EL ORO.—The Mexican Light & Power Company, Limited, has determined to transmit power to El Oro—one of the most extensive mining camps in the southern republic. The current will be generated at the Necaxa plant, which is now being hastened to completion. This plant is to have an initial capacity of 45,000 hp, the equipment consisting of Escher-Wyss turbines, Siemens & Halske generators and General Electric transformers. Later on it will be equipped with further machinery, which will bring up the development to no less than 80,000 hp. The use of electricity at El Oro will permit of the working of several low-grade mines now lying dormant owing to the prohibitive cost of steam power. It is estimated that electric current can be furnished at less than half the cost of the existing means of operation. Primarily, it was the intention of the Mexican Light & Power Company, in which F. S. Pearson is one of the leading spirits, to furnish current for use in Mexico City and vicinity. The extension of the transmission lines to El Oro, representing a total of about 175 miles, will make the system one of the largest in the world.

EQUIPMENT FOR A BRICK FACTORY.—The Schwarz System Brick Company, 8-10 Bridge Street, New York, has just installed at Charleston, S. C., the first brick plant in this country to be electrically operated throughout. The initial capacity of the equipment is 75 hp, but it will be considerably added to in the near future. The generator is a 50-kw, 250-volt, 850-r.p.m. machine built by the Northern Electrical Manufacturing Company, of Madison, Wis. It is belted to a 75-hp horizontal engine built by the Houston, Stamwood & Gamble Company, of Covington, Ky. Two Northern motors of 22-hp and 10-hp capacity, 220 volts, are used for operating the elevators, lime crushers, preparing machines and brick press.

CONDUIT FOR CINCINNATI SUBURB.—Mr. G. M. Gest, the expert subway contractor of New York and Cincinnati, Ohio, has just been awarded a contract by the Bell Telephone Company, of Cincinnati, for installation of a large conduit system through Cumminsville, one of the outlying districts of that city. Work is to be started immediately.

NAVAL ELECTRICAL SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, will receive bids until April 26 for the following supplies for the Portsmouth, Boston and New York Navy Yards: One 24-in. electrically-driven engine lathe; one electrically-driven deck winch; seven 20-hp electric motors.

SALE OF LIGHTING PLANT.—The Milford Electric Light and Power Transmission Company, of Milford, Ill., has been sold through the agency of J. S. Maurer & Co., to Mr. E. Lindner, of Pecatonica, Ill., for $15,000.

BALL ENGINE CONTRACT.—The Ball Engine Company, Erie, Pa., has been awarded a contract for three 225-hp direct-connected engines for the Seelbach Hotel, of Louisville, Ky.

LARGE EXPORT TRADE.—United States domestic manufactures exported in February, 1904, were greater in value than in any preceding February, and formed also a larger per cent. of the total exports than in any preceding February. For the eight months ending with February the total manufactures also exceeded the total in the corresponding eight months of any earlier year. The fiscal year 1900 was the banner year in exports of manufactures from the United States, but from present indications the fiscal year 1904 will show an even larger total of manufactures exported. The month of February shows a total of thirty-eight million dollars' worth of manufactures exported, against thirty-four million dollars in 1900, while for the eight months ending with February the total is two hundred and eighty-eight millions, against two hundred and sixty-eight millions in the same months ending with February in 1900. These figures, which are presented by the Department of Commerce and Labor through its Bureau of Statistics, indicate pretty clearly that the fiscal year 1904 will show a larger total of manufactures exported than any preceding year. In the eight months for which a record is already made the total exceeds by twenty millions that of the highest record previously attained, that of 1900, while the fact that February, 1904, exceeds by four millions the figures of February, 1900, also indicates that the increase noted in the earlier months of the year is continuing in the latest available months and thus likely to carry the year's total considerably beyond that of 1900. Details as to electrical apparatus are not yet forthcoming, but scientific instruments, including smaller electrical goods show an increase in the eight months from $4,647,940 to $5,935,808.

WAR DEPARTMENT ORDERS 120 BOATS.—The Electric Launch Company of Bayonne, N. J., has just received an order from the United States War Department for 120 boats for the artillery corps' use in planting submarine mines. The boats will be capable of handling 500 mines, and will be used as tenders to the new submarines now building. This is the largest boat order in numbers ever placed by the department, and was obtained by the builders under competitive bidding with all the leading manufacturers of the country. The boats, if placed in line, would equal nearly a half mile in length. Over 30,000 feet of the best boat cedar and 32,000 feet of ship oak will be used in their construction. A ton of copper nails and rivets will be required to fasten the timber together. The boats are now building and will be all completed on June 30, 1904. Charles G. Gates, of New York, has placed an order with the Electric Launch Company for a 23-foot electric yacht tender for use on his yacht "Charmary." The tender will be of the navy type of light weight, with capacity of operating forty sea miles on one charge of the battery. It is the same type that the United States Navy Department has recently purchased, and which are in use on the U. S. S. *Mayflower*, U. S. S. *Florida*, U. S. S. *Dixie* and other warships.

MORE C. & C. MOTORS FOR HAMBURG-AMERICAN DOCKS.—The C. & C. Electric Company, 143 Liberty Street, New York, has secured a further order—the seventh—for 35-hp motors to be installed on the Hamburg-American docks at Hoboken, N. J. The motors will be direct-connected to hoists built by the Consolidated Iron Works, of Hoboken. This installation when completed will be the most extensive electric hoisting plant for dock use in the world. The machinery will handle both cargo, freight and coal. The C. & C. people have taken another order for an 80-hp motor for shipment to the Rogers Locomotive Works, Paterson, N. J. A 40-kw and a smaller generator have been ordered by F. A. Kittredge, contractor of Everett, Mass., for installation in a Massachusetts manufacturing plant.

TO PURCHASE EQUIPMENT FOR MEXICAN MINES.—The Northern Mexico Development Company, which was recently organized under the laws of New Mexico, with a capital of $1,000,000, has acquired the Aventura & Santo Domingo mining properties, located in the Sabinal district on the Sierra Madre line, for the development of which considerable electrical equipment will be utilized. The company proposes to make a specialty of power plants for the operation of mines, etc. Britton Davis, of El Paso, Texas, is president of the concern, C. N. McAdoo, of Greensboro, N. C., vice-president and treasurer, and D. C. Sutton, of the Candelara Mining Company, at San Pedro, State of Chihuahua, Mexico, has been appointed general manager.

TELEPHONE GROWTH AT COLUMBUS, OHIO.—The directors of the Citizens' Telephone Company, which operates in connection with the United States Long-Distance Telephone Company, have decided to contract for the erection of an exchange building which will be 90 by 90 and three or four stories high. They have also decided to contract for an automatic switchboard that will accommodate 10,000 patrons and give the exchange a full capacity of 18,000 instruments. Their present capacity is only 6,000, but they have applications which have been on file for months to the number of 1,600. A director of the company says: "We paid 8 per cent. dividend last year and also built the Farmers' Telephone line, costing $100,000, out of the proceeds."

OFFICE BUILDING AND APARTMENT HOTEL.—Percival R. Moses, electrical engineer, 35 Nassau Street, New York, will act as consulting expert on the installation of electrical equipment for a ten-story office building, which is to be constructed at Binghamton, N. Y., by the Security Mutual Life Insurance Company. The capacity of the equipment has not yet been determined on. Mr. Moses is about to let lighting contracts for three 65-kw generators to be direct-connected to 13-in. x 12-in. high-speed simple automatic engines for the big apartment hotel now being built at Sixty-ninth Street and Broadway, New York, by the Construction Realty Company.

LIGHTING EQUIPMENT FOR SYDNEY.—Some $1,250,000 are to be expended in an extension of the lighting system in Sydney, New South Wales. Six hundred arc lamps will be used for public lighting, of which 340 will be erected at first. Tenders will very shortly be invited locally. The scheme has no reference to the Sydney City & Suburban Electric Traction system, which is being constructed for the most part with American equipment. The tramways are operated by the New South Wales Railways Commissioners, whereas the lighting system will be carried out by the municipal authorities of Sydney.

SHOSHONE FALLS POWER.—Articles of incorporation have been taken out in Idaho to the Shoshone Falls Power & Lighting Company, which will launch a large power enterprise. A power plant is being built on the Snake River from which current will be transmitted to Salt Lake and intermediate cities. Three power plants in all will be erected with a total capacity of 80,000 to 100,000 hp. The capital stock of the company is $2,500,000, with a bond issue of equal amount. All the stock and half the bonds are subscribed. Prominent men of Idaho and Utah are promoting the company.

ANOTHER MEXICAN PROJECT.—A company to be called the Rosa Amarillo Company is now in process of formation for the purpose of acquiring large properties in Mexico. An extensive electric power plant will be built to operate an electric railway, smelters, etc. M. D. Watson, who is primarily interested in the scheme, is now on his way here with a view to closing the financial end of the deal and awarding contracts for equipment. The property is situated at Cantitlan Purificacion, State of Jalisco.

EXTENSIVE MEXICAN ELECTRIC RAILWAY SCHEME.—The construction of an electric railway between Puebla, one of the leading cities in Mexico, and Vera Cruz, the principal seaport city of the southern republic, is mooted. The proposed line will pass the famous Popocatepetl sulphur volcano, which was recently purchased by a New York syndicate. General Muncio P. Martinez, of Puebla, is primarily interested in the railway scheme. The length of the road will be some 130 miles.

WATER POWER FOR LARGE MEXICAN COTTON MILLS.—Mexican advices state that an American syndicate has purchased the immense water fall known as Calda de Tontepec, located in the district of Acaxtian, in the State of Oaxaca. The syndicate proposes to utilize the motive power to be generated by the falls for the purpose of operating a large cotton factory situated in the vicinity, which is at present run by steam power. The price paid for the water rights exceeds $100,000, United States currency.

PENDING SPANISH CONTRACT.—The Westinghouse interests are figuring on a very important contract for the construction and equipment of a large central power station at San Andres de Polomar, Spain, in which it is proposed to utilize industrial gas for the generating of electric current for transmission principally to Barcelona for light and general power purposes. The length of the transmission line will be about 10 miles.

ELECTRIC TRACTION FOR SANTOS, BRAZIL.—Santos, one of the most flourishing seaport towns in Brazil, having a population of about 10,000 people, is to have an up-to-date American equipped electric traction system. James Mitchell, general manager of the Sao Paulo Tramway, Light & Power Company, Limited, is primarily interested in the project.

PENNSYLVANIA'S POWER HOUSE.—Milliken Brothers have been awarded the contract for the construction of the power house for the eastern section of the Pennsylvania, New York & Long Island Railroad. This is part of the Pennsylvania Railroad tunnel system. About 2,500 tons of structural steel will be used in the construction of the power house.

EQUIPMENT FOR JAPANESE ARSENALS.—The Westinghouse interests have recently been allotted several orders for electrical equipment to be installed in Japanese Government arsenals, etc. The orders were secured through the Japanese house of Takata & Co.

WARSAW EXPOSITION POSTPONED.—The electrical exposition which it was proposed to open at Warsaw, Poland, this year has been indefinitely postponed owing to the Russo-Japanese war.

General News.

THE TELEPHONE.

RIVERSIDE, CAL.—The Sunset Telephone Company will spend $15,000 in the extension and improvement of its service.

LOS ANGELES, CAL.—The Home Telephone Company, of Whittier, is installing a switchboard with a capacity of about 800 telephones.

LOS ANGELES, CAL.—The Home Telephone Company, of this city, has just issued an official statement showing that it has now installed and in operation 11,747 telephones, as compared with 8415 when the plant was taken over from the construction company last October. The authorized capital stock of the company is $3,000,000, with an authorized bonded indebtedness of $2,500,000. The company also announces that it has secured, for itself and affiliated companies in Southern California, the exclusive right to the use of the automatic telephone, and has entered into a contract with the Automatic Electric Company to install in the near future a new station on Grand avenue, in the southwestern section of the city, with 4000 automatic telephones. It will be followed immediately by similar sub-stations at East Los Angeles, Boyle Heights, and eventually the entire plant will be operated under the automatic system.

ALTON, ILL.—The Kinloch Telephone Company has installed a complete fire alarm system in the Alton hose houses in connection with its telephone system.

INDIANAPOLIS, IND.—The recent high water greatly damaged telephone property and impaired the service in this city. The water flooded the conduits.

OAKLAND CITY, IND.—The city council has granted the Oakland City Independent Telephone Company a franchise for a period of twenty-five years.

WARRICK, IND.—The Elberfield & Millersburg Telephone Company has been incorporated with a capital stock of $450. The incorporators are Fred Kampe, Henry Kelle and Henry Ahrens.

DALEVILLE, IND.—The Daleville Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. C. H. Forrest, R. C. Stone and F. D. Rushing are the incorporators.

CAMDEN, IND.—The Camden Coöperative Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $4000. U. E. Tesh, C. E. Baker, Fred G. Arnick, J. S. Plank and O. W. Wyatt are the incorporators.

SUMMITVILLE, IND.—The Independent Telephone Exchange at this place has been sold to the Madison and Delaware Counties Telephone Company. The purchasing company will at once improve the local plant, install a modern switchboard and extend and connect the lines with its own system.

LEBANON, IND.—The Central Union Telephone Company has taken steps toward the building of a local system in this city as a competitor of the Lebanon Telephone Company, an independent concern.. The Central Union claims to have a franchise granted by the council years ago that permits it to operate a local system.

LOGANSPORT, IND.—The Home Telephone Company in this city now has 1800 telephones in operation, and a hundred or more applications are on file waiting for telephones. The company has numerous connections with smaller systems and exchanges in the towns of the surrounding country. It has decided to purchase another switchboard, and has contracted with Butterfield & Co. to lay a number of additional cables. The company will establish a local exchange in Young America. Applications for local services in Walton and Galveston have also been filed with the home office.

RICHMOND, IND.—Representatives of the Greenville and Eaton, Ohio, and the Richmond Home Telephone Companies held a meeting in this city March 25 for the purpose of perfecting arrangements for long distance service The object is to get independent service between Dayton and Richmond this spring in order to make the circuit complete between St. Louis and the East in time for the World's Fair business. The distance between Richmond and Dayton is the only link that remains uncompleted to afford long distance service from St. Louis to Pittsburg and New York. It is understood that the United States Telephone Company will put in the Dayton-Richmond line as it operates the line between Dayton and Pittsburg. Connection will be made at Richmond with the new-long distance lines extending West. When these lines are completed the Richmond Home Telephone Company can get long distance service to all points of importance in the country.

WATERLOO, IOWA.—The United States Telephone & Telegraph Company will build an office building here.

WEBSTER CITY, IOWA.—The Martin Telephone Company will lay 10,000 feet of underground cable during the coming summer.

COOPER, MICH.—The Mutual Telephone Company has just been formed here.

JACKSON, MICH.—The Leslie Telephone Exchange with the United States Telephone Company, will build a trunk line to Eaton Rapids.

LAKE CRYSTAL, MINN.—The Blue Earth County Telephone Company has been incorporated with a capital stock of $25,000. The directors are William Crane, David Crane, and others.

MANKATO, MINN.—At the annual meeting of the Mankato Citizens' Telephone Company the following-named officers were elected: Dr. J. H. James, president; H. A. Patterson, vice-president; W. A. Willard, secretary and treasurer. Reports read at the meeting showed that the company is making steady progress and now has 806 telephones in use.

MEMPHIS, MO.—The Scotland County Telephone Company has been incorporated with a capital stock of $10,000. The directors are H. G. Merritt. C. M. Moore and others.

CAPE GIRARDEAU, MO.—The Cape Girardeau Bell Telephone Company, owned by Henry L. Rosier and John Tiapek, of Ste. Genevieve, has bought the Cape Girardeau Telephone Exchange. The new company expects to begin work at once in changing its system from a grounded to metallic circuit and otherwise improve the same.

ST. LOUIS, MO.—The directors of the Kinloch Long-Distance Telephone Company who went to Indianapolis, Ind., and Louisville, Ky., have returned to the city. They made arrangements for the extension of the present long distance service in several directions. At Louisville, representatives from independent companies in a territory extending through Kansas, Kentucky, Michigan, Ohio and Pennsylvania were met. As a result, arrangements were made to connect a large number of smaller lines in various states under a common management. The St. Louis subscribers to the Kinloch long distance telephones will soon be able to reach Cleveland, Columbus, Cincinnati and other Ohio towns. By June the arrangement will extend to Pittsburg, Harrisburg and Baltimore.

VERDIGRE, NEB.—The Verdigre Telephone Company has been incorporated with a capital stock of $10,000.

GUIDE ROCK, NEB.—The Guide Rock Telephone Company has filed articles of incorporation with a capital of $1000.

ABSECON, N. J.—The Keystone Telephone Company of Philadelphia is building a line between Camden and Atlantic City.

BINGHAMTON, N. Y.—The Hawleyton Telephone Company has been incorporated with a capital stock of $500. The directors are G. W. Vossberg, C. S. Gage and others.

WATKINS, N. Y.—The Reading & Rock Stream Telephone Company has been incorporated with a capital stock of $10,000. The directors are H. H. Smith and H. S. Howard.

ALBION, N. Y.—The Hotel Telephone Company of Albion has been incorporated with a capital stock of $50,000. The directors are C. M. Beattie, Garrison Babcock, Rochester, and G. L. Merrill, Albion.

MONTPELIER, OHIO.—The Montpelier Telephone Company has increased its capital stock from $15,000 to $50,000. W. A. London is president.

HARTSGROVE, OHIO.—The Hartsgrove Citizens Farmers' Association, which was formed late last year, now has 500 subscribers connected up and 35 miles of toll lines. The system is rapidly being extended. Robert Marro is president and E. W. Hunt manager.

ASHLAND, OHIO.—The Central Union Telephone Company will proceed at once with the work of installing an exchange in Ashland. The Central Union Company has been negotiating for the purchase of the Ashland exchange of the Star Telephone Company, an independent company.

GEORGETOWN, OHIO.—The Brown County Telephone Company, capital $20,000, has been incorporated by J. C. Martin, O. E. Bare, W. J. Marshall, H. C. London and G. Bamback. The company will build an exchange at Georgetown with lines through Adams, Highland and Brown counties.

GREENSBURG, PA.—The Borough Council has granted a franchise to the Johnstown and Pittsburg Long Distance Telephone Company.

PHILADELPHIA, PA.—According to dispatches from Philadelphia the Keystone Telephone Company since the first of the year has installed new telephones to the number of 1200. The statement is made by an official that the net earnings for the first quarter of the present year will surpass largely those of the corresponding period last year, when the profits were $41,000.

HILLSBORO, TEXAS.—The city council has voted to grant a franchise to the Independent Telephone Company.

CUSHING, TEXAS.—Dr. Crawford, of Alto, who has established a telephone exchange here, will make improvements.

DALLAS, TEXAS.—The application of Messrs. Waterbury and Whitney, of Houston, Texas, for a franchise for an independent telephone sysytem for the city of Dallas has been referred to a committee of the city council. There is considerable opposition to the franchise being granted.

BROADFORD, VA.—The Broadford Telephone Company has been incorporated with a captial stock of $5000. L. H. DeForest is president.

PRAIRIE DE CHIEN, WIS.—The Union Telephone Exchange of this city has been sold to J. W. Calloway.

CUMBERLAND, WIS.—The Dunn County Telephone Company will build lines through Dunn and Barron counties. Exchanges are to be put in at Barron, Ridgeland, Cameron, Dallas, Chetek and Rice Lake.

MERIDA, MEX.—Extensive improvements are to be made to the local telephone system here which was recently badly damaged by fire.

SIERRA DE ALMOLYA, MEX.—E. V. Combe is building a telephone line from this place to Vaca station, situated on the Mexican Central Railroad.

ST. JOHN, N. B.—Application is being made by a company seeking the right to conduct a general telephone business in the counties of St. John and Charlotte, N. B. The title of the new company is The Citizens' Telephone Company, and it will be connected with the present Forest Telephone Company at Calais, Me., with a main central office at Calais for both the New Brunswick counties.

OTTAWA, ONT.—The North American Telegraph Company is applying to the parliament of Canada for an amendment to the charter of the company to enable it to increase its capital from $1,000,000 to $10,000,000, and to extend its line to Manitoba and the Northwest and to change its head office from Kingston, Ont., to Winnipeg, Man.

TORONTO, ONT.—The Bell Telephone Company of Canada has offered the Board of Control of the city of Toronto to pay the city $20,000 per year for an exclusive franchise of five years, the price of telephones to remain at $50 and $30 as at present. The Stark Telephone Company offered to furnish telephones at $6 per year, with a charge of one cent per call up to $15. The Canadian Telephone & Telegraph Company offered to furnish telephones at $36 and $24. The Board has taken time to consider these bids.

Electric Light and Power.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation made its first annual payment, under its sinking fund provisions, to the Mercantile Trust Company on March 15. The money is to be invested in the underlying securities and the bonds of the corporation.

SAN FRANCISCO, CAL.—The Reno Power, Light and Water Company has been incorporated with a capital stock of $1,000,000 by P. L. Flannigan and W. H. Patterson, both of Reno, Nev.; Charles L. Gibb, of Berkeley, and Joseph A. Fontaine and Frank P. Deering, of San Francisco.

LOS ANGELES, CAL.—The Tracy Engineering Company, of San Francisco, wants to install a 500-hp plant for the city of Riverside and sell it to the city at the end of ten years, the city to buy the power in the meantime at the rate of $5.90 per horse power per month and pay for a minimum load of 300-hp.

LOS ANGELES, CAL.—The Alamo Electric Power and Milling Company proposes to install a 500-hp plant at Ensenada, Lower California, to serve the principal mines of the famous Alamo mining district, at an expense for power and milling machinery of not less than $150,000. The company's headquarters are in Los Angeles. W. E. Hampton, an electrical construction engineer of San Francisco, is drafting the plans for the power plant.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Co. has, in a general way, planned to make a considerable increase in its electric generating equipment. It is considering the advisability of adding 10,000-kw in generating capacity at the independent plant known as Station "A." This would permit of shutting down the steam plants at the other two power stations. Contracts have been placed with the Westinghouse Electric & Manufacturing Co. for 1300 series alternating arc lamps with the necessary 200-light regulators for the same. The new lamps will enable the company to do away with the direct current series arcs in street lighting as it has already done in commercial lighting.

WASHINGTON, D. C.—The Atlas Light & Power Company has been incorporated here by A. C. Smith, S. J. Lamson, E. W. Scribner, E. L. Bradford, P. H. Burch, R. Wermelle and R. K. Van Mater.

WASHINGTON, D. C.—Bids will be received April 12 at the Bureau Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards, Norfolk, Va., and Pensacola, Fla., a quantity of arc lamps, electrical supplies, conduit and fittings, etc. H. T. B. Harris, Paymaster-General, U. S. Navy.

TERRE HAUTE, IND.—The Terre Haute Electric Company will build a new power house in this city. Contracts for the building have not yet been let.

CICERO, IND.—The town council has granted a 25-years' franchise to John Plain for an electric lighting plant. Mr. Plain announces that he will at once erect a new electric lighting system here.

MENTONE, IND.—The Mentone Electric Light and Power Company's plant has been sold through the J. S. Maurer & Company agency, of 804 Monadnock Block, Chicago, to J. H. O'Rourke, of Algonac, Mich.

ANNAPOLIS, MD.—A bill was offered in the House by Mr. Lipman to provide for municipal ownership of electric lighting plants in Baltimore City. A motion to lay the order on the table was carried.

MERRIMAC, MASS.—Jas. Dickens, of Newburyport, is preparing plans for the electric light plant for Merrimac.

ST. LOUIS, MO.—The Ada Electric Light and Power Company has been incorporated with a capital stock of $40,000, full paid. The incorporators are Charles I. Patterson, Allen B. Patterson and William F. Klanke.

VERSAILLES, MO.—W. K. Palmer, Kansas City, Mo., is engineer for the municipal lighting plant for Versailles. Plans and specifications are ready. Bids will be required on boilers, engines, generators, switchboard, poles, etc., together with the building.

ST. LOUIS, MO.—The city of St. Louis, through the Harbor and Wharf Commissioner, March 23, formally ratified its previous verbal acquiescence in the contention of the Laclede Power Company, that the latter had riparian rights in front of its station at the corner of Lewis and O'Fallon streets. This gives the company the right to take water from the river which it will use for condensing purposes in the operation of its engines, and ends the controversy which has been going on for two years and which came acute when it was discovered last winter that the power company was building an intake beneath the wharf opposite its works.

ST. LOUIS, MO.—A plan to brilliantly illuminate the new city hall is being worked out by Thomas B. Carter, supervisor of city lighting. The Twelfth street entrance is to be lighted from fourteen posts of artistic design. Six of these will support clusters of 25 incandescent lights. Four smaller posts, with 12 lamps each, will light the circular driveway, and four of the same size will illuminate the portico. Arc lights on specially designed brackets will be placed at the Clark avenue and Market street entrances. The rotunda, now being completed, will be lighted by 2000 incandescent lamps. Of these 250 will form a chandelier below the skylight, and the others will be fixed to the pillars surrounding the rotunda. The fixtures for these are being designed by the architects. Many other lights will be placed in the halls. The total number will be about 5000.

HELENA, MONT.—The Ox Bow, in the Missouri River, near Helena, is to be a thing of the past according to the plans of the Ox Bow Power Company, recently organized. The Ox Bow is a loop in the river about 12 miles around but at one point only a quarter of a mile separates the two turns of the river. There is here a difference in level of about 20 feet, and it is proposed to construct a dam, make a canal, and establishing a power plant at some convenient point. It is estimated that the expense of putting in such a plant will be about $750,000. Before work can be commenced, a congressional enactment, permitting the damming of the river, will be necessary.

WATKINS, N. Y.—The citizens have voted to issue $20,000 bonds to construct an electric light plant, to be operated in connection with the water works.

CANTON, N. Y.—The Canton Electric Light & Power Company has petitioned for a 20-year franchise for lighting the village. It is proposed to install new machinery.

BURGAW, N. C.—John W. Reilly, of Wilmington, is interested in the construction of electric light plants at Burgaw and Clinton.

WAYNESVILLE, N. C.—B. J. Sloan has contracted to furnish this city with power for lighting for 10 years, the power to be generated at the falls of Pigeon River, by the construction of a dam. The capacity of the plant will be 1500-hp.

HAMILTON, OHIO.—The city will issue $5000 bonds for improving the lighting system.

PHILO, OHIO.—C. U. Shryock, of Zanesville, has secured a franchise from this village for the construction of water works and an electric light plant. The villages of Duncan's Falls and Taylorville will also be supplied.

BELLEVUE, OHIO.—The franchise of the Bellevue Light and Power Company expires May, 1905. The council is considering a proposition to erect a municipal lighting plant. A committee has been appointed to investigate the cost of such a plant.

OKLAHOMA CITY, OKLA. TER.—F. C. French, of Oklahoma, has made application for an electric light franchise.

OREGON CITY, ORE.—Supplementary articles of incorporation have been filed by the Oregon Water Power & Railway Company, changing its name from Oregon General Electric Company, under which it was originally formed. Fred. S. Morris, J. Frank Watson, A. B. Croasman, W. H. Hurlburt and William T. Muir are the incorporators.

TERREHILL, PA.—Michael N. Nolt, New Holland, Pa., writes that he proposes constructing an electric light plant on Conestoga River, at a cost of $6000.

CHARLESTON, S. C.—By a new contract with the Consolidated Company, of Charleston, this city will save over $5700 on lights. Arc lights are reduced from $97.50 to $80 per year, to be followed the next year by a reduction to $75.

DAYTON, TENN.—Edgar Stone, of the Dayton Light and Power Company, writes that it is proposed to construct an electric light plant, at a cost of $8000.

KNOXVILLE, TENN.—The city council of Knoxville has named a committee on municipal ownership of the electric light plant. Mayor Gass is reported as being in favor of the new plan.

RUSK, TEXAS.—W. W. Welsh is interested in the construction of an electric plant.

UVALDE, TEXAS.—Colonel Ike Pryor and son, Dave, contemplate installing an electric light and power plant at Uvalde. They are also arranging to establish a large irrigation plant near here.

PRAIRIE VIEW, TEXAS.—An electric light and power plant is to be installed at the State Prairie View normal school, situated here. Prof. Brown, of College Station, Texas, can give information.

RICHFIELD, UTAH.—The Clark Power Company is considering the construction of a power plant near here to supply power for all towns of the county. The plan also includes the construction of electric railways.

WEST SEATTLE, WASH.—The Council has passed an ordinance requiring that all electric light and power wires be placed in underground conduits.

FOND DU LAC, WIS.—The bid of the Citizens' Light, Heat and Power Company, of Milwaukee, for the franchise, under which a new electric lighting and power plant is to be established in this city, was accepted by the Common Council.

SUNDANCE, WYO.—It is reported that the Economic Power Company, organized by Henry K. Mayham, of Denver, Colo., will build a $900,000 power plant west of this place, to supply power and electric light to many towns and mines in the Black Hills.

KINGSTON, ONT.—It was voted to purchase the plant of the Light, Heat and Power Company.

OTTAWA, ONT.—The rights of Mr. E. S. Jenison, of Chicago, to the water power of the Kekabeka Falls and Ecarte Rapids, Ont., have been fully restored by the private bills committee of the Ontario Legislature.

BRANTFORD, ONT.—A peculiar accident happened recently to the electric plant of this city. It appears that muskrats burrowed through the embankment skirting Lake Mohawk, whence the electric plant obtains its power, causing the earth to cave in and effecting a large breach and put the plant out of business. An auxiliary plant was set up, but local factories, run by electricity, were forced to close pending repairs to the embankment. The pranks of the muskrats cost the electric company upwards of $5000.

OTTAWA, ONT.—The Dominion government has determined not only to light the Welland Canal by electricity, but by the same power to operate the gates, valves, bridges and sluiceways of the canal. The electric energy will be furnished by the Cataract Power Company, of Hamilton, Ont. The whole stretch of the canal will be lighted instead of merely the locks as at present. Some 550 arc lights will be distributed between Port Dalhousie and Port Colborne, a distance of 27 miles. At each of the 25 locks there will be six arc lights, while along the banks of the canal there will be one light in every 400 feet. In addition there will be a special equipment of arc lights for the piers at the head and foot of the canal.

MONTREAL, QUE.—The Shawinigan Water and Power Company, of Shawinigan Falls, Que., has just completed arrangements for the erection of another transmission line, from the Falls into Montreal, with a capacity of 10,000 additional horsepower. This entire additional power will be taken by the Montreal Light, Heat and Power Company. In order to meet the increasing demands for power, the Shawinigan company is just completing at its works the installation of a third unit consisting of a water wheel with a capacity of 6000 hp and a generator of 3750 kw capacity, thus giving the company an increased output of 5000 hp. A similar additional unit will be installed this summer.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Bessemer, Brookwood & Blocton Railway & Light Company has been granted a franchise by the city of Birmingham to build an electric railway.

CAMDEN, ARK.—The Interurban Transit Company has been incorporated by H. C. Homeyer, C. P. Brice, C. C. Gunnels and J. G. McDonald. The company proposes to carry passengers and freight and to sell electric power. Capital, $350,000.

WASHINGTON, D. C.—The Old Dominion and Great Falls Railway Company has bought a $23,000 site in Washington for its power plant.

WILMINGTON, DEL.—Rights of way are being secured for the extension of the Middletown & Odessa Electric Railway from Middletown to Clayton and Smyrna.

ATLANTA, GA.—It is stated that the recently incorporated Georgia Traction Company has been successfully financed and that it will be built between Athens and Carnesville, Ga. Mr. Van Wey, of Toledo, Ohio, is president of the company.

FREEPORT, ILL.—Right of way is being secured for the proposed electric railway from Freeport to Polo and Dixon, and application has been made for a franchise in Polo. O. T. Smith is president of the company.

EAST ST. LOUIS, ILL.—Articles of incorporation have been filed by the St. Louis, Vandalia & Eastern Electric Railway, with a capital stock of $50,000. The incorporators are: William M. Folger, Charles G. Sonnerman, George D. Steinbauer, H. C. Doyle, T. N. Lakin, of Vandalia.

CHICAGO, ILL.—The Chicago City Railway Company, Chicago, contemplates the erection of a great central electric power plant at West Thirty-eighth and Halsted streets, to cost $4,000,000, the purpose being to operate all the trolley lines from the one central power plant.

TAYLORVILLE, ILL.—The stockholders of the American Central Traction Company have perfected their organization by electing the following officers: J. N. C. Shumway, president; Ernest Hoover, vice-president; Warren Powell, second vice-president; David M. Sharp, secretary and manager; E. W. Height, treasurer. The company has been incorporated at $250,000, and will begin the construction of interurban lines from here to Assumption, Mount Auburn, Springfield and East St. Louis.

CRAWFORDSVILLE, IND.—It is announced that the Consolidated Traction Company will soon receive bids for the construction of a large power house in this city. Edward Hawkins is president of the company.

WATERLOO, IOWA.—The Rapid Transit Company proposes to extend its line to Ossian.

MARSHALLTOWN, IOWA.—Petitions are being circulated in this city by the Marshalltown Electric Street & Interurban Railway Company, to be presented to the City Council, to call a special election to decide whether or not a 3-per-cent. tax shall be levied for the purpose of aiding the construction of an interurban line from Marshalltown to Grundy Center. The company asks the payment of one-half of the tax when the line is completed from Marshalltown to Grundy Center and the other half one year later. J. G. White & Company, of New York, are understood to be considering a proposition to build the line.

GREENVILLE, LA.—The City Council has granted the concessions asked by the Delta Light and Power Company for the extension of its tracks. It was decided at a meeting that if this city and Leland would donate or subscribe $50,000 of stock the company would extend the line to Leland, which is about 12 miles from Greenville.

ANNAPOLIS, MD.—A "Jim-Crow" bill for the electric cars of the whole State has been introduced in the House.

BAY CITY, MICH.—The Bay City Traction & Electric Company will install a storage battery plant in the building on Water street now used as office quarters.

FARIBAULT, MINN.—Hon. Donald Grant, of this place, has under consideration the building of an electric railway here.

MINNEAPOLIS, MINN.—The Minnesota Power & Trolley Company has been advised from Washington that the President has signed the bill permitting the construction of a dam across the Mississippi River, 2 miles above Elk River and without requiring the installation of a lock.

DULUTH, MINN.—Articles of incorporation of the Lake Superior & Northern Railway Company have been filed. The incorporators are: L. R. Martin, who is president and treasurer; H. P. Gardiner, vice-president and secretary; H. B. Fryberger, H. C. Fulton and M. A. Armstrong. The company is capitalized at $50,000, while its limit of indebtedness is $5,000,000. The purpose of the corporation is to construct and operate railway lines in this state and elsewhere, build telephone and telegraph lines, carry on a freight and passenger business and acquire right of way, depot grounds and freight yards.

JEFFERSON CITY, MO.—The Forest Park & Richmond Heights Railway Company has been chartered to build a branch line one mile long from St. Louis City to Richmond Heights, and has a capital of $25,000. The stockholders are: N. E. Niesen, Robert Rutledge, James McCausland, Charles J. Roberts and Bernard Christian.

ST. JOSEPH, MO.—The St. Joseph Interurban Railway Company filed articles of incorporation March 22. Its capital stock is $100,000. The incorporators are: George C. Sims, of Des Moines, Iowa; A. C. Plummer, of Altoona, Iowa; Alice M. Butler, John C. Landis, Jr., of St. Joseph. The company will build an electric railway from Savannah to Platte City, through St. Joseph.

ALBANY, N. Y.—The Assembly Railways Commission has decided to report favorably the Wallace third-rail protection bill. It requires companies operating third-rail lines to cover or in some way guard the third rail, so that persons will not run risk of injury from it. The elevated roads in New York City are, of course, the main ones affected by the bill.

ELMIRA, N. Y.—A certificate of incorporation has been filed in the office of the Secretary of State for the Elmira & Corning Short Line. Among the directors named are: Joseph Powers, of Troy; G. Tracy Rogers, of Binghamton; William R. Compton, of Elmira; A. Lee Smith, of Elmira. It is understood that the Powers & Mansfield Company has made the surveys and is actively connected with the enterprise. The length of the line to be built is about 13½ miles from the city limits of Elmira into the city of Corning, and that of this distance 12½ miles is upon private right of way. It is proposed to equip the line with a protected third rail.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company, Cleveland, Ohio, has placed a contract with the Aermotor Company, Chicago, for two structural steel towers to be used in carrying high tension circuits over Black River, Lorain, Ohio.

TOLEDO, OHIO.—Stockholders of the Toledo & Indiana Railway Company and the Toledo, Hicksville & Fort Wayne Railway Company, which is affiliated with the first mentioned, will meet April 5 to consider a proposition to extend the Toledo & Indiana Railway to Fort Wayne by way of Defiance.

CORTLAND, OHIO.—C. G. Phillips, general manager of the Warren, Cortland & Jefferson Traction Company, states that preliminary surveys for the road have been completed, and that the work of grading will be started at once. Engineers of the Westinghouse Electric & Manufacturing Company have suggested that a large power house be erected at Kinsman to supply power for this line as well as the Cleveland & Sharon Traction Company, which is being built by the same interests.

GUTHRIE, OKLA.—A charter has been issued to the Oklahoma City, Lexington & Sulphur Springs Electric Railway Company, of Lexington. The capital stock is $1,000,000. The stockholders are: Charles Stewart, of Parkersburg, W. Va.; J. S. Little, H. L. Forehand, E. Duffy, W. J. Reed, E. J. Keller, R. E. Thacker, G. A. Teague, A. Hutchins, E. P. Mosely, Jay Sherman, of Lexington.

SCRANTON, PA.—The directors of the Scranton Railway Company have authorized an outlay of $300,000 for improvements to the system.

FRANKLIN, PA.—A company, with $400,000 capital, has been formed in Pittsburg to build a 53-mile electric railway between Franklin and Butler, where connection will be made with a line between Pittsburg and Butler, now approaching completion.

YORK, PA.—It is stated that the capital stock of the York County Traction Company is to be increased from $1500 to about $5,000,000, preparatory to the building of new lines in this county. Lines are planned to run to Hanover, Dillsbury, Lewisberry, Yorkana, Airville, Brogneville, Collinsville and Delta.

PHILADELPHIA, PA.—Plans have been approved by the Board of Surveyors for double tracks for the Philadelphia Rapid Transit Company on Twenty-ninth street, from Lehigh avenue to Allegheny avenue. The line will be a connecting branch of the Lehigh and Allegheny avenue lines.

MECHANICSBURG, PA.—The Cumberland Valley Electric Passenger Railway Company will be offered for sale on June 25, under foreclosure brought by the Harrisburg Trust Company, trustee. The successful bidder will have to pay $25,000 cash on the spot when the sale is declared, and the balance of the purchase money must be forthcoming on July 1.

LEWISTOWN, PA.—The Lewistown & Reedsville Electric Railway Company contemplates important improvements. Contracts have been awarded to P. E. Lane & Co., of Atlantic City, N. J., for the extension of the line from the present terminus to the Pennsylvania Railroad station at Lewistown Junction.

HARRISBURG, PA.—A charter has been granted at the State Department to the Inter-State Electric Railway Company, capital $200,000, to build a 20-mile line from the intersection of Vine and Main Streets, Port Allegheny, McKean County, through the towns of Burtonville, Roulette, Mina and Coudersport, Potter County. The directors are: L. B. Seibert, of Coudersport, president; H. H. Cobb, F. L. Andrews, M. L. App, D. S. Seibert, W. T. Church, H. A. Avery.

LEAD, S. D.—An electric railrway, fifty miles long, will be built this spring connecting Lead with the coal mines of northeastern Wyoming.

BELTON, TEX.—Arthur C. Kretz, of Reading, Pa., engineer for the proposed Temple-Belton Interurban Electric Railway, is here making a preliminary investigation of the route of the proposed road.

WACO, TEX.—A movement has been inaugurated looking to the construction and operation of an interurban electric railway between this city and Dallas, by way of Hillsboro and Waxahachie. Colonel James B. Baker, of Waco, is interested in the project and can give information.

BELLINGHAM, WASH.—Specifications have been ordered by the City Council for a municipal electric lighting plant to be operated by the power of Whatcom Falls.

COLFAX, WASH.—The County Commissioners have granted the franchise for an electric railway asked for by S. J. Crutcher, A. J. Smith and associates of Pine City, through the north part of Whitman County to Colfax. The promoters purpose building a line from Spokane via Spangle, in Spokane County, to Pine City, in Whitman County, thence via St. John to Colfax.

ST. ANSELME, QUE.—The Ste. Claire Electric Company is considering the construction of an electric railway through the counties of Dorchester, Bellechasse and Levis.

TORONTO, ONT.—Notice is given that application will be made to the Parliament of Canada, at its next session, for an act incorporating a company under the name of the Nipissing, Ottawa & Montreal Railway Company, with power to construct a line of railway from a point at the east end of Lake Nipissing to the city of Montreal, and also a line extending from said point along the north side of Lake Nipissing and French River to a point on Georgian Bay, and to acquire, own and operate water power and generate electric power for lighting and motive purposes.

New Industrial Companies.

THE INSULATED COPPER COMPANY, of Islip, N. Y., has been incorporated with a capital of $25,000. Directors: W. K. Post, R. D. Upham and H. B. Johnson, New York.

THE BAXTER LIGHTING COMPANY has been incorporated at Camden, N. J., with a capital of $25,000. Incorporators: Lewis F. Baxter, George M. De Gunther and L. Howard Weatherby.

THE MARINE MAGNETIC CONTROL COMPANY, of New York, has been incorporated; capital, $100,000. Directors: J. O. Stevens, Plainfield, N. J.; Albert Graham and Edward Pfuhler, New York.

THE COLONIAL ENGINEERING COMPANY, of New York, has been incorporated; capital, $1000. Directors: T. J. Kane, New Brunswick, N. J.; J. A. C. Johnson, Englewood, N. J., and W. C. Furley, Brooklyn.

THE ELECTRIC AND STEAM ENGINEERING COMPANY has been incorporated at St. Louis, Mo. The capital stock is $5000, full paid. The incorporators are B. D. Kribben, W. J. Burton, E. R. Suits and R. H. Moore.

THE TOWER STORAGE BATTERY COMPANY, Cleveland, O., capital stock $10,0000, has been incorporated by E. B. Robbins, T. Rowland, C. A. Gilbert, G. D. Reed and J. H. Van Derveer. The company will manufacture automobile batteries.

THE FARIBAULT MANUFACTURING COMPANY has been organized at Faribault, Minn., for the manufacture of dynamos, motors and gasoline engines. Active operations have already commenced. Hon. Judge James Hunter is vice-president of the company.

Legal.

WIRELESS TELEGRAPH LITIGATION.—Judge Lacombe in the United States Circuit Court, New York City, on March 30, denied an application for a preliminary injunction against the De Forest Wireless Telegraph Company and others in proceedings instituted by the National Electric Signalling Company for alleged infringement of patent. The application sought to restrain the De Forest company from using certain apparatus to which the National Company claims exclusive rights, chiefly the liquid barretter patented by Prof. Reginald A. Fessenden, an instrument for receiving Hertzian waves. The De Forest company was represented by Cornelius D. Ehret, of Philadelphia, and Francis X. Butler, and the National Electric Signalling Company by Kenyon & Kenyon. Judge Lacombe, in his opinion, did not pass on the merits of the case, simply stating that the question at issue should be left for final hearing.

Obituary.

CHARLES J. POWER, a well-known telegrapher, died at his home in New York City, March 21. At the time of his death he was chief operator in the Commercial News Department of the Western Union Telegraph Company, at 195 Broadway. Deceased was 43 years of age.

Educational.

LEHIGH UNIVERSITY.—The Register of Lehigh University, South Bethlebem, Pa., just issued, copies of which may be had on application, shows the attendance of 615 students from 24 States and 10 foreign countries, of whom 90 are taking the course in electrical engineering. There are 54 in the teaching staff. Thirteen four-year courses of instruction are offered at the University: the classical course, the Latin-scientific course, the courses in civil, mechanical, marine, metallurgical, mining, electrical, and chemical engineering, analytical chemistry, geology, physics, and electrometallurgy. A list of graduates of the University, 1304 in number during the 38 years of its existence, indicates that this institution is exerting a very marked influence on the industrial development of the United States, and also of foreign countries. Provision is made for worthy and needy students whereby they may postpone payment of tuition until after graduation.

UNIVERSITY OF WISCONSIN, SUMMER SCHOOL FOR ARTISANS.—The fourth annual sessions of the Summer School for Artisans, held under the direction of the College of Engineering of the University of Wisconsin, begins June 27, and continues for a period of six weeks. Courses of study are offered in the following subjects: (1) Steam, Gas and Other Heat Engines. (2) Applied Electricity. (3) Mechanical Drawing and Machine Design. (4) Materials of Construction, Fuels and Lubricants. (5) Shop Work. Three sessions of this school have been held. The first, in 1901, marked a new departure in educational methods and was begun as an experiment, but its success has justified the continuation of these sessions. In 1903 students came from twelve states, and among them were representatives of the following occupations: Machinist, electrician, draftsman, stationary engineer, erecting engineer, chief engineer of electric plant, carpenter and manual training teacher. The class instruction consists of lectures given by members of the regular faculty of the College of Engineering, and as the entire laboratory equipment of this college is available for instruction in the school, opportunities are thus afforded for laboratory practice, otherwise available only in a regular engineering course. A large number of the students enrolled have had correspondence instruction. The requirements for admission do not extend beyond a working knowledge of English and arithmetic, but the policy is to allow a large amount of individual work so that the student may take advantage of all the preparation he has obtained. As the demand renders it necessary, advanced courses will be established in the various subjects.

Personal.

MR. PAUL JONES has been appointed secretary and treasurer of the Lincoln, Neb., Gas & Electric Light Company. He was formerly connected with the Denver Gas & Electric Company as its accountant.

MR. W. E. GILMORE, the active manager of the Edison Mfg. Co., and several other Edison enterprises at Orange, N. J., leaves this week on a trip to Europe to look after various important matters there in Mr. Edison's behalf.

MR. BENJAMIN H. BLOVER, formerly with the Underwriters' Laboratories and the past year engineer of the Chicago Fuse Wire & Mfg. Co., at Buffalo, N. Y., is now associated with the Westinghouse Electric & Mfg. Co., at East Pittsburg, Pa.

MR. THOMAS B. BAILEY'S election to the directorate of the American Telephone and Telegraph Company to fill the vacancy caused by the death of J. Malcomb Forbes is said to be but a temporary one. Mr. Bailey has his hands full as purchasing agent of the company.

MR. C. J. H. WOODBURY recently addressed the Worcester, Mass., Board of Trade on the "Telephone System of To-day." He fully described the modern telephone system and its operation, the subject being illustrated by over 100 lantern slides.

MR. M. J. FRANCISCO, of Rutland, Vt., past president of the National Electric Light Association, has been confined to his bed for seven weeks past with a severe attack of pneumonia. He is recovering, but it may be some weeks before he is able to resume active duties.

MR. P. G. GOSSLER has resigned his position as general superintendent and engineer of the Montreal Light, Heat and Power Company, to take effect May 1. He has accepted the general managership of the operating department of J. G. White & Co., of New York.

MR. A. C. RAHE, manager of the Smith Storage Battery Company, of Binghamton, N. Y., was in New York last week. Not only was he interested at the time in storage batteries for special lines of work, but he had in mind some other lines which promise important and interesting developments.

MR. W. B. POTTER, chief engineer of the electric railway department of the General Electric Company, has returned from a recent trip to the West Indies, whither he went to rest and recuperate after a severe attack of overwork and grip. He has benefited greatly by the holiday in summer seas.

MR. EDWIN W. RICE, JR., has been elected during the past week a director of the General Electric Company to fill the place left vacant by the death of William C. Whitney. Mr. Rice is a director in several street railway and electric lighting companies, and is already a vice-president of the General Electric Company.

MR. E. C. HURD, president of the proposed electric railway from Omaha to Beatrice, has completed plans and has come on to New York to finance the undertaking. Before leaving, he arranged with the Omaha & Council Bluffs Street R. R., which owns all Omaha electric lines, to permit the use of its tracks as soon as the new line is completed.

MR. C. H. HINES, electrical engineer of the mechanical department of the Canadian Pacific Railway, is at Fort William, Canada. The Canadian Pacific announces that it will build a large central power house at Fort William and equip it with two 750-hp engines, to be used to generate current to drive all the machinery in the big grain elevators, as well as coal-handling machinery.

DR. F. A. C. PERRINE.—The Clarkson School of Technology has just reprinted in pamphlet form, as part of its *Bulletin*, Dr. Perrine's admirable Founder's Day Address, "The Success of the Educated Man." He claimed that the modern "humanities" are really the great engineering arts, and that the work of the educated engineer has elevated the entire world up to more pleasant places for mankind to live in.

MR. C. C. STARR.—The Canadian Westinghouse Company, Ltd., of Hamilton, Canada, has recently engaged Mr. C. C. Starr, who was formerly connected with the firm of John Starr, Son & Company, to act as its representain the maritime provinces, with headquarters at 134 Granville street, Halifax, N. S. The maritime provinces are included in the district of the Canadian Westinghouse Company's Montreal office, and Mr. Starr will be consequently an attaché of that office.

MR. R. M. BARWISE, well known in the electric automobile and incandescent lamp fields, is returning to New York from Philadelphia and will carry on for the Pope Mfg. Co. on upper Broadway, a handsome garage and show room for Pope Waverly electrics. Mr. Barwise, in addition to considerable executive force, and electrical knowledge, combines a close familiarity with the bicycle and automobile arts, and a host of old friends welcome him under his new connections with Col. Pope and Mr. E. Mason.

MR. W. W. WHEATLEY.—We learn that Mr. W. W. Wheatley, who was for a time superintendent of the trolley system of the Brooklyn Rapid Transit Company, has gone to Mexico, where he is to assume charge of the electric railway system of the City of Mexico. Mr. Wheatley sailed last month to take up his new work. It is said that his salary is to be $15,000 a year in gold. The Mexican road is owned by Wernher, Beit & Company, of London. Mr. Wheatley was with the Brooklyn Rapid Transit Company for two years. He then became general manager of the Public Service Corporation in New Jersey, but remained less than a year under extremely exacting and trying conditions.

MR. EDWARD WESTON, of Newark, N. J., has had conferred upon him the degree of LL.D. by McGill University, of Montreal, Canada, in recognition of his inventions and investigations in electrical science. It is appropriate that this well-deserved acknowledgment should come from Canada, and from one of the most progressive seats of learning under the British flag, and one where moreover electricity has received special attention. Mr. Weston has been an American citizen a great many years, and all his notable work has been done in this country, but he is an Englishman by birth, and in many of his attributes. He studied medicine originally, and first took up electrochemistry. He was president of the American Institute of Electrical Engineering in 1888.

MR. W. F. BAKER has been appointed contract agent of the New York Telephone Company in succession to Mr. F. H. Bethell, promoted to the management of the Potomac Telephone Company, with headquarters in Washington. Mr. Baker has been 6½ years with the department, and for the last two years special agent for the Dey street division. He is a graduate of Harvard University, class of '93, and is a native of Springfield, Mass. He was at one time in the insurance business, and was also city editor of the *Springfield Union*, one of the leading newspapers of New England. Although the company has to-day no fewer than 140,000 subscribers in connection or under contract for service, Mr. Baker believes enthusiastically in the possibilities of great growth and extension in the metropolitan territory.

MR. HARMAN S. SALT has been made manager of the Dale Company, of New York City, and assumed his new duties on April 1 at headquarters in the Hudson Street factory. Mr. Salt, although quite a young man, has had a long and successful career in the field of electrical manufacturing. He entered the service of the Western Electric Company, in New York City, in 1887. He displayed executive ability from the start, and in 1891 was put at the head of the export department, in which during the past thirteen years he made a most creditable record. For a time he was also out on the Pacific Coast for the Company, with beneficial results to its affairs there. Mr. John Dale in his growing business in lighting fixtures and specialties has therefore enlisted experience and ability, in Mr. Salt, that will prove extremely valuable.

MR. J. W. LATTIG.—At its offices, 112 North Broad street, Philadelphia, the employees of the United Telephone & Telegraph Company, as well as the officers of the York State Telephone Company, the officers of the Eastern Electrical Construction Company and the officers of the Eastern Telephone Manufacturing Company, with whom he has held business relations, presented last week to the retiring general superintendent, Mr. J. W. Lattig, a handsome dinner set of 150 pieces, and a beautiful cut glass water set. Mr. Lattig has been with the United Telephone & Telegraph Company for two and one-half years and during that time, as shown by the handsome gift, he has earned the good-will and earnest co-operation of everybody from the officers of the company on down. Mr. Houck, the traffic manager, made the presentation in a neat speech, to which Mr. Lattig replied briefly and feelingly. Mr. Lattig's resignation as general superintendent of the company went into effect on April 1, when he assumed new duties with the Delaware & Atlantic Telephone & Telegraph Company.

HON. S. N. D. NORTH, director of the U. S. Census Bureau, contributes to the *Annals of the American Academy* an interesting article showing how, under the protective tariff, American manufacturers have grown so strong that they have now only invaded foreign markets but penetrated to foreign soil as a foothold. He cites a number of examples and says: "The Western Electric Company, of Chicago, is interested in extensive factories in London, Paris, Antwerp and Berlin, not all of them carried under the name of that company, but all of them established and controlled by its capital. The General Electric Company has three or four such establishments, and has recently constructed a huge new factory at Rugby, in England. The Westinghouse Company has just finished, at Trafford Park, in England, one of the largest electric factories in Europe, employing two or three thousand men, and it has other factories in Havre, France, and St. Petersburg, Russia. The Singer Machine Company has three large plants in Europe, under its direct control. The Chicago American Tool Company is building a plant at Frazerburg, near Aberdeen. The Hoe printing presses are made in London, as is also American linotype machinery. The Draper Company has recently completed its new factory in Lancashire, to supply the greatest cotton-manufacturing district of the world with the American fast-running Northrup loom. This list might be extended indefinitely, and a fine field for investigation is opened for the full measurement of this remarkable transplantation."

Trade Notes.

MR. A. C. LIPPINCOTT, 109 Franklin Avenue, Scranton, Pa., will be glad to send to any engineer a fine catalogue of indicators, reducing wheels, planimeters, steam separators, etc., by addressing him as above.

PITTSBURG TRANSFORMERS.—The Pittsburg Transformer Company has issued a little folder giving some suggestive facts about these well-known transformers. The folder is accompanied by an attractive calendar for April. The picture is that of a pretty girl, presumably one of those referred to in the folder.

AUTOMATIC TELEPHONE EXCHANGES.—In a pamphlet of 32 pages issued by the Automatic Electric Company of Chicago are given copies of many letters received from patrons of the Home Telephone Company of Dayton, Ohio, testifying to the satisfactory service rendered by the automatic exchange in that city. An illustration of the Dayton automatic exchange is given, which shows a very extensive equipment.

THE NATIONAL-ACME MANUFACTURING COMPANY, Cleveland, Ohio, maker of the Acme multiple spindle automatic screw machine, does a large trade in special work for manufacturers of electrical apparatus. These specialties include set screws, cap screws, machine screws and milled work turned from steel, iron, zinc and brass. The company has recently issued an attractive monthly calendar, which gives a view of one of its machines.

"BURIAL EXPENSES" is the title of a folder issued by the Ewing-Merkle Electric Company, 1006 Pine Street, St. Louis, Mo., on the subject of the Stombaugh guy anchor. The title is rather funereal, but the subject is a living one to telephone men, who are eternally confronted with the problem of guying poles. The Stombaugh anchor meets such cases very completely. It screws into the ground and affords an anchorage that is steadfast and good for all time.

STEAM HAMMERS.—The David Bell Engineering Works, Buffalo, N. Y., has issued a very complete catalogue devoted exclusively to steam hammers. This company makes a specialty in 10 sizes, from 250 lbs. to 1600 lbs. falling weight. These hammers are in use in practically every part of the country and in foreign countries as well, and their field of use is constantly increasing. They are especially adapted to the use of manufacturers of electrical machinery. The catalogue fully describes and illustrates these hammers, and gives all the dimensions of each.

NATIONAL ALTERNATORS.—The National Electric Company, Milwaukee, Wis., has recently issued a 40-page pamphlet on the subject of its alternating-current machinery for lighting, power and railway service. The National Company has developed a line of revolving field alternators up to 1500 kw capacity. These machines represent the latest development of engineering design, and both the mechanical and electrical features have been carefully worked out. Their construction and features are completely described and clearly illustrated. Tables and diagrams at the back give the principal dimensions of the machines of the various types.

A HANDSOME CALENDAR, quarto size, has been issued by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago and Rochester, N. Y. It shows a beautiful girl in evening dress sitting at a desk telephone set of the company's make, receiving very pleasant news, transmitted evidently with very distinct articulation. A special feature is the fact that the picture is not a "half-tone," but a real photograph. At the side is a large rose spray with the flowers and leaves in natural colors. The monthly calendar slips are detachable. Copies of this artistic calendar can be had on application by the heads of telephone operating companies, the request to be accompanied with 10 cents for mailing.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 29, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St. N. Y.]

755,054. SERVICE-METER FOR TELEPHONE-LINES; Charles E. Scribner, Chicago, and Frank R. McBerty, Evanston, Ill. App. filed April 2, 1900.

755,127. ELECTRIC SELECTIVE SYSTEM; Juliene Auguste Géhrung, St. Louis, Mo. App. filed February 8, 1902.

755,308. SERVICE-METER FOR TELEPHONE-LINES; Frank R. McBerty, Evanston, Ill. App. filed July 16, 1900.

755,515. COUNTING SYSTEM FOR TELEPHONES; Johann Heinrich Meyer, Madgeburg, Germany. App. filed May 26, 1902.

755,630. BELL; William W. Dean, Chicago, Ill. App. filed March 24, 1902.

755,642. ELECTRIC ACCUMULATOR-PLATE; Chaimsonovitz Prosper Elieson, Paris, France. App. filed Oct. 16, 1903. (See Current News and Notes.)

755,643. PROCESS OF MAKING ELECTRIC ACCUMULATOR-PLATES; Chaimsonovitz Prosper Elieson, Paris, France. App. filed Oct. 16, 1903. (See Current News and Notes.)

755,646. MULTIPLEX TELEGRAPHY; Stephen D. Field, Stockbridge, Mass. App. filed March 5, 1903. Current reversals and currents of different strength are transmitted by a single mechanism so arranged as to act without interference and in transmitting the reversals the potentials are altered by a series of steps between the maximum of one polarity and that of the opposite, thus making it easier to "balance" the system. Two other transmissions are superposed upon the first two by giving different frequencies to a vibratory key.

755,647. MULTIPLEX TELEGRAPH; Stephen D. Field, Stockbridge, Mass. App. filed March 24, 1903. Improvements upon the preceding invention.

755,659. ELECTRIC WATER HEATER; James F. Hathaway, San Francisco, Cal. App. filed Aug. 10, 1903. A handle having a heater attached thereto and adapted to be plunged into a vessel of water.

755,669. CURRENT SELECTOR FOR CHARGING SECONDARY BATTERIES; Miller R. Hutchison, New York, N. Y. App. filed May 5, 1903. An electrolytic cell adapted to permit the flow of current in one direction but to prevent it in the opposite direction, is placed in circuit with the battery and a lamp for charging purposes, the lamp showing when the current is flowing to the battery.

755,697. ELECTRIC INCANDESCENT LAMP SOCKET; Guy H. Proctor and John B. Daley, Somerville, Mass. App. filed 30, 1903. Details.

755,708. HIGH OR LOW PRESSURE SIGNAL ALARM; Frank H. Schmitz, New York, N. Y. App. filed Sept. 4, 1903. A plunger is forced upward by the fluid pressure and closes a circuit at a critical point.

755,731. CONTROLLER FOR ELECTRIC MOTORS; Magnus W. Alexander, Lynn, Mass. App. filed June 13, 1903. When current fails or drops below a certain strength, the contact arm of the controller is automatically disconnected from the hand lever and returned to its off-position.

755,732. ELECTRIC MOTOR; Ralph E. Barker, Lynn, Mass. App. filed Aug. 7, 1903. The weight of the field coil is sustained upon lugs projecting from the head castings of an inclosed motor.

755,739. MAXIMUM DEMAND INDICATOR; Harry W. Brown, Boston, Mass. App. filed Aug. 2, 1902. The indicator comprises a conductor which is magnetic at low temperatures but non-magnetic at high temperatures; a variation of magnetism causes an indication on a scale.

755,740. SYSTEM OF ELECTRICAL DISTRIBUTION; Harold W. Buck, Niagara Falls, N. Y. App. filed Sept. 4, 1902. A motor generator set having means for regulating the voltage on the alternating current system in response to variation of load on the direct current system.

755,743. REMOVABLE CONTACT FINGER TIP; Frank E. Case, Schenectady, N. Y. App. filed July 9, 1902. The tip is separate from the finger and formed to be readily attached and detached.

755,744. CONTROLLER; Frank E. Case, Schenectady, N. Y. App. filed Oct. 1, 1902. An elongated coil is arranged across the face of a controller drum so that its field of force includes all of the arc gaps, a single coil thus serving to disrupt arcs at any point on the controller.

755,757. MULTIPLE RATE METER; Alexander J. R. Fiego, Lynn, Mass. App. filed July 21, 1903. Two dial-trains are alternately connected with the meter-motor by electro-magnets whose circuits are closed by a clock.

755,766. TRANSFORMER; Walter A. Hall, Lynn, Mass. App. filed Sept. 29, 1902. A transformer core consisting of oppositely disposed bundles of iron laminæ arranged radially to fill the center of the core with a mass of laminated iron polygonal in cross-section to form cooling spaces in the periphery of the center of the core.

755,771. ELECTRIC SWITCH OR CIRCUIT BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed Jan. 29, 1900. Mechanism for operating the circuit breaker from a point of safety to the operator.

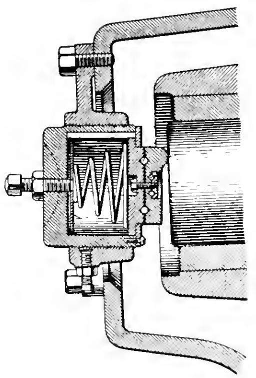
755,772. SWITCH; Edward M. Hewlett, Schenectady, N. Y. App. filed Aug. 14, 1903. Means for closing the field circuit of a generator through a resistance shunt, comprising a snap switch and an auxiliary shunt terminal on which said switch closes just before opening the armature circuits.

755,774. ELECTRIC CLOCK; Frank Holden, London, England. App. filed April 16, 1900. Details.

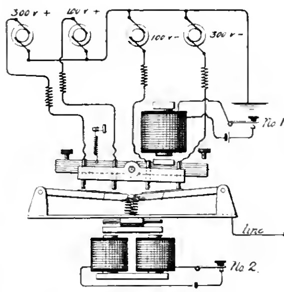
755,775. SYSTEM OF ELECTRICAL DISTRIBUTION; Lewis L. Holladay, Lynn, Mass. App. filed Aug. 21, 1902. A plurality of secondary coils on a transformer, one feeding a circuit with lagging current and the other feeding a consumption circuit with leading current.

755,782. ELECTRICAL CONTACT DEVICE; John Lindall, Boston, Mass. App. filed Oct. 8, 1903. A third-rail contact shoe consisting of a box-shaped piece of metal resting at its extremities against a leaf spring to prevent free movement or rattling.

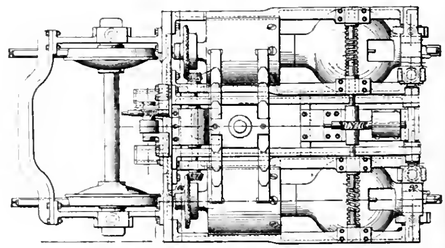
755,783. ELECTRIC FIRE ALARM; August Lueckert, St. Louis, Mo. App. filed Dec. 10, 1902. Details.



755,787—End Play Device for Rotary Machines.



755,646—Multiplex Telegraphy.



755,905—Electric Traction System for Railways.

755,787. END PLAY DEVICE FOR ROTARY MACHINES; David Miller, Schenectady, N. Y. App. filed Aug. 20, 1903. A disk having a boss which rests against the end of the shaft is mounted to rotate upon a thrust plate mounted in a plane oblique to the end of the shaft.

755,791. MEANS FOR CLOSING FIELD CIRCUITS OF ROTARY CONVERTERS; William B. Potter, Schenectady, N. Y. App. filed Sept. 17, 1903. By means of a polarized armature the proper polarity of the armature brushes at the instant the field is connected to them, is ensured and by a proper adjustment of a spring the voltage at which the field circuit will be closed can be adjusted, thus the danger arising from closing a field circuit at the wrong instant is avoided.

755,793. STARTING DEVICE FOR INDUCTION MOTORS; Henry G. Reist and Arthur W. Henshaw, Schenectady, N. Y. App. filed June 27, 1902. The invention consists of a motor starting device comprising a starting switch having contacts carried by the rotable member, and an operating mechanism, arranged to give a step-by-step movement to the switch in one direction, the mechanism being also arranged to permit a continuous movement in the reverse direction.

755,796. FUSIBLE CUT OUT; Howard R. Sargent, Schenectady, N. Y. App. filed March 14, 1900. A fusible strip is placed in an air-tight strong cartridge, otherwise empty, so that the gases evolved by the blowing of the fuse will not destroy the cartridge.

755,797. ARC LAMP HANGER; Howard R. Sargent, Schenectady, N. Y. App. filed Sept. 2, 1902. An automatic hook which engages when the lamp is lifted and disengages by a slight upward movement.

755,800. TRANSFORMER; Louis M. Schmidt, Lynn, Mass. App. filed Sept. 19, 1902. A transformer having portions of its core extended beyond the body of the transformer to form supporting feet and a winding surrounding the core except near the feet, the terminals being brought out in the unwound space.

755,814. COUPLING ELECTRIC MOTORS; David P. Thomson, Rugby, England. App. filed Sept. 8, 1903. Unison running is accomplished by connecting corresponding fixed points in the armature winding by equalizing connections of such a character that only equalizing current will flow through them.

755,815. ELECTRIC ARC LAMP; Elihu Thomson, Swampscott, Mass. App. filed Aug. 19, 1901. A self-induction coil in series with the arc, a polarized armature connected with a movable carbon and a closed coil operating to assist the movements of the armature.

755,819. INDUCTION MOTOR; Pendleton G. Watmough, Schenectady, N. Y. App. filed Sept. 2, 1902. The stator has a two-part ring-core over which the coils are slipped and then an externally slotted ring is passed into the ring-core so that its slots will embrace the sides of the coils and produce, in effect, a "tunnel" winding.

755,822. TRAIN CONTROL SYSTEM; George Whittlesey, Washington, D. C. App. filed Sept. 26, 1902. A multiple train control system in which the standard car controllers are utilized and the number of train wires reduced to four.

755,824. MEANS FOR STARTING ALTERNATING CURRENT DYNAMO ELECTRIC MACHINES; Jonathan E. Woodbridge, Schenectady, N. Y. App. filed Sept. 11, 1901. Comprises means whereby an electro-motive force of gradually increasing frequency can be impressed upon the machine to be started and also means whereby the field of a machine can be excited by a direct current.

755,825. RAILWAY BRAKE APPARATUS; Granville T. Woods and Lyates Woods, New York, N. Y. App. filed Dec. 31, 1902. The invention comprises various ways of bringing a train to a stop, controllable either by the motorman, or self-acting in case he is disabled; or by a passenger, or by a flag-man at the roadside.

755,827. RHEOSTAT; William C. Yates and Paul Zimmer, Schenectady, N. Y. App. filed July 25, 1903. A rheostat by which resistance may be cut into a circuit in large steps until near the desired amount and any large step then graduated by small steps for more exact regulation.

755,828. RHEOSTAT; William C. Yates, Schenectady, N. Y. App. filed Aug. 22, 1903. Details.

755,829. CONTROLLING INDUCTION MOTORS; Arnaldo P. Zani, Milan, Italy. App. filed June 30, 1900. (See Current News and Notes.)

755,830. TUB FOR ELECTRIC BATHS; Jcself Zwiebel, Neu-Ulm, Germany, App. filed Nov. 24, 1903. Rods supporting the electrodes have insulated portions to which the electrodes can be transferred to alter the number in circuit and accordingly the direction and strength of the current.

755,840. DETECTOR FOR ELECTRICAL DISTURBANCES; Jagadis Chunder Bose, Calcutta, India. App. filed Sept. 30, 1901. (See Current News and Notes.)

755,853. ELECTRIC-POWER-TRANSMISSION SYSTEM; Max Deri, Vienna, Austria. App. filed May 28, 1902. (See Current News and Notes.)

755,889. ELECTRIC RAIL BOND; Jang Landsing, Brooklyn, N. Y. App. filed April 25, 1900. A strap of metal slitted into narrow strips between its extremities, the strips being bent at succeeding points to afford the necessary flexibility.

755,890. ELECTRIC SIGNALING DEVICE; Thomas C. Laney, Toledo, and Charles S. Longnecker, Delta, Ohio. App. filed Nov. 24, 1902. Details.

755,897. ELECTRIC LOCK; Frank Lombardi, Brooklyn, N. Y. App. filed Dec. 19, 1903. Details.

755,899. ELECTRIC RAILWAY SYSTEM; Timothy Mahoney, San Francisco, Cal. App. filed April 20, 1903. Details.

755,905. ELECTRIC TRACTION SYSTEM FOR RAILWAYS; August Meuschel, Montreal, Canada. App. filed May 4, 1903. The driving means instead of being cylindrical like car wheels, are spherical in form and rotate in variable planes, parallel to the line of motion of the car, so that the effective diameter of the driver can be altered without altering the speed of rotation of the driver.

755,954. ELECTRIC LAMP AND SOCKET; Albert N. Soden, Trenton, N. J. App. filed Dec. 10, 1902. The lamp is an inverted cone in shape and has an outer transparent wall and in inner reflecting wall, a number of filaments embracing the latter and being singly or jointly insertable in the circuit by a suitable switch.

755,999. ELECTRIC TROLLEY HEAD; John T. Cherry, Plymouth, and Edward H. Clive, Devonport, England. App. filed Nov. 3, 1902. Details.

756,025. ELECTRIC LIGHT CIRCUIT PROTECTOR; Stanley Kalbach, Wildwood, N. J. App. filed May 12, 1902. Details.

756,026. INSULATOR; William S. Kinsley, Stewart S. Bell, Reading, Mass. App. filed Aug. 10, 1903. A two-part block carrying the conductor between them and held together by a binding wire, the block being supported by a bail having a threaded shank.

756,045. SHUNT CONTROLLER FOR ELECTRIC MACHINES; Nels O. Nelson, Chicago, Ill. App. filed July 13, 1903. The output of a frictional generator is controlled by means for forming a shunt circuit between inductor bars arranged adjacent to the collecting combs.

756,049. SWITCH FOR INCANDESCENT ELECTRIC LAMPS; Conrad M. Pitel, Meriden, Conn. App. filed Nov. 23, 1903. A switch designed for hanging lamps.

756,050. COUPLING FOR INCANDESCENT ELECTRIC HANGING OR SUSPENSION LAMPS; Conrad M. Pitel, Meriden, Conn. App. filed Nov. 23, 1903. Details.

756,091. TELEPHONE-CABINET; William B. Altick, Lancaster, Pa. App. filed May 16, 1902. (See next week's issue.)

756,117. ELECTRIC LAMP SUPPORT FOR CONVERTIBLE SIGNAL LANTERNS; Louis H. W. Kerber, Chicago, Ill. App. filed May 13, 1903. A framework arranged to receive either an electric or an oil lamp.

756,119. ELECTRIC RESISTANCE; Hans Von Kramer, Bath, England. App. filed Sept. 1, 1903. Details.

756,156. SIGNAL APPARATUS FOR TROLLEY RAILWAYS; Almo L. Cheatham, Louisville, Ky. App. filed Aug. 8, 1903. A contact arranged to be touched by the trolley wire when it lifts the main conductor in passing.

756,167. CONTROLLING ELECTRIC BOOSTERS; Edward M. Hewlett, Schenectady, N. Y. App. filed Oct. 20, 1902. An auxiliary booster is provided and adapted to be inserted in place of an incapacitated booster feeding any one of a number of circuits.

756,176. PROTECTIVE SHEATH OR ENVELOP FOR STORAGE-BATTERY PLATES; Achille Meygret, Paris, France. App. filed March 29, 1904. (See Current News and Notes.)

756,181. INSULATOR; Louis McCarthy, Boston, Mass. App. filed Feb. 11, 1904. Oppositely placed metallic portions connected by a piece of insulating material and surrounded by a molded insulating composition, the latter being formed with a number of petticoat edges.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, APRIL 16, 1904. No. 16.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

NEW YORK, SATURDAY, APRIL 16, 1904.

CONTENTS.

FEASIBILITY OF PIPE GALLERIES.

The serious accident and fire which occurred last week at Fulton Street and Broadway, New York City, throwing out of operation for some time thousands of telephonic and telegraphic circuits, must necessarily revive discussion as to pipe galleries and the best means of preventing such accidents. The manner in which Broadway has been excavated for the underground road has foreboded some such disaster as this, more particularly because the electrical cables have been deprived of their wonted conduit protection. As a matter of fact, this accident has been regarded as an argument in favor of pipe galleries, but it seems to us that this is a view of the case hardly justified by the facts. If these telephone and telegraph cables had not been disturbed from their normal location, they would have been enclosed in the usual fire-proof brick manhole and in fire-proof ducts. The cables would have been stood neatly against the walls of the manhole and would not have been surrounded by inflammable burlap and by the mass of woodwork which fed the flames. Now, in most of the pipe gallery schemes which have been discussed from time to time, the plan has been broadly that of carrying the cables in masses through an open tunnel, thus exposing them throughout their entire length to the danger of just such an accident as that which has occurred and which will inevitably occur again unless greater care is taken.

Another view of the pipe gallery question suggested by this accident brings up, apparently, a danger of the first magnitude. If in such galleries there should also be carried with the electrical conductors enormous gas and water mains with their various connections, the liability to fire, flood and explosion would appear to be seriously enhanced. With a big gas pipe broken, the gas rushing forth in vast volume and mixing with the air in the pipe gallery would, if ignited, as it undoubtedly would be, cause a pretty lively concussion. A sensational Sunday journal might easily depict without a great strain of the plausibilities an explosion the whole length of Broadway under such conditions, tumbling into the street like a pack of cards the sky-scrapers with which it is lined. On the other hand, the bursting of a water main might drown out like a lot of rats the passengers in nearby subway trains before they could be extricated.

At first glance, the pipe gallery idea has many recommendations, particularly in the ready accessibility of the various services and the facility with which new services can be installed, thus, for example, rendering new competition feasible, which to-day does not appear easy to effect. On the other hand, it does seem as though in working out a pipe gallery scheme, the first consideration should be given to dividing up the services rather than bunching them, so that as in a sectional water-tube boiler, the danger would be lessened rather than increased. The grave financial, legal and other problems of the gallery are, moreover, to be borne in mind before any such plan could be adopted, and the subject is well worth the closest consideration that the best engineering minds can give it. At first glance the pipe gallery appears to be a ready solution of many troubles, high in the list of which is the present abominable and incessant ripping up of the streets. On the other hand, as this accident of last week suggests, it is most desirable that the remedy should not be worse than the evil attacked

Transformers Efficiency Curves.

Elsewhere we print an article by Dr. Kennelly which embodies an elegant treatment of the subject of constant-potential transformer efficiency. Assuming that the excitation losses are constant—which assumption appears entirely valid within practical limits—it is shown that, having the test curve of a transformer, by a simple geometrical construction, the relation between, and the values of, the several factors of loss may be readily determined. This follows from the demonstration given that at the point of maximum efficiency the excitation and I^2R losses are equal, and at this point the drop of pressure in the transformer resistance is half the drop of efficiency. These conclusions follow from the fact established that, under the above assumption, the efficiency curve of a constant-potential transformer is an acute hyperbola, having for one of its asymptotes a straight line representing only the copper loss. It is to be hoped that Dr. Kennelly will publish the application of this treatment to the case of constant-potential shunt motors and generators even if, as stated, the limits of accuracy are less; for it will have much value in putting in a new light the fundamental principles of such apparatus.

An Example in Line Design.

Mr. Wiley's brief article on another page is a capital sample of the art of line calculation under rather trying conditions. It is very seldom that a construction such as described is necessary or justifiable. In the first place, 250 volts is a pressure seldom to be advised for a motor distribution in large units; and in the second place, it is extremely unusual to be obliged to go to the long span construction with so heavy cables as in this case. However, given the conditions there was nothing for it but to go ahead and run the spans, and this seems to have been done in a very workmanlike manner. The only thing which we should be disposed to call in question is the sufficiency of the factor of safety considering the use of material having a rather low and uncertain elastic limit. We hope that some one competent for the work will take up the investigation of the elastic limit of electrical aerial conductors, with particular attention to the elongation factor. Aluminum has very obvious advantages for long span work by reason of its small weight and relatively good conductivity, yet from all the data now at hand we should hesitate to use it with quite the same factor of safety used for copper. However, in this case the proof of the pudding is in the eating and a few seasons of storms will show whether the strain is a little large for the elastic limit or not. One thing we hope Mr. Wiley will follow up carefully, and that is the actual as compared with the theoretical deflections. The expansion of wires under considerable tension has been very inadequately studied, and the behavior of aluminum cable under this condition is extremely well worth investigating. The sag of a long catenary is a wonderfully sensitive index of the coefficient of expansion, the temperatures are easily obtained from resistance measurements, and the resulting data are highly desirable. On many transmission circuits the use of long spans is being considered to cheapen line construction and to lessen the number of insulators. Aluminum is the material usually chosen for such constructions, hence an exact knowledge of its behavior under practical conditions is really important. We trust Mr. Wiley will make good use of his opportunities and take regular deflection measurements at intervals through the next year. The results will be most instructive.

The Preparation of Material for Standard Cells.

Two interesting papers presented last week before the American Electrochemical Society, the one by Profs. Carhart and Hulett, the other by Dr. Wolff, deal with the precautions that are necessary in order to insure electrochemically pure mercurous sulphate. A substance such as mercurous sulphate may be defined as being electrochemically pure, when its electromotive force is zero with respect to the same substance chemically pure. In order to procure electrochemically pure mercurous sulphate, the authors of both papers arrived independently at methods identical in all essential points. They use a process for producing the crystals at the anode. This is just the reverse of the ordinary method of depositing metals from salts. Profs. Carhart and Hulett went further and prepared and tested cadmium cells in which the electrolytic mercurous sulphate was used. Judging from the results reported in the manufacture of cadmium standard cells using the electrochemically generated mercurous sulphate, the authors are to be congratulated on their success. Some extended experience will, however, probably be needed before the final success of the method can be determined. The saturated solution cadmium cells thus produced appear to have an e.m.f. of 1.01908 international volts at 21.1° C. This is an e.m.f. of six significant figures. If we can even get four digits quite correct we can afford to smile gently upon the fifth and sixth, so far as concerns ordinary industrial requirements.

Weak Spots in the Patent System.

Our American patent system is, on the whole, perhaps as good as any other, yet one cannot have much personal experience with it or long watch its operations without realizing that it has some serious failings. To one of these we referred recently, namely, the practice of granting patents on current engineering development. Another conspicuous defect is the absence of any provision compelling the patents to be worked even in the most perfunctory fashion. Of course, this failing seems to be in the direction of liberality toward the poor inventor, but we very much question whether in the long run this apparently benign provision works to the inventor's benefit. At the present time almost every class in the Patent Office is rich numerically, in inventions. An attempt to work up the state of the art in almost any line discloses large numbers of more or less conflicting patents running back over a long term of years. Of these very few are fundamental in their bearing upon the art. Most of them are interlinked with their predecessors in a more or less complicated fashion and belong in the category of improvements. But of the whole mass of patents, primary and secondary, only a very small percentage have any record of practical usefulness. The vast majority is composed of patents unsuccessful and entirely unworked, or of patents taken out for purely defensive purposes, and never seriously intended to be worked. The result is that the inventor honestly striving to produce an article of industrial importance continually finds his way blocked by prior patents touching his invention, more or less remotely, but still sufficiently in the way to hinder material improvements or to control them if made. Even if the way be not completely blocked, it is so far obstructed as to make it difficult to get proper claims, or even claims sufficient actually to protect the new invention. How to avert this trouble is a very serious problem.

We are more than half inclined to the opinion that some requirements for working should be introduced in our patent system at the first opportunity for the purpose of giving the public and particularly inventors of improvements a fair show. The technical working required in some countries abroad is altogether insufficient since it is only necessary to go through the motions without really doing anything by which the public can benefit. Something considerably more drastic in the way of a remedy is needed to really put the unused patents and those held up for litigious purposes finally out of action. We should almost be inclined to favor a primary term of not more than seven years, followed by a reissue for a similar period on the presentation of evidence sufficient to show to the office that the invention is actually being manufactured and sold in the open market in good faith and in quantities sufficient to adequately meet current demands. At the expiration of this reissue term, a second similar reissue might be permitted after a somewhat more stringent inquiry. In case reissue were denied the patent would simply go out of existence and the invention would at once become public property. Such a scheme would eliminate all the dead failures and most of the patents held for obstructive purposes, either on paper or in reality, and would clean the way for improvements. It would obviously have been made, if in existence, to clear up some of the most celebrated tangles of recent years, and it would certainly tend to lessen the mass of fruitless litigation that now burdens our patent system. It, of course, throws heavy responsibility on the officials in charge and opens the way for some perhaps questionable decisions, but after all we have to depend on the office for the original patents themselves and for the present reissue system, and the responsibility is seldom abused. With the immense mass of patents that has been accumulating some sort of relief is absolutely necessary if the march of improvement is to continue unobstructed. The details of any proposed system of relief naturally require to be worked out with great care, and we are far from proposing a simple panacea to meet all cases; yet some means ought to be provided for getting unused and unsalable patents out of the way without waiting seventeen years for them to die of old age.

MOLECULAR CONDUCTIVITY.

In a paper presented last week before the American Electrochemical Society, Mr. C. J. Reed attacks the definition and customary text-book enunciation of "molecular conductivity." There is certainly force in Mr. Reed's argument. It seems indisputable that the definitions and statements current in electrochemical text-books relating to "molecular conductivity" are loose, and out of conformity with the definition and statements adopted in physics for conductivity. It is very desirable that this evil should be eradicated and electrochemical dicta brought into conformity with those of general physics. On the other hand, Mr. Reed, after demolishing the theoretical basis of the term "molecular conductivity," as used by electrochemists, takes the position that all theoretical deductions based on investigations of "molecular conductivities" have no physical significance. By this we suppose he means that they are scientifically meaningless, valueless and heretical. Here we have to differ with him. We think he goes too far when, after hacking the definition to pieces, he throws overboard the whole idea framed in the definition. As usual in such cases, it is a matter of language. We think the ideas are valuable, represent important scientific facts and should be carefully preserved. The language of the definition is at variance with physical terminology, and since the latter is to be regarded as of earlier foundation and logically sound, the more modern electrolytic phraseology should be amended in such a manner as to conform therewith.

In electromagnetics, a resistance is a quantity that in absolute measure must be expressed in absohms, or the units which may be called absolute ohms; while in practice it is measured in units a billion times as big; i. e., in ohms. Resistivity is a specific property of matter in regard to resistance when referred to unit dimensions, and may be defined as the resistance of a unit cube of the substance between opposed parallel faces. Such resistivity to be in absolute measure, must be expressed in absohm-centimeters; or, if expressed in practical measure, must be in ohm-centimeters. Conductivity is the reciprocal of resistivity, and, in absolute measure, must find expression in abmhos per centimeter, or the units implied thereby; while in practical measure it must be in mhos per centimeter. The conductivity of a homogeneous material may be defined as the conductance of a unit cube of the material between any pair of opposed faces. Of course, no man can be compelled to express the conductivity of sea water in the units above-named. He may express his conductivity in terms of the conductivity of mercury (at a standard temperature), for example. It would be perfectly correct to do so; but it would not be the international physical system of measurement, which is the C. G. S. system. In the C. G. S. magnetic system there is one and only one unit for any one physical quantity, and conductivity must, in that system, be measured in terms of the unit which we have described as the abmho-per-centimeter. This name is open to dispute, but the unit is beyond dispute. In precisely similar fashion we may express the velocity of light in any definite unit that we please, such, for example, as cubits per hour; but if we state it in the international physical system there is one and only one unit—the centimeter per second.

Electrochemists theoretically determine molecular conductivities of solutes in aqueous solutions by taking a thin tank of glass, the side walls of which are parallel, vertical and 1 cm. apart. They electroplate or apply electrodes to these walls, so as to have the electrodes parallel, vertical and 1 centimeter apart. Whatever the density of the solution to be tested may be, they pour in enough of the solution to contain one gram-molecule of the solute. For example, with potassium chloride solution, they pour in as much as contains 74.5 grams. They then measure the conductance of the electrolytic cell and express it in terms of the conductance of a prism of pure standard temperature mercury—1 meter long and 1 sq. mm. in cross-sectional area. They call the result the molecular conductivity of the solution for that particular dilution. Of course, we do not mean that the process is actually conducted in the above manner, but we believe that it may be properly conceived of as being so executed. There is nothing in all this to criticize except the definition. What is measured is essentially a conductance multiplied by an area, expressed in absolute measure in abmho-sq.-cms.; or in practical measure in mho-sq.-cms. It is not consistent with electrics or the electrical department of physics to call the quantity arrived at a "conductivity." If it is called a conductivity, then this conductivity is inconsistent with the ordinary conductivity of electrics, a quantity which can only find expression in the absolute unit that we may call an absohm-per-centimeter.

The quantity which the electrochemists derive is a conductance multiplied by an area, or a conductivity multiplied by a volume. The same quantity may in fact be derived by measuring the resistance (between parallel faces), of a cubic centimeter of the solution, determining the corresponding conductivity in mercury units, and then multiplying by the volume of solution in cubic centimeters which would contain a gram-molecule. The quantity is, therefore, correctly expressed in current physical terms, either as a conductivity volume, or a conductance area. In absolute measure it must be expressed in the unit which may be called an abmho-square-centimeter. But whatever this unit be called, it is the only unit which can be used if we are to keep in the international C. G. S. system. No particular harm is done by calling the quantity a molecular conductivity, until we begin to think about conductivities as defined in the ordinary way, and then a clash becomes inevitable. No error would be involved if the quantity were rechristened "molecular-volume-conductivity," or "molecular-conductivity-volume." All propositions now enumerated concerning molecular conductivities could then be made concerning molecular volume-conductivities without any danger of inconsistency. In any case it seems unnecessary to retain the old Siemens mercury unit, or the specific resistance of mercury, in the definition. It may be troublesome to reconstruct tables which have been laboriously prepared in terms of mercury, but after all, part of the business of construction is reconstruction, and the old order giveth place to new. The pride of science lies in its junk heap.

British Views of American Technical Education.

In a cable account of the report of the Mosely Education Commission, which recently visited this country—which consists of a large volume containing the separate reports of the twenty-six commissioners—the New York *Sun* says that the commissioners have much to say about the relations between education and industry, and the reliance of manufacturers on the schools for the best and brightest men, while the highly trained lads from the technical schools in England find difficulty in getting employment in a manufactory. The commissioners think that engineering students in the United States stay too long at school, and, according to Prof. Armstrong's view, overteaching is the bane of American schools of every grade.

Prof. Ayrton makes the following comparison of results: "The American student usually is not as scholarly nor as well read as the English student of the same age, but he has his knowledge in a better form to apply. The British system turns out a man full of knowledge and principles, while the American product is a business man with a scientific training. The characteristics of each nation have their advantages.

"To America we look for that rapid, bold and successful application of science to industry which has brought about the commercial invasion of the world; while to Europe we look for those scientific imaginings and creations which apparently are so unimportant to-day, but which to-morrow revolutionize old industries and give birth to new ones."

Mr. Blair, of the Irish Department of Technical Instruction, writes that the best ability in the United States is not to be found in the professions and in politics, as in Great Britain, but in the industries and in commerce.

Among the general conclusions are the following: That while education is not the prime cause of the remarkable progress during the last thirty years in America, it is a powerful contributory cause and the essential condition of its maintenance; that the root of educational progress in America and the secret of any superiority that its institutions possess lie in the good will of the people and the universal belief in the value of education, and that there is nothing like finality in American educational institutions any more than there is in the British.

Union Engineering Building.

In order to enable the three national engineering societies to avail themselves of Mr. Carnegie's gift of a building for headquarters and library purposes, etc., the conference committee has had drafted a bill incorporating what is known as the United Engineering Society to hold the property for the societies. This bill was introduced in the State Senate by Senator Townsend, of Utica, and has already passed both the chambers, and has gone to the Governor for signature this week. The bill is virtually a transcription of the act incorporating the Cooper Union, its purposes being in most respects, if not all, identical with regard to the public objects of the building.

The conference committee has also selected the following well-known firms of architects who have consented to join in a limited competition for the plans of the Engineering Building, as well as of the Engineers' Club, namely, Carrere & Hastings, Clinton & Russell, Whitfield & King, Ackerman & Partridge, Palmer & Hornbostel and Lord & Hewlett. The committee also expects this week to provide itself with a professional adviser whose assistance it will enjoy in connection with the architectural part of its work. In addition to the six competing firms, each of whom will be paid for its plans, there will be an open competition in which the leading competitors will be compensated by four prizes. It is believed that this mixed competition will furnish the committee with a wide range of desirable designs. Some of the best firms of architects do not enter these competitions, but it was Mr. Carnegie's wish that the matter should be put on this broad basis.

During the absence of Dr. S. S. Wheeler in Europe, Mr. Gano S. Dunn has been appointed by the American Institute of Electrical Engineers as its representative in his place on the conference committee. Mr. Dunn is a member of the Institute council.

Telegraphy in Central Africa.

Some details have been made public recently as to the telegraph line from the Atlantic shore of the African continent to Lake Tanganyika, a distance of about 1,500 miles, for which $600,000 was voted by the Congo authorities. The completed line thus far is only 750 miles long. It took about two years to construct the line from the sea to Stanley Pool, 450 miles. The crossing of wide rivers presented a tough problem. It was nearly a year before the wire was stretched across the widest river between Matadi and Stanley Pool. The river is nearly half a mile wide. Two steel poles were finally erected on hills 2,620 ft. apart. The posts are 50 ft. high and their tops are over 200 ft. above high water level in the river.

Above Stanley Pool to Equatorville, the present terminus of the line, the difficulties were still greater and nearly all the work was done by natives under the direction of Europeans. The most difficult piece of work was the crossing of the Kasai River, the second largest Congo tributary. It was necessary to keep the wire so high that it would not interfere with steamer traffic on the river. Fortunately, where it was desired to cross a rocky island stands in midstream. A high steel post was erected on the island and two others on the banks of the river, so that the crossing was made in two spans, one of 1,472 ft. and the other of 2,198 ft. The wire is suspended about 20 ft. above the smokestacks of the steamers. The posts to which the wire is attached are either of iron or living trees and, therefore, proof against the attacks of white ants; but elephants sometimes knock down the iron posts and every now and then storms throw down trees across the line. Communications are interrupted occasionally for hours at a time by electric discharges during the heavy tropical storms.

Among the minor embarrassments are birds, which make their nests on the wire; wasps, which settle in the insulators, and spiders, that cover the poles from top to bottom with their webs and collect a litter of leaves and twigs.

The line, however, is wonderfully facilitating business and is used both for telephone and telegraph service. Each telegraph station is protected by a squad of native soldiers.

Irrigation Plans in California.

Details have appeared in these pages from time to time as to the use of electric power in connection with pumping and irrigation in California. We now note a further development. A new co-operative water company, to be known as the Anaheim Mutual Water Company, is being started at Anaheim, Cal. Those materially interested in its formation and who will receive the greatest benefit as well as subscribe for the stock are a number of ranchers living between Anaheim and Buena Park. The new company, it is stated, has received sufficient support to assure its success, and the necessary agreements have been drawn up by local attorneys.

The plans provide for developing the water by means of pumping plants. The Edison Electric Company proposes to put down a series of wells in the territory to be covered, and agrees to develop 300 inches of water by June 15 next. Ranchers and others taking stock in the company are to make a deposit of 20 per cent. of the amount subscribed with the First National Bank, which is to be paid over to the Edison Company, together with the additional 80 per cent. Upon the development of the amount of water agreed upon the plant is to become the property of the Anaheim Mutual Water Company, the electric company merely furnishing the power after the plant is completed. The proposed plant will allow one-fourth of an inch of water to the acre, providing for 1,200 acres to be represented in the new company.

Institute Meeting.

The 186th meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West Fifty-seventh Street, New York, Friday evening, April 22, at 8.15 o'clock. The following papers will be presented: "The Mechanical Construction of Revolving-Field Alternators," by David B. Rushmore; "Contribution to the Theory of the Regulation of Alternators," by H. M. Hobart and Franklin Punga, of London, England.

New Radioactive Elements.

Prof. Charles Baskerville announced last week his discovery of two new radioactive elements in monazite sand from North Carolina. One he calls carolinium and the other Berzelium. These elements owe their development partly to the use of thorium dioxide, and have a higher power of luminosity. He showed the properties before the Chemists' Club. A cable dispatch from London quotes Sir W. Ramsay's prompt appreciation and approval of this work.

A Long-Span Transmission Line.

By B. Wiley.

The accompanying illustrations show a recently installed 250-volt direct-current power line from the Carrie Furnaces, situated on the Monongahela River, just below Braddock, Pa., to the Homestead Steel Works. The power house is directly back of the pole on the far side of the river, and the point of distribution about 500 ft. from the pole on the near side. The one particular feature is the excessive span adopted, the distance between supports being practically 1,000 ft.

When this problem of line construction was first introduced the three methods considered were as follows:

First, a pole line on the opposite side of the river from the power station to the bridge, shown on the right, across the bridge and down the river to the mill on the Homestead side. Second, a submarine cable system. Third, the present arrangement.

By rough calculation it was deduced that the latter was the most economical, simple of construction, and, from a general engineering standpoint, the most desirable. The span consists of four 800,000 circular mils aluminum cables anchored to steel structural towers on either side of river. These towers are of heavy material and securely braced by four 1¼-in. tie rods. They were made and erected by the Homestead Steel Works. Fig. 1 gives a general arrangement view of the lines, and shows location and height of the towers. The details of attachment of cable to the towers are shown in Fig. 2. The cables were cut to the required length and furnished with aluminum sleeves, *A*, which were clamped to the cable under hydraulic pressure. These sleeves on opposite ends are threaded right and left hand, respectively, and fit copper clevice bolts, *B*. *C* is a steel forging and *D* a strain insulator. *E* is a steel tension bolt for adjustment of sag and *F* represents portion of tower. The leads to and from the cable are flexible stranded wire, and the connection was made by flaring the ends, wrapping them about copper clevice bolts, *B*, and then soldering.

The following extract from Foster's Handbook, as quoted from a publication of the Pittsburg Reduction Company, sets forth very plainly the advantages to be derived in this particular case, by the use of aluminum in preference to copper cables; and the preceding material was selected:

"Aluminum wire, rods and bars will be furnished of 63 per cent. electrical conductivity, which will have an equal tensile strength per unit of area with the copper, and, therefore, with the electrical conductivity equivalent of 48 per cent. of the weight of the copper and sectional area of 160, against the area of the copper section 100. The tensile strength of aluminum conductors will be as 100 for the copper is to 160 for the aluminum. This would mean, if a square inch of copper conductor was used of, say, 32,000 pounds per square inch tensile strength, the equal conductivity area of 1 6/10 in. of aluminum would have a tensile strength of 51,200 pounds.

"It has already been determined that with aerial lines the snow and ice load is practically as heavy on lengths of small wire as upon larger sections, so that no objections on this score can probably be found to the use of the larger section of aluminum wire.

"Both on account of having only 48 per cent. of the weight and on account of having about 60 per cent. more strength, the aluminum conductor could be used in much longer spans between supports and the number of expensive poles and insulators can be materially diminished."

The conditions that form the basis of the calculations are as follows: Line voltage, 250; load to be carried, 800 amp.; drop of voltage permissible, 40 volts; necessary size of copper conductor, 1,000,000 circular mils; necessary size of aluminum conductor, 1,600,000 circular mils; (duplicate lines of 800,000 circular mil cable were used for convenience of construction); maximum sag allowable at 212° F., 35 ft.; maximum wind probable pressure, 40 pounds per sq. ft.; minimum temperature, 20° F.; probable ice coating, ¼ in. thick. The tensile strength of hard-drawn aluminum wire is 35,000 pounds per sq. in.; its conductivity, 63, as compared with copper at 100; and the coefficient of expansion, .0000231 per degree Fahrenheit.

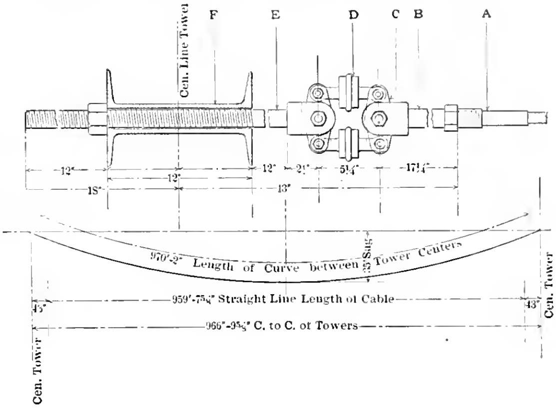


FIG. 2.—DETAILS.

The problem to be considered is, what is the maximum tension in the cable under the most severe conditions as noted above, as compared to the ultimate strength of the cable?

When a wire is suspended between two supports it takes a curve known technically as the catenary. In the case at hand, the catenary comes very close to the parabola, which gives the following relations:

$$T = \frac{L^2 w}{8 d} \qquad (1)$$

Where T = tension in cable at ends,
L = length of span in feet,
w = weight per foot of wire,
d = the central deflection in feet.

Obviously T will be a maximum when w is at its maximum and d at its minimum. The wire will have its greatest weight per foot when coated with ice and is withstanding a heavy wind pressure; and the deflection will vary directly as the temperature.

The weight of 1 ft. of 800,000-cm. Al cable	=	.736 lbs.
The weight of ¼ ft. ice coating per ft.	=	.389 lbs.
Total weight per ft.	=	1.125 lbs.

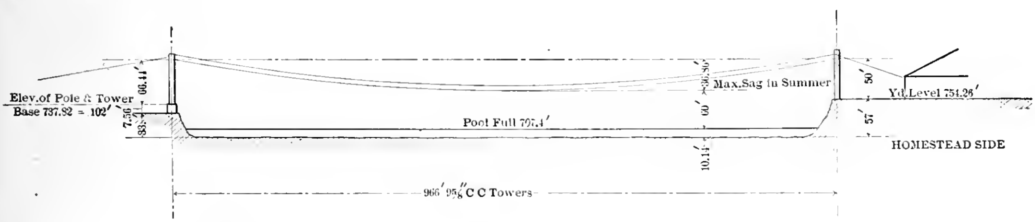


FIG. 1.—ELEVATION OF SPAN.

Taking the wind pressure at 40 pounds per sq. ft. and as acting on the cross-section of ice-covered wire, the pressure per foot is 4.166 pounds. As this force acts at right angles to the weight, the resultant force $= \sqrt{1.125^2 + 4.166^2} = 4.31$ pounds, which may be considered the maximum for w.

For the catenary curve, $L' = L + \dfrac{8d^2}{3L}$.

Where L' = actual length of cable,
L = length of span,
d = central deflection.

Transposing, $d = \sqrt{\dfrac{3L\,(L' - L)}{8}}$

From these two formulæ, d can be figured for any temperature, the initial sag being 35 ft. at 212° F. The following table gives the sag for temperatures between 212° F. and minus 20° F.:

Temp. F.°	Deflection Ft.
212	35.0
200	34.7
190	33.8
180	33.2
170	32.5
160	31.8
150	31.2
140	30.5
130	29.9
120	29.2
110	28.5
100	27.8
90	27.1
80	26.4
70	25.6
60	24.9
50	24.1
40	23.3
30	22.5
20	21.7
10	20.9
0	20.1
—20	19.2
—20	18.3

Substituting in equation (1) the values,
$w = 4.31$ pounds (the maximum weight),
$d = 18.3$ ft. (minimum deflection),
$L = 1{,}000$ ft.

$$T \text{ (the maximum tension)} = \frac{1{,}000^2 \times 4.31}{8 \times 18.3} = 29{,}400 \text{ pounds.}$$

The sectional area of 800,000-cm. cable is .8 sq. in., giving a tensile strength of $.8 \times 35{,}000 = 28{,}000$ pounds per cable. Comparing this result with the maximum tension, 29,400 pounds, it is seen that the line will not stand the severe conditions as set down. To relieve the strain, the line should be lengthened in the fall, and, to prevent excessive sag, taken up again in the spring.

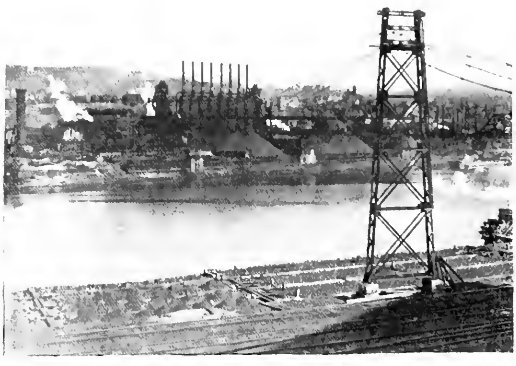


FIG. 3.—VIEW OF ONE TOWER AND THE LINE.

Suppose a range of temperature from 60° F. to — 20° F. be taken for the winter. Then the line could be allowed a drop of 35 ft. at this maximum temperature, which by reference to the table, would make the equivalent sag at — 20° F., 28.4 ft.

Substituting in formula (1),

$$T = \frac{1{,}000^2 \times 4.31}{8 \times 28.4} = 19{,}000 \text{ lbs.,}$$

or the one setting would give a safe tension on the cable for the conditions noted; though for severe conditions it would be well to give the maximum drop of 35 ft., as the adjustment requires only a few minutes' work.

As a summation, the maximum strain per cable is 19,000 pounds, or per tower, $4 \times 19{,}000 = 76{,}000$ pounds. The horizontal component due to the wind pressure is transmitted to the foundations and the direct pull to the steel brace rods behind.

The method of stringing the cables was very simple, and may be of some interest to the reader. The cables were wrapped on a large reel, which was set in a securely anchored frame, and arranged to revolve on a shaft. This equipment was placed on the near side of the river. It was provided with a brake, or rather sufficient friction to stop the reel as soon as the tension on the cable was released. The free end of the cable was passed through an ordinary snatch block hung at the top of the near tower. On the far side of the river, just back of the tower, was placed an electrical winch; and, from the drum a 1½-in. hemp line was passed through a snatch block at the top of the tower and carried across the river by a rowboat. The rope was fastened to the cable on the near side and pulled across by the winch, the boat supporting the end and thus being towed back for the return trip with rope for the next cable. When all but a few turns of the cable had been reeled off, a line was fastened a few feet from the end still on the reel. When the end reached the top of the tower, this line was used as a temporary anchor while the bolt was being placed. The 1½-in. line was replaced by a 2-in. line and sufficient slack was then taken up to allow the anchor bolt of the far end to be fitted into place. As these bolts were made extra long, there was still considerable sag in the cable; hence the tension was not great. The bolts were then adjusted to give the required sag. It was about 30 minutes' work to run a cable after starting it from the reel.

Streamers or Side Discharges from Electrodes.

By Alfred G. Dell.

In a former article on some of the phenomena of rotating discs, I stated that frequently streamers were seen coming from the electrodes under the discs. I propose to briefly describe some of their peculiarities.

They generally appear coming from one or the other of the zinc electrodes about ⅛ or ¼ in. back of the discharge point. Sometimes there are one or two discharges apparently coming from the inside edge of the electrode, and sometimes they seem to twist around the point. I have noticed that they often follow close to the metal and meet the point discharger, but sometimes they strike the disc, but always inclined towards the direction of the sparks from the points. I have never seen any inclined away from the sparks. It would seem there is some cause besides sharp edges or minute scratches or points, although scratches, etc., encourage their production.

I have tried various ways to prevent them, but have not succeeded entirely. Sometimes they will suddenly cease and there will be no more seen unless the arrangement is changed. I am inclined to think they always come from only one of the electrodes, and never from both. They are exceedingly thin, long discharges. In daylight nothing is seen of them, but in the dusk or dark, with the use of a lens, they are well seen with all their changes. When they strike the disc, they interfere with its rotations. If I knew why they should sometimes cease, I would more fully understand them.

It would be well for those working with an induction coil to be on the lookout for this phenomenon as its effects are injurious to the spark discharge. A low humidity in the boxes containing the discs reduces the effect and sometimes entirely prevents it, which I would suppose is on account of the conductivity of the air being reduced.

I have sometimes thought they might be capacity discharges from the windings of the secondary of the induction coil, something like the residual discharges from Leyden jars. The discharges taking place from only one electrode, be it plus or minus, would seem to strengthen that theory.

Municipal Electricians.

At a meeting of the executive committee of the International Association of Municipal Electricians, April 2, the following papers were assigned, to be read at the ninth annual convention to be held at St. Louis, September 13 and 14, 1904. "Street Lighting, Principles Involved and Systems Used," A. S. Hatch, Detroit, Mich.; "The Limitations of the Telephone for Fire Alarm Purposes," Adam Bosch, Newark, N. J.; "The Inspection of Theatres, from an Electrical Standpoint," Wm. H. Thompson, Richmond, Va.; "Methods of Testing," Walter M. Petty, Rutherford, N. J.

The Efficiency Curves of Constant-Potentia Transformers.

By A. E. Kennelly.

An alternating-current transformer of the ordinary constant-potential type consumes a certain amount of power at no load, or with open secondary circuit. This power, expended in the excitation of the transformer, is wasted in hysteresis and in eddy currents. The exciting current is usually so small a fraction of the full-load current that the I^2R losses, or copper losses, in the transformer coils at no load may be ignored.

Under load, it is assumed that the hysteresis and eddy-current losses remain unaltered. This is not quite correct; but it is sufficiently nearly correct for practical purposes. Consequently, the excitation losses may be regarded as constant, or independent of the load, and the loss which increases when the load increases is the copper loss, or I^2R loss, in the primary and secondary coils. Under sensibly non-inductive load, this I^2R loss increases as the square of the output.

Let Fig. 1 represent diagrammatically the windings of an actual

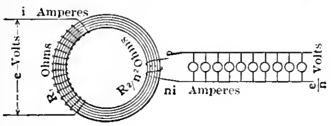


FIG. 1.

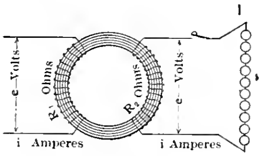


FIG. 2.

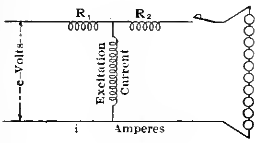


FIG. 3.

transformer, having a primary e.m.f. of e volts and a secondary e.m.f. of $\frac{e}{n}$ volts, where $\frac{1}{n}$ is the ratio of transformation. If R_1 be the primary resistance in ohms, the secondary resistance is $\frac{R_2}{n^2}$, where R_2 is the equivalent resistance of the secondary coil if rearranged with the same amount of copper, but with a number of turns equal to those in the primary winding. If i be the current in the primary coil, and the current of excitation is neglected, $n\,i$ will be the secondary current.

In Fig. 2 the same transformer is represented ideally as a level transformer, instead of a step-down transformer, the number of turns in the secondary winding being the same as in the primary. The e.m.f. in each circuit at no load is e volts. The current in each circuit under load is i amperes. The primary and secondary winding resistances are R_1 and R_2 ohms, respectively.

Fig. 3 gives the equivalent conductive circuit of the inductive system of Fig. 2. The two coils, R_1 R_2, are in series, while the current of excitation passes through a branch midway between them.

In the diagram, Fig. 4, the derived excitation circuit, with its p watts of constant loss, is separated altogether from the transformer, which is reduced to an equivalent resistance r ohms, delivering a current of i amperes under a pressure of e volts.

The efficiency n of the transformer, as represented by the system of Fig. 4, will be

$$n = \frac{e\,i - i^2r - p}{e\,i} \qquad (1)$$

where $e\,i$ is the input at primary terminals in watts, p the constant

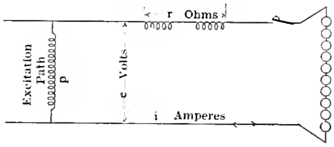


FIG. 4.

excitation loss in hysteresis and eddy currents (watts), while i^2r is the copper loss in both windings taken conjointly.

If n be plotted as ordinates to i as abscissas, we obtain the ordinary efficiency curve, such as that shown in Fig. 6, which is taken from the published data for a 2.25 megawatt transformer.*

This curve of n is a hyperbola. In other words, the efficiency curve of a constant-potential transformer with constant excitation, or frictional losses, is a hyperbola.

Equation (1) may be expressed in the form:

$$n = 1 - \frac{i}{I} - \frac{i_0}{i} \qquad (2)$$

where I is the current strength $\left(\frac{e}{r} \text{ amperes}\right)$ which would flow through the apparatus as represented in Figs. 3 or 4, if the secondary coil were short-circuited and the windings were devoid of reactance.

The current i_0 also represents the non-inductive current, $\frac{p}{e}$ amperes, which would expend, under the pressure e volts, a power p equal to the excitation losses.

In order to show that n in equation (2) represents a hyperbola, let us take the simple case of a transformer in which the constant primary pressure $e = 100$ volts, the total equivalent level resistance is $r = 1$ ohm, and the constant frictional loss is 50 watts. In this case $I = \frac{e}{r} = 100$ amperes; and $i_0 = 0.5$ ampere. Equation (2) becomes

$$n = 1 - \frac{i}{100} - \frac{0.5}{i} \qquad (3)$$

In order to elicit the geometrical meaning of this equation, let us first assume that the frictional loss is made to disappear, so that there is no loss of power in excitation.

Then
$$n = 1 - \frac{i}{100} \qquad (4)$$

This is the equation of a straight line. The straight line is shown in part at $A\,C\,D$ in Fig. 5, where the abscissas are amperes through the transformer assumed as level, and the ordinates are efficiencies. Following the line $A\,C\,D$ and taking 8 amperes (or 800 watts input) as the full load of the transformer, the full load efficiency will be 0.92, or 92 per cent. the efficiency at half load 0.96, etc. Similarly, the full-load drop in the transformer would be $1 - 0.92 = 0.08 =$ 8 per cent., and if the secondary pressure were 100 volts at no load, it would be 92 volts at full non-inductive load, disregarding phase relations. Consequently, if a transformer had no frictional loss, its efficiency would follow a straight line and the line of drop of pressure.

Next suppose, on the other hand, that the transformer has no resistance, but has the assigned excitation loss. Then equation (3) becomes

$$\eta = 1 - \frac{0.5}{i} \qquad (5)$$

This is the equation of a rectangular hyperbola. The hyperbola is shown in Fig. 5 by the dotted curve $E\,C\,F\,G$. Its asymptotes are the two rectangular, or mutually perpendicular, lines $A\,B$ and $A\,O$. On this assumption of negligible resistance, the half-load

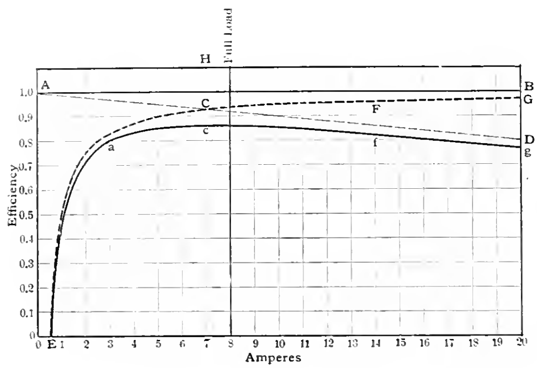


FIG. 5.

efficiency would be 0.875, and the full-load efficiency 0.938. The efficiency steadily increases, the portion $F\,G$ beyond F is very nearly a straight line, and the efficiency becomes nearer to 100 per cent. as the load increases.

If now the transformer possesses both excitation loss and resistance loss, as expressed in equation (3) the efficiency curve is the sum of the rectangular hyperbola and the straight line, or becomes

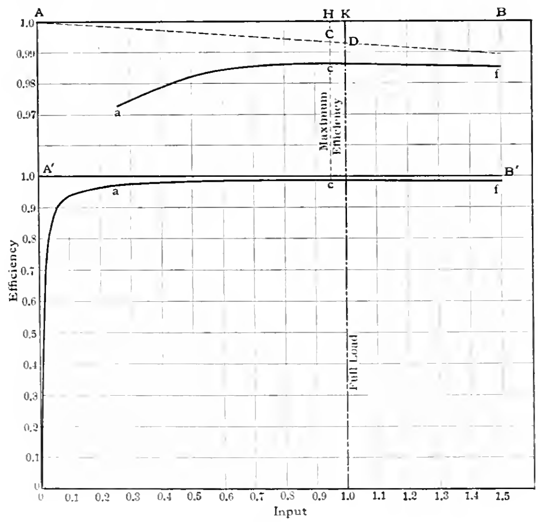


FIG. 6.

the acute hyperbola $E\,a\,c\,f\,g$, whose asymptotes are the straight lines $E\,O$ and $E\,D$.

On the hypothesis of resistance loss only, the efficiency continually diminishes with load along the straight line $A\,C\,D$. On the hypothesis of excitation loss only, the efficiency continually increases along the rectangular hyperbola, $E\,C\,F\,G$. With the actual transformer of virtually constant excitation loss plus resistance loss, the efficiency rises to a maximum on the acute hyperbola $E\,a\,c\,f\,g$, at the abscissa where the resistance line $A\,D$ cuts the hyperbola of pure excitation $E\,C\,G$. This intersection is at C and the maximum value of the efficiency lies immediately below it at c. Moreover, the intersection C lies midway between c, the point of maximum actual efficiency, and the straight line, $A\,B$.

Consequently, the resistance drop in the transformer at the point c of maximum efficiency is half the drop of c below the horizontal of 1.0, or 100 per cent. efficiency. Thus, in Fig. 5 the maximum actual efficiency at c is 0.8596, representing an efficiency defect of 0.1414, or 14.14 per cent. at a current of 7.07 amperes. The drop in resistance will, therefore, be $\frac{14.14}{2} = 7.07$ per cent. at 7.07 amperes, or corresponding to a resistance of one ohm.

Again, the percentage loss of power in resistance $C\,H$ is seen in Fig. 5 to be equal to the percentage loss of power in friction $C\,c$, at the point of maximum efficiency. Consequently, at the input of $100 \times 7.07 = 707$ watts, the efficiency defect of 14.14 per cent. represents $0.1414 \times 707 = 100$ watts, equally divided between 50 watts in friction (p), and 50 watts in resistance (I^2R).

The efficiency curve of a constant-potential transformer tells at a glance the amount of power expended in excitation, since this is half the power lost at maximum efficiency. It also tells at a glance the resistance drop in the apparatus, since the resistance drop is half the efficiency drop at the point of maximum efficiency.

As an example of these principles we may consider the efficiency curve of the transformer represented in Fig. 6. The curve in the lower part of the diagram is so nearly flat that it is difficult to point to the maximum; but by using an enlarged scale, as in the upper part of the diagram, it is easy to see that the efficiency reaches a maximum of 0.9865 at c, or 95 per cent. of full load. The efficiency drop is, therefore, 1.35 per cent. at this point, and the resistance drop following the straight line $A\,C\,D$ is $\frac{1.35}{2} = 0.675$ per cent. If this is the resistance drop at 95 per cent. of full load, the full-load resistance drop in the transformer, neglecting phase, is $\frac{0.675}{0.95} =$ 0.712 per cent., or $K\,D$.

The output at 95 per cent. of full load in a 2.25 megawatt transformer will be 2,140,000 megawatts. Half the efficiency defect at this maximum point, or 0.657 per cent., or 14,100 watts (14.1 kw), will be the excitation loss, and the remaining half will be I^2R loss at this load.

Summing up the above relations we have:

1. The efficiency curve of a constant-potential transformer is an acute hyperbola.
2. The point of maximum efficiency corresponds to equal excitation and I^2R loss, or equal losses in iron and copper.
3. The drop of pressure in resistance in the transformer at maximum efficiency is half the drop of efficiency.

It can be shown that these propositions also hold when the curve is drawn to output as abscissas instead of input.

Similar reasoning applies to constant-potential shunt motors and generators subject to somewhat greater limitations in accuracy.

The Evansville Municipal Telephone Scheme Illegal.

The Evansville Municipal Telephone Company's scheme has been declared illegal by a ruling of Judge Robison, special judge, in overruling the demurrer of the city in the suit by R. D. Richardson to enjoin the city from embarking in the municipal telephone business. The ruling practically disposes of the question.

Judge Robison held that the scheme is illegal because the preferred stockholders are allowed to name certain of the directors, which is contrary to the statute, and that the contract between the city and the telephone company is void because employees of the city are interested in the company as private stockholders. Immediately after the ruling by Judge Robison the directors of the Municipal Telephone Company held a meeting to discuss the status of affairs, but no definite action was taken. In legal circles the decision is regarded as a death blow to the municipal telephone idea in Evansville. An appeal is not likely as it is generally believed that Mayor Covert and others prominent in the scheme are heartily glad that the decision has afforded them an excuse to let go of one of the most unique schemes ever devised in this State.

*The Electrical World and Engineer, June 22, 1901.

Theoretical Determination of Power Curves.

We give below several communications having for their subject the article by Mr. W. J. Berry, which appeared in our issue of January 30:

I have before me your number of January 30, containing a paper by Mr. W. J. Berry, on the theoretical determination of power curves. I am much surprised to find that the writer of this paper did not know of any rigid mathematical demonstration of the fact that, with an impressed e.m.f. of sine-wave shape, the resultant power curve is a sine curve of double frequency. I think it might interest him and your readers to know another demonstration, which does not involve any knowledge of calculus.

Let T be the period,

$$f = \frac{1}{T} \text{ be the frequency.}$$

We can represent the e.m.f. by the curve

$$y = A \sin \left(2\pi \frac{x}{T} \right)$$

where x represents the time. The current is represented by

$$y' = A^1 \sin \left[2\pi \frac{x}{T} + \phi \right]$$

where ϕ, which may be positive or negative, represents the difference of phase. Then the power is

$$y'' = y\,y' = A\,A^1 \sin 2\pi \frac{x}{T} \sin \left(2\pi \frac{x}{T} + \phi \right)$$

Now, by using the well-known formula,

$$2 \sin p \sin q = \cos (p - q) - \cos (p + q),$$

we have

$$y'' = \frac{A\,A^1}{2} \cos \phi - \frac{A\,A^1}{2} \cos \left[4\pi \frac{x}{T} + \phi \right]$$

If we transform the equation to a parallel x-axis at the distance

$$K = \frac{A\,A^1}{2} \cos \phi,$$

$$y''' = y'' - K = - \frac{A\,A^1}{2} \cos \left(4\pi \frac{x}{T} + \phi \right)$$

$$= \frac{A\,A^1}{2} \sin \left[4 \frac{\pi x}{T} + \frac{\pi}{2} + \phi \right]$$

or

$$y''' = \frac{A\,A^1}{2} \sin \left[2\pi \frac{x}{\frac{T}{2}} + \frac{\pi}{2} + \phi \right]$$

which shows that the power curve is a sine curve, whose period is $\frac{T}{2}$ and frequency $2f$.—Q.E.D.

It may be noticed that this demonstration saves the consecutive differentiating and integrating of the same function, which process is somewhat new to me. Very truly yours,

MONTREAL, CANADA. V. R. HEFTLER.

In the ELECTRICAL WORLD AND ENGINEER for January 30, Mr. William J. Berry gives an interesting demonstration of the fact that alternating-current power is a simple harmonic quantity of twice the e.m.f. frequency. I give below a somewhat briefer proof of one step in his demonstration which may interest your readers. A somewhat different notation is used:

Let p, e, i be instantaneous and E, I maximum values; ω angular velocity, t time, ϕ a constant angle of phase difference.

Mr. Berry shows that we may write:

$$p = e\,i = E\,I \sin \omega t \sin (\omega t \pm \phi),$$

$$= E\,I\,[\sin^2 \omega t \cos \phi \pm \sin \omega t \cos \omega t \sin \phi],$$

$$= E\,I\,[\sin^2 \omega t \cos \phi \pm \tfrac{1}{2} \sin 2\,\omega t \sin \phi],$$

the second term in the binominal being a simple harmonic of double frequency. I should suggest that instead of the differentiation, integration and substitution for K, the constant of integration, we might treat the first term as follows:

$$\cos^2 \omega t - \sin^2 \omega t = \cos 2\,\omega t$$
$$\cos^2 \omega t + \sin^2 \omega t = 1$$

$$2 \sin^2 \omega t = 1 - \cos 2\,\omega t$$

whence

$$p = \frac{E\,I}{2} \cos \phi - \frac{E\,I}{2} \left[\cos 2\,\omega t \cos \phi \mp \sin 2\,\omega t \sin \phi \right]$$

$$= \frac{E\,I}{2} \cos \phi - \frac{E\,I}{2} \cos\,[2\,\omega t \pm \phi],$$ or if we use $E\,I$ effective,

$$= E\,I \cos \phi - E\,I \cos\,[2\,\omega t \pm \phi],$$ a displaced sine wave

of double frequency, in which the displacement is the average power as the sine wave part $E\,I \cos\,(2\,\omega t \pm \phi)$ averages zero. This gives the significance of K directly as the average power.

SCHENECTADY, N. Y. JOHN C. PARKER.

In the issue of the ELECTRICAL WORLD AND ENGINEER of January 30 I notice an article by William J. Berry on power curves. In it he states that "every alternating-current engineer knows that with an impressed harmonic e.m.f. of sine-wave shape the resultant power curve is a sine curve of double frequency; but so far as the present writer knows there exists no rigid mathematical demonstration of this fact." The matter is so simple that the proof of the proposition is generally not given in full. Every mathematician knows that the product of two sines is another of double the frequency, independent of the phase relation. Following is a solution with notes on this question:

Let e be the instantaneous e.m.f.,
i " " " current,
p " " " power,
E_m " " maximum e.m.f.,
I_m " " " current,
E " " effective e.m.f.,
I " " " current,
P " " average power,
t " " time in seconds,
f " " frequency,
and ϕ " " angle of lag or lead.

We then have

$$p = e\,i = E_m \sin 2\pi\,f\,t \times I_m \sin (2\pi\,f\,t \pm \phi).$$

From formulæ for the value of the sine of the sum or difference of angles,

$$\sin (2\pi\,f\,t \pm \phi) = \sin 2\pi\,f\,t \cos \phi \pm \cos 2\pi\,f\,t \sin \phi,$$

$$\therefore \quad p = E_m\,I_m\,[\sin^2 2\pi\,f\,t \cos \phi \pm \sin 2\pi\,f\,t \cos 2\pi\,f\,t \sin \phi].$$

From formulæ for the functions of double and half arcs,

$$2 \sin^2 2\pi\,f\,t = 1 - \cos 4\pi\,f\,t, \text{ and } 2 \sin 2\pi\,f\,t \cos 2\pi\,f\,t = \sin 4\pi\,f\,t.$$

$$\therefore \quad p = \frac{E_m\,I_m}{2}\,[2 \sin^2 2\pi\,f\,t \cos \phi \pm 2 \sin 2\pi\,f\,t \cos 2\pi\,f\,t \sin \phi],$$

or
$$p = \frac{E_m\,I_m}{2}\,[(1 - \cos 4\pi\,f\,t) \cos \phi \pm \sin 4\pi\,f\,t \sin \phi].$$

$$p = \frac{E_m\ I_m}{2} \cos\phi - \frac{E_m\ I_m}{2} [\cos 4\pi ft \cos\phi \mp \sin 4\pi ft \sin\phi],$$

$$p = \frac{E_m\ I_m}{2} \cos\phi - \frac{E_m\ I_m}{2} \cos (4\pi f t \pm \phi).$$

Now, $\dfrac{E_m\ I_m}{2} = E\,I$ and $P = E\,I \cos\phi$;

$$\therefore \quad p = P - E\,I \cos (4\pi f t \pm \phi) \quad . \quad . \quad . \quad . \quad . \quad \text{Eq. } (a)$$

Equation (a) can, of course, be rewritten.

$$P - p = E\,I \cos (4\pi f t \pm \phi),$$

$$\text{or} \quad P - p = E\,I \sin \left[\frac{\pi}{2} - (4\pi f t \pm \phi)\right]$$

This shows a curve of twice the frequency and symmetrical with respect to an axis, which is a distance P or the average power above the X axis of the e.m.f. and the current.

In Franklin and Williamson's "Alternating Currents," page 60, you will find the remark that

$$p = P - A \cos (2\omega t - \Theta),$$

which is identical with Eq. (a) by changing the symbols; also on page 62, Example 36, this question is given as an example showing that the authors do not consider it as involving any mathematical difficulty.

Steinmetz, on page 364 of his "Alternating-Current Phenomena," shows that

$$p = P\left(1 - \frac{\sin (2\beta - \omega)}{\cos \omega}\right)$$

where $\beta = 2\pi f t$ and $\omega = \phi$ of the above notation. This is also identical with Equation (a).

BURLINGTON, VT. W. H. FREEDMAN.

The following is perhaps a more direct method of developing the power curve than that given by Mr. Berry in your issue of January 30.

Let the equations of instantaneous values of e.m.f. and current be, respectively,

$$e = E \sin a \qquad (1)$$
$$i = I \sin (a \pm \beta) \qquad (2)$$

where E is the maximum value of e.m.f., I the maximum value of current, a the angle of phase and β the angle of lag or lead (phase displacement).

The value of the power in the circuit is, at any instant,

$$w = e\,i = E\,I \sin a \sin (a \pm \beta)$$
$$= W \sin a \sin (a \pm \beta) \qquad (3)$$

Differentiating with respect to a,

$$D_a w = W [\sin a \cos (a \pm \beta) + \cos a \sin (a \pm \beta)]$$
$$= W \sin (2a \pm \beta) \qquad (4)$$

For a maximum, this is

$$W \sin (2a \pm \beta) = 0$$
$$\text{or} \quad \sin (2a \pm \beta) = 0$$

and occurs when $2a \pm \beta = n\pi$, where n is zero or a whole number. Hence, the value of a for a maximum value of ω is

$$a = \frac{n\pi \mp \beta}{2} \qquad (5)$$

and occurs four times, while a varies from 0 to 2π.

Hence, the curve defined by (3) has double the periodicity of either (1) or (2).

From (4), we have

$$w = W \int \sin (2a \pm \beta)\, d\,a$$
$$= -\frac{W}{2} \cos (2a \pm \beta) + C \qquad (6)$$

where C is the constant of integration. Transforming axes so that $w = 0$, $a = 0$, we have

$$C = \frac{W}{2} \cos\beta$$

and from (6)

$$w = -\frac{W}{2} \cos (2a \pm \beta) + \frac{W}{2} \cos\beta$$
$$= \frac{W}{2} [\cos\beta - \cos (2a \pm \beta)] \qquad (7)$$

the equation of the power curve.

Now, substituting in (7) the values of a obtained in (5) we have

$$w_{max} = \frac{W}{2} \{ \cos\beta - \cos [(n\pi \mp \beta) \pm \beta] \} \qquad (8)$$

For $\beta = 0°$ we have

$$w_{max} = W \text{ and } 0 \text{ (two values of each).}$$

For $\beta = 90°$ we have

$$w_{max} = \pm \frac{W}{2} \text{ (two values of each).}$$

That is, when current and e.m.f. are in phase, two values of the maximum vanish, and the two remaining values are both positive and equal to $E\,I$. The power curve then has the same periodicity as the e.m.f. and current curves, with both crests on the same side of the axis of time.

When current and e.m.f. are not in phase, but differ by an angle β, the power curve has double the periodicity of either, with alternate crests on opposite sides of the axis of time. When $\beta = 90°$ the areas of these two crests are equal and the integral of the curve, taken between $n\pi$ and $(n + 1)\pi$ is zero— the condition of a wattless circuit.

NEW YORK. BASSETT JONES, JR.

I was much interested in the article in your issue of January 30 by Mr. William J. Berry, entitled, "The Theoretical Determination of Power Curves," as I had a few days previous to seeing it worked out a proof of the same law with which Mr. Berry deals. I obtain the same final equation, but in a slightly different and, to my mind, in a somewhat better manner, as follows:

I shall use the notation adopted by Mr. Berry and omit the first part of the demonstration as my work is the same as his up to the equation,

$$y'' = a' \sin^2 x \pm \frac{\beta'}{2} \sin 2x$$

From Wentworth's Trig. § 33. $\cos 2x = \cos^2 x - \sin^2 x$.

Substitute for $\cos^2 x$, $1 - \sin^2 x$, and we get $\sin^2 x = \dfrac{1 - \cos 2x}{2}$;

and thus

$$y'' = \frac{a'}{2} - \frac{a'}{2} \cos 2x \pm \frac{\beta'}{2} \sin 2x.$$

Putting for a' and β' their values, $A\,B \cos\phi$ and $A\,B \sin\phi$, respectively,

$$y'' = \frac{A\,B}{2} \cos\phi - \frac{A\,B}{2} (\cos 2x \cos\phi \mp \sin 2x \sin\phi),$$

$$\cos 2x \cos\phi \mp \sin 2x \sin\phi = \cos (2x \pm \phi).$$

Hence,

$$y'' = \frac{A\,B}{2}\cos\phi - \frac{A\,B}{2}\cos\,(2\,x \pm \phi)$$

$$= \frac{A\,B}{2}\cos\phi - \frac{A\,B}{2}\sin\left(\frac{\pi}{2} - 2\,x \pm \phi\right)$$

$\frac{A\,B}{2}$ cos ϕ is the constant of integration K used by Mr. Berry.

The effective values of y and y'' are $y_e = \frac{A}{\sqrt{2}}$ and $y'_e = \frac{B}{\sqrt{2}}$, and their vector product,

$$y_e y'_e \cos\phi = \frac{A\,B}{2}\cos\phi = K.$$

To prove that the axis, X', is the axis of symmetry of the curve $y\,y'$, it is necessary and sufficient to prove that K is the arithmetical mean of $y\,y'$. This mean is given by the area under one cycle of the curve divided by the base, or

$$\text{mean} = \frac{1}{180}\int_0^{180°} (A\,B\,\sin^2 x\cos\phi \pm A\,B\,\sin x\cos x\,\sin\phi)\;d\,x,$$

since while x varies from 0 to 180°, $y\,y'$ goes through a complete cycle, being of double the frequency of the curves y and y',

$$\text{mean} = \frac{A\,B}{180}\left\{\cos\phi\int_0^{180°}\sin^2 x\,d\,x \pm \sin\phi\int_0^{180°}\sin x\cos x\,d\,x\right\}$$

$$= \frac{A\,B}{180}\left[-\frac{1}{2}\cos\phi\,\cos x\sin x + \frac{x}{2}\cos\phi \pm \frac{1}{2}\sin^2 x\right]_0^{180°}$$

When $x = 0$ all terms in brackets become zero, and when $x = 180$ all but the second vanish, giving for the mean,

$$\frac{A\,B}{180} \times \frac{180}{2}\cos\phi = \frac{A\,B}{2}\cos\phi = K.$$

The quantity $\frac{A\,B}{2}\cos\phi$, being the vector product of the effective values of the pressure and current waves, is obviously the power as measured by an ordinary wattmeter.

LOS ANGELES, CAL. FRANK R. STOWE.

The Uses of Natural Gas.

The most profitable customers that the natural gas companies have are the householders. The natural gas companies of to-day supplied 509,695 domestic consumers in 1902. So says Mr. F. H. Oliphant in his report on the "Production of Natural Gas in 1902, which has just been published by the United States Geological Survey as part of its annual volume on Mineral Resources. Natural gas, he states, is used on many other hearths than the purely domestic. Iron mills, steel works, glass works and various other establishments to the total number of 8,103 made use of its energies in 1902. The number of natural gas companies that supplied the 509,695 home bodies and the 8,103 establishments in 1902 was 2,147, which represented a gain of 602 companies over the enrollment of 1901.

One of the most effective uses to which natural gas has been put is as motive power for engines. The natural gas engine came into favor about ten years ago, when its use was first employed in pumping wells. Afterward, in forms of magnitude ranging from 5 to 500 hp, it was extensively introduced into manufacturing plants, where it has successfully demonstrated its economy and reliability. Owing to the large number of points that are often widely separated and are difficult to supply with other fuel, it is particularly applicable to the pumping of oil wells and to driving pipe line pumps.

Serious Subway Fire In New York City.

At ten minutes to nine on Wednesday morning, April 6, a remarkable accident occurred in the excavation for the rapid transit tunnel at the southwest corner of Broadway and Fulton Street, in New York City. To obtain the space necessary for the tunnel, the contractors have been obliged to rearrange all of the underground structures found in the path of their work. The task of doing this is plainly one of the first magnitude and has been rendered enormously difficult on account of the conditions imposed by public opinion, which required that the work should be carried on without interruption of street traffic. As a result of these conditions, the spectacle of gas pipes carried overhead along Broadway, New York, has been one of the many curiosities of the metropolis. Near this point, and in front of St. Paul's Church, is a shaft connecting between the tunnel and a temporary bridge extending across Broadway.

The disturbance which has been caused to the telephone, telegraph and electric light circuits in this subway excavation has been typical of that which has taken place along the entire route of the rapid transit tunnel, already nearing completion from the City Hall northward. From the location in trouble last week and running south to Wall Street, and some distance beyond, as well as running north to the City Hall and the Postal Building, at Murray Street, there extends the most complex and important wire network which exists

FIG. 1.—CABLES AT SCENE OF THE FIRE.

in this or any other country. This, together with the ponderous gas and water mains and sewers, with their various lateral connections, constitutes a plexus of underground conductors unparalleled in their importance and intricacy. In the midst of this system, which is the spinal cord of the city's underground communications, there occurred the accident above referred to. It was simple in its nature and insignificant in the direct damage which it produced. Its indirect consequences were far-reaching and not only produced a paralysis of the local means of communication, but also suspended for the time being important lines of communication to all parts of the United States and Canada.

To make way for the subway structures the contractors had removed the usual protecting manhole provided by the Empire City Subway Company for the conductors running in its ducts and had massed the cable thus exposed in a tangle most inextricable in its nature. To protect these cables from damage by workmen, the contractor had wrapped them with burlap coverings and surrounded them with woodwork. One of the cables which had been damaged was being repaired by a telephone splicer, who, in the carrying out of his work, employed the usual pot of heated paraffine, melted lead and gasoline stove. On account of some circumstance, which will probably never be discovered, the paraffine took fire and flame was immediately communicated to the burlap about the cable and to the woodwork. The heat generated for the time being was intense. The burlap took fire and melted off the lead covering of 22 large telephone cables, containing 5,250 pairs of wire, 8 Western Union cables carrying important telegraphic circuits, 5 Postal Telegraph cables carrying wires of equal importance, a burglar alarm cable of the Holmes Electric Protective Company, a cable of the American District Telegraph Company, a cable of the New York Stock Quotation Company, a cable of the Automatic Fire Alarm Company, a burglar alarm cable of the Mercantile Electric Company, a city fire alarm telegraph cable, a Gold & Stock Ticker cable, several circuits of the police telephone system and some other circuits of a miscellaneous nature.

The effect upon the telephone service was immediate and profound. The short-circuiting of these wires overloaded the ringing generators and storage batteries of the Cortlandt Street central office. This resulted in the operation of the circuit-breakers. By this means not only were the wires in the cables actually injured thrown out of service, but all of the wires centering at Cortlandt Street, coming in through cables from other directions, were rendered inoperative. In addition to this, a mass of trunk wires extending from the Broad,

FIG. 2.—EXCAVATION AT ANN STREET, NEAR SCENE OF FIRE.

John and Cortlandt Street offices and going to points north were made useless.

At nine o'clock on the morning in question the Cortlandt Street office had been put entirely out of business. To do this it took just ten minutes. All of the other offices were intact, but communication between the three offices above mentioned was cut off to all points north and communication between these three offices themselves was also cut off. Included among these injured cables was one of the Pupin cables which had just been laid, to replace the overhead west side line so recently removed. The interruption of this cable cut off long-distance communication with points in the east, including New Haven, New London, Providence, Boston and other New England points. Important Buffalo and other up-State wires were also thrown out of service.

The confusion which this produced in the business community of New York can hardly be described. Mayor McClellan organized a set of special messengers, which he called his "pony express," but notwithstanding this he declared that the business of the city was practically suspended. Large commercial houses, newspaper offices and other large concerns tried in vain to find a substitute for the telephone. Some of them went temporarily out of business.

To meet this emergency the resources of the New York telephone Company were not found wanting. Available for work in this emergency there were the entire staff of the construction department, consisting of 800 men and the staff of the maintenance department, consisting of 1,000 men. This was a case, however, where mere numbers would not count. It was impossible to employ in the very limited area where the damage occurred more than twenty-five men at a time. Five minutes after the accident the machinery of the telephone company was at work to repair the damage. A plan of campaign was determined upon. Relays of picked men were provided, and within an hour and a half after the accident all of the long-distance wires in the Pupin cable were restored to service. By afternoon the damaged local wires began to operate and at nightfall 800 of the damaged trunk lines were in successful operation and 200 of the subscribers' lines were restored. By the morning of Thursday a still further increase in the number of wires was reported and by Thursday night the entire telephone system was again working as though the accident had never occurred.

To those who were permitted to pass the cordon of police, which was thrown about the scene, the results obtained seemed to be nothing short of marvelous. The various telegraph and other companies concerned were also represented in full force, so that by Friday the service of the companies concerned was proceeding normally.

While the occurrence of this accident was the cause of extraordinary inconvenience to the telephone company and to the public, and produced excitement rarely witnessed in down-town New York, it served one good purpose. It called attention to the inestimable value of the telephone service as exemplified in this city and served to bring to public attention in the most sensational manner the utter paralysis of business which would result were the entire telephonic and telegraphic system of this city suspended. Owing to the fact that Manhattan Island is divided into seventeen telephone districts, each with its own fire-proof central office and underground subway connections, a complete interruption of the telephone service could be brought about only by a catacylsm. The results produced by this temporary interruption of even one office has shown the wisdom of the engineering plans, which have provided that all of the eggs should not be placed in one basket, .i e., one big exchange. The conditions which obtained at the corner of Fulton Street and Broadway are by no means unique. They are merely typical of the snarl of telephone cables which has been produced at scores of places throughout Manhattan Island during the construction of the underground road. That the service has not heretofore noticeably suffered from these interruptions can only be interpreted as evidence of the extraordinary care manifested by those charged with the maintenance of the telephone service.

The General Electric-Allgemeine Electricitats Gesellschaft Combination.

A special meeting of the Allgemeine Electricitäts Gesellschaft was held at Berlin February 27, at which was submitted a report of the details of recent arrangements entered into by that company with the General Electric Company and several European electric manufacturing companies.

Referring to the amalgamation of the Allgemeine Electricitäts Gesellschaft with the Union Elektricitäts Gesellschaft, it was stated that the barriers have been removed, and now that the relations to the American company have been adapted to the new condition of affairs "this amalgamation seems to be the last conclusion in the joining of interests which were but a step in this direction." Referring to the journey of Managing Director Mr. Rathenau to the United States, one of the more important reasons is stated to have consisted in the settling of the future relations between the Allgemeine Electricitäts Gesellschaft and the General Electric Company. "The latter company is the most important representative of the electrical industries in that part of the world. The works of this company are of vast dimensions. It controls a large staff of able men from the scientific and practical engineering world; and it furthers with ample means and rare generosity the development of electrical industry both in laboratory and testing shops. A close relation to this firm seemed all the more desirable to the Allgemeine Electricitats Gesellschaft by the alliance of the Union Electricitäts Gesellschaft with the Thomson-Houston Company, which has since been absorbed by the General Electric Company. The General Electric Company has various branch companies in Europe, i. e., England, France and the Mediterranean, which companies have retained the name of Thomson-Houston. In America the General Electric Company controls the Edison General Electric Company, the Thomson-Houston Electric Company, Fort Wayne Electric Works, Stanley Electric Manufacturing Company, Eddy Electric Corporation, General Incandescent Arc Light Company, Sprague Electric Company and the Northern Electric Company.

"The territory of the Union Electricitäts Gesellschaft comprised Germany, Central and Northern Europe and the Balkan States. With the aid of local capital they had founded the Austrian and Russian Union Electricitäts Gesellschaft and the Union Electrique in Brussels. The various companies are confined to their geographical territories by agreements between these companies and the parent company, but they are at liberty to extend their field of operation by a special agreement. In this manner the Union Electricitäts Gesellschaft has, by an arrangement with the Mediterranean Thomson-Houston Company, acquired the right to carry on business in Italy, subject to certain conditions.

"The element which unites all the companies of this vast group is the interchange of patents and experience. Not only did we endeavor to join this concern and establish friendly relations with the European undertakings, but we were anxious to universalize the more important technical and commercial interests, which we possess in our steam turbine patents and those of Riedler-Stumpf. The combination of the latter with those of the Curtis group, which the General Electric Company had acquired for its own exploitation in the United States, and which it was about to utilize in other countries, seemed to us very useful, indeed. Our numerous agreements with the American and European companies contain the following chief points:

"1. An understanding by which the Allgemeine Electricitäts Gesellschaft and the General Electric Company define the territories of their own and their branch companies and each party leaves to the other the rights and experience for each individual territory. The exclusive territory of the General Electric Company comprises the United States of America and Canada, that of the Allgemeine Electricitäts Gesellschaft Germany, including Luxemburg, Austria-Hungary, Russia in Europe and in Asia, Finland, Holland, Belgium, Sweden, Norway, Denmark, Switzerland, Turkey and the Balkan States. With regard to the territories of the various branch companies in Europe, separate agreements have been made. For the other continents, including South America, a joint working of the two large concerns is proposed, an agreement which will no doubt result in a profitable joint undertaking. The present condition of affairs holds good in Spain and also in Greece.

"2. The General Electric Company and the Allgemeine Electricitäts Gesellschaft will form a company with a capital of three million marks for the exploitation of the Riedler-Stumpf and the Curtis steam turbine patents in the territory of the Allgemeine Electricitäts Gesellschaft. In this combination the Curtis patents are valued at 1.8 million marks and the Riedler-Stumpf patents at 1.2 million marks. The Allgemeine Electricitäts Gesellschaft has secured a license to supply all non-European countries with the exception of the United States and Canada. In these latter countries the General Electric Company has secured the Riedler-Stumpf rights.

"3. The rights for the use of the Curtis patents for marine engines had been secured by the International Curtis Marine Turbine Company. This company had given the license to the Allgemeine Electricitäts Gesellschaft for their European territory, while the Allgemeine Electricitäts Gesellschaft allowed the marine turbine company to use the Riedler-Stumpf patents for their marine work.

"4. For the purpose of working the steam turbine patents of Profs. Riedler and Stumpf, the Allgemeine Electricitäts Gesellschaft has formed a 'Company for the Introduction of Inventions, Limited.' The patents have now passed into the possession of the Vereinigte Dampfturbinen Gesellschaft and in the United States in the hands of the General Electric Company, the marine patents having been secured by the marine turbine companies and the inventors, Messrs. Riedler and Stumpf, derive part of the profits from the facilities granted to the Allgemeine Electricitäts Gesellschaft.

"5. A similar contract to that concluded with the General Electric Company has been made with the Thomson-Houston Company for the export trade. Various additional rights have been granted to the British Company, such as a financial participation in the branch companies of the Allgemeine Electricitäts Gesellschaft and of a company which may eventually be formed in Great Britain for the manufacture of Nernst lamps. The Allgemeine Electricitäts Gesellschaft reserves the right to also supply turbines in addition to the other manufactures.

"6. Similar to the relations with the British Company there also exists an exchange of patents and experience with the French Thomson-Houston Company. The Allgemeine Electricitäts Gesellschaft will restrict their French establishment to the sale of their manufactures in France and will supply engines and steam turbines to the French company only. This company has secured the option to draw shares of the Society Francaise d'Electricite Allgemeine Electricitäts Gesellschaft up to a certain amount. On the other hand, the French Thomson-Houston Company guarantees to the Allgemeine Electricitäts Gesellschaft a demand of dynamos in proportion with the turnover of apparatus up to the present time."

The report states that the various agreements give the right to form the following companies:

"1. A company for the manufacture of turbines, turbo-generators and accessory apparatus. The Allgemeine Dampfturbinen Gesellschaft is to be equipped with a share capital of five million marks, to be paid in as required. The shares are subscribed for by the Allgemeine Electricitäts Gesellschaft. For the establishment of a factory it is proposed to use the land, buildings and plant of the Union Electricitäts Gesellschaft, the working of which has been absorbed by the Allgemeine Electricitäts Gesellschaft. The above-mentioned real estate will be let to the Allgemeine Dampfturbinen Gesellschaft for a number of years with the option of their purchasing it outright. The technical management will be in the hands of Director Lasche, who, up to the present, has been looking after the turbine construction work of the Allgemeine Electricitäts Gesellschaft.

"2. The above-mentioned Turbine License Company: This company has already been formed under the name of Vereinigte Dampfturbinen Gesellschaft M. B. H. (United Steam Turbine Company, Limited.)

"3. An Italian company with a capital of six million lire: This will be transferred to the organizations of the Allgemeine Electricitäts Gesellschaft and the Thomson-Houston Company, as well as the Italian turbine patents of the entire group.

"4. An arrangement somewhat similar to that existing between the Allgemeine Electricitäts Gesellschaft and the Union Electricitäts Gesellschaft has been arrived at between the Société Belge d'Electricité Allgemeine Electricitäts Gesellschaft and the Union Electrique in Brussels. A formal amalgamation of these two companies may take place in the future.

"Although the expense in connection with the companies enumerated, the purchase of patents and the sums advanced represent a considerable amount, this is still further increased by the taking over of the shares of the Austrian Union Electricitäts Gesellschaft in which the Berlin Union Electricitäts Gesellschaft is largely interested, and which for this reason and also for the purpose of establishing suitable works in Austria we wish to entirely reorganize.

"Finally the Allgemeine Electricitäts Gesellschaft will probably have to supplement and safeguard the working stock of the Union Electricitäts Gesellschaft, who obtained heretofore the greater part of their working material on a credit system, should they wish to follow the course of action which they have successfully carried out in financial matters during the past twenty years."

After giving details of the plans made for obtaining the necessary capital to carry out the programme detailed above, the report takes up the matter of the arrangements made with the firm of Brown, Boveri & Co. concerning which the following information is given:

"The firm of Brown, Boveri & Co. was formed in 1891 as a limited liability company for the manufacture of electrical apparatus and construction of electric central stations and equipping of railways. In consequence of their large share in the development of the electrical industry and the important contracts, the firm received the municipal power stations, etc., their works had to be enlarged from year to year. The investments in connection with this development led to the transformation of the limited liability company into a joint stock company. Messrs. C. E. L. Brown, W. Boveri, C. Baumann-Stockar and S. W. Brown-Sulzer, of the board of directors, were appointed managers. The works at Baden (Switzerland) employ 2,000 men. In order to increase their output in Germany the firm formed a branch company in Mannheim. The original limited liability company did excellent business from the very first, but their balance sheets have not been published. The balance of the joint stock company show that the decline of business which set in with the new century, while certainly reducing the receipts, has not affected the solid basis of the undertaking. The dividends were 16 per cent., 5 per cent. and 7 per cent., respectively, for the three years, and the dividend for the year ending March 13, 1904, is estimated at 9 per cent.

"The firm of Brown, Boveri have only on rare occasions taken over installations, limiting their field of operation to manufacture. Their foreign organization comprises a branch office in Cologne, Frankfort-on-Main, Metz and Brussels, small branch companies in Paris, Milan and Christiania, representatives in Berlin, Munich, Stuttgardt, Moscow, Madrid, Stockholm, Hartlepool and Melbourne. Practically at the same time as the formation of the joint stock company took place, the firm of Brown, Boveri & Co. took over the manufacture of steam turbines. Agreements with the company for the construction of Brown-Boveri-Parsons steam turbines, in which Messrs. Brown, Boveri & Co. are interested, enabled this firm to build Parsons turbines for Switzerland, Germany, France, Italy, Russia and Belgium. In order to supply turbines for marine purposes, the Turbinia German Parsons Marine Company was formed. With the exception of a few modifications regarding distribution of work and abolition of unnecessary competition, the company will continue to work independently as heretofore and under the same management.

Electric Automobile Delivery Wagons.

During the past week, under the auspices of the Automobile Club of America, as already noted in these pages, trials have been conducted, of the nature of an endurance test, of automobile delivery wagons for freight, express, etc. Seventeen vehicles started and of these fifteen were still "in the ring" when the contest closed on Saturday night. This is regarded as an excellent showing. We illustrate some of the electric types herewith. The data of the test are now being grouped and analyzed, as to the trips made around New York City, under the varying conditions, and the results are awaited with much interest.

In a paper read before the Automobile Club of America as a preliminary to these trials, Mr. Hiram Percy Maxim gave some most interesting data relating to electric automobiles. He considers that the electric automobile has arrived at what would seem to be a fixed and possibly final type. In all but the smaller pleasure vehicles it has two series motors independently connected each to one of the driving wheels. The storage battery is carried below the body between the axles and almost never inside a part of the body. As compared with the steam, gasoline and combination gasoline and electric automobiles, the electric system is practically the only motor system in general use in commercial wagon service. In New York City alone there are now approximately 300 electric wagons and trucks in service.

All wagons of 2,000-pounds capacity, which is the capacity generally used by department stores and for light express service, have to make about 30 miles per day, and the battery equipment of such a wagon should correspond to this service. The price of such a wagon with the usual type of department store body is about $2,500. A good battery will do 95 days work in such a wagon before it needs cleaning, which consists in cutting each connecting strap so that "mud" may be washed from the plates and from the jar. The cells are then reconnected, or "burned" together, and after being given a slow charge are again ready for service. After this cleaning they run about 75 days more before the mud has again accumulated to a point requiring another cleaning. After this second operation it is usually found that the wooden separators, if used, require to be replaced by new ones; this latter requirement involves the separation of plates when they are removed from the jar and means more labor and a greater breakage of separators and plates than at the first cleaning. When this has been done and the battery has gone into service for the third time, it is good for about 60 days more work before all of the active material on the positive plates has been shed and their useful life ended. When this point is reached a new set of positive plates is substituted and since this means the handling of fragile acid-soaked wood separators, these also must be replaced by new ones. The battery then starts out entirely fresh except for the negative plates. In most cases these hold out and show no signs of failure until the next cleaning and they do not appear to give out together as do the positives. An average might be set at one set of negative plates for every 1⅔ sets of positive plates.

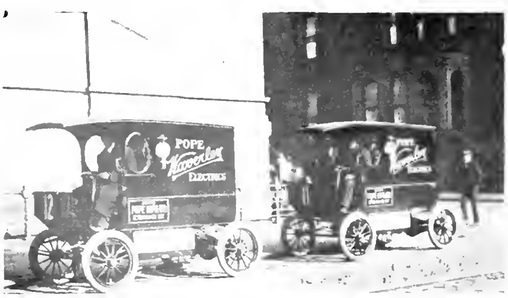


FIG. 1.—ELECTRIC DELIVERY WAGONS.

Taking a full year's work, the cost per annum for a battery under the above conditions is about as follows: New positive plates,


FIG. 2.—ELECTRIC EXPRESS WAGON.

$155; new negative plates, $84; new wooden separators, $26.10; rubber separators, $4.55; rubber jars broken in service and handling, $21.70; total repair in connection with battery, $65; supplies and all other expenses, $43.50. Total, $404.85. On the basis of 30 miles per day and 288 full working days per year for such a wagon, this means 8,640 miles per year, which brings the battery maintenance expense to 4.68 cents per vehicle mile, or $1.40 per day.

As to rubber tires, on a 2,000-pound wagon, a 3½-in. tire is a generous one and the price of a set of such tires, allowing something for scrap, is about $188. In New York City such tires may be depended upon for about 9,000 miles service, which is equivalent to 2.09 cents per vehicle mile, or 62.7 cents per day.


FIG. 3.—ELECTRIC EXPRESS WAGON.

For charging, the requirement is 14.2 kw-hours per day per vehicle. If this is taken from an isolated plant with which a stable or store may be equipped, the cost would never be above 2 cents per kw-hours, and when taken from the street mains it usually amounts to something nearer 4 cents. Assuming 3 cents, on a basis of 288 working days per year, the total consumption is 4,090 kw-hours, which at 3 cents is $122.70 per annum, or 1.42 cents per vehicle mile.

For the cost of general repairs it is stated that the annual charge will be about 4 cents of the price of the wagon, the batteries and tires being left out. In the modern type of wagon costing $2,500, the price less batteries and tires is $1,827; 4 per cent. of this is $73.10 per annum, or 85 cents per vehicle mile as the average for general repairs for this size of wagon. The depreciation may be taken at 10 per cent. on a price of the vehicle less the batteries and tires, which would amount to $182.70, or 2.12 cents per vehicle mile. Taking the interest on the investment at 8 per cent., this would be $125 per annum, or 1.45 cents per vehicle mile.

The various items are, therefore, as follows: Battery maintenance, $404.85; tire maintenance, $180; cost of charging current, $122.70; general repairs, $73.10; depreciation, $182.70; interest on investment, $125. This makes a total per annum of $1,088.35, or 12.61 cents per vehicle mile. This amounts to $3.78 per day, or if 250 packages per day are delivered, to 1.51 cents per package.

The paper next took up the cost of maintaining 3-ton and 5-ton trucks. By the means of an analysis similar to that which precedes, the annual cost of such a truck is found to be $1,609.77, or 23.2 cents per vehicle mile, or 11.6 cents per ton mile, or $5.57 per day. In a similar manner the cost of a 5-ton truck is found to be $1,760.85 per annum, or 30.57 cents per mile, or with the average load, 8.74 cents for every ton hauled a mile, or $6.11 per day.

The paper gives a lengthy discussion of the various items in the above totals. The conclusion is that the direction for the future motor lies in reducing the cost due to the battery, tires and depreciation.

As to the battery factor, it is stated that two new automobile batteries are at present being weighed in the balance, one of these being that of Mr. Edison, and the other a Planté type. The latter is an old battery conventional in form, but owing to its construction its active material sheds less rapidly than in the pasted type, the plates consequently lasting longer. It is stated that this battery has a most creditable record to date.

As to the Edison battery, it is claimed by the manufacturers that the plates never need renewing in the sense in which that term is considered in the paper. The Adams Express Company has for four months been operating with this battery four of its delivery wagons, and at the present time the manufacturers' claims have been equalled. While a much longer experience will be required to determine the value of this battery, it is theoretically directed in the proper line of improvement and, therefore, worthy of most careful consideration. It suffers, however, from its higher cost and the large amount of charging energy which is lost in recharging. The 2,000-pound wagon which now sells for $2,500 would cost $3,005 with this battery, while the saving in weight is only 375 pounds, and the battery requires 60 per cent. more energy than is required in

FIG. 4.—ELECTRIC TRUCK.

charging lead batteries. In the case of the 2,000-pound wagon this means $204 per annum, instead of $122.70 with the lead battery. It would seem fair to expect more repairs with the Edison battery. An analysis of the different items show, however, a net gain per ton mile for the Edison battery amounting to quite a considerable amount, being 13 per cent. in the 2,000-pound wagon, 12 per cent. in the 3-ton wagon, and 12½ per cent. in the 5-ton truck.

The Planté battery above referred to, which is known as the Manchester "box" type, has a strictly Planté positive plate and what is called a "box" negative plate, and is stated to be unquestionably the longest-lived and most rugged storage battery in existence. The cost of maintenance of this battery is discussed and the calculation shows a net gain practically identical with that of the Edison battery. For instance, in the 2,000-pound wagon it will cost for maintenance 10.93 cents per vehicle mile.

The rubber tire is stated to meet every practical requirement of

FIG. 5.—ELECTRIC DELIVERY WAGON.

automobile traction. The iron tire, while by no means impracticable, does not enable a motor vehicle to give its best performance. Experiments with hard wood tires in segmental blocks and with grain end on have been tried with satisfactory results except during the winter season, when they slip on ice and snow, although very much less so than iron tires. They are long-lived, semi-yielding, semi-noiseless, have very good wearing qualities, give good steering way, even taking car tracks at very close angles and are very cheap. Mr. Maxim considers that while not possessing all the necessary qualifications of a truck tire, they may yet be looked to as indicating the direction in which development should proceed.

The paper also contains a discussion of the maintenance charges of a gasoline vehicle. In the case of a vehicle corresponding to the 2,000-pound electric vehicle, the cost is found to be 9.12 cents per vehicle mile, as compared with 12.61 cents for the corresponding electrical vehicle, or with 11 cents if compared with the Edison battery, or with 10.93 cents if compared with the Manchester "box" battery. For a 3-ton vehicle the cost is 16.1 cents per vehicle mile as against 23.26 cents per vehicle mile for the electric vehicle, 20.47 cents for the vehicle equipped with the Edison battery, or 20.36 cents if equipped with the Manchester "box" battery. In the case of the 5-ton vehicle, the figures are 21.8 cents per vehicle mile, as compared with 30.57 cents for the electrical vehicle, 26.75 cents for the same equipped with the Edison battery, or 26.55 cents if equipped with the Manchester "box" battery.

In conclusion Mr. Maxim said that aside from the inherent peculiarities of the gasoline system which prevent it entering the field at present monopolized by the electric system, there would seem to be good reasons for believing that it will be cheaper at least than the best that we have in sight for the electric. It opens up at once the great field of suburban freight transportation which the electric cannot hope to enter, and which is already calling loudly for some kind of a motor vehicle. Mr. Maxim considers that the time has arrived when we may expect to see the gasoline commercial wagon and truck emerge from the gasoline touring car, just as the electric commercial wagon and truck emerged from the electric phaeton and brougham. As to the steam and combination systems, it is difficult to consider them other than as temporary expedients to be used only until the gasoline system takes final hold.

Washington Meeting American Electrochemical Society.

The meeting of the American Electrochemical Society, held on April 7, 8 and 9, in Washington, D. C., was in its social features perhaps the most enjoyable meeting held by the Society. All the papers presented were interesting and some of them were exceptionally so. The attendance, however, which had been expected to reach a very high figure, did not meet expectations, the number of members and guests registered being somewhat below a hundred. This seems to emphasize what has been pointed out before in this journal, that a national engineering society which holds two general meetings a year, holds one too many.

The very great interest shown in the Society was emphasized by the fact that 50 per cent. of the total membership cast votes for new officers. The results of the election were announced in the Saturday meeting, and were as follows: President, Prof. Henry S. Carhart, Ann Arbor, Mich.; vice-presidents, Mr. C. J. Reed, Philadelphia, Pa.; Mr. E. G. Acheson, Niagara Falls, N. Y., and Prof. C. F. Burgess, Madison, Wis.; managers, Dr. W. H. Walker, Boston, Mass.; Mr. C. E. Acker, Niagara Falls, N. Y., and Mr. Edward Weston, Newark, N. J. Mr. P. G. Salom was re-elected treasurer and Mr. S. S. Sadtler was elected secretary. Prof. Burgess was elected both vice-president and manager, and accepted the former office.

From the report of the secretary it appears that 196 new members were elected last year. The total number of members has now passed the 700 mark. From the report of the treasurer, which was read by Mr. Reed, in the absence of Mr. Salom, it appears that the surplus of the Society at present amounts to $1,652.52. In addition the Society holds $250 for the Frenzel prize, which has not yet been competed for.

As already stated, the social features of the meeting were extremely enjoyable, thanks to the excellent programme arranged by the local committee, with Col. Samuel Reber, U.S.A., as chairman and Mr. Clinton Paul Townsend as secretary. First in importance was the cordial reception of the members of the Society by President Roosevelt at the White House on Thursday noon. On the afternoon of the same day a complimentary excursion on a special "Seeing Washington" trolley car to all parts of the city was much enjoyed, since the weather was good and the parks of Washington presented themselves in the glory of spring. On the evening of the same day a "smoker" was greatly enjoyed, while on the evening of Friday a subscription banquet was held at the Shoreham. Dr. Wiley was a most humorous toastmaster, while Dr. J. W. Richards, Prof. H. S. Carhart, Col. Reber, Mr. C. J. Reed and Dr. Needham made speeches.

Prof. H. S. Carhart,
President American Electrochemical Society.

On the afternoon of Friday a visit was made to the Navy Yard, where the visitors were enabled to see a shrinking of the jacket on one of the largest modern guns. The National Bureau of Standards was also open for inspection on Friday and Saturday. On the afternoon of Saturday visits were made by different parties to the Bureau of Chemistry, the Bureau of Engraving and Printing and an excursion, either by trolley or boat, to Mount Vernon.

In the business meeting on Thursday the amendment to the constitution, according to which the president, vice-presidents and managers shall, after the expiration of the full term of office to which they were elected, be ineligible for immediate re-election, was carried unanimously. It was also announced that the board of directors has decided to hold the next meeting during the week of the International Electrical Congress in St. Louis in September.

Following is a report of the papers presented at the meeting and of the discussion which followed the reading of papers:

STANDARD CELLS.

A paper on this subject was read by Dr. F. A. Wolff, of the National Bureau of Standards. In view of the fact that the advisability of an international agreement concerning the fundamental electrical units will be discussed in St. Louis at the International Electrical Congress this autumn, the author gave a review of the main points which are to be taken into consideration in connection with this question. Of the three units—ohm, ampere and volt—only two should be defined; the third one, then, follows from the two others by means of Ohm's law. Of these three units, the ohm is already exceedingly well defined and its definition can be easily made perfect by slight modifications. The ohm should, therefore, surely be chosen as one of the two fundamental units to be defined; the question is thus whether for the second unit the ampere or the volt is to be selected.

The author discussed the comparative advantages and disadvantages of defining either the ampere or the volt. A high accuracy can be obtained in both cases, but if the volt is defined in terms of the e.m.f. of a standard cell, one obtains certain distinct advantages which are not obtained when selecting the ampere as a fundamental unit. As standard cells, both the Clark and cadmium cells show a good constancy and accuracy, but the latter has the enormous practical advantage of a low temperature coefficient. The hysteresis, due to temperature variations in the Clark cell, may cause considerable mistakes in practice which are, of course, absent in the Weston cell. Moreover, the mortality of the Clark cell is quite high on account of its construction, and a layer of gas may be formed and interrupt the circuit. This is not the case in the Weston cell. For these reasons the author is sure that the Weston will replace the Clark cell.

The author then discussed the various methods of the preparation of the materials and described especially a new method of preparing mercurous sulphate in a uniform and well-defined state. It will be remembered that this is most important because the German Reichsanstalt and the British National Laboratory have found that lack of uniformity of the mercurous sulphate was the principal reason in the variation in the results so far obtained with standard cells. Dr. Wolff's method of preparing the mercurous sulphate is an electrolytic one. He uses a mercury anode and a mercury cathode with an electrolyte of sulphuric acid. The grain structure of electrolytic mercurous sulphate is such that there is no probability that it may influence the e.m.f. The author finally thinks that a Weston cadmium cell with saturated solution should be used for establishing the second unit. The unsaturated type of the Weston cell is also very good and its temperature coefficient is absolutely zero. The apparatus for the electrolytic preparation of the mercurous sulphate was exhibited.

PREPARATION OF MATERIALS FOR STANDARD CELLS AND THEIR CONSTRUCTION.

A paper on this subject by Prof. H. S. Carhart and Dr. George A. Hulett was then read by Prof. Carhart. The authors first discussed the preparation of mercury, cadmium sulphate, cadmium amalgam and then dealt at length with the production of mercurous sulphate and it is very interesting to note that the method developed by the authors is in all essential points identical with that worked out independently by Dr. Wolff. Their method for securing Hg_2SO_4 free from nitrate was described as follows:

In a flat-bottomed beaker or deep crystallizing dish is placed mercury a centimeter or so deep. This is covered with dilute sulphuric acid (one to six) to the depth of some 10 cm. A platinum wire, protected except at its end by a glass tube, makes contact with the mercury, which serves as the anode; the cathode is a sheet platinum in the H_2SO_4 solution. A current of about 0.3 amp. is passed from the mercury into the solution; crystalline mercurous sulphate at once begins to separate on the surface of the mercury. A stirrer, consisting of a glass rod bent at right angles at the bottom, must be used to keep the mercury surface exposed. The foot of the stirrer passes close to the mercury and must be driven rapidly by a motor.

About 2.8 grams an hour can be prepared in this way. The sulphate should be protected from the light. By means of a separating funnel the excess of mercury may be readily removed from below, leaving the sulphate with more or less finely divided mercury mixed with it. The authors strongly recommend their method as a standard preparation of mercurous sulphate. It gives a lower e.m.f. with mercury than any preparation obtained from $HgNO_3$ and H_2SO_4

or a sulphate. Samples made at different times and with different materials show an extremely close agreement.

The authors have also built cadmium cells in which their electrolytic mercurous sulphate was used and have obtained excellent results from the same. The construction of the cadmium cells is described as follows: Fig. 1 shows the cell ready to be filled. The tubing is drawn out and contracted at *a* so as to leave the diameter about 6 mm., and with thin walls at this point. Fragments of the cadmium amalgam may be introduced into the clean, dry cell, and may then be melted by dipping the leg of the cell into hot water; or the amalgam may be melted under cadmium sulphate solution, and may then be introduced in liquid form by means of a small tube, slightly contracted at the end, and of a diameter that will allow it to pass freely through the neck, *a*. This tube is used as a pipette, and permits the melted amalgam to be introduced rapidly and without splashing. The mercury, the thin paste and the concentrated cadmium sulphate solution may be introduced in the same manner. An alternative method is to introduce the materials through little funnels made out of small test tubes. The funnels must pass through the neck, *a*, of the cell and must reach well down toward the bottom.

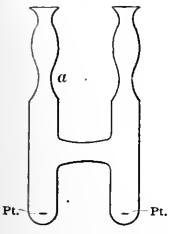


FIG. 1.—DIAGRAM OF CADMIUM CELL.

The electrolytic mercurous sulphate, which has stood with mercury under dilute sulphuric acid, is brought into a Gooch crucible, avoiding free mercury, which interferes with the filtering; it is then washed first with sulphuric acid (made by adding 0.5 c. c. concentrated H_2SO_4, density 1.84, to a liter of water), and then with concentrated cadmium sulphate solution. It is better to reject the top layer, which may be slightly darkened. The paste is next made in a clean agate mortar by grinding together crystals of $CdSO_4$ $8/3H_2O$, and a little mercury, and then mixing in about three volumes of the mercurous sulphate and enough saturated cadmium sulphate solution to make a thin paste. After the mercury and the paste have been introduced into the positive side of the cell, both legs are filled up to the cross tube with the dry, clean crystals of $CdSO_4$ $8/3H_2O$. Enough of the saturated cadmium sulphate solution is finally added to fill the cell to the top of the cross tube.

The sealing off is readily done by means of two small horizontal blast flames, 3 cm. long, directed in a line towards each other and just meeting. The narrow part, *a*, of the cell is brought between the impinging flames, the glass quickly softens, and the top part is drawn off. There is no noticeable heating of the contents of the cell, but it may be advisable before one has acquired the proper skill, to protect the cell by an asbestos disc fitted to the tube below the point, *a*.

One of the special features of these new types of cells is that they do not require any ageing process to reach their equilibrium in e.m.f. The cells reach their equilibrium immediately. This fact, together with the lower value of the e.m.f., compared with that of cells made by the use of mercurous sulphate prepared in any other way, points to the purity of the electrolytic salt, compared especially with that made from the nitrate of mercury.

In the discussion Mr. H. N. Potter urged that the glass from which the containing vessel is to be made should be exactly defined. Glass has, in general, no well-defined composition. Since now pure silicon can be produced cheaply (by the electric furnace process of Tone) we could use it. Dr. Wolff then stated that he had not yet set up cells with the electrolytic sulphurous sulphate, but from its crystalline character and purity he considered it specially suitable for standard cells. Prof. Carhart recommended that if the cadmium cell is adopted as a standard of e.m.f., we should distinguish between the "Weston cell, primary standard" (with saturated solution) from the unsaturated type, which we should call the "Weston cell, secondary standard." Mr. Carl Hering asked whether there was not an uncertainty introduced by hermetically sealing the cell. Prof. Carhart replied that the uniformity of the figures obtained in the tests was so excellent that the hermetical sealing process, which is done at about 20° C., apparently does not introduce any disturbing effect.

SINGLE POTENTIALS OF HALOGEN ELEMENTS.

A paper on this subject was then read by Mr. William Roy Mott. He began with an attack on the ionization theory and considered the solution tensions, assigned to metals by this theory, as impossible. He gives the following single potentials for dilute aqueous solutions: Chlorine, -2 volts; iodine, -0.87 volt; bromine, -1.53 volts; fluorine, -2.53 volts. In a table he gave the voltages of decomposition of various chlorides, fluorides, bromides and iodides in such a form that the well-known additive law is clearly exhibited. This became still more evident by plotting the results in form of a diagram in which equal increments mark the displacement of one metal by another metal or of one halogen element by another halogen element; this results in two sets of parallel lines. This diagram can be used in the calculation of any one of the three factors—the total decomposition voltage, the single potential of the anion and the single potential of the cation, when the other two factors are known. The additive law holds much better for dilute aqueous solutions than for solid salts. Solid salts may, in different forms, possess very different amounts of energy; for example, amorphous silver iodide has a heat of formation of 8.6 large calories, while the crystalline variety has a heat of formation of 14.2 large calories. This introduces a difference of 0.33 volt in their respective decomposition voltages. The author finally expresses the opinion that his results add force to the law that solubility is largely determined by the mutual affinity of the solvent and solute as represented by the heat of solution.

In the discussion which followed Dr. R. Gahl defended briefly the dissociation theory against the attacks of the author and claimed that the author's calculations of the absolute values of single potentials was in disagreement with the principles of thermodynamics.

THE CONTINUOUS ADVANCE OF ELECTROCHEMISTRY.

Dr. J. W. Richards' presidential address, which was delivered at a special meeting on Thursday night, dealt with the above subject, which was discussed under three headings. The author first dealt with the investigation and classification of electrochemical phenomena. He showed what an enormous work has been done in the past in the field of electrochemistry, but thinks that, in spite of the important results obained, even more could have been accomplished by true co-ordination and co-operation. National societies, like the American Electrochemical Society, are operative in bringing workers in different fields together. The author gave a list of such subjects which need further investigation.

The second point discussed by Dr. Richards was the building of a comprehensive electrochemical theory. He thinks that we are now passing through a transition state. He expresses as his own conception of the state of solution that the solute is in an abnormal physical state having resemblance to the gaseous state, and that in some cases a definite compound of the solvent and the solute exists in the solution, it also being in an abnormal physical state, but not abnormal chemically. From J. J. Thomson's recent theoretical investigations of the structure of the atom as a compound of electrons, we might conclude that the dissociation theory will be replaced by the electronic theory.

The third part of his paper dealt with the application of electrochemistry to industrial needs. The author gave a review of what has already been accomplished and spoke at some length on the recent process of Tone for producing silicon in the electric furnace. In concluding he said: If in the battle of industrial competition you are summoned by the conservatives of the industry to strike your colors, answer with the courage and determination of the intrepid Capt. John Paul Jones: "Surrender, sir? We have only begun to fight."

THE COMPOSITION AND RESOLUTION OF VOLTAGES.

The first paper read at Friday's session was by Dr. J. W. Richards on the above subject. It was essentially an enlargement of a former paper presented by the author to the Philadelphia Section of the Society and abstracted in these columns in the issue of February 13, 1904, page 323. The author now gave various numerical examples. For the composition of voltages at the anode, he gave the calculations for the solution of impure copper as it takes place in copper refining, and the solution of a copper-nickel alloy which is one of the steps of the Browne process. As examples of the resolution of voltages at the cathode he discussed the decomposition of a copper-silver alloy on the cathode and the deposition of a metal on the cathode with simultaneous liberation of hydrogen.

In the discussion which followed, Mr. Mott thought that various points might change this method of calculation; for instance, the heat of alloying is not taken into account, nor the overvoltage, etc. Mr. Hering thought that Dr. Richards' calculation is based too much on theoretical considerations, and Dr. Gahl thought that a method of calculation on the basis of the ionization theory would give different results. On the other hand, Mr. Lawrence Addicks and Mr. C. J. Reed stated that the results of Dr. Richards' calculations were in agreement with those actually observed in practice and Dr. Richards also stated that measurements made by him had been found in agreement with his theory.

MOLECULAR CONDUCTIVITY.

A paper on this subject was presented by Mr. C. J. Reed, who pointed out that electrical conductivity is a property of matter, which can be measured only by employing a unit in which there is a definite section, across which the flux is measured, and a definite length in the direction of the flux. Mr. Reed claimed that this is not sufficiently taken into consideration by electrochemists. He compared the ordinary method of electrochemists for measuring molecular conductivities with the case that somebody might measure the conductance of a certain cube of silver between opposite faces, then fuse the silver with n times its volume of lead and measure the conductance of the resulting alloy between faces having n times the area of the original faces, and would then conclude from this that the conductance so measured represents the molecular conductivities of the silver in the two conditions of concentrations. It is wrong to assume that in an aqueous solution of a salt only the salt is a conductor for the electric current. The author claimed that there exists a certain confusion in books and papers on the dissociation theory, due to a lack of distinction between conductivity and molecular conductivity. He concludes that the term molecular conductivity and all theoretical deductions based on investigations of molecular conductivities of different degrees of dilution have no physical significance.

In the discussion which followed, Dr. E. F. Roeber endeavored to show at some length that the term molecular conductivity follows as a consequence from the ionic hypothesis of the electrolytic conductivity of dilute aqueous solutions, and that there is no confusion whatever on this point in the electrolytic dissociation theory. Messrs. Hering, Gahl, Richards and Reber also participated in the discussion. Mr. Reed claimed that Roeber's definition of molecular conductivity is different from that ordinarily used in text-books.

ECONOMIC BALANCE IN AN ELECTROLYTIC COPPER REFINERY.

A paper on this subject was read by Mr. Lawrence Addicks, of the Raritan Copper Works. The author pointed out the close independence of the relations between various factors which form the economic balance in an electrolytic copper refinery. He separated the problem into three variables—tank resistance, age of electrodes and current density. Tank resistance is made up of metallic conductors, contacts, anode slimes, counter e.m.f. due to concentration changes, electrolyte, and a negative quantity due to imperfect efficiency. He discussed these various factors in detail. Concerning the temperature coefficient, he remarked that it is large, and that it is necessary to strike a balance between power saving, cost of heating, increased contact losses and increased cost of keeping the copper contents of the electrolyte down to the required figure. Concerning the question of age of electrodes, much depends upon whether or not the refiner is charged with interest on the metals tied up in the process. Finally, from the standpoint of current density the problem becomes largely one of output. In the light of this multiplicity of relations, it is easy to see why no two refineries use just the same current densities, temperatures, etc. A difference in the cost of labor or power or supplies would tip the economic balance to a new reading at once. Finally, the lowest cost per ton may not be the cheapest cost per ton. This apparent paradox is due to the fact that with a current density somewhat greater than that giving the lowest cost per ton, the output may be sufficiently increased to give greater earnings in spite of the higher cost per unit.

In a communicated discussion, Prof. Bancroft claimed that Mr. Addicks had not given an adequate discussion of the conditions as they exist. Mr. Addicks replied to this criticism and remarked that the final economic balance is the summation of a large number of balances.

HEAT OF NEUTRALIZATION

The next paper read was that of Mr. G. M. Westman on the theory of the heat of neutralization given by Dr. J. W. Richards to the Society last year. The author offers various theoretical objections to Richards' theory and also objects to the assumption that ionization is in no sense to be regarded as a re-solution or a decomposition of the molecules of the constituents. When more water is added to the solution, the molecules expand further and their constituents are further removed from each other. In the discussion which followed, Prof. Carhart remarked that the author's considerations were entirely hypothetical and Dr. Richards stated that the last statement of the author is in agreement with his own view that the dissolved state is similar to the gaseous state.

THE ENERGY OF IONS.

Dr. L. A. Parsons' (University of Utah) paper on this subject was then presented and, in the absence of the author, was read by Mr. S. S. Sadtler. The author discussed at length the objections which had formerly been raised by Mr. Reed against the dissociation theory from the standpoint of the principle of the conservation of energy. He endeavored to show that the views of the dissociation theory are fully in agreement with the energy principle. He also developed some conclusions from the electronic theory of ions.

In the discussion which followed, Mr. Reed thought that the theory developed was that of Dr. Parsons and not the dissociation theory; he also repeated some of his former arguments. The discussion was also participated in by Messrs. Cabot, Richards and Roeber, who defended the dissociation theory, and Gahl, who thought that some apparent difficulties would disappear if one would consider the ionic theory in the light of the electron theory.

ELECTROLYTIC CONDENSER.

A paper by Mr. C. I. Zimmerman was then read in the absence of the author by Mr. A. B. Marvin. The well-known property of the aluminum electrode of permitting the current to pass only in one direction, but not in the other, has already been made use of to construct an electrolytic rectifier, which consists essentially of a combination of an aluminum electrode with an iron electrode. The author has now made use of the same property for devising an electrolytic condenser, which is essentially a combination of two aluminum electrodes. Such an electrolytic condenser is cheaper than other condensers. It shows some leakage, but may be operated continually with an efficiency of 95 per cent. at 110 volts.

Saturday's session was opened with a discussion of Mr. Zimmerman's paper. Mr. Mott gave some additional data on the formation of an oxide film on aluminum. Mr. E. E. F. Creighton remarked that the dielectric strength of the oxide film is so enormously greater than other solid dielectrics that one might suppose the existence of gases in the film. Dr. Karl Guthe confirmed this view and stated that he had found experimentally that gas is contained in the film. Mr. Mott stated that the leakage current is not very large at low voltages in certain electrolytes, like phosphate, etc., but if one approaches the critical voltage, the leakage current becomes large. He has found the dielectric constant of the oxide film to be about 10. Dr. Gahl remarked that in experiments with aluminum electrolytic condensers he had been unable to get constant results.

A STUDY OF THE ELECTRIC ARC.

A paper on this subject was presented by Dr. William S. Weedon, of the General Electric Company. The author gave a great many highly interesting details, but stated frankly that it is still too early to give a complete theory of the electric arc. He only used direct-current arcs. Details were given on the copper arc in air, the copper arc in hydrogen, the iron arc in hydrogen and the carbon arc in hydrogen. It seems that oxidation or combination with the surrounding gas, is not absolutely necessary for the production of a luminous arc, but such a combination facilitates its formation. With regard to the amount of material fed to the arc, there is apparently the tendency for the arc to ionize the surrounding atmosphere if there is not enough material vaporized from the electrode. If much heat is developed, more is vaporized than is employed in transporting the current. Between these two extremes both the atmosphere and the electrode vapor are ionized.

There is a slow gradation from the spark discharges to the true arc, passing through the intermediate stage where both kinds of discharge are present. The main distinction, therefore, between the arc and the spark discharge is that in the former vaporized material from the electrode or electrodes undergoes most of the ionization which takes place, while in the latter the surrounding atmosphere suffers most of the ionization.

The structure of metallic arcs in air are in general as follows: The middle path is not luminous, but the light is derived from the outer mantle and most frequently from that portion of the outer mantle next the inner path. In the carbon arc the outer mantle is not well defined, owing to the fact that the product of combustion is gaseous. It seems probable that the inner non-luminous path is in a way comparable to the Crookes dark space.

From a number of experiments on metallic arcs it seemed probable that the cathode determines the character of the arc, but there are other facts which distinctly contradict such a general statement. The author gave some hypothetical conceptions on the electronic theory of the phenomena in the arc. The paper was discussed by Messrs. Creighton, Browne, Hering and Richards.

COPPER VOLTAMETER.

Some phenomena observed in connection with the use of a copper voltameter were described in a paper of Dr. Isaac Adams and Mr. Barry MacNutt. The paper was read by Mr. MacNutt. The authors had made a determination of the intensity of the horizontal component of the earth field by means of the tangent galvanometer in connection with a copper voltameter. The main points observed were peculiar irregularities in the current when the reversals took place through the galvanometer, and the authors conclude that the reversals should not be made too often, not oftener than, say, every five minutes. Allowance must also be made for the re-solution for the deposited copper. If these precautions are taken, the copper voltameter is suitable for such measurements. In the discussion Mr. Carl Hering remarked that in measurements requiring such an accuracy, the copper voltameter should not be used at all. Mr. MacNutt replied that the consistent results obtained show that the copper voltameter is reliable if only the proper precautions are taken.

ELECTROLYTIC IRON.

A very interesting paper by Prof. C. F. Burgess and Mr. Carl Hambüchen was then read by Prof. Richards. The object of their investigation was to produce, if possible, pure iron in such quantities and at such cost as to make it a valuable material for further inquiry into its properties. They used an electrolyte consisting of ferrous and ammonium sulphates. The current density at the cathode was 5 to 10 amp. per sq. ft. of cathode surface and at the anode slightly less. The e.m.f. for each cell was slightly under one volt, the temperature of the electrolyte being about 30° C. The anodes consisted of ordinary grades of wrought iron and steel, while the starting sheets for the cathodes were of thin sheet iron previously cleaned of rust.

The current efficiency of decomposition was very closely 100 per cent.; that is, there is a deposition of about 1 gram per amp.-hour. The e.m.f. being 1 volt, gives about 2.2 pounds of iron per kw-hour. Although their work was directed toward the production of electrolytic iron in a tense and massive condition rather than in a high degree of purity, analyses which were made showed the purity to be in excess of 99.9 per cent. Not a trace of carbon was detected, and silicon and manganese and other impurities commonly found in iron appeared to be absent. The only impurity which was detected was hydrogen, which was present in appreciable quantities in the metal as taken from the electrolytic tanks. Hydrogen can be driven off, however, almost completely, if not entirely, by heating to a white heat, the evolution commencing at a temperature below 100° C. and becoming rapid at a temperature below a red heat.

The metal containing the hydrogen is so hard that it can be filed or sawed only with difficulty and it is so brittle that it is readily shattered by a sharp blow from a hammer. After the expulsion of the gas it becomes softer and after having been raised to a welding temperature it assumes properties of malleability and toughness similar to those of Swedish iron. The coefficient of hysteresis, the permeability and the electric resistance of electrolytic iron are greatly influenced by the amount of hydrogen in it.

Such electrolytic iron should be useful as a basis for investigating the properties of iron and its alloys. Electrolytic iron also naturally offers a means of manufacturing chemically pure iron compounds and for standardizing solutions in the analytical laboratory. Unless the difficulties encountered in the working of electrolytic iron on account of its roughness offer too serious an objection, it should compete favorably with the purer grades of commercial iron, which are used for various purposes, and which sell for 3 cents and upwards per pound.

In the discussion Mr. Woolsey McA. Johnson remarked that he had made similar experiments, using an electrolyte of ferrous sulphate with an addition of organic acid. He also suggested a furnace for melting pure iron. Mr. Carl Hering remarked that there seems to be but little hope to reduce iron by electrolysis from the ores for two reasons; first, on account of the large area of the tanks required for deposition and secondly, on account of the large energy required. He asked why in the Burgess-Hambüchen process wrought iron or steel is used for the anodes. Cast iron would be much cheaper. Messrs. Johnson and Richards explained that the reason was probably that anodes of cast iron disintegrate too rapidly and the amount of anode scrap is then excessive.

THE REDUCTION TEMPERATURE OF ZINC OXIDE.

A paper was then presented by Mr. Woolsey McA. Johnson, of the Lanyon Zinc Company, on thermo-electric determinations of the reduction temperature of zinc oxide. The author described the furnace used for this purpose and pointed out that Acheson graphite can be so easily machined that it can be used for furnaces or apparatus of almost any form. The methods of the determinations were described in detail. Some of the results are given in the following table:

Material to be Reduced.	Reducing Material.	Corrected Mean of Means.
C. P. Zinc Oxide	1100° Charcoal	1022° C.
C. P. Zinc Oxide Calcined at 1300° C.	1100° Charcoal	1025
C. P. Zinc Oxide	Soft Coke	1029
C. P. Zinc Oxide Calcined at 1300° C.	Soft Coke	1061
C. P. Zinc Oxide	Graphite Turning	1084
Roasted Colorado Ore	Soft Coke	1029
Roasted Joplin Ore	Soft Coke	1073
Roasted Joplin Ore	1100° Charcoal	1059

The results bring out quite clearly what has been the somewhat indefinite opinion of zinc smelters from practical observation, namely, that the temperature of roasting effects the ease of reduction and that different reducing materials have different rates of reduction. He also proposed the hypothesis that the reduction of zinc oxide is caused by the very slight vapor pressure of solid carbon and the slight dissociation pressure of zinc oxide tending to break up the zinc oxide into zinc and free oxygen.

Mr. S. S. Sadtler then showed some samples of porous diaphragms which may be ground down to any convenient thickness, so that their resistance is very small. Mr. C. J. Reed read a letter from Prof. Bancroft in which he called the attention of the Society to the "relative decimal card index for electrochemical interests," suggested by Mr. L. Voege in Zurich, Switzerland. The members of the Society were asked for co-operation. A paper by Mr. Voege on this subject had been sent, but was not read at the meeting. It will be published in the *Transactions* of the Society.

The following three papers were not read or discussed at the meeting, but advance sheets were distributed:

DISSOCIATION BY MEANS OF ALTERNATING CURRENT.

A note by Mr. William H. Davis referring to some experiments made for the purpose of perfecting a method of recovery of cyanogen from the double salts of a cyanide solution. The author describes an experiment in which he found that with the use of a porous cup, rendered semi-permeable with copper—ferro-cyanide, "an alternating current would raise the estimated pressure of a solution concentrated so that complete dissociation was not present."

ELECTROLYTIC PREPARATION OF WHITE LEAD.

In a paper by Mr. C. F. Carrier, Jr., some observations are recorded on the preparation of electrolytic white lead. The author investigated whether basic lead carbonate of the desired composition can be produced by some process differing essentially from that of Luckow, and the process of Richards and Roepper was chosen as the subject of the experiments. It consists in electrolyzing a 5 per cent. solution of a mixture of 1 part Na_2SO_3 and 40 parts CH_3COONa with lead anodes, a small quantity of some nitrate being added to aid the solution of the anode. With a current density of 100 to 200 amp. per m^2, the acetic acid anions are supposed to be decomposed at the anode, yielding CO_2 to precipitate the white lead, the necessary admixture of hydroxide being formed by action of the sulphite.

The author found that the use of copper cathodes reduces the voltage between the cell terminals. With a current density of 100 amp. or more per m^2, the anode dissolves irregularly, "pitting" badly. With a solution containing enough hydroxide to precipitate white lead, spongy lead is deposited on the cathode. To prevent a large deposit of lead on the cathode, it would seem necessary to have a permanent store of CO_3 ions in the solution, thus making Na_2CO_3 or other soluble carbonate an essential constituent of the electrolyte. The solution effect of nitrates on lead, when added to the acetate solution, seems to have a higher efficiency than chlorates alone. The tendency of lead to deposit on the cathode is less with the more dilute solution.

FERRO-NICKEL FROM PYRRHOTITE.

A paper by Mr. E. A. Sjöstedt gives an account of electric smelting experiments made at Sault Ste. Marie for the manufacture of ferro-nickel from pyrrhotite. The problem presented for solution consisted in the utilization to the best advantage of the nickeliferous pyrrhotite of the Sudbury district, with special reference to the saving of the sulphur and iron, as well as of nickel and copper contained in the ore. It was decided to hand-sort the ore at the rock house using the grade higher in copper and gangue for the ordinary matte smelting, and the grade low in copper and gangue, but high in sulphur and nickel for the ferro-nickel industry. Since this latter ore with its high sulphur content requires a large excess of basic admixture which, however, results in a slag too refractory to be kept fluid by the blast furnace heat, it was decided to try an electric furnace process.

He describes various preliminary experiments. The final furnace used is shown in Fig. 2, and contains a rectangular water-jacketed

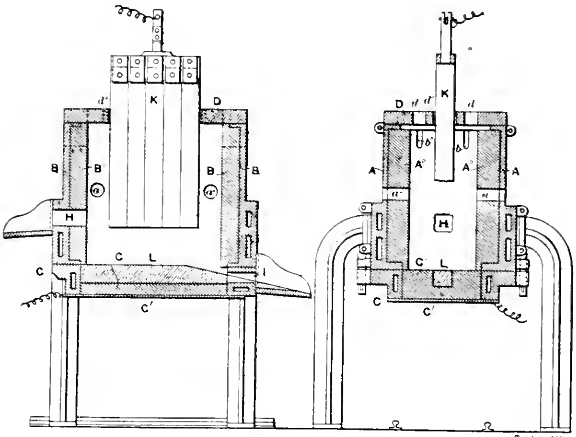


FIG. 2.—SJÖSTEDT FURNACE.

body case, $A B$, with refractory lining, A^0B^0, provided with a slag notch, H, vent holes, a^0, and stroke holes, b^0, a water-jacketed bottom frame, C, held removably on that body, and provided with a refractory lining on a plate, C^1, screwed to that frame, and having a tapping hole, I, provided in one of the ends; a cover of refractory material, D, having feed and vent holes, d and d^1, and opening for the electrode; an upper electrode, K, and a bottom electrode, L, embedded in the bottom lining, C^0, and its ends in contact with the metallic frame of the bottom.

In this furnace ferro-nickel was made for several days from poorly-roasted ore (with about 3 per cent. sulphur and about 53 per cent. iron) at the rate of 60 pounds per hour with an electric energy of 108 kw. With a furnace of 300 or 500 hp, which would be more economical, 200 hp would probably suffice for obtaining a gross ton of ferro-nickel per 24 hours. He gives an estimate of the cost from which he concludes that a profit of over $5 per ton metal produced could be obtained. The process has, however, not yet been established on a commercial scale.

Technical Education.

In a very interesting address recently delivered before the Thomas C. Clarkson Memorial School of Technology on Founder's Day, Dr. F. A. C. Perrine took as his subject, "The Success of the Educated Man," which he treated largely with reference to success in science and engineering. Referring to the importance of fundamental knowledge, he said: "The student often chafes at the beginning of engineering and professional training at the apparent remoteness of the technical knowledge itself. He wonders at the very deep foundation being laid before he begins the study of its applications. If he be a true student and is to become a successful man, it is this foundation which in future will remain and form the basis of his power, remaining even after the whole superstructure has been swept away. Conditions change and methods change, and only scientific fundamentals remain. The arts of to-day have been rapidly changing arts, and indeed the knowledge of to-day is often, we may almost say always the ignorance of to-morrow. Power only comes to him who can build continuously while sweeping aside from his foundations the structures so fondly thought stable; and beginning anew, mount each time higher and higher with a more and more stable superstructure."

Magnet Steel.

During the past several years considerable work has been done abroad on the subject of producing a magnetic material for electrical purposes uniting the properties of high permeability and low hysteresis. One of the most promising outcomes is a magnetic material patented several months ago by Robert A. Hadfield, of Sheffield, England. From the patent specifications, the following is abstracted. An important feature of the process is the heat treatment described:

The object of the invention as stated is to produce an improved material having specially high permeability and electrical resistance and low hysteresis qualities. These qualities can be produced by alloying iron with other elements, among which are silicon and aluminum, phosphorus also yielding satisfactory results, as well as combinations of two or three of these elements.

Pure Swedish or other suitable pure iron is melted in a common crucible or electrically along with silicon or aluminum or phosphorus, employing a percentage of these additions varying from one-quarter of one per cent. to 5 per cent. Only one of the three elements mentioned or two of them, or all three may be employed. Instead of the crucible process the decarbonized or desiliconized iron produced by any steel-making process—such as the open-hearth, the pneumatic or the electrical process—may be used, adding to such iron the desired percentage of silicon, aluminum or phosphorus. The molten alloy is then poured into suitable ingots.

As an example of the exact composition of the alloy produced, one actually manufactured contains 2.75 per cent. silicon, .07 per cent. carbon, .08 per cent. manganese, .03 per cent. sulphur, .03 per cent. phosphorus.

The material produced as above described is valuable on account of its high magnetic permeability, its high electrical resistance, and low hysteresis for efficient use in transformers and other electrical apparatus in which these qualities are useful.

The superior qualities of improved alloy can be still further enhanced by a treatment involving alternate heating and cooling and generally carried out as follows: The material is first heated to between about 900° and 1,100° C. and allowed to cool, preferably quickly. Then it is reheated to between about 700° and 850° C.—that is, to a temperature lower than the one attained during the first heating—and then allowed to cool very slowly. In practice the cooling has been often extended to last several days. Either one or both of these treatments may be frequently repeated, or after the first treatment has been carried out the second type of heating may be frequently repeated. A steel alloy of the composition above mentioned may be taken, heated to 1,070° C., cooled quickly to atmospheric temperature, reheated to 750° C., cooled slowly, again reheated to 800° C., and again cooled slowly. When the best results are desired it is of great importance to use the exact temperatures that correspond to these results, and careful pyrometer readings should be taken for this purpose. It is important to keep the percentage of elements, such as carbon and manganese, which are not used for the purpose of the invention, as low as possible—say carbon under about .12 per cent. and manganese under about .12 per cent.

It will be seen that a certain proportion of pure iron is replaced with a body such as silicon, aluminum or phosphorus, which are materials of low magnetic properties or so-called "non-magnetic" materials. This addition has a very remarkable effect on the magnetic permeability, the electrical resistance, and the hysteresis quality of the alloy produced. In fact, the improved alloy has a higher magnetic permeability and a lower hysteretic constant than any magnetic body of which there are data, including the purest iron. This remarkable result may be due to the strong chemical affinities of the aluminum, silicon, on phosphorus for oxygen and the halogens.

Aluminum and phorphorus and their combinations with each other or with silicon are to be considered equivalents of silicon for the purposes of the invention, as well as any other element or combination of elements which will produce the same result—to wit, a greater magnetic permeability, a higher electrical resistance, and a lower hysteresis quality than is exhibited by the purest commercial iron obtainable.

New Telephone Patents.

MESSAGE-COUNTING DEVICES.

The establishment of the message rate system of telephone charges upon so sound a basis that it completely overshadows its predecessor, the flat rate system, brings almost every exchange manager face to face with the knotty problem of recording individual calls. For years the operators have been burdened with the responsibility and labor of writing charge checks, and although the very appreciable drag upon the service rendered necessary the employment of more operators than previously to handle a given amount of business, the extra expense of these was more than compensated by the savings in other directions. With the recent rapid growth in the telephone subscriber list, and the accompanying and necessary tendency toward larger and larger switchboards, the annual charges on switchboard for each extra operator bid fair to counteract the advantages of message charging. In the endeavor to meet the emergency all sorts of message-counting devices have been produced, ranging from a completely automatic and unsuccessful meter at the central office, to slot machines on the subscriber's premises. Many of these devices have the defect that unscrupulous users may "beat" them.

Recently there have appeared patents for three devices designed to avoid this possibility by so arranging the apparatus than conversation with a desired party can only be carried on after a toll has been registered. In all three of these devices the counting mechanism is at the premises of the subscriber and all tolls are registered manually by him.

The first of these systems has been invented by J. H. Meyer, of Magdeburg, Germany. Herein there is located at the subscriber's station in addition to the usual apparatus, a push-actuated counter and an associated instruction target. At the central office the pairs of connecting cords have a switching key and two listening keys. Of these latter one gives connection toward the calling subscriber only, while the other is used in connection with the called subscriber only. The operation of the system may be described in general terms as follows: Upon the central office operator receiving a calling signal and making response with the proper answering cord and associated answering listening key, and the desired number is ascertained, she completes the connection to the called subscriber. For communicating with him the calling listening key must be used. When the operator desires the calling party to converse with the called one, she manipulates her switching key. This latter performs several functions, but most important for our present purposes is that of energizing a relay in the cord circuit, to open one of its lines and thereby separates the calling and called lines, and the sending of a current impulse to the calling station to display the instruction target through the agency of an electromagnet, the target bearing a legend, "Please press the button and then call." When the button is pushed the count is registered, the target obscured and the cord circuit by the release of the cord circuit relay automatically completed, thus permitting through conversation.

A second of these systems is described in a patent granted to F. R. McBerty, of Evanston, Ill., and assigned to the Western Electric Company. In this system the answering response of the operator causes a current to flow through a polarized magnet at the subscriber's station in a manner to release a latch controlled by its armature. This results in a half count upon a register associated with the subscriber's instrument. Upon the response of the called subscriber, the operation of cord circuit relays controlled thereby, reverse the circuits toward the called subscriber and cause through the agency of his polarized relay a short-circuiting of his transmitter. He can, therefore, hear the responding voice of the called party, but cannot converse with him until he has removed the short-circuit about his transmitter by pushing his counter button and charging up a call on his register.

The third system upon these same lines is the combined work of F. R. McBerty and of Charles E. Scribner, of Chicago. The patent for this system is also assigned to the Western Electric Company. In this system a short-circuiting of the transmitter is caused by the first response of the operator, it being necessary for the subscriber to press his counting button upon the request of the operator, before he can give the desired line number to her for connection.

TELEPHONE CABINET.

Under the above title there has been patented by W. B. Atlick, of Lancaster, Pa., a telephone enclosing booth designed to shield the user from extraneous noises. This booth comprises a stationary floor, roof and side pieces, the whole adapted to be closed by a folding curtain which registers at its top and bottom with floor on roof rails. A horizontal cross-section has the shape of the letter D, the rounded portion being the closed curtain. When open the curtain, made of vertical strips hinged together bellows fashion, passes into a small space behind one of the side boards. Glazed lights, in either side board and a roof window admit the necessary light.

IMPROVED POLARIZED RINGER.

Every telephone man is familiar with the polarized bell to the extent of a recognition of the necessity for adjustment of the relative positions of the armature and magnet poles, and everyone who has attempted to regulate this adjustment must have been impressed by the awkwardness of that arrangement most common, namely, that in which a brass yoke carrying the armature trunions, is driven and clamped upon threaded frame posts by means of two nuts. Mr. W. W. Dean, of Chicago, has invented a bell in which other means for accomplishing this adjustment is provided. This is shown in Fig. 1, which is a sectional view of the armature end of the magnets.

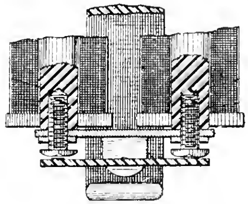


FIG. 1.—DEAN BELL.

As may be seen, extension poles in the shape of bolts with hexagonal heads are threaded into the pole pieces, lock nuts on these serving to securely clamp the brass yoke piece against the core ends. Experience only can prove how much of an improvement this is over the usual adjusting means. The Kellogg Switchboard & Supply Company has obtained the patent for this ringer, by assignment.

SELECTIVE SYSTEM.

Fig. 2 shows a novel sort of selective system, in this case arranged for four stations. Each station is equipped with a special

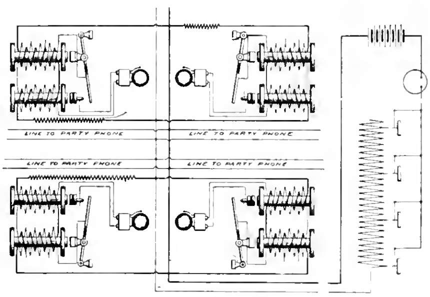


FIG. 2.—GÉHRUNG SELECTIVE SYSTEM.

limit relay, the contact of which controls the local bell circuit. The limit relay is comprised of two electromagnets, each with its own armature. One of these armatures carries the contact anvil, while the other carries the contact. The electromagnets at each station are in series and are bridged on the line through a greater or less resistance. The condition for sounding a signal is that while the contact anvil armature at the desired station is not attracted toward its magnet, the contact armature is attracted toward its magnet. In order to bring this about the magnets are adjusted to begin to respond at definite currents and are so arranged that as the current at which the anvil magnet of one station just fails, the contact magnet of the next succeeding station just operates. For example, when station 1, shown in the lower left-hand corner, is desired, the operating current is put on the line at the central office through a resistance such that while the anvil armature of No. 3 fails to respond to its magnet, the contact armature responds, causing a closure of the bell circuit thereat. At station No. 4 at the right of No. 3 neither armature responds and thus the bell contact remains open, while at both Nos. 1 and 2 both armatures respond and thus the anvil is kept from contact with the contact point and the bells fail. The patentee of this system is J. A. Gehrung, of St. Louis.

St. Louis Street Railway Convention.

A decision to hold the 1904 convention of the American Street Railway Association at St. Louis was reached at the meeting of the executive committee of the association held at that city recently, as already noted. It was found that the World's Fair management would designate October 12 as "American Street Railway Association Day," thus making it one of the formal days of the Exposition. They also promised the association their cordial co-operation in making the meeting a success in every respect, and also placed at the disposal of the association for its meetings "Recreation Hall," which is in the great building known as "Festival Hall," and is located in the central part of the grounds. For the meetings of the subsidiary associations they offered smaller halls in the same building. As October is a very attractive month in St. Louis, it was decided to accept these offers and designate October 12 and 13 as the days of the convention. It was also proposed to make the entire week commencing with Monday, October 10, one which would offer special attractions to street railway men, and to this end it has been suggested that the American Railway, Mechanical and Electrical Association should hold its convention on Monday and Tuesday, October 10 and 11, and that the Street Railway Accountants' Association should hold its meetings on Friday and Saturday, October 14 and 15. The annual banquet will be held on Thursday evening, October 13.

The Southern Hotel has been designated as the headquarters of the association. There are a large number of other hotels, however, among them "The Inside Inn," which is the large building erected within the Exposition Grounds for the accommodation of visitors, and which will undoubtedly be patronized by a great many people. The secretary of the association is now preparing a circular which will give such information as will enable any person by the exercise of a little care to be well located during "Convention Week" at the Fair. The association will also send to all members before the meeting, a book giving the names of every hotel and lodging house in St. Louis, their location and the rates per day and week, and will exercise every endeavor to have all attendants at the convention well cared for. Assurances were also secured from leading hotels in regard to rates, and were regarded as very satisfactory.

The Metric System.

We have received from Mr. George W. Colles a lengthy communication on the metric system, in which it takes issuance with some statements in favor of the system which have appeared in these columns. The arguments may be condensed as follows:

The favor shown by the British Colonies for the metric system is of no moment, for, as far as that system is concerned, there is no more connection between Great Britain and Canada, or Australia, than between Great Britain and the United States. He states that the action by the Colonies has been in a series of petitions and resolutions, legislative or otherwise, and the Colonies that have acted are confined to the Transvaal, Australia, Cape Colony and New Zealand, in which "raw ochlocracies about any kind of law or propaganda may be expected to take root." The adoption by Great Britain of the metric system has, he asserts, been vigorously urged for more than fifty years, but without effect; on the other hand, the Imperial system of weights and measures, first established in 1824, has been steadily improved and consolidated by successive further acts of Parliament, "which leave no doubt as to the sort of progress that Great Britain is really making." It is stated that the comparison of the metric system to a labor-saving machine is an old stock in trade, and has been knocked in the head so many times that it "ought to be dead, even if it isn't." Prof. Charles Davies, who is pronounced one of the most eminent specialists of education that this country has produced, opposed the labor-saving view, and it is stated that the University Convocation of the State of New York, which is pronounced an eminently competent body in education, reported its emphatic opposition to the system on this particular ground.

CURRENT NEWS AND NOTES.

DISCUSSION OF INSTITUTE PAPERS.—In the report in our issue of April 2 of the discussion of the Institute papers read at the March meeting, the several references to remarks stated to have been made by Prof. D. C. Jackson should have credited the authorship to Mr. William B. Jackson instead.

THE TROLLEY AND THE FARM.—According to State Statistician Johnson, of Indiana, the dearth of farm hands in that State is due to the rapid development of the interurban electric railway. The uncertain hours of farm work, it seems, cause men holding steady jobs to give them up in order to assist in building an electric railway, and then permanently to abandon their former line of work if a position as motorman or conductor is available, or they can secure any other berth on the road.

MOVING A MEXICAN TOWN.—Advices from Mexico say: "The Mexican Light & Power Company, which is installing the great water power and electric transmission plant in the State of Puebla, ninety miles from the City of Mexico, has just completed moving a town of 1,000 population. The engineers found that the town of Necaxa occupied a site particularly suitable for the necessary reservoir, and the company forthwith purchased the entire town and moved it to a new location. All the buildings, including the Catholic Cathedral, were razed and reconstructed on the new site. The new town bears the name Canadita. The initial capacity of the plant will be 45,000 hp. F. S. Pearson, of New York, is the engineer."

CHICAGO MUNICIPAL OWNERSHIP.—The chief interest in the recent city election in Chicago centered in the vote on the proposed municipal ownership of the street railways. In this connection what is known as the "Mueller law," passed by the last Legislature, was submitted to the people. The law authorizes cities in Illinois to construct, own, operate and lease street railways, and to provide the means therefor. The vote stood 152,433 for and 30,104 against the proposition. On the proposition that the city should at once take over the street railways into its control the vote stood 120,744 for and 50,893 against. For the temporary licensing of street railways until such time as the city is prepared to take them over, the vote was 120,181 for and 48,056 against.

SCENIC TUNNEL AT NIAGARA.—The new scenic tunnel, run under the Horseshoe Falls of the Niagara, was recently opened for inspection of the engineers and park authorities by the Ontario Power Company. This tunnel cost the power company over $25,000, and is designed to present the grand scenic beauties of the cataract as never before seen. A shaft was sunk 127 ft. from the interior of the Table Rock House, and from the bottom the tunnel runs a distance of over 800 ft., following the contour of the Horseshoe, and coming out under the first heavy fall of water over the brink. Small lateral tunnels run from the main one into the gorge. The shaft has been walled up and an electric elevator installed, from the foot of which to the mouth of the main tunnel is a broad plank walk. Immense glass observation rooms will be constructed at the mouth of the lateral tunnels, where the visitor, reclining in an easy chair, can view the fierce onrush of the great torrent.

ANGLO-FRENCH TELEPHONY.—The telephone service between London and Paris was extended on April 11 to the provincial towns in England and France, between which communication is at present practicable. The charge will be $1.92 for a conversation of three minutes, except in the cases of Bordeaux, Lyons, Marseilles and St. Etienne, when $2.40 will be charged. Subscribers in London will be able to communicate with the following towns: Amiens, Armentières, Bethune, Bordeaux, Boulogne, Caen, Calais, Cambrai, Chartres, Denain, Dieppe, Dijon, Douay, Dunkirk, Elbeuf, Havre, Lens, Lille, Lyons, Marseilles, Nancy, Orleans, Paris and suburbs, Roubaix, Rouen, St. Etienne, St. Quentin, Tourcoing, Tours and Valenciennes. Communication will at the same time be available between the post offices at Birmingham, Bradford, Brighton, Bristol, Cambridge, Cardiff, Derby, Hull, Ipswich, Leeds, Leicester, Liverpool, Lowestoft, Manchester, Newport (Mon.), Norwich, Nottingham, Sheffield, Southampton and Yarmouth, and renters of wires into those offices on the one hand and Paris and certain of the above-named French towns on the other.

TRANSMISSION LINE MEETING IN CHICAGO.—The Chicago branch of the A. I. E. E. will hold a meeting the evening of April 26 to discuss "High-Tension Lines."

STREET RAILWAY CONVENTION.—The annual convention of the American Street Railway Association is to be held at St. Louis, Mo., on October 12 and 13, with headquarters at the Southern Hotel. Secretary T. C. Penington announces that a circular on the subject will be issued in a few days.

HIT BY A SHOE.—Brides and bridegrooms have been known to be seriously injured by the blow received from old shoes thrown after them for luck, or to express the jealous disappointment of the thrower. But for dangerous missiles, of this kind, the palm should be awarded apparently to those used on the Brooklyn elevated system. One of these shoes, accidentally detached from the car, fell on a mounted policeman, smashed his hat, cracked his skull, and sent him into hospital badly wounded.

N. E. L. A. QUESTION BOX.—The interest in the "Question Box" of the National Electric Light Association is indicated by the fact that the preliminary list of questions for consideration at the coming Boston meeting numbers almost 450, the greater part referring to station operation. We understand that a large proportion of the questions have already received answer in communications, thus showing that the interest is not only on the part of those who "want to know." The section of the transactions comprising this feature should be of unique value to members of the association, and in itself tends to largely increase the membership.

EQUIPPING ILLINOIS CENTRAL.—It is reported from Chicago that the Illinois Central is negotiating for twenty motor cars for use in the suburban service of the company. It is said that the order for the motor cars has been given to the General Electric and that the order will be increased to forty motors within a year. It is well known that the Illinois Central has had a standing offer to adopt for the suburban traffic any electric system which could be demonstrated to be equal to the work. If electricity is adopted as a motive power it is expected that the suburban trains eventually will consist of electric motors drawing steel side door cars, the latter being practically indestructible. The conditions of traffic in and around Chicago are regarded as very favorable for electric traction.

MENELIK'S TELEPHONE.—An interesting report has been received by the Navy Department from Lieut. Hussey in command of the escort for United States Consul R. P. Skinner, who recently visited Emperor Menelik, of Abyssinia for the purpose of negotiating a treaty. One of the most surprising things in connection with the expedition was the fact that the Emperor was kept informed by telephone of the progress of the American party. Three days were spent at Harar, where the Emperor's nephew called up his uncle by long-distance telephone to tell him that the Americans were coming. The Americans were met in state outside of the royal settlement and escorted to the Emperor, the time arrangement of the programme being made possible by the use of that great civilizing agent—the telephone.

WIRELESS TELEGRAPHY IN THE WAR.—According to the London *Electrician* of March 25, "The longest press message yet transmitted by wireless telegraphy appeared in last Monday's *Times*. It was about 1,400 words in length and had been transmitted by wireless telegraphy from the *Times* dispatch boat with the Japanese fleet to Wei-Hai-Wei, and thence by ordinary cable. The *Times* not only commissioned a dispatch boat so as to secure early news from the seat of the war, but also enterprisingly wired to the De Forest Wireless Telegraph Company in America to fit up an installation upon it, and a corresponding station on the mainland at Wei-Hai-Wei. The De Forest Company claims for this apparatus a speed of from 20 to 30 words per minute, and probably the range of a ship's installation would be at least 100 miles—possibly greater if local circumstances are propitious. The stations are attended to by members of the De Forest Company's staff, and although not completed quite so quickly as was anticipated at the *Times* in London, to judge by the result in Monday's paper it should now be working most satisfactorily."

LETTERS TO THE EDITORS.

Individual Motor Drive.

To the Editors of the Electrical World and Engineer:

SIRS:—Referring to my letter published in your issue of March 12 and Mr. Cooper's criticism of the same in your issue of March 26, I would like to state that whether or not motors can be obtained that will operate over a wide range of speed without sparking under weakened field, is not a question of theory but one of fact. I can testify to having seen and tested such motors in practical operation, as well as under a controllable generator load.

In one of these tests a motor frame rated as 10 hp at 825 r.p.m., with full field strength delivered 3 hp at speeds varying from 250 to 1,100 r.p.m. This motor was belted to a generator whose load was varied so as to keep approximately 12 amp. at 220 volts flowing through the motor armature. The field current was varied by the rheostat from 1.05 to .3 amp., resulting in the speed variation above mentioned. The load was then increased to 18 amp. in the motor armature, with the field current remaining at .3 amp., resulting in a slight falling off in speed, and so little of sparking at the tip of the brushes that it would not be noticeable except by very close scrutiny. This motor weighed approximately 1,050 pounds, and can be purchased for a trifle over $200, and is a perfectly practical and commercial device. I have also seen in practical operation many other motors whose speed was regulated over a wide range by altering the shunt field strength.

The 5-hp motor to which I referred in your issue of March 12 was tested by both the superintendent and first assistant engineer of the Cutler-Hammer Manufacturing Company before I wrote you about it. This company is at least alive to the fact that the variable-speed, constant-voltage motor has reached a practical, commercial stage, and it has developed a special drum controller for use in connection with these motors for driving various machine tools, etc., which has already entered largely into use; 14 will be in operation at the St. Louis Exposition shortly after May 1, where they may be seen. The horse-power capacity of the motors to be used with these controllers varies from 1 to 10, and the speed variation from 2 to 1 to 4 to 1. Motors can be obtained of at least one manufacturer that will commutate well over a speed variation as high as 6 to 1. So much for facts.

Now for Mr. Cooper's criticism of my rules for determining the size of suitable motors. Reference to these rules as printed in your issue of March 12 will show that I specifically limited them to motors designed to operate at variable speed under variable field strength, within, of course, the limitations of speed for which the motors were designed. The rules which I drew up were intended to be up to date, and are not applicable to motors designed in the nineteenth century.

It is true that I did not state how to design a satisfactory variable-speed motor, for, to be candid, I do not know how, and would not tell if I did. I do know, however, and stated plainly, that there are a great many elements of design which affect the degree of sparking. I know, further, that there has been no radically new discovery made which enables expert designers to produce motors that commutate well under wide variations of field strength. This result has been attained by considering each and every factor of design that tends to reduce sparking with the utmost care, and applying expert skill of the highest order to produce a harmonious blending of all these various factors. It is enough to proclaim that certain expert designers have succeeded, and that the great boom in the individual application of motors, which Mr. Cooper states would result, is now due.

MILWAUKEE, WIS. H. H. CUTLER.

Oerlikon Vertical Motor-Generators.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of March 26 you are so kind as to publish an article descriptive of the vertical motor-generator sets as installed by our firm at Lend-Gastein. Unfortunately, an erroneous statement was made in the article on page 609 where you say: "The motors are of the synchronous type." As a matter of fact, they are non-synchronous. Will you kindly correct this in one of your next numbers. The motors have their rotor windings short-circuited upon themselves. The starting of the motor is performed by starting the generators, which are, of course, separately excited.

Oerlikon, Switzerland. E. Huber.

The Telephone Receiver in Electrical Measurement.

To the Editors of Electrical World and Engineer:

Sirs:—Having once investigated the use of telephone receiver for the measurement of capacity, inductance and resistance, I was much interested by Mr. J. A. Campbell's article on the "Shielded Balance" in your issue of April 2. I will not criticise the principle of the shielded resistance, but can say at once that such a device will be of little service in improving the utility of the telephone receiver in connection with the Wheatstone bridge. The trouble is mainly in the electromagnetic induction between various parts of the bridge, and the capacity effect is comparatively small in ordinary cases, except when using extremely high e.m.f. To avoid the electromagnetic induction in such case by means of magnetic shields of iron is, of course, physically impossible.

In short, it is a mistake to cling to the Wheatstone bridge when we have to do with alternating current, and the right solution is to be found in the use of differentially-wound telephone receivers on which I contributed an article to your issue of May 23, 1903. On further investigations, my methods proved wonderfully accurate for measuring capacity, inductance as well as resistance, and I could even measure with accuracy the capacity of a spherical conductor only 3 inches in diameter isolated in space in a laboratory of Tokio Imperial University. I sincerely wish that Mr. Campbell would try a differential receiver, in which, I am sure, he will find a very practical thing.

I take advantage of this occasion to correct an error. In my former paper I stated that a certain relation between capacities and resistances was required for the measurement of capacity, but I found afterward that such was not at all necessary, as may be easily proved.

Schenectady, N. Y. H. Ho.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Output and Design Coefficient.—Press.—A communication in which the author proposes the following output equation: Output in watts equals the "design coefficient," multiplied by revolutions, multiplied by the square of the diameter of the armature, multiplied by the sum of the core length and the length of the end connections. The design coefficient equals the final temperature rise multiplied by the radiation capacity of unit surface at unit peripheral speed, divided by the product of the armature loss factor and the total loss of efficiency factor.—Lond. *Elec.*, March 25.

Variable-Speed Motors.—Burleigh.—An illustrated article on speed variation of speed current motors. To obtain the best results, the reactance volts at maximum speed should not exceed 2.5 and the ampere-turns per pole should never be less than the ampere-turns required for the gap. For motors up to about 20 hp a four-pole machine with series-wound armature and four sets of brushes seems to be the best. At a voltage of 220 a very good motor can be fairly economically produced with a speed ratio of three to one or even four to one, while a speed ratio of two to one is quite high enough for a 500-volt motor. The author gives the complete data of the design of a 4-hp motor for 400 to 1,200 revolutions at 110 volts and for a 6-hp motor for 300 to 900 revolutions at 220 volts (making use still of the old Kapp lines).—Lond. *Elec. Rev.*, March 25.

REFERENCE.

Tandem Connection of Induction Motors.—Müller.—A mathematical article in which the author refers to the fact that the well-known Heyland-Behrend circular diagram of the induction motor in its original form does not apply to speeds above synchronism. He now shows that for the tandem connection the diagram for speeds above synchronism also differs from the ordinary diagram.—*Elek. Zeit.*, March 24.

Lights and Lighting.

Mercury Vapor Lamp.—An illustrated description of a new type of mercury vapor lamp designed by Bastian and Salisbury (its efficiency being lower than that of the Cooper Hewitt type and its chief commercial advantage being apparently the convenient shape of the lamp). Fig. 1 shows the lamp in its normal position. *E* is a spun copper bell-shaped cover which protects the internal mechanism from wet and provides a means for suspending the lamp and fixing the tubes and other devices. *G* is an ordinary glass globe. As shown in the illustration, the lamp is not at work, and the mercury in the tube, *T*, connects the two wires sealed into the glass. Fixed to one end of the glass tube is an iron plunger, *C*, which acts as a core to the electromagnet, *M*. The resistance, *R*, the electromagnet, *M*, the carbon filament lamp, *L*, and the mercury in the tube, *T*, are all connected in series. On closing the switch the core, *C*, is drawn up by the electromagnet; *T* being pivoted at *P* and the continuity of the mercury being broken, an arc is formed. The tilting of the tube is thus effected automatically. The pressure of the mercury vapor set up by the arc then forces the mercury up into the left-hand bulb and thus cuts out the auxiliary resistance, *R*. All these operations occupy but the fraction of a second. The carbon filament lamp, *L*, just above the mercury tube, is added for the purpose of overcoming the absence of red rays and this lamp is, therefore, under-run so as to make its radiation rich in the required red rays. An efficiency of 2½ cp per watt is claimed when the carbon auxiliary is not used

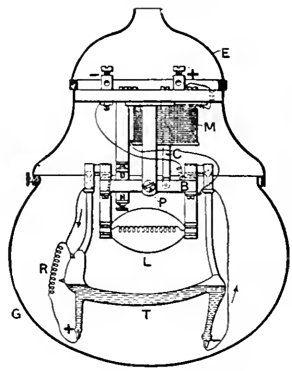


FIG. 1.—MERCURY VAPOR LAMP.

and of 1 to 1.5 cp per watt when the latter is used. Each lamp requires from 40 to 60 volts and 0.65 amp., the candle-power being 80. Lamps have been run both continuously and intermittently for over 1,500 hours and the inventors believe that the average life will be about 3,000 hours. The lamp is intended especially for side street lighting to compete with incandescent gas light. Editorially, it is stated that apparently the color defect has not been entirely overcome; "although the condition of the over-run carbon lamp does constitute a distinct improvement, yet the rays do not mix as well as might be expected and the resulting illumination is still of the nature of moonlight." The resistance of the carbon filament in series decreases the voltage across the terminals of the mercury tube and consequently the length of this tube.—Lond. *Elec.*, March 25.

REFERENCE.

Train Lighting.—Aliamet.—An illustrated article on the system of train lighting used by the Northern Railroad Company in France. The incandescent lamps are supplied with current from storage batteries placed in each car, so that the different cars are independent from each other. The storage batteries are charged in the stations and are connected in series for this purpose. Since the number of cars in a train changes from train to train and from day to day, and since on the stations either 115-volt direct-current or 85-volt two-phase current are available, it was necessary to transform the voltage so that it fits the number of storage batteries to be charged in each case. This is done by means of the Lanhoffer voltage transformer, the principle of which was described in the Digest last week. Drawings are given of this machine and of the connections used for charging.—*La Revue Elec.*, February 15.

POWER.

Electric Winding Machines.—GEORGI.—An illustrated paper read before the Glasgow Section of the (Brit.) Inst. of Electrical Engineers. Electric winding machines have made rapid headway during the last few years in Continental Europe, especially in the mines of Silesia and Westphalia. One great advantage of electric winding is to diminish very considerably the coal consumption, which can be brought down to about 1/3 of its original value if a modern generating plant is adopted. The author points out that the utmost security of working is required since the winding engines are not only used for the extraction of minerals, but also for transporting men. The speed of the machine will have to be regulated independently of the load; that is, independently of the current in the armature and with the utmost possible economy. These conditions are stated to be fulfilled in the system of Ilgner, with which it is possible to connect any number of winding engines to any kind of electrical distribution system, without diminishing the favorable steam consumption. The arrangement is based on the fact that a direct-current shunt-wound motor with a field of constant intensity and fed by an independent source runs with a speed directly proportional to the applied voltage and to the number of turns on the armature. The torque is, of course, a function of the current in the armature. If, therefore, a direct-current dynamo is arranged with independent excitation whose voltage can be regulated from zero to a positive or negative maximum by means of a field resistance, then a motor coupled on the same circuit and having a constant field, will run at a speed varying between zero and the positive and negative maximum. The starting of a machine is thus most economical and at any time the energy consumed is only equal to the product of the voltage by the current. In the Ilgner system the current taken from the supply drives a converter, composed of a motor, direct-current dynamo and a heavy fly-wheel. An automatic slipping device is fixed to the motor by means of which, should a dynamo call for energy, and, therefore, the current in the motor have a tendency to augment, the automatic friction clutch is released, the fly-wheel giving up kinetic energy. The weight and speed of the fly-wheel are calculated so that for a given slip the output of the motor remains the same. Thus the winding engine, as far as the supply station is concerned, may be considered as an ordinary motor of constant output. Owing to the motor being shunt wound, the speed is practically independent of the load. Illustrations are given showing the general arrangements of the governing and safety apparatus and also of the motor-driven winding apparatus.—Lond. *Elec.*, March 18.

Steam Turbines.—An illustrated description of the Riedler-Stumpf steam turbine, which occupies an intermediate position between the De Laval and Parsons types. In order to reduce the speed of the shaft, wheels of large diameter are employed, made of 10 per cent. nickel steel with the buckets cut into the periphery. Contrary to the De Laval construction, a rigid shaft is employed, which is supported by either one or two bearings. This is made possible by very accurate balancing. The center of gravity in a 2,000-hp turbine installed in the Berlin electric plant was specified to be within 0.004 in. of the geometrical center. This condition was very well fulfilled and the center of gravity could afterwards be made correct within 0.004 in. The nozzles are square in cross-section. The complete nozzle ring furnishes a full steam-jet ring. If partial admission is intended, the nozzles are united to an arc and the rotor buckets not played upon by the steam are covered, to decrease the ventilating resistance. Between the rotor and the nozzle the clearance is in the 2,000-hp turbine 0.12 in. measured radially and 0.4 in. when measured in the axis of the nozzle. The radial clearance has, it is said, been increased to 0.2 in. without affecting the efficiency. At brake tests of the 2,000-hp set, when the output was 1,917 hp a consumption of 17.6 pounds of steam per kw-hour was observed, the speed being 3,800 r.p.m.—Lond. *Elec.*, March 25.

Italian Hydroelectric Stations.—BIGNAMI.—A fully-illustrated description of the various hydroelectric stations of the Alta-Italia Company, which supplies current for lighting, traction and general power purposes to Turin and a great many towns in the neighborhood. Three-phase currents are generated at 450 volts and the voltage is then raised by transformers to 12,000. This was the voltage originally intended for transmission, but it was later decided to double the transmission voltage and therefore special transformers were interposed which raised the voltage from 12,000 to 24,000. The arrangement is shown in Fig. 2. The special transformers are

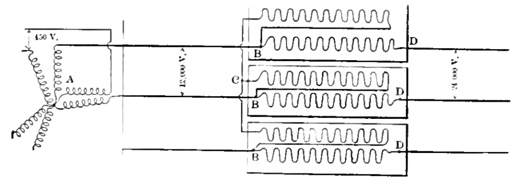


FIG. 2.—DIAGRAM OF TRANSFORMER CONNECTIONS.

single-phase with a transformation ratio of one to one. One of the windings is put in series with the line; the other winding is star-connected at one end to the corresponding circuit of the other transformers, and at the other end is connected with the 12,000-volt line. The arrangement is clearly shown in the diagram.—*Eng'ing Mag.*, April.

REFERENCES.

Gas Engine.—An illustrated description of the construction of the Nürnberg gas engine. It is stated that the makers guarantee a consumption of this engine of 2,100 calories (8,334 B.T.U.) per effective hp-hour running on blast-furnace gas. This corresponds to a thermal efficiency of 30 per cent. At 3/4 load the gas consumption is increased about 10 per cent.—*Power*, April.

Producer Gas and Water Power.—NAGEL.—A note in which the author points out that near coal mines producer gas power can be produced at about the price of power at Niagara Falls, and that the blast furnace will be of the same importance as a gas producer, as it is at present as iron producer. A 1,000-hp producer gas plant completely erected and including engine costs about $66,000; figuring depreciation, interest and working expenses with a coal price of $1 per ton, 1 hp for 24 hours will cost 5.55 cents.—*Electrochem. Ind.*, April.

Lubricants.—An article by Doane on the selection and testing of lubricants and another article by Davis on lubricating oils and their properties; how to test them and detect adulterations.—*Power*, April.

TRACTION.

Accident on Paris Underground Railway.—A long editorial, summarizing and criticizing a report of the technical committee which had investigated the disaster on the Paris Metropolitan Railway in August last. A summary is first given of the causes of the accident, and the lessons from the disaster are summarized for the prevention of similar accidents. The investigating technical committee lays the greatest stress on the requirement that it should be possible for the train staff to cut the current off the conductor rail at any point. For this purpose, it is suggested that the rail should be cut up into a number of separately fed sections, such that not more than five or six trains can be on any one section, and that every train shall carry a "short-circuit bar," which can be dropped across the conductor and running rail in case of need and so actuate the circuit-breakers controlling the section. The committee also urges that the lighting of the stations and tunnels should be provided from a number of sources, some of them entirely independent, not only of the traction supply, but even of the company's generating and sub-stations. It appears that the committee considers that the non-inflammable car is at present hardly attainable, so that short-circuits must be expected, and when they do occur some risk of fire is unavoidable. The writer of the editorial thinks that the committee has inverted the proper order of the measures required and that the essential condition of safety would be to design and equip the motor cars in such a way that ignition of combustible material is hardly possible. "With rubber-covered cables boxed in with wood a shoe that cannot be readily lifted from the rail, and circuit-breakers or fuses set for too heavy a current, it is conceivable that a short-circuit may put a car into a blaze in a few seconds and constructions carrying such risks must be avoided." It is also pointed out that from what happened it appears that neither train men nor the station staff had been instructed how to deal with an electric fire.—Lond. *Elec.,* March 25.

Rail Bonds.—HARRINGTON.—The conclusion of his Franklin Institute paper giving a summary of commercial rail bonds. Illustrations are given of special rail bonding tools and the ajax bond and the Camden & Suburban Railway bond are described. No. 1 of the latter consists of a square copper casting with two grooves from 4/0 B. & S. gauge copper wire; the casting has a 1 1/16-in. hole in the center. A cast-iron casting with corresponding grooves and hole is provided. The bond is applied by grinding off the web of the rail with an emery grinder and treated with Edison-Brown alloys, serving to amalgamate the surface of the rail and fill valleys and depressions and irregularities of the surface. The 4/0 wires and the copper casting grooves are also treated, the whole is then bolted to the web of the rail with a one-inch bolt, using a lock washer. The bond plates are located each side of the fish or joint plate and are connected by two 4/0 wires. Results of tests are given and Conant's method of bond testing is described as well as the method used by the Camden & Suburban Railway. The latter simply uses a car having mounted therein a barrel of water, rheostat included in circuit, a Weston ammeter, also a Weston voltmeter to obtain line voltage. A small truck with wood framing having two axles and 33-in. wheels on 3-ft. centers, with a Weston millivoltmeter located in the car and having its terminals connected to the axles of the small truck, the car is run so that the small truck will trail between car and power station. As all readings are taken relatively, that is, comparing readings of equivalent joint lengths and solid rail lengths, nothing need be done except to run and make notes.—*Jour. Franklin Inst.,* April.

REFERENCES.

Italian Electric Railways.—A note stating that a new electric railway will be installed from Rome to Naples. Energy will be derived entirely from water power. Another Italian electric railway has been opened from Naples to the base of the old funicular railway. The first and the last section of this line are adhesion roads, while the middle part is a cog wheel line. Gas power is used and for the production of the gas, two Dawson gas generators of 200 hp are employed. They supply gas to two engines coupled to two direct-current dynamos, which are operated in parallel with a storage battery.—Lond. *Elec.,* March 25.

Large Tramcar.—An illustrated description of a tramcar constructed by the Hartlepool Electric Tramways Company, and having a seating capacity of 84 passengers, 42 inside and 42 outside. The total cost, exclusive of trucks, was $700.—Lond. *Elec.,* March 25.

Train Lighting.—See the abstract under "Lights and Lighting."

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Central Station.—An illustrated description of the municipal electric station of Sunderland. The old plant contains 11 steam-driven generators aggregating 2,165 kw, while the new and principal station is equipped with five direct-current dynamos aggregating 1,280 kw, and three 5,500-volt, three-phase alternators with an output of 2,250 kw. The total capacity of the two stations is, therefore, 5,695 kw. The system has been, until recently, partly the original three-wire, 110-volt system, and partly a two-wire, 220-volt system. The original three-wire system has now been done away with, however, and a uniform system of distribution is obtained from two wires at 220 volts. This system has been adopted partly on account of the large demands which may be expected from the 21 shipbuilding and engine works in the borough, a large number of which were already electrically equipped with 220-volt motors driven from the works' own generating plant; and partly because of the steady development towards sub-station distribution in Sunderland. The principle is to generate three-phase currents at one station at 5,000 to 5,500 volts and transmit to sub-stations, where the current will be transformed by motor-generators and distributed to areas, the radius of the largest area not exceeding 5/8 of a mile. In each of these sub-stations will be a large storage battery. Two of the largest shipbuilding works are already connected to the station, one containing 22 motors with an aggregate capacity of 520 hp, the other 23 motors of 445 hp. Two large sub-stations have already been erected capable of accommodating plants to the extent of 2,500 kw.—Lond. *Elec.,* March 25.

ELECTRO-PHYSICS AND MAGNETISM.

Thermoelectric Forces in a Heated Wire.—SCHNEIDER.—Some remarks referring to a former article of Egg-Sieberg, who described a number of experiments in which a uniform metallic wire was connected to a galvanometer and by heating the wire under certain conditions thermoelectric forces were observed. Egg-Sieberg believed that the source of the current was in the unsymmetrical drop of temperature on both sides of the heating point. The author shows that this is not correct, and that also in this case there exists a contact of two mechanically and chemically different bodies, since when an iron wire is heated the iron is partly charged into oxide. From this point of view all the phenomena may be explained.—*Elek. Zeit.,* March 24.

REFERENCE.

N-Rays.—Lummer points out a source of error in the observation of N-ray effects which may easily mislead the observer. It is the conflict between the rods and cones of the retina in viewing a faintly luminous object.—*Phys. Zeit.,* March 1. Bichat has examined a number of metals for their transparency to N-rays, and has found that they show a well marked selective absorption. This offers a ready means of isolating definite homogeneous beams.—*Comptes Rendus,* February 29; abstracted in Lond. *Elec.,* March 25.

ELECTRO-CHEMISTRY AND BATTERIES.

Aluminum.—BENNIE.—A description of a new process for the production of aluminum proposed by Gin. The metallic aluminum is obtained by means of reducing aluminum by a zinc-sodium alloy. The aluminum chloride is prepared from beauxite by means of chlorine by the same electrolytic operation which furnishes the zinc-sodium alloy. The chlorine and zinc-sodium alloy are prepared by electrolysis on one hand of the double chloride of zinc and sodium and on the other of the double chloride of sodium and potassium. These two operations disengage chlorine, the first supplying the zinc destined for the cathodic bath of the second, in which the zinc-sodium alloy is prepared. The reduction which finally yields the metallic aluminum also reconstitutes the double zinc-sodium chloride in such fashion that the various operations form a closed cycle with regeneration of the intermediate compounds.—*Electrochem. Ind.,* April.

Benzine Fires.—JUST.—In chemical cleaning works sudden fires sometimes start when the cleaned woolen materials are taken out of the bath. During the motion of the materials in the benzine, electrostatic charges are produced due to the friction, the benzine becoming negatively and the material positively charged. When the material is taken out, a spark occurs and ignites the explosive mixture of benzine vapor and air. Richter has found that such fires are prevented if 1/20th to 1/50th per cent. of oleate of magnesia is added to the benzine. The present author shows that this is due to the considerable increase of conductivity of the solution. He describes an experiment which shows that electrostatic charges which are being developed are quickly carried off to earth on account of the increased conductivity of the solution.—*Zeit. f. Elektrochemie,* March 25.

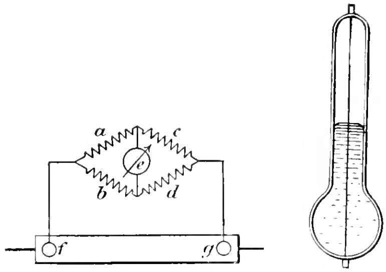
REFERENCE.

Preparation and Compression of Pure Gases.—HUTTON AND PETEVAL.—An illustrated paper on the preparation and compression of pure gases for experimental work. The authors deal especially with hydrogen, nitrogen, carbon monoxide and ethylene and describe the electrolytic production of hydrogen.—*Electrochem. Ind.,* April.

UNITS, MEASUREMENTS AND INSTRUMENTS.

British National Physical Laboratory.—A long extract of the annual report of this laboratory. While the work has prospered, the financial position gives rise to anxiety. In the electrical department, the experiments made on standard cells seem to show that differences remaining in the mercurous sulphate obtained from different makers, even when repurified in the standard manner in the laboratory, are the main cause in the differences observed between different standard cells. It is hoped that it may be possible to prescribe a standard method of preparing the sulphate, which will eliminate these differences. At present the electrical test of purity is more sensitive than the chemical. The construction of a standard ampere balance has been undertaken according to the designs of Jones and Ayrton. The coils of the balance consist of helices of bare copper wire wound on marble cylinders and its working depends very greatly on the accuracy with which these coils are wound and measured. The tests on insulating materials will be continued; the investigations now in progress relate to the distribution of temperature within the layers of the field coil of a dynamo or motor. Tests, as ordinarily made, give the mean temperature of the coils and it is desired to know by how much the maximum temperature differs in practice from the mean. Specimens of nickel-steel will be subjected to tests of electric conductivity, permeability, etc. In the optical division the first piece of research is the investigation into the conditions under which the pentane lamp may be considered as standard. Its intensity varies greatly with the quantity of aqueous vapor present and also with the barometric pressure and with the carbonic acid. The pentane lamp can only be treated as a secondary standard, and the next series of experiments will relate to the establishment of some primary standard, e. g., the radiation from a square centimeter of incandescent platinum at a definite temperature, or that from a "perfectly black body" at a definite temperature. In the electrical division of the physics department, the standard British Association air condensers were measured from time to time, their constancy being satisfactory within the limits of accuracy attained. The work in connection with the mercury standards of resistance was carried to a successful conclusion. Of these 8 are of Jena glass and three of verrefdur, the length varying from 60 to 120 cm. Fittings for each tube have been constructed enabling the measured resistance to either include or omit the "end correction," the value of the latter having been determined for the special kind of connecting cups used. The result of the observations on the whole 11 tubes shows that the difference between the international ohm, as defined by a uniform column of mercury 106.300 cm. long and 14.4521 grams mass at 0° C. is known to about 0.001 per cent. The platinum-silver and manganin standards of the British Association were also tested and marked changes were noted in certain coils. In the thermometrical department the research work consisted mainly of a continuation of the investigation on the various high-temperature standards. In addition to the comparisons of gas and platinum thermometers investigations were made on the behavior of thermo-junctions for high temperature measurements, and in particular the junctions of platinum and platinum-rhodium obtained from the Reichsanstalt, where they had been standardized at a number of fixed points. The discrepancies between the instruments were found to be very small. Between the two types of instruments, least affected by temperature lag—namly, the platinum thermometers and junctions—the difference in one set of experiments, extending from 500 to 1,000° C., never attains 1° C. and the several series of independent measurements with different fillings of the gas thermometer concord as closely as could be expected.—Lond. *Elec.*, March 18, 25.

Direct-Reading Switchboard Instruments.—Edgecumbe and Punga.—The first part of a paper read before the (Brit.) Inst. of Electrical Engineers. The authors first discuss the accuracy which may be attained. The great difficulty which is met with in the design of electrical instruments is the smallness of the forces dealt with. The greater the force for a given weight, the smaller will be the frictional error, but any attempt to increase the forces beyond a certain point is almost invariably accompanied by increased electric errors, quite apart from the question of excessive power consumption. The authors give a table of the electrical errors of various types of instruments (due to hysteresis, change of temperature, change of frequency, and stray fields). In a second table they give data on power consumption of various commercial types of instruments. They then discuss the general features of permanent-magnet, moving-coil ammeters and voltmeters; the chief source of error to be guarded against is the variation with time of the springs and magnet. The number of ampere-turns required in the moving coil varies in practice from ½ to 1 ampere-turn. Under these circumstances, for any given size of coil the necessary potential difference at its terminals is inversely proportional to the sectional area of the wire used. A limit is, however, soon reached; firstly, owing to the fact that a decreased resistance means an increased current, and with it the chance of contact resistance troubles, and secondly, owing to the resistance of the letting-in springs or strips. The best results are obtained when the resistances of the coil and springs are to one another in the inverse ratio of their temperature coefficients. A method for getting over the temperatures error, which is due to Campbell, is shown in Fig. 3, where e represents the moving coil, while the points f and g are connected to the shunt. The arms, a and d, are composed of copper; b and c of a material having a negligible temperature coefficient. If the resistance of a, d and e be 3 ohms each, while b and c have a resistance of 1 ohm each, practically perfect compensation will be obtained. The resistance having



FIGS. 3 AND 4.—DIRECT-READING SWITCHBOARD INSTRUMENT.

as large a negative coefficient as may be desired can be constructed as shown in Fig. 4. It consists of a thermometer tube, inside which is stretched a thin platinum wire. Any increase of temperature causes the mercury to expand, and hence to short-circuit more or less of the wire according to the dimensions of the apparatus. The authors point out that unless carefully shielded, moving coil instruments are contrary to the usual assumption, very considerably affected by stray magnetic fields. The ordinary cast-iron case appears to be quite an efficient shield for switchboard instruments. The authors then discuss moving-iron instruments. Almost all the errors to which they are liable, apart from those of a purely mechanical origin, are traceable to hysteresis in the iron. They remark that it is often assumed that an instrument whose indications are practically independent of frequency will also be independent of wave form and vice-versa. While this is true for all errors which depend purely on self-induction, it is far from being true when the errors arise from the iron itself. They then discuss magnetic shielding and damping. The paper is to be concluded.—Lond. *Elec.*, March 25.

Use of Condensers in Alternating-Current Measurements.—Peukert.—An article on the application of condensers for providing a lower e.m.f. at the terminals of an alternating-current instrument, when making measurements on a high-tension circuit. The author first discusses the case in which a number of condensers in series are connected across a line and the measuring instrument is connected to the terminals of one condenser. If all the condensers are identical then the voltage is reduced in proportion to the number of condensers employed. This method has been employed by the Allgem. Elek. Ges., in Berlin, and also in connection with the electrostatic voltmeters of Kelvin, Ayrton and Mather. Another method is to connect the measuring instrument in series with a condenser. To make the reading independent of the frequency, an air condenser should be used, since its capacity is independent of the frequency. The formulas for both cases are given.—*Elek. Zeit.*, March 24.

Universal Shunt.—An illustrated description of a universal shunt designed by Rymer-Jones, a diagram of which is given in Fig. 5.

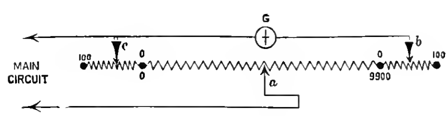


FIG. 5.—UNIVERSAL SHUNT.

The shunt is contained in a single box provided with two dials. The slide resistance coils on the left-hand dial consist of 99 coils of 100 ohms each, with one sliding contact arm, a, while, by way of vernier for slight alterations of the multiplying power of the shunt, there are, at both ends of these coils other extension resistances, each extension having a total resistance of 100 ohms. These extensions have each a separate sliding contact, both being actuated by the same handle, and so disposed that when one of these contact arms press on the zero stud the other arm is on its 100 stud. As the one contact moves from the zero towards 100 of its scale, the other moves from 100 towards 0 by equal distance. There is, therefore, always a total resistance of 10,000 ohms between the contacts, b and c, between which the galvanometer terminals are connected, while a

and c are in the main circuit. The vernier resistance studs, on which the marked contact arm presses, are arranged to give consecutive multiplying powers of 2, 3, 4, 5, 6, 7, 8, 9 and 10 ten-thousandths, after which the resistance is increased regularly by two ten-thousandths at a time. Thousandths and hundredths are read off the left-hand scale at a and tenths and units from the right-hand scale at b. The multiplying power of the shunt is the scale reading divided into 10,000; that is, the reciprocal of the scale reading, multiplied by 10,000.—Lond. *Elec. Rev.*, March 25.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Hettinger.—A preliminary paper on a new theory of wireless telegraphy. The author endeavors to base his theory not on that of the propagation of electromagnetic waves, but considering the problem like an ordinary problem of alternating-current engineering in closed circuits. The action of the vertical wires is represented in this theory by a self-inductance and capacity. Each vertical wire forms a condenser, C_{AT} with the earth, and the two vertical wires at the transmitting and receiving stations form together a capacity, C_{AA}, as indicated in Fig. 6. The coherer is rep-

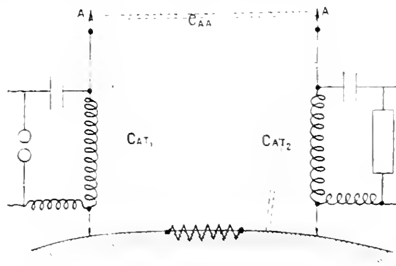


FIG. 6.—WIRELESS TELEGRAPHY.

resented as a condenser of high capacity in series with a resistance. The earth is introduced as a resistance and also forms the second plates of the two condensers, the first plates of which are represented by the two vertical wires. The author claims that in this way he is enabled to give a complete theory of the phenomena of wireless telegraphy on the basis of ordinary alternating-current engineering. —*L'Eclairage Elec.*, March 26.

Miscellaneous.

Aluminothermic Preparation of Pure Metals.—Goldschmidt.—An article on the production of pure metals free from carbon by the aluminothermic method and on their applications for various metallurgical purposes. The preparation is carried out in a sort of crucible in which several hundred kilograms of metal are reduced in the single operation. On account of the great rapidity of reaction, the operation is completed in scarcely 30 minutes. The principle is to use equivalent quantities of oxide and aluminum. But in practice the great facility with which aluminum alloys itself makes it advisable to use somewhat more of the oxide and less of the aluminum than would correspond to a mixture in equivalent proportions. The author discusses especially the production and uses of chromium, manganese and molybdenum. While pure chromium free from carbon is specially useful for the production of special steels, the applications of pure manganese are rather in the copper, brass and nickel industries.—*Electrochem. Ind.*, April.

Diastoloscope.—Charrie.—A note on a new optical instrument of remarkable power, called the diastoloscope. "It is a kind of eye piece which is attached to a microscope in place of the ordinary eye piece. Instead of lenses, it contains two cones on the same axis. The field of view shows a central blank space surrounded by a ring, in which the object under examination appears considerably magnified, although distorted. The distortion does not interfere with the mapping out of hitherto undiscoverable detail. The author reproduces figures of diatoms showing considerable dilatation and detail, and expects to realize magnifications of 6,000 diameters."—*Comptes Rendus*, February 29; abstracted in Lond. *Elec.*, March 25.

Reference.

Thawing Water Pipes by Electricity.—An article giving a summary of the results obtained with this method last winter in various cities, especially Newark, Ottawa and Ogdensburg.—*Eng. News*, March 17. (Several references to this application of electric current were published in Electrical World and Engineer recently.)

New Books.

The Story of the Atlantic Cable. By Charles Bright. New York: D. Appleton & Co. 222 pages, 54 illustrations. Price, $1 net.

Mr. Bright has already written on the submarine cable in more voluminous form, but his larger volumes are not generally accessible to the American public. He now tells the story again very succinctly and well, and his book is a useful and desirable companion to that by Dr. Field, who may perhaps be said to have taken the American point of view. Aside from the historical portion, which is, of course, by no means new, though ever interesting as a narrative of a great achievement, there is much other matter of value, in handy condition. Mr. Bright gives details as to existing lines, tariffs, capitalization, etc. He states that the fifteen Atlantic cables now in existence represent $100,000,000, with a gross annual yield of $6,000,000. The reproduction of some of the old plates and portraits was a good idea. Mr. Bright's treatment of the subject is popular, and is intended for the general reader rather than in any sense for the technical student.

Moderne Gesichkpunkte für den Entwurf Elektrischer Maschinen und Apparate (Modern points of view in the design of electrical machinery and apparatus). Dr. F. Niethammer, München and Berlin. 192 pages, 237 illustrations.

Dr. F. Niethammer, who is favorably known from his writings, has attempted in this book to go over the entire field of electrical apparatus, and to give suggestions as to their design and construction. He has studied very carefully the designs of the last few years, and, basing his judgment on a thorough theoretical knowledge, he has selected the best of what he found here and there, and offered it to the engineer in a condensed and comprehensive manner. The problem, which the author has attempted to solve is: Is it possible to build economical and efficient machinery for any desirable r.p.m. for any desirable capacity, for any practical and reasonable voltage and for operating conditions as they are actually found?

After a short introduction, in which the electrotechnics are rightly called the technics of high speed and "par excellence," the question of efficiency, losses, heating, ventilation, the present maximum voltages and the insulation are taken up in general. We regret to notice that, although American makes are referred to in several instances, in general the author has overlooked the great importance of local economical conditions, price of labor and material and the bearing they have upon the economy of the design and the method of construction. The frequently great differences between the designs of European and American manufacturing companies are often due just to these points.

When treating heating and ventilation, an attempt is made to use as a basis the formula.

$$T = C\frac{A}{O}, \text{ or } T = C\frac{A}{O\ (1 + .1\ v)}$$

where T refers to rise in temperature, A to losses, O to total external surface, v to surface speed, while C is a constant. The constant, C, has a wide range of variation and values of C are given for different constructions. The author has himself proven, however, that these constants are rather unsatisfactory, by saying that the results do not agree very well with the formula. On the other hand, he is in favor of artificial cooling, when the results do meet the expectations. Why do they? Because, when they are found differing from the calculation, the artificial means (amount of cooling water, air pressure, etc.) may be varied, until the guaranteed temperature is obtained. This is certainly a very convenient way of getting the desired temperatures. The engineer does not require infallible constants which substituted in a formula will give him accurate results for any case. The careful determination of the efficient radiating surface, and a careful heat run, will give sufficient data for obtaining the heating of different sizes of the same type.

The chapter on insulation is rather meagre, and as to the present state of this subject it is not modern at all. We learn very little as to the different kinds of insulating material; the author is still in the mica age. The effect of heat on the break-down of insulating materials is not taken into account. In order to test the insulation of different apparatus, the author gives some figures for overpotential test. These are rather low according to American demands, and do not always express the endurance of the insulation. A heavy overload test is perhaps even more important for that purpose.

Electrical apparatus more particularly is taken up in the other chapters with a very keen eye and broad view. The reader will find many useful suggestions especially as to electromechanical construction. The best parts of the book are the chapters on polyphase generators and synchronous motors. The young designing engineer will find this book valuable, and the last pages give him some interesting advice and suggestions concerning shop practice, business organization, and the commercial part of engineering with many references to American practice, which the author seems greatly to admire.

BOOKS RECEIVED.

Die Metalle. By Dr. Bernhard Neumann. Halle: Wilhelm Knapp. 421 pages, illustrated. Price, 16 marks.

La Telegraphie Sans Fils. By Andre Broca. Paris: Gauthier-Villars. 234 pages, 52 illustrations. Price, 4 francs.

Les Chemins de fer Electriques. By Henri Marechal. Paris: Ch. Beranger. 556 pages, 516 illustrations.

Briquettes and Patent Fuel. By Philip R. Bjorling. London: Rebman, Limited. 254 pages, 121 illustrations. Price, $3.75.

Dynamomaschinen für Gleich und Wechselstrom. By Gisbert Kapp. Berlin: Julius Springer. 620 pages, 255 illustrations. Price,

Elektro-Akustische Untersuchnugen. By Robert Hartmann-Kempf. Frankfurt: Gebruder Knauer. 255 pages, 105 illustrations.

Die Elektrische Buhnen und Effekt-Beleuchtung. By Dr. Th. Weil. Leipzig: A. Hartleben. 256 pages, 205 illustrations. Price, 4 marks.

Wechselstromtechnik. By M. T. Zsakula. Leipzig: A. Hartleben. Four volumes. 264 + 216 + 200 + 200 pages, illustrated. Price per volume, 4 marks.

Essais Industriels des Machines Electriques et des Groupes Electrogenes. By F. Loppe. Paris: Gauthier-Villars. 280 pages, 129 illustrations. Price, 8 francs.

Compendium of Drawing. Chicago: By American School of Correspondence, Armour Institute of Technology. 410 + 477 pages, illustrated. Two volumes. Price, $3 per volume, $5 per set.

Practical Laws and Data on the Condensation of Steam in Covered and Bare Pipes. By Charles P. Spaulding. New York: D. Van Nostrand Company. 102 pages, illustrated. Price, $2.00.

Steam Turbine Power Plant for Boston Navy Yard.

An interesting departure in engineering practice by the authorities of the United States Navy, Department of Yards and Docks, is marked by the introduction of Westinghouse-Parsons steam turbines for furnishing power for lighting the buildings and yards, and power for operating dry dock pumps and miscellaneous machinery. The initial installation of this character is in process of construction at the Charlestown Navy Yard, Boston, Mass., and for the present one Westinghouse-Parsons turbine generating unit of 750-kw capacity will be placed in service. This turbine will be of the new short-barreled type and is now under construction at Pittsburg. A Worthington surface condenser will be employed, using salt water for circulation. The condensers will be located between the foundations, which consist of concrete piers. A running vacuum of 28 in. will be secured through the aid of a dry-air pump. Steam will be furnished at 150 pounds pressure by Babcock & Wilcox boilers in units of 350 hp, equipped with Roney mechanical stokers. Coil superheaters in the boiler settings will furnish to the turbine a superheat of about 100° F. The boiler house will be equipped with a complete outfit of coal and ash-handling machinery.

The present power plant is the outcome of an appropriation made in 1898 by Congress for a dry dock and pumping plant to be located at the Charlestown Navy Yard; the new plans for a dry dock equipment providing for a power plant located near the outer end of the new dock with piping connections to both old and new docks so that the one pumping plant would be able to handle them simultaneously or separately. During the period of construction of the new dock the Department of Yards & Docks at this Navy Yard underwent considerable enlargement necessitating an immediate increase in an electrical generating equipment for supplying light and power to buildings and departments.

In view of this situation, it was decided to supersede the dock pumping plant, originally provided for, by a central lighting, power and heating plant for the entire department, although retaining the dry dock pumping equipment which will now be electrically driven from the central station. It is also intended to supply from this plant electric light and power to the vessels docking which do not happen to be under steam. The power system as now under construction is, therefore, considerably more comprehensive than originally laid out.

The turbine plant will supply three-phase alternating current at 2,300 volts, this voltage being used for general distribution and for direct use in large motors, while for lighting lower voltage will be provided by transformation. The turbine generator will be served by a 37½-kw Westinghouse compound exciter unit.

The engineering work is under joint execution by the Department of Yards and Docks and the constructing engineers, Westinghouse, Church, Kerr & Co., who are installing the plant.

Wireless Telegraphy in the War.

During the recent demonstration of the De Forest wireless telegraph before the British Post Office between Holyhead, England, and Howth, Ireland, arrangements were made by the De Forest Company with the *Times*, of London, and Captain Lionel James, its famous war correspondent, then about to start for Yokohama. This contract demanded that two complete sets of wireless telegraph apparatus, manned by two expert operators, should be shipped to the front. Within ten days the full outfits, including even two kerosene oil engines, and weighing all told over four tons, were shipped express to Vancouver, where the men just caught the steamship *Empress of Japan*. At Shanghai, China, Captain James had chartered the little steamer *Hai-mun*, a two-master, on which topmasts were rigged to the height of 75 ft., all the vessel could safely carry. There the apparatus was transferred, and during the voyage north to Wei-Hai-Wei the two experts, Athearn and Brown, both New Yorkers, worked unceasingly until the ship's set was completely installed and in operation.

Capt. James' lieutenant, Mr. Fraser, had preceded him to Wei-Hai-Wei, and there the men found nearly complete a bamboo mast 180 ft. high, rigged in the best possible fashion, considering the unsatisfactory wood which alone could be obtained for that purpose, and the great dearth of necessary supplies. A pair of rough bungalows were thrown together by coolie labor, and the task was begun of moving the engine and heavy machinery from the dock to the promontory where stands the station. This point is some ten miles east of the town of Wei-Hai-Wei, accessible only by pony messenger, over a narrow and rocky trail. The utmost energy and ingenuity was required on the part of the English and Americans to get the Wei-Hai-Wei apparatus quickly installed. The fact that just three weeks from the date of landing at Wei-Hai-Wei, the *Times* printed a column-long dispatch from Capt. James, received by wireless is a tribute to the spirit and ability which is so characteristic of that correspondent and his staff. Since that time numberless dispatches have been flashed from the masts of the little *Hai-mun*, far out in the Corean Gulf, near Chemulpo, or even in company with the Japanese fleet in battle off Port Arthur.

Each set is of 1-kw capacity and comprises a 2½-hp Secor oil engine, a 60-cycle, 500-volt generator with separate exciter, oil transformer delivering 20,000 volts, oil transmitter key, regular Shoemaker-De Forest oscillator and syntonizer, electrolytic receiver, with relay and bell attachment and highly sensitive telephone receivers. The *Hai-mun* being without electric power, carried an oil engine, the same as the shore station.

It was the original intention to install one station upon one of the Sir James Islands in the Chemulpo peninsula and transmit thence to Wei-Hai-Wei, a distance of 175 miles, but Capt. James decided that an installation upon a boat would give him greater mobility and save long delays in getting dispatches to the transmitting station.

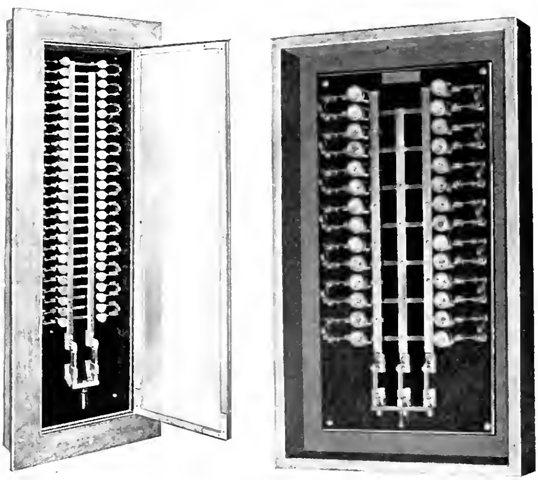
The De Forest apparatus in the Yellow Sea has not been exempt from serious competition by the Japanese wireless stations on board their vessels of war. Whether intentionally to interfere or in the ordinary operation of their stations there has been a continuous stream of wireless signals in that neighborhood, but the methods of syntonization employed in the De Forest apparatus, the speed with which the press dispatches are rushed through with the alternating-current transmitter—25 to 30 words per minute—(which greatly exceeds the speed of the Japanese system) together with the telephonic method of sound reading, have, it is said, enabled the American operators to send the longest wireless dispatches on record, without error or delay.

Barring an accident to the receiving mast on the Wei-Hai-Wei Peninsula from a typhoon, the *Times* news service by De Forest wireless system has been uninterrupted.

Capt. James' dispatches form a series of masterly and graphic pen pictures of the war, standing alone amid the mass of mutilated, conflicting reports which have come from the seat of conflict.

Fuse Plug Cabinet Panels.

The line of cabinet panels manufactured by the General Electric Company has been received with favor by contractors and architects throughout the country. These panels are furnished for 125 and 250-volt service, in a variety of arrangements and circuits. The distinctive feature is the employment of the Edison fuse plugs on the different circuits. The plug type of panel is considered to have an advantage over the cartridge fuse type in that the bus-bars and connections are placed considerably below the level of the tops of the plugs, thus rendering very remote the liability of a short-circuit. The fuse plugs furnished with the 125-volt panels are fitted with a mica cap, which enables one at a glance to know on what circuit the fuses

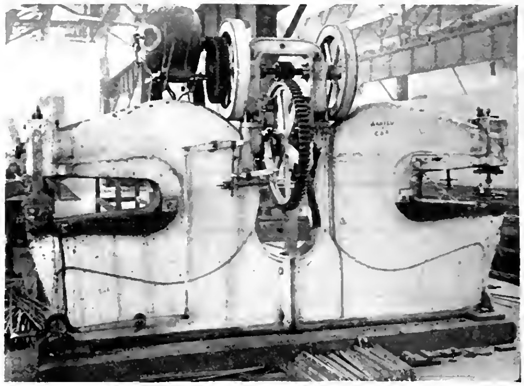


FIGS. 1 AND 2.—CABINET PANELS.

have blown. The 250-volt panels are fitted with a reloadable type of fuse plug easily inserted, without danger of shock. These panels are neat in appearance, compact and well finished; and owing to the nature of the Edison plug no injury to the panel itself can take place when the fuses blow. Fig. 1 shows a cabinet panel for 26 two-wire, double-branch circuits from two-wire mains with main and circuit switches, while Fig. 2 shows a somewhat smaller panel arranged for 14 two-wire, single-branch circuits from three-wire mains with main and circuit switches. The spacing of the different panels is in conformity with the results of the National Board of Fire Underwriters.

Punch and Shear Motor-Driven.

In the busy shops of the Charlestown Navy Yard are found many instances of the effectiveness of motor-drive as applied to punching and shearing machinery. The character of the work done is such as to subject the motors to very severe conditions of load and in every case they have answered all the demands made upon them. The accompanying half-tone shows a Long & Allstatter Company double punch and shear driven by a Crocker-Wheeler semi-enclosed 2-hp motor, wound for a pressure of 220 volts and a speed of 975 r.p.m. The machine does work up to punching a ½-in. hole in ½-in. iron, 35 strokes to the minute, or shearing a 1-in. round or a 3 x ½-in. flat bar. It will receive punching tools, or cross-cut or splitting shears. This type of machine is built with a throat from 4 to 30 in. in depth. The respective sides of the double machines are entirely independent, so that one side may be run while the other is idle or



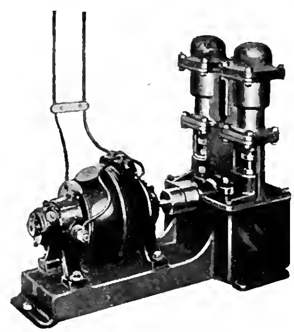
MOTOR-DRIVEN PUNCH AND SHEAR.

both may be operated at the same time. There is an automatic stop which may be used to arrest the slide at any point in the stroke.

The simplicity of attachment and convenience in operation of this motor-drive equipment is evident. It means a rapidity of control and a saving in floor space and permits a flexibility of shop arrangement, with respect to light, etc., that is out of the question with the old method of shaft and belting.

Direct Connected Electric Pump.

The engraving herewith illustrates an improved type of direct-connected electric pump for supplying tanks with water in office buildings, apartment houses, hotels and residents. The makers claim for it high efficiency, simplicity and durability. By a special switch



MOTOR-DRIVEN PUMP.

the apparatus operates automatically and starts pumping when the water in the tank is low, stopping when the tank is full.

The pump requires no foundation and can give service for months without attention. There are no oil cups, nor places to use a squirt can, lubrication being automatic. The outfit consists of an electric motor driving a duplex double-acting brass pump through a speed-reducing device which consists of a worm and gear running in a closed bath of oil. It is noiseless and by reason of its compactness and few parts is very reasonable in price. The space occupied is, length, 30 in.; height, 27 in.; width, 15 in. It was designed by Mr. Milan W. Hall, a pioneer in this line of work, and Mr. Charles S. Pease, of 13 Dutch Street, New York City, who is well known in the electrical and mechanical field, is general agent.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock prices were firmer as a rule and showed considerable strength, notwithstanding the renewal of litigation in the Northern Securities matter. Support was given to prices by large interests and a favorable effect was produced by the declaration of the regular dividend on United States Steel preferred. There was little movement in the industrial list as a whole, although amalgamated Copper was supported moderately. In the Curb market the volume of business was larger and prices are generally higher, the heaviest operations being in copper shares. The rise in the latter was based on improved trade conditions. Among the declines are noted Otis Elevator, Interborough Rapid Transit and New Orleans Railway preferred. In the electric and traction stocks on the regular exchange there was no particular influence at work, and each stock fluctuated independently of all others. Allis-Chalmers common closed with a net loss of ½ point, while the preferred gained 3 points net, the closing prices being 7⅛ and 43 respectively. General Electric lost 1 point and Westinghouse gained 3½, the former closing at 163⅝ and the latter at 162½. These two stocks, it will be noticed, are just now nearly alike in price. Brooklyn Rapid Transit closed at 46⅛, this being a gain of 2 points, and Metropolitan Street Railway, 117, a gain of 5⅛. Western Union made a net gain of ½, closing at 89, and American Telephone and Telegraph lost 1¼, closing at 123. Following are the closing quotations of April 12:

NEW YORK.

	Apl. 5	Apl. 12		Apl. 5	Apl. 12
Allis-Chalmers Co.	7½	7¼	Electric Vehicle	7¼	7
Allis-Chalmers Co. pfd.	43	40	Electric Vehicle pfd.	10	10
American Tel. & Cable	85	84	General Electric	163	164
American Tel. & Tel.	126	126⅛	Hudson River Tel.	..	..
American Dist. Tel	23	23	Metropolitan St. Ry.	111¾	115¼
Brooklyn Rapid Transit	44¼	46⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	170	165	Marconi Tel.	..	..
Electric Boat	20	20	Western Union Tel.	88¼	88¾
Electric Boat pfd	50	50	Westinghouse com	160	160
Electric Lead Reduction	¾	¾	Westinghouse pfd	175	175

BOSTON.

	Apl. 5	Apl. 12		Apl. 5	Apl. 12
American Tel. & Tel	126	126⅛	Western Tel. & Tel. pfd.	80	80
Cumberland Telephone	113	113	Mexican Telephone	1¼	1½
Edison Elec. Illum	225½	237½	New England Telephone	120	121
General Electric	163	..	Mass. Elec. Ry.	19	20¼
Western Tel. & Tel	8	8	Mass. Elec. Ry. pfd	74	75

PHILADELPHIA.

	Apl. 5	Apl. 12		Apl. 5	Apl. 12
American Railways	43	43	Phila. Traction	95½	96
Elec. Storage Battery	56	57	Phila. Electric	5⅞	5¾
Elec. Storage Battery pfd.	56	57	Phila. Rapid Trans.	13¾	13¾
Elec. Co. of America	8	8			

CHICAGO.

	Apl. 5	Apl. 12		Apl. 5	Apl. 12
Central Union Tel.	..	..	National Carbon pfd.	..	100
Chicago Edison	..	150	Metropolitan Elev. com.	..	15
Chicago City Ry.		160	Union Traction	..	5½
Chicago Tel. Co.	..	..	Union Traction pfd.	..	30½
National Carbon	..	28			

*Asked

NEBRASKA TELEPHONE REPORT.—The Nebraska (Bell) Telephone Company reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.
Gross	$1,049,907	$905,660	$754,971
Expenses	857,310	737,220	617,345
Net	$192,597	$168,440	$137,626
Dividends	115,768	99,000	81,222
Surplus	$76,829	$69,440	$56,404

The general balance sheet is given below:

	1903.	1902.	1901.
Assets:			
Construction	$2,238,974	$2,039,603	$1,674,796
Supply department	144,738	73,027	67,372
Real estate	192,547	158,910	141,317
Stock and bonds	1,867	2,100	100
Accounts and bills received	285,136	141,480	39,005
Cash	45,568	33,025	38,192
Total	$2,908,830	$2,448,145	$1,960,782
Liabilities:			
Capital stock	$2,196,900	$1,800,000	$1,500,000
Surplus	211,029	334,201	214,760
Reserve	400,237	239,672	218,779
Bills and accounts pay	100,664	74,272	27,243
Total	$2,908,830	$2,448,145	$1,960,782

LIGHTING IN CALIFORNIA.—The California Gas & Electric Corporation has consummated an important deal by the purchase of the systems of the Standard Electric Company, of California, and the United Gas & Electric Company, a monopoly in the supplying of electric power to twenty of the principal countries of the State. The Standard has a capitalization of $5,000,000 authorized stock and $5,000,000 in bonds, all issued and outstanding. The United Gas & Electric Company was capitalized at $2,500,000 in authorized stock, of which $2,286,000 is outstanding, and has $2,000,000 in authorized bonds, of which $1,100,000 is outstanding. The price paid for the two companies has not been made public, but it is said to be a high one. The Standard Electric Company's main plant is in Amador County. It supplies Sacramento and San Joaquin Counties, joining with the United Gas & Electric Company in supplying the counties around San Francisco Bay, its lines running through San José up the west side of the bay, into this city. Details and illustrations of the Standard system have been given in the pages of ELECTRICAL WORLD AND ENGINEER.

ELECTRIC SUPPLY COMPANY, of Savannah, Ga., has recently been incorporated for the purpose of extending its wholesale department and to add an automobile department, which has been accomplished. The paid in capital is now $25,000 and the prospects are exceptionally bright. Its sales extend over four Southern States, and the construction department is crowded with a number of large contracts. Among them is the lighting plant for Sandersville, Ga. The officers are as follows: David Wesson, of the Cotton Oil Company, president; Ed. M. Wilson, vice-president; Joseph S. Walker, treasurer and manager; E. C. Richardson, secretary. The board of directors is composed of wealthy and representative business men of this city. Among them are the following: W. V. Davis, treasurer Savannah Trust Company; Harvey Granger, of Granger Stubbs Lumber Company; William Kehoe, of Kehoe Iron Works; H. H. Bruen, of Patterson & Downing Co.; E. Moyle, merchant and capitalist; Capt. W. B. Stephens, a wealthy attorney, and others.

INDIANAPOLIS TRACTION TERMINAL.—The Indianapolis Traction and Terminal Company gross earnings increased $167,000 for the year ended December 31, 1903, over those of the constituent companies for the preceding year, and the months of January and February, 1904, each show an increase of about $10,000. The guarantee on the $5,000,000 Indianapolis Street Railway stocks is now 4 per cent. per annum, or $200,000, an increase of 1 per cent. over 1903, and rises 1 per cent. per annum up to 6 per cent. in 1900. A substantial surplus over the guarantee is stated as being earned and the proceeds of $3,000,000 5 per cent. bonds sold by the Terminal Company, which issue is a first lien on the terminal property, has correspondingly improved the position of the Indianapolis Street Railway 4s ahead of them.

CENTRAL AND SOUTH AMERICAN TELEGRAPH.—The annual report of the Central and South American Telegraph Company for the year ended December 31, 1903, shows as follows:

	1903.	1902.	Changes.
Gross	$1,072,134	$1,002,572	Inc. $69,562
Op. exp.	405,296	388,031	Inc. 17,265
Net	$666,838	$614,541	Inc. $52,297

There was expended from net earnings $62,710 for cable used in repairs and improvements, leaving a surplus after 6 per cent. dividends ($463,536) of $140,592. The total surplus December 31, 1903, was $820,912.

ATLANTIC COAST ELECTRIC.—Mr. James Smith, Jr., receiver of the Atlantic Coast Electric Railroad Company, has filed his report in the United States Circuit Court at Trenton, N. J., showing that the road is in good physical condition and capable of first-class operation. The report shows that the receipts for the year ending January 31, 1904, were $309,530, disbursements $262,064, leaving a balance of money on hand at the date of the report of $47,456. The report further shows that there were 4,048,671 passengers carried in the year.

BIRMINGHAM, ALA., BONDS.—The Birmingham, Ala., Railway, Light and Power Company has voted for an issue of $10,000,000 of 4½ per cent. bonds, with the proceeds of which it will take up the present $6,000,000 of 5 per cent. bonds, leaving a treasury surplus of $3,400,000 for the making of betterments to local properties. Holders of the present bonds will exchange bond for bond into the new issue and receive a bonus of $100 on each $1,000 bond besides. The project was launched with practically unanimous vote.

GEORGIA RAILWAY AND LIGHTING COMPANY, of Atlanta shows a gross for nine months ending December 31, 1903, of $1,424,286, a net of $605,860, and a surplus after all payments and deductions of $228,914.

BELL TELEPHONE BOND NOTES.—Speyer & Co., and Lee, Higginson & Co. have purchased from the American Telephone and Telegraph Company $20,000,000 5 per cent. 3-year secured gold coupon notes, to be dated May 1, 1904. The notes are secured by $25,000,000 of the company's present 4 per cent. bonds. The notes cannot probably be delivered before May 10. The $20,000,000 American Telephone notes are going very rapidly. Only a limited amount will be offered at the present price of 99 and interest, which is equivalent to a 5.33 per cent. basis. These notes are being offered in London, Paris, Berlin and Frankfort, and a large number of them are expected to be sold in these cities. The American Telephone and Telegraph Company had a number of offers from different syndicates, some of which were for bonds and some for notes, but the company showed its confidence in easier monetary conditions in the future by issuing 3-year 5 per cent. notes instead of a long-term bond. Although the payment for the entire amount will not be required of the syndicate at once, a good proportion of it will be paid immediately, and the syndicate has the privilege of anticipating the balance. The disappointed bond houses say that the price paid by the syndicate, which is comprised solely of Lee, Higginson & Co. and Speyer & Co., was 97½.

ELECTRIC COMPANY OF AMERICA.—The Electric Company of America net earnings for the fiscal year ending December 31, 1903, roundly $398,000, represent the amount applicable to pay the 6 per cent. dividend, requiring only about $240,000 per annum. It is understood that most of the $400,000 cash which the company had at the beginning of 1903 has been reinvested, the company having purchased small plants in the Middle West during the year. In 1902 interest on the cash loaned out and in bank constituted about $25,000 of other income, but except for a small item of "other income," the income in 1902 is entirely from operation of plants. The amount of dividends and interest received by the company, as the holding company, from the stocks and bonds of the subsidiary local lighting companies, is understood to be around $430,000. The corresponding income in 1902 was $366,587. The net earnings applicable to the dividend was $352,478. The company shows ordinarily between $300,000 and $400,000 bills receivable, against current liabilities of a few thousands dollars only.

NEW YORK TRANSPORTATION.—President Sanderson, of the New York Transportation Company, stated at the annual meeting last week that the company has about $750,000 in bank. About $300,000 has been spent in new construction, principally in connection with establishing the express business. The earnings from the express business so far have been somewhat disappointing, while the earnings from the vehicle department are increasing. Those who are familiar with the company's affairs point out that the franchises are worth more than the par value of the outstanding stock. The hard winter has unfavorably affected profits. The following directors were re-elected: Henry Sanderson, Harry Payne Whitney, Philip P. Dodge, George H. Day, G. Herbert Condict, George W. Wesley and William H. Palmer, Jr. The New York Transportation Company is capitalized at $5,000,000. It operates the Fifth Avenue stage line and a large electric automobile business.

CROCKER-WHEELER COMPANY INCREASES ITS CAPITAL.—A doubling of its capital stock, which has been $1,000,000, is announced by Crocker-Wheeler Company, of Ampere, N. J. The company, which is the largest of the independent electrical manufacturers of dynamos, motors, etc., was organized in 1892 by Dr. Schuyler Skaats Wheeler and Prof. Francis B. Crocker, on a relatively modest basis. It now has fifteen branch offices from Boston to San Francisco and does one of the largest businesses in the world in electric power apparatus. The capitalization was several times increased until in 1899 it had become $1,000,000. In view of the rapidly expanding business the stockholders have now decided to increase this amount to $2,000,000. The excellent balance sheet for last year was given in this department recently.

INCANDESCENT LAMP COMBINATION.—It would appear that in addition to those licensed to manufacture incandescent lamps under the General Electric patents in accordance with the recent pooling arrangement on prices, etc., are the Tipless Lamp Company, 316 Hudson Street, New York, and Monarch Electric Manufacturing Company, Warren, Ohio. So far as known, the following concerns have not applied for a license: American Incandescent Lamp Company, Kentucky Electrical Company, Germania Electric Lamp Company, Missouri American Electric Company, Moline Incandescent Lamp Company, and the Sawyer-Man Co., as already announced.

KEYSTONE TELEPHONE COMPANY, of Philadelphia, reports for the March quarter a net of $78,910, a gain over the corresponding period last year of $37,592.

DIVIDEND.—The Twin City Rapid Transit directors have declared a quarterly dividend of 1¼ per cent. upon the common stock, payable May 16.

Commercial Intelligence.

THE WEEK IN TRADE.—With the advent of more spring-like weather trade has received new life, and for the most part events have been favorable. The better weather conditions have increased retail distribution in the cities and helped farmers in their planting preparations. Wholesale and jobbing distribution have been strengthened in tone rather than in volume by the more favorable weather and the resumption of out-door work is helping distribution of iron and steel. The soft coal industry has also improved, owing to the removal of the fear of a general strike of miners. Collections, however, do not yet reflect any improvement in trade conditions, being especially backward in some sections of the Middle West, where recent floods have caused damage. *Bradstreet's* states that trade activity for this year's first quarter is behind that of the corresponding period last year. Failures exceed those of 1903 by 8 per cent. in number, though 5 per cent. less than those in 1902. Liabilities exceed those of a year ago by 70 per cent., and, owing to bank suspensions, are the heaviest since 1897. There were 201 business failures for the week ending April 7, as against 212 the week previous, and 163 the corresponding week in 1903. It is pointed out that the general level of prices in March for 8 out of 13 classes of products, including bread stuffs, meats, textiles, hides and leather and building materials, fell off about 1 per cent. for the month, but is still in excess of a year ago at this time, and near the highest for four years. The iron trade appears to be cheerful. Finished products are in moderate demand at leading markets. Among the other metals copper is firmer. Large producers have started an upward movement in prices based upon the recent heavy exportation and not upon any increase in demand here. Business, however, still lags. Quotations are 13⅛ @ 13⅜ c. for Lake; 13⅛ @ 13¼ c. for electrolytic and 12⅞ @ 13⅛ c. for casting stock.

EXTENSIVE PLANT FOR SILVERSMITH SHOPS.—The new plant now under construction by Dominick & Haff, silversmiths, at 543 West Twenty-third Street, New York, is to be installed with one of the most extensive electrical equipments hitherto utilized in the manufacture of silverware. The Crocker-Wheeler Company, through its New York office, 39-41 Cortlandt street, has secured the contract. There will be one 150-hp and one 50-hp engine type, 260 r.p.m., 250-volt generators direct connected to engines of 225-hp and 75-hp capacity, respectively, built by the Ames Iron Works. The motor installation will consist of 56 machines. There will be 37 constant speed motors and accessories and 18 variable speed machines. The latter will be of multiple voltage, which is to be furnished by a three-unit balancing transformer. The motors will range in capacity from ¼ hp to 30 hp. The average capacity will be 7½ hp. Most of the machines will be individual drive. They will be used for operating blanking presses, embossing presses, drop hammers, metal rollers and lathes.

THE CHIPMAN ELECTRIC PURIFYING COMPANY, of 13 Park Row, New York, and Schofield Building, Cleveland, Ohio, have appointed Col. W. S. Rogers manager of their Western office in Cleveland. This department includes all of the territory west of Pennsylvania. The Chipman process contemplates not only the purification of water under pressure for steam boilers, but has been worked out for municipal work in clarifying and purifying water for towns and cities. Plans are now being drawn up for a plant to furnish thirty million gallons per day for the city of Montreal. Mr. Rogers is well known as one of the pioneers of the arc lighting industry, having been in the old Brush Electric Company for 15 years. He has been watching the purification of water for electricity for some time, and has made up his mind that it is as far ahead of sand filtration as electric cars are of cable and horse cars.

EQUIPMENT FOR ATLANTA TERMINAL RAILWAY DEPOT.—The new Atlanta (Ga.) Terminal Railway depot is to be equipped with considerable plant for light and power purposes. Through the Atlanta office of the Harrisburg (Pa.) Foundry and Machine Works which is under the management of Glenny & Castanedo, two 150-hp and one 225-hp engines have been contracted for. The first engine will be direct connected to Westinghouse generators of 100 kw capacity each. The other engine will be direct connected to a 150-kw Westinghouse generator.

EQUIPMENT FOR MEXICAN MINES.—The San Felipe Mining Company, whose headquarters are in Philadelphia, and of which Colonel N. Z. Seitz is vice-president and general manager, is about to install an electric plant for the purpose of driving the mill drills, etc., on its mining properties located in the Ixtlan district, State of Jalisco, Mexico. Power will be derived from a hydraulic plant to be erected in the vicinity of the mines.

PELTON WATER WHEELS.—There are now running something more than 11,000 Pelton wheels in various parts of the world, in connection with electric transmission, mining, manufacturing and other industries, aggregating in excess of 1,000,000 hp. In the United States there are: California, Oregon and Nevada, 7,647 wheels, 708,370 hp; Washington, Idaho and Alaska, 623 wheels, 58,225 hp; Utah, Colorado and Montana, 176 wheels, 24,970 hp; Hawaii, New Mexico and Arizona, 208 wheels, 13,800 hp; Middle, West and Atlantic States, 146 wheels, 5,670 hp. In foreign countries there are: Mexico and Central America, 636 wheels, 152,905 hp; various South American States, 371 wheels, 24,660 hp; Australia, Japan and India, 484 wheels, 40,250 hp; East and West India Islands, 243 wheels, 30,250 hp; British Columbia and Nova Scotia, 52 wheels, 10,500 hp; England and South Africa, 77 wheels, 12,220 hp; Germany, France, Italy and Spain, 341 wheels, 4,820 hp; Norway, Sweden and Denmark, 36 wheels, 2,800 hp. The total is 11,040 wheels, 1,089,440 hp. Results in excess of 80 per cent. efficiency are reported by the Gold Stream plant of the British Columbia Electric Railway at Victoria, B. C. So well satisfied is this company that it has given the Pelton Company another contract to increase the output of the plant. This additional installation will consist of a water wheel unit for direct connection to a 1,000-kw, 400-r.p.m. Canadian-Westinghouse generator. This unit will consist of two wheels fitted with the latest type of Pelton buckets and needle nozzles both with pilot control, to operate under an effective head of 600 ft. The wheels will be mounted one on each end of the main shaft, which will be carried on ring, oiling, ball and socket generator type bearings. The wheels will be completely enclosed in sheet steel housings, mounted on heavy bed plates, designed also to carry the armature of the generator, thus making a complete iron-mounted integral unit with the Westinghouse engine type generator. This will give considerable reserve capacity to the plant which has been operating most successfully for a number of years.

THEATRE STEEL CURTAINS.—The Iroquois Theatre disaster in Chicago has led to some radical improvements in theatre drop curtains. Mr. Emery Stanford Hall, consulting architect for seven Chicago theatres, has placed in the Academy of Music a curtain of his own design and has awarded contracts for the placing of similar curtains in the Bijou, Alhambra and Haymarket theatres to the Sykes Steel Roofing Company. It is Mr. Hall's belief that it is dangerous rather than safe to use a very heavy gauge steel in the curtains, as was shown by accidents in "sticking." Mr. Hall's curtains weigh about 2 tons each, according to the size of the arch, and are made from 24-gauge black corrugated sheets protected on the stage side by asbestos. This curtain has no side bearings, but is under tension at all times between upper and lower cables, which hold it in place. Those from which it is hung are carried over pulleys high above the stage and support heavy counterweights in the basement, which keep them taut, also allowing for expansion and contraction. Under ordinary circumstances the curtain is raised by a motor connected through a worm gear with the drum around which the cables pass, but in case the motor should get out of order, by pulling a controlling rope attached to the lever of the drum the latter is disengaged from the motor and the curtain can be raised by hand. An electric button is placed on every fly floor and also at a point in the house, each button having the right of way over the rest of the machinery, so that by touching it the curtain may be instantly lowered. The lowering is effected by counterbalancing weights which weigh 200 pounds less than the curtain, allowing for friction and permitting it to fall by its own weight without shock to the stage floor. The motor which raises the curtain runs at four speeds and is controlled by switches in the flies.

MEXICAN LIGHT AND POWER PROJECTS.—A number of projects are being considered at present for the construction of electric lighting and power plants in various parts of Mexico. Steps have been taken by the municipal authorities of Lagos, a city of 20,000 population in the State of Jalisco, for the installation of a light and power system. At Real del Monte, which has about 4,000 inhabitants in the State of Hidalgo, a plant is also to be built. The State government has contributed $3,500 towards the undertaking. Longinos Gonzales, of Tescaltiche, State of Jalisco, population about 10,000, has filed an application with the State authorities requesting the necessary permission to establish a light and power plant. Power will in this instance be generated by steam. Zacatlan, a city of some 25,000 people, State of Puebla, is to have a municipal light and power system. Plans have already been drawn up by the city council for submission to the State government for approval. The Compania Maustral de Guadalajara, which operates a 2,000-hp hydraulic plant at Las Juntas for the purpose of transmitting current to Guadalajara for lighting purposes chiefly, is about to let contracts for 2,000 hp additional equipment.

PLANT FOR CEMENT WORKS.—The extensive improvements contemplated by the Phoenix Cement Company, Nazareth, Pa., have all been laid out by Dodge & Day, modernizing and contracting engineers, Nicetown, Philadelphia, Pa., and it is thought the work will be started in the near future. Most of the buildings will be enlarged, electrical transmission used throughout, and the entire plant thoroughly modernized in order to materially increase the output to keep pace with the growing demand for the Cement Company's product. This will necessitate the installation of considerable additional power equipment, as well as a 200-kw generator, tandem compound engine for generator, one 50 and one 75-hp motor, as well as a number of smaller motors; charging cars, turntable, coal and ashes conveyor, underfeed stokers, steam locomotive for hauling cars to and from the quarries; electric hoist, electric air compressor, blower and exhauster, air-cooling conveyors, elevators, automatic weighing machine, extension of the track system, etc.

A 1,500 KW. CURTIS FOR LONG ISLAND PLANT.—The Nassau Light and Power Company, which furnished power to Roslyn, Mineola, Hempstead, Seacliffe, Port Washington, Floral Park and several other Long Island villages, is to remove its plant from the first mentioned place to the water side at Glenwood, about four miles distant, which location will permit of a cheaper coal supply and better facilities for condensation. The rearrangement and enlargement of the condensing equipment has been entrusted to the Worthington branch of the International Steam Pump Company, 114 Liberty Street, New York. Two 400-kw Westinghouse turbines which are already installed at Roslyn will be transferred to the Glenwood plant, and additional equipment consisting of a 1,500-kw Curtis turbine has been contracted for. The transformers, switchboard, etc., have been ordered from the General Electric Company. Mr. C. O. Mailloux is acting as consulting engineer for the Nassau Company.

GOULD STORAGE BATTERY CONTRACTS.—The Gould Storage Battery Company, Astor Court Building, New York City, reports that among recent contracts closed by the company, are the following: Chambersburg, Greencastle and Wynesboro Railway, Waynesboro, Pa., two floating batteries, one of 242 cells, and one of 244 cells. Additional plates for Lexington Street Railway Company, Lexington, Ky., increasing the present output to 352 kw. Elder & Johnson, Dayton, Ohio, 60 cells of 400 amp. discharge, with Gould c.e.m.f. booster, for elevator regulation in Rebold Building. Bank of Montreal, Montreal, Can., 61 cells with a discharge of 960 amp., with motor driven end cell switch. Isolated and residential plants for C. C. Williams, Cohassett, Mass.; W. T. Smith, Elka, Nev.; United States Navy, Navy Yard, New York. Also six central battery system telephone plants at different places.

ALLIS-CHALMERS FOUNDRY PURCHASE.—The Bollmann-Wilson Company's foundry plant at Norwood, Cincinnati, has been sold to the Allis-Chalmers Company, through the Bullock Electric Manufacturing Company, of Ohio The foundry was established by Hoefinghoff & Lane at the request of the Bullock Company, which stated that it would take all the castings that the foundry would turn out. This purchase will give the Allis-Chalmers Company a modern equipped foundry, a shop with an area of 40,000 sq. ft. and six acres of land. The property lies across the street from the Bullock plant on Forest Avenue. It is the intention to improve the property and make additions. Besides the castings that will be needed for Bullock products there will be manufactured castings for Allis-Chalmers manufactures.

LIGHTING EQUIPMENT FOR SAN REGIS HOTEL.—More lighting equipment will be ordered shortly for installation in the new San Regis at Fifty-fifth Street and Fifth Avenue, New York. The machinery contracted for last year is capable of developing 1,000 kw. It consists of two 450-hp and the same number of 300-hp Harrisburg four-valve engines direct connected to Western Electric Company generators of 300-kw and 200 kw capacity respectively. The additional equipment will comprise a 300-kw lighting set. The contract will be awarded through Trowbridge & Livingston, 424 Fifth Avenue, the architects of the hotel.

THE INTERNATIONAL TELEPHONE MANUFACTURING CO., Chicago, have recently installed a complete inter-communicating system in the City Hall, Chicago. Each station is provided with an "International" desk set with long-distance transmitter, double pole receiver, and metallic jack plug-switch, enabling any one station being called directly from any of the others in the system. Any number of pair of instruments may be used simultaneously without interference.

TO ELECTRICALLY OPERATE OAXACA MINES.—Mexican advices state that application has been made to the fomento department by Don Manuel M. Mimiago y Camacho for a concession to utilize the waters of the Rio Atoyac in the State of Oaxaca, between the districts of Ocotlan and Ejutla. A large hydraulic plant is intended to be constructed. The current will be used for operating various mining plants in these districts.

EQUIPMENT FOR CANTON MANUFACTURING PLANT.—Parlin & Orindorff, the large agricultural implement manufacturers, of Canton, Ohio, are about to increase their power plant. An additional 500-hp equipment—one unit—will be installed.

General News.

THE TELEPHONE.

NEW DECATUR, ALA.—The franchises in this place of the Southern Bell Telephone Company, the American Telephone and Telegraph Company and the American Telephone and Telegraph Company of Alabama, have been revoked. The Morgan County Telephone Company is now in sole possession of the field. It is expected that the three first named companies will apply for an injunction against the city.

REDDING, CAL.—The Redding, Ingot & Wengler Telephone Company has been incorporated here with a capital stock of $10,000.

RED BLUFF, CAL.—The Balls Ferry Telephone Company is being organized by L. D. Cheeney, D. L. Gover and others. A line will be built from Balls Ferry to Anderson and Cottonwood.

SAN DIEGO, CAL.—The Home Telephone Company, which is to establish a local system, has filed articles of incorporation, the capital stock being $500,000. Among the incorporators are F. F. Graves and F. F. Boyce.

MORRIS, ILL.—The Stevens County Telephone Company has been reorganized with Mr. Berg as president.

TREMONT, ILL.—The Independent Telephone Exchange of Tremont has been incorporated by A. J. Davis, F. J. David and W. H. Ames. The capital stock is $20,000.

DUVALL, ILL.—The Okawa Township Telephone Company has been incorporated with a capital stock of $2500. The directors are G. L. McCullough, A. Roberts and others.

CHICAGO, ILL.—A rumor presages the organization of a telephone supply company to act in the interests of the Interstate Independent Telephone Association. Mr. Henry A. Barnhart, of Rochester, Ind., is quoted in a Chicago daily as saying such a company, with about $1,500,000 capital, is necessary to the life of the smaller independent telephone companies by reason of the absorption of supply houses.

WABASH, IND.—After wrangling for a year or more the city council has granted a franchise to the Central Union Telephone Company. The company's franchise expired over a year ago, and during this time the council and the company have been at sword's points while the company was doing business by sufferance. The officials of the Central Union say they propose making extensive improvements and will make a strong bid for a fair share of the business in Wabash and vicinity.

INDIANAPOLIS, IND.—The traffic committee of the Independent Telephone Association, which is composed of nearly all the long-distance independent telephone companies in the country, held a meeting in this city on April 2, and discussed plans for the betterment of long-distance service. Steps were taken toward the building of connecting links for the independent long-distance lines by agreeing to employ competent and expert telephone men to map out proper plans for perfecting the general scheme contemplated, and competent engineers to oversee the work. The members of this committee were appointed at a previous meeting and those attending the meeting were: F. S. Dickson, J. B. Hodge and B. W. Overley, of Cleveland, Ohio; C. H. Ledlie, R. M. Foster, St. Louis; M. R. Patton, Kansas City; C. L. Spain, Pittsburg, and S. P. Sheerin, Indianapolis.

SLOAN, IA.—The People's Rural Telephone Company is being formed here.

WEBSTER CITY, IA.—The Hamilton County Mutual Telephone Company has ordered a new switchboard, wire and other material, and will extend its system.

DES MOINES, IA.—The Hartley & Primghar Telephone Company, of O'Brien County, has been incorporated by W. N. Hulbert and others. The capital stock is $2000.

DES MOINES, IA.—The Elkhart Mutual Telephone Company has been incorporated with a capital stock of $10,000, the incorporators being O. F. Mathis, Albert Peterson, W. D. Cory, R. H. Ault and A. P. Besser.

ONOWA, IA.—The farmers of Fairview have decided to build an independent telephone line. The proposition of the Monona County Telephone Company to furnish service at $1.25 per month was not regarded by them favorably.

WHEATLAND, KAN.—The Wheatland Telephone Company has been organized to build a line from Wheatland to Conway.

PORTLAND, ME.—The Naples Telephone Company has been organized here to build lines in Naples, Bridgton, Casco and Raymond. The capital stock is $10,000.

DETROIT, MICH.—The Calhoun County Telephone Company has increased its capital stock from $150,000 to $250,000.

GRACEVILLE, MINN.—The Parnell Co-Operative Telephone Company has been granted a franchise in this place.

NEW ULM, MINN.—The Minnesota Central Telephone Company will build a line between this place and Sleepy Eye.

FARIBAULT, MINN.—Three telephone companies are seeking to do business in this city. The Northwestern (Bell) Company, which now controls the field, the Tri-State and a local company—the Rice County Telephone Company—are trying to secure franchises. Mr. A. R. Tracy, of Faribault, may give further information.

MERIDIAN, MISS.—The electrical committee has reported favorably on the movement to grant a franchise to an independent telephone company. The Cumberland Telephone Company also offered to grant any reasonable demands that would tend to lessen the friction which would be probable in case of two companies occupying the field.

NELSON, NEB.—The Nuckolls County Telephone Company will be organized here with a capital stock of $50,000.

MOCKSVILLE, N. C.—The Mocksville Telephone Company, of Mocksville, with a capital of $900 paid in and $10,000 authorized, has been chartered by L. G. Horn, of Mocksville, and others, to operate in five counties.

BINGHAMTON, N. Y.—The Treadwell Telephone Company has been incorporated to build a telephone line within the counties of Delaware and Otsego. The company now has about 100 miles of line and about 100 telephones in use.

SALEM, OHIO.—The Columbiana County Telephone Company is preparing to install new selective ringing telephones on its party lines in this district.

PAINESVILLE, OHIO.—The new telephone company organized at Perry, near here, has been organized as follows: President, W. W. Cook; secretary, F. E. Morrison; treasurer, E. M. Orcutt.

ALLIANCE, OHIO.—The Stark County Telephone Company has arranged a rate for interchange of service with the Bergholz Telephone Company and the Eastern Ohio Telephone Company. A rate will also be made with the Harrison County system.

ADAMSVILLE, OHIO.—The Adamsville Telephone Company has been organized with J. B. Rhodes, president; F. P. Winn, secretary, and S. M. Winn, manager. The company will install an exchange at Adamsville and will place contracts for material at once.

GIBSONBURG, OHIO.—The Seneca Telephone Company has been incorporated with a capital stock of $20,000 to build a line in Seneca and Sandusky counties. The incorporators are: N. B. Ervin, C. B. Synder, F. C. Hornung, F. W. Zorn and A. H. Miller.

LORAIN, OHIO.—The Ohio Telephone & Telegraph Company, which has been refused a franchise in Lorain, has made an arrangement with the Western Union Telegraph Company whereby it will use the latter's poles in Lorain and a small exchange will be fitted up.

CRESTLINE, OHIO.—The Crestline Telephone Company has elected J. Bapst, president; C. R. Callaghan, vice-president and general manager and F. A. Knapp, secretary. The company has 400 telephones in operation. It was decided to build new lines throughout the rural district in the vicinity of Crestline.

CINCINNATI, OHIO.—Mayor Mills has vetoed the ordinance granting a franchise to the Norwood Citizens Telephone Company. His reason for this action is that "It does not bind the company by bond or forfeiture to erect and operate a plant including an automatic exchange of reasonable capacity within a specified and reasonable time."

WEST MILLGROVE, OHIO.—A franchise has been granted to the West Millgrove Telephone Company, which will be incorporated at once with a capital stock of $2500. Construction material has already been ordered. The officers of the company are: President, Wilbur Rosendale; vice-president, J. P. DeWolfe; treasurer, C. D. Stearns; secretary, S. L. Ghaster.

CLEVELAND, OHIO.—The Federal Telephone Company has disposed of its interests in the Wood County Telephone Company, of Bowling Green, Ohio, to a company headed by H. A. Ashbrook, D. A. Yoder and J. S. Yoder, of Toledo. The company operates an exchange with 900 subscribers. It is the intention to reconstruct and extend the entire system and install a new board.

WOODSFIELD, OHIO.—The directors of the Woodsfield Telephone Company have chosen J. B. Rhoades as president; W. E. Mallory, vice-president; P. E. Fraley, secretary and treasurer, and F. C. Huth, general manager. The capital stock of the company was increased from $15,000 to $25,000. A number of extensions and improvements during the coming summer are contemplated.

CARNEY, OKLA.—The Carney Automatic Telephone Company has been organized here with a capital stock of $10,000. C. E. Wilcox, of Carney, is one of the incorporators.

QUAKERTOWN, PA.—The residents between Quakertown and Riegelsville along the line of the Quakertown & Eastern Railroad, are interested in the formation of a company to build a telephone line between the two towns. It is proposed to make a business arrangement with the Bell Company, which will make a charge of $3.60 per year per telephone.

TROY, S. C.—The Troy Telephone Company, of Greenwood County, S. C., has been commissioned with $800 capital. A. J. Davis and others are interested.

CHARLESTON, S. C.—The Edgemoor Telephone Company, of Chester County, S. C., has been chartered with $25,000 capital. H. B. Heath is president and J. D. Glass, secretary and treasurer.

ANDERSON, S. C.—The directors of the Anderson Telephone Company have decided to increase the capital from $10,000 to $30,000. This company owns several other lines in the county and has an agreement with the Bell Company as to long-distance service.

ABERDEEN, S. D.—The Dakota Central Telephone Company will extend its line from here to Mitchell.

LEWISBURG, TENN.—It is proposed to build a telephone line between Lewisburg and Yell. Mr. B. J. Coleman and J. K. Jobe are interested in the enterprise.

CORNERSVILLE, TENN.—A telephone company has been organized here to establish an exchange. A switchboard will be leased from the Cumberland Telephone Company, and the 25 subscribers will furnish the poles and wire and employ the operator.

ROCKINGHAM, VA.—The Rockingham Mutual Telephone Company has increased its capital stock $25,000.

SNOHOMISH, WASH.—The Skagit Farmers' Telephone Company has asked for a franchise in this place.

UTICA, WIS.—The Utica Telephone Company has been incorporated with a capital stock of $5000. The directors are G. Pickett, R. Mackie and others.

Electric Light and Power.

SAN FRANCISCO, CAL.—An official of the California Gas & Electric Corporation says that while the water supply and electric power plants owned by the South Yuba Water Co. and the Central California Electric Co. have not yet been taken over, the option held will probably be exercised within a month. This deal and the taking over of the Standard Electric Co. were arranged for at the same and the financing of the one depended upon the other.

YREKA, CAL.—The Little Shasta Power Company, recently incorporated, will be a sub-company of the Siskiyou Electric Power Company. Contracts have been signed by the Siskiyou Electric Power Company to deliver at Montague all of the power required by the Little Shasta Company. The Little Shasta Company has purchased the Terwilliger power line and will sell electrical energy for light and power throughout the Little Shasta Valley. Mr. W. H. Roberts, M. T. Jones and J. F. Reisser are among those interested in the enterprise.

SAN FRANCISCO, CAL.—The Northern California Power Company, which has its principal office in San Francisco, and plants in Shasta County, has commenced paying monthly dividends, the first one of five cents per share being payable March 25, 1904. At the recent annual meeting of this company H. H. Noble was re-elected president; Edward Whaley, secretary, and Antoine Borel & Co., treasurer. The gross earnings of the company for the year 1903 were $150,924.56, while those for the preceding eleven months amounted to $85,582.35. The earnings for February, 1903, were $14,221.84; 1902, $9,224.44; increase, $4,997.40. The financial report showed a surplus net earnings to March 1, 1904, of $97,111.23. At present 3634 hp is being developed at the Volta power station, and an additional 4000 hp installation is almost ready for operation at the Kilarc station on Cow Creek. With a few weeks of dry weather this plant will be ready to transmit current over the new line which connects with the main transmission line at Delamar. An additional 3-phase line will extend down Pitt River to Kennet. Redding, Red Bluff, Tehama and a number of other towns in a territory extending over three counties are supplied with light and power from this system. The annual report mentions a rather high figure as an estimate of the amount of power which might be obtained by developing the company's water rights on Pitt River.

SAN FRANCISCO, CAL.—The details of the contracts recently awarded by the San Francisco Gas & Electric Company for the increase of plant at Station "A" include one General Electric 11,000-volt, three-phase rotating-field engine-type generator, a Union Iron Works vertical engine and five Babcock & Wilcox boilers. The generator will be direct connected to the triple expansion engine. Two of the engines from Station "B" will be moved to Station "A," formerly the Independent Electric Light & Power Company's plant. This will become the principal generating station for the city and will have a capacity of 15,000 kw or more. The present plans contemplate an increase of 10,500 kw there. The changes will enable the company to dispense with steam engines at the old stations. The contract for the new boilers was placed through Charles C. Moore & Co., who will also move six Heine boilers from another station and remodel the boiler plant. All of the boilers in the station will be equipped with B. & W. marine oil furnaces and the Charles C. Moore & Co. oil fuel system will be installed. Two special Goubert oil heaters will be used. The five new B. & W. boilers will have forged steel drums and superheaters. The auxiliaries will also be supplied through Chas. C. Moore Co. Steam-driven pumps will be used throughout instead of extending the electric motor system for condensing apparatus, etc. Two compound duplex Snow feed pumps each having a capacity to feed a 16,000-hp boiler plant will be installed.

WASHINGTON, D. C.—A bill has passed the Senate, and is now in the hands of the District of Columbia Committee in the House, providing for the regulation of electric wiring in the District of Columbia.

WASHINGTON, D. C.—Bids will be received April 19 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing 176 electrical equipments for ammunition hoists, etc., for the U. S. Navy. Address H. T. B. Harris, Paymaster-Gen., U. S. N.

JOLIET, ILL.—Harlow A. Griswold and Attorney G. A. Munroe, of Chicago, are interested in the construction of a power plant about 10 miles below Joliet. About $1,000,000 will be expended.

CICERO, IND.—John Plain, of Cicero, has secured a franchise for an electric light plant.

JASPER, IND.—The town of Jasper is negotiating with the electric light company for the purchase of its plant here. An appraisement has been made and a sale is quite probable. New machinery and other electrical apparatus will be added to the plant in case of sale.

VINCENNES, IND.—The Vincennes Light & Power Company, incorporated under the laws of Michigan, has been admitted to Indiana. The company will invest $200,000 in this city in the purchase and taking over the property of the Citizens' Gas Light Company and Vincennes Electric Light & Power Company and will hereafter operate the same. Edward M. Deane, D. W. Smith, H. T. Heald and E. M. Deane, all of Grand Rapids, are the stockholders.

OGDEN, IA.—The Northwestern Equipment Co., of Minneapolis, Minn., has secured the contract for constructing an electric light plant for $9000.

LOWELL, KAN.—The Spring River Power Co., of Lowell, has been incorporated, with a capital of $450,000, by Sam'l Brown, of Chicago; T. F. Garver, J. B. Larimer and others, of Topeka, to furnish electric power.

LOUISVILLE, KY.—An ordinance is before the city council requiring that all electric wires in the city be placed underground. A similar bill was presented a few weeks ago but it was withdrawn on account of some imperfections.

PRESQUE ISLE, ME.—The electric lighting and heating station owned by the Presque Isle Electric Light Company was destroyed by fire March 25.

PORTLAND, ME.—Electric wires on Congress street in this city are to be placed underground.

BALTIMORE, MD.—A bill has been reported to the Legislature at Annapolis requiring that all electrical contractors and workers shall be licensed, and providing for a Board of Managers.

ANNAPOLIS, MD.—A bill has been introduced in the Legislature providing that no telephone company shall engage in the electric lighting business in the City of Baltimore. The bill is said to be aimed at the Maryland Telephone Company, which recently applied for a franchise to conduct electric lighting in that city.

CAMBRIDGE, MASS.—The Massachusetts Board of Gas and Electric Light Commissioners has authorized the Cambridge Electric Light Company to issue $100,000 additional capital stock to pay for extensions to the plant.

BOSTON, MASS.—At the annual meeting of the Electric Lighting Engineers of New England, held at the Parker House on March 16, the following officers were elected for the ensuing year: President, J. W. Cowles, Boston; vice-president, F. S. Richardson, No. Adams; secretary and treasurer, C. R. Brown, Boston; directors, W. H. Coughlin, Worcester; F. C. Smith, Somerville; W. C. Woodward, Providence; W. E. Holmes, Newton; S. F. Smith, Salem; E. H. Mather, Portland.

GRAND RAPIDS, MICH.—The entire municipal lighting system in this city was put out of service a few days ago by the high water in the river extinguishing the fires in the boilers at the plant. The city was in darkness for the time being.

ST. LOUIS, MO.—A contract has been let for the erection of a power house between the observation wheel and the ice plant, just west of the power plant of Machinery Hall, at the World's Fair. This plant will supply the power for the wheel and the ice plant. The wheel will be illuminated by 6000 electric lamps. P. D. C. Ball, who is also installing the ice plant, is erecting the power house.

RENO, NEV.—The Reno Power, Light & Water Company is incorporated, with a capital of $1,000,000, by P. L. Flannigan and W. H. Patterson, both of Reno, and others.

DELHI, N. Y.—The question of issuing $20,000 bonds for a municipal lighting plant is under consideration here.

ROCHESTER, N. Y.—It is reported that the Clark syndicate, which controls the Rochester Railway Company, is negotiating for the purchase of the Rochester Gas & Electric Company. The railway company, it is stated, has not sufficient electric power. It now obtains 1000-hp. from the electric company. The latter concern owns extensive water rights, many of which have not been developed and which could be utilized for the generation of a large amount of power.

HILLBURN, N. Y.—A new plant is being built for the Rockland Electric Company at Hillburn, N. Y., to use the new high-powered Westinghouse gas engines with producer gas, using the Loomis-Pettibone system. This producer plant is located in a separate building, and supplies gas to the Ramapo Iron Works and the Ramapo Foundry Company for heating and metallurgical purposes, as well as power gas to the generating station. The electrical system will supply current to local industries, as well as light the Ramapo Valley some 14 miles in extent. The equipment aggregates 1200-hp power, employing 350 single crank engines of the double acting type, and a small vertical single acting engine for the exciter. Each main engine is direct connected to Westinghouse polyphase generators, arranged for parallel operation.

NEW YORK, N. Y.—The following are among the recent additions to the membership of the National Electric Light Association: Active: Colorado, Boulder, The Boulder Electric Light and Power Company; Michigan, Cheboygan, Cheboygan Electric Light and Power Company; Minnesota, Montevideo, Montevideo Electric Light and Power Company; Mississippi, Indianola, Indianola Light, Ice and Coal Company; Missouri, St. Joseph, St. Joseph Railway, Light, Heat and Power Company; Ohio, Bellevue, The Bellevue Light and Power Company; Ohio, Massillon, Massillon Light, Heat and Power Company; South Carolina, Darlington, Darlington Light and Water Company; Texas, Beaumont, Beaumont Ice, Light and Refrigerator Company. Associate: New York City, J. J. Kennedy, Consulting Engineer; New York City, The Cassier Magazine Company; Philadelphia, Pa., James H. Dawes, Supt. of Construction Nat'l Gas and Construction Company.

JONESBORO, N. C.—A. F. Spencer, of Sanford, N. C., has been granted a franchise to supply light, heat and power in this place. He has also secured the contract to light the streets with arc and incandescent lights for five years.

DAYTON, OHIO.—Mayor Snyder has vetoed the ordinance granting a franchise to the Dayton Electric Light Company. The reasons for the Mayor's actions are, it is stated, that the company has not kept its contract with the city as to prices for commercial lighting and power; that the ordinance does not impose underground wire conditions, besides other reasons.

EL PASO, TEX.—The Southern Pacific Company will install an electric power plant here for the operation of the machinery of its railroad shops.

BRYAN, TEX.—The city council of Bryan has granted a franchise to H. B. Dorsey, of this place, for the erection and operation of an electric light and power plant here.

SOUR LAKE, TEX.—Two applications for franchises to establish an electric light plant and a water works system at Sour Lake are pending before the city council. One application is by Messrs. Sloan, Maxwell and McVeigh, of Sour Lake, and the other by Mrs. C. W. Allen, of Houston.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Standard Power Company, with a capital stock of $1,000,000, have been filed with the Secretary of State. The purpose of the company is to establish a power plant at a cost estimated at $500,000 on the Sevier River in the southern portion of the State. It will have a capacity of about 5000 horse-power, and work on the project will be commenced early during the present season.

WAUWATOSA, WIS.—The action of the city administration last fall in giving away electric street railway and lighting franchises, in opposition to a petition of voters asking for a referendum vote, was the cause of an earnestly fought contest at the recent municipal election resulting in victory for the independent citizens. A proposition for a twenty-year franchise for city lighting by a Milwaukee company was defeated by a large majority.

The Electric Railway.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company has voted to issue $10,000,000 bonds for refunding and for improving the system.

WILMINGTON, DEL.—The Wilmington New Castle & Southern Railway Company has been organized with the following officers: Henry L. Evans, president; Willard Saulsbury, vice-president; Chauncey P. Holcomb, secretary; Francis R. Morrison, treasurer; Henry L. Evans, Harry A. Richadson, Peter J. Ford, Willard Saulsbury, T. Bayard Heisel, Harry J. Stoeckle and Francis Kelley, directors. The capital stock of the company is $300,000. The new company is the result of a merger of the Wilmington & New Castle and the New Castle & Delaware City companies. The officers of the new company were authorized to issue $650.000 bonds, of which $300,000 are to be used in taking up bonds to the same value of the constituent companies, and the proceeds of the remainder are to be utilized for improvements and extensions.

ATLANTA, GA.—A charter for the Piedmont Electric Railway Company to extend from Atlanta to Roswell, Alpharetta and Cumming, Ga., has been granted to E. S. Brazelton, of Birmingham, Ala.; Charles Kingsbery, E. C. Atkins, T. J. Hightower, C. W. Hunnicutt, John T. Stocks, H. L. Hunter, B. F. Curtis, Charles R. Maddox, R. E. Bondurant, J. A. Tiler and John Burnett, of Atlanta.

CHICAGO, ILL.—The stockholders of the Lake Street Elevated Railroad have voted to change the name to the Chicago & Oak Park Elevated Railroad Company.

JOLIET, ILL.—The Joliet, Newark & Southwestern Railroad Company, of Newark, has been incorporated, with a capital stock of $10,000. The incorporators are: H. K. Thunemann, O. L. Miller, A. M. Sweetland and others.

CHICAGO, ILL.—The South Side Elevated Railroad Company stockholders voted unanimously to increase the capital stock of that company by $7,226,700 to a total issue of $17,550,500, at a special meeting on April 7. The proceeds of this new issue will be used to defray the cost of the proposed extensions to Englewood and to the Stock Yards, and for the construction of a third track for express service between 12th Street and 43d Street.

BLOOMINGTON, ILL.—The Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway, incorporated recently, with a capital stock of $50,000, is to be organized here on April 12. The plan of the company is to build an electric railway from Bloomington to Lincoln and thence to Springfield, and from Peoria to Lincoln, with a cross line from Morton to Pekin. F. H. Funk and F. W. Aldrich, of Bloomington, are among those interested.

. CRAWFORDSVILLE, IND.—It is stated that the Consolidated Traction Company will erect a power house at once. Edward Hawkins, Indianapolis, is president.

NEW ALBANY, IND.—The directors of the Highland (Electric) Railroad have ordered that this road, which ceased operations three months ago, be offered for sale at auction.

BEDFORD, IND.—The Bedford Street & Interurban Railway Company has organized as follows: V. V. Williams, president; W. N. Mathews, vice-president; E. B. Thornton, treasurer; W. R. Martin, secretary.

EVANSVILLE, IND.—A. L. Rich, of Cincinnati, and H. W. Richardson and J. E. Bohanon, of Louisville, who recently purchased the Henderson (Ky.) City Railway system for $250.000, announce that they will at once extend the road a distance of 12 miles to Evansville, and establish an interurban system between the two cities. The Evansville & Henderson Traction Company, capitalized at $10,000, has filed articles of incorporation. The directors are: H. E. Randall, C. C. Tennis, J. W. Prietiard and C. H. Baltin.

TERRE HAUTE, IND.—Contracts will soon be let for the construction of the new power house of the Terre Haute Electric Company. Contracts for the machinery for the plant were let early in the year. The General Electric Company will furnish all of the electrical machinery. The boilers will be furnished by the Aultman & Taylor Company.

INDIANAPOLIS, IND.—The Union City, Winchester & Muncie Traction Company has filed articles of incorporation. The company is capitalized at $10,000, but reserves the privilege to increase the capital to $2,000,000. The company proposes to build a line from Union City to Muncie. Dr. J. E. Lowes, J. E. Feight, Theodore Shockney and W. B. Gebhart are the incorporators.

LEBANON, IND.—At the annual meeting of the stockholders of the Indianapolis & Northwestern Traction Company the following officers were elected: George Townsend, president; Philip L. Saltonstall, vice-president; Chauncey Eldridge, treasurer; Winthrop Smith, secretary; George Townsend, W. S. Reed, S. R. Anthony, Thos. Pettigrew, Philip Saltonstall, Chauncey Eldridge and Winthrop Smith, directors.

IOWA CITY, IA.—The city council has voted a franchise to the Iowa City, Davenport & Muscatine Electric Railroad. A special election will be held at an early date for the purpose of ratifying this action of the council.

COLUMBIA, KY.—W. K. Azbill, of Columbia, says the plan to build an electric railway between Columbia and Lebanon, a distance of 46 miles, is in the primary stages.

SPRINGFIELD, MASS.—The Springfield & Eastern Railway Company, operating in and about Palmer, has decided to apply for a grant of location from Ludlow into Springfield.

NEWBURYPORT, MASS.—The Citizens' Electric Street Railway Company lost about $60,000 March 28, by the burning of its car houses on Merrimac Street and some twenty-eight cars and plows. Seven cars were in use on the street, and these are all that were saved.

FITCHBURG, MASS.—The directors of the North Leominster, Shirley & Ayer Street Railway have voted to begin at once the construction of a line from North Leominster to Ayer. W. W. Sargent, superintendent of the Fitchburg & Leominster Street Railway, is to have general charge of the new line, which makes connection at North Leominster with the Fitchburg & Leominster. It is the intention to build on to Lowell eventually.

NEGAUNEE, MICH.—Among the improvements contemplated by the Negaunee & Ishpeming Street Railway & Electric Co. is the enlargement of the electric light plant, for which plans are now being prepared. An order will soon be placed for the new machinery. The capacity will be increased from 5000 to 10,000 incandescent lights. H. F. Pearce, Negaunee, is manager.

ST. LOUIS, MO.—Mayor H. L. Ponder, of Walnut Ridge, Ark., and S. C. Dowell, president of the Lawrence County bank of that city, were in St. Louis recently to complete arrangements for the organization of the Hoxie and Walnut Ridge Electric Light, Power and Transit Company, a venture in which some prominent St. Louisans are interested. The company is capitalized at $65,000, and its primary purpose is the installation of an electric railway between Hoxie and Walnut Ridge. These towns are connected now by a mule car line.

LINCOLN, NEB.—The property of the Lincoln Traction Company will be resold, Judge Holmes having decided that the company's bid of $1,025,000 for its own property did not comply with the terms.

RENO, NEV.—The franchise and property of the Reno Traction Company has changed hands by purchase, and S. C. Griffith, president of the company, announced that work on the prospective road will be commenced at once.

ROCHESTER, N. Y.—The Rochester, Scottsville & Caledonia Railway Company has been organized.

WELLSVILLE, N. Y.—Interest has again been revived in the proposed electric railway from Wellsville to Bolivar. Oak Duke, of Wellsville, is interested.

AMITYVILLE, N. Y.—The Huntington & Amityville Traction Company has accepted the franchise granted it here, and posted a bond of $7500 to insure compliance with the terms of the grant.

ADDISON, N. Y.—Attorney Seibert, of Coudersport, is interested in the proposed electric railway from Addison to Olean, connecting at the latter place with the proposed line to Bolivar. The distance from Addison to Olean by this route is about 72 miles.

CINCINNATI, OHIO.—The statement is made here that the Westinghouse Company is negotiating for the equipment of the Cincinnati, Dayton & Toledo Traction Company with single-phase motors.

CLEVELAND, OHIO.—On April 2 more than 100 of the motormen and conductors of the Cleveland & Southwestern Traction Company went on strike because of the refusal of the company to remove General Manager Nicholls, who is charged by the men with making rules unfair to them.

TOLEDO, OHIO.—The Toledo Railways & Light Company is building an addition to the boiler house at its main power station, and has placed a contract with the Ricard Boiler Company, of Toledo, for four 650 hp water-tube boilers, to be equipped with stokers.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green and Napoleon Railway Company has filed a mortgage for $1,000,000 to the Union Trust Company, of Detroit. The money will be used in extending the road eastward to Port Clinton and westward to Napoleon. Work on the extensions is to start at once.

PITTSBURG, PA.—The McKeesport & Clairton Connecting Railway Company has accepted the ordinance granting the company a right of way in McKeesport.

HARRISBURG, PA.—The State Department has issued a charter to the Allen Street Railway Company, capital $30,000, to build a 5-mile line between Nazareth and Bath, Pa. The directors are: Thomas D. Danner, of Easton, president; Peter Raub, J. R. Ballentine, H. G. Seip, Edward McCaffrey, C. F. Seip, all of Easton.

HARRISBURG, PA.—A charter has been issued by the State Department to the Grove City Street Railway Company, capital $18,000, to build a 3-mile line in Grove City. The officers are: Edward Austin, president; R. N. Washabaugh, Arthur H. Springer, Samuel G. Bailey, J. H. Mehring, A. B. Stone, Vernon Hazard, directors.

BRISTOL, VA.—Plans are being discussed for building an electric railway from Cleveland, Va., to Lebanon, and thence through Washington County to Bristol.

RICHMOND, VA.—The street railway company here has announced that after April 15 it will enforce the law which permits conductors to separate white and negro passengers. Any persons failing or refusing to observe the orders of the conductor will be liable to a fine of $25, and may also be ejected from the car for such refusal.

NORFOLK, VA.—The Norfolk, Portsmouth & Newport News Company in which has been merged the Norfolk Railway & Light Company, the Berkley Street Railway Company and other like concerns, it is stated, is about to be dissolved. It is reported that the dissolution is due to the fact that after a trial the combined railways did not find the arrangement profitable and all concerned felt that by the individual operation of the roads larger dividends could be paid to the stockholders.

WELLSBURG, W. VA.—H. G. Lazear, of Wellsburg, has been granted a franchise for the construction of an electric railway from Wellsburg to Bethany.

WATERTOWN, WIS.—The City Council has passed the franchise giving the Oconomowoc & Watertown Heat, Light & Power Company permission to build an interurban electric railway through the city.

PORT ARTHUR, ONT.—The Electric Railway & Light Commissioners have recommended the installation of a storage battery plant in the power house.

SARNIA, ONT.—The St. Clair Tunnel Company has had engineers on the ground making estimates on the cost of installing a system of electric power for operating the trains through the tunnel.

NEW INDUSTRIAL COMPANIES.

THE AUTOMATIC SCENIC PHONOGRAPH COMPANY has been incorporated in New York with a capital stock of $5000. The directors are: C. C. Reinhardt, Christopher Peel and C. T. Willard.

THE CENTURY ELECTRIC CORPORATION, of San Francisco, Cal., has been formed by F. M. Greenwood, C. M. Wood, E. F. Weihe, L. D. Hitzeroth and H. S. Tittle, with a capital stock of $250,000.

THE TALMONT ELECTRIC ENGINEERING COMPANY has been incorporated in New York with a capital stock of $5000. The directors are: Adolph Talmont, G. D. Roedelsperger and M. J. Hornthal.

THE McCLEARY ELECTRIC COMPANY has been incorporated at Detroit, Mich., with a capital stock of $10,000, of which $6500 has been paid by a transfer of the McCleary & Colquitt Company's stock and fixtures.

THE ELECTRIC SUPPLY AND MAINTENANCE COMPANY, of Troy, N. Y., has elected officers as follows: President, A. V. Phillips; vice-president, A. S. Crable; secretary, Henry Schneider; treasurer, H. G. Hammett.

THE BISON MOTOR COMPANY, of Buffalo, N. Y., has been incorporated to manufacture motors, engines, etc., the capital stock being $25,000. The incorporators are: F. I. Alliger, Tonawanda; F. Wende, Wm. A. Lutz, Buffalo.

THE RANDALL MOTOR CAR COMPANY, of Ft. Wayne, Ind., has incorporated capitalized at $10,000. The company's manufacturing plant and principal office will be in Ft. Wayne. F. P. Randall, A. L. Randall and Louis Olmhaus are directors.

THE HEAT, LIGHT AND POWER IMPROVEMENT COMPANY OF AMERICA has been incorporated in New York City with a capital stock of $600,000. The incorporators are James P. Bowery, Andrew Ritchie and Charles Eldridge, of New York City.

THE SOLOMON RIVER DITCH COMPANY has been organized at Portland, Me., for the purpose of conducting a general electrical power, light and heat business. The capital stock is $1,000,000, of which nothing has been paid in. George F. Gould, of Portland, has been elected president.

LEGAL.

INDEPENDENT TELEPHONES IN CINCINNATI.—Judge Nipper in the Probate Court at Cincinnati, has decided that independent telephone companies have the right to use the streets of Cincinnati. This right, he stated, was granted by the statutes of Ohio, and all the court was required to do was to decide the manner in which the streets shall be so occupied. The companies concerned are the Cincinnati Telephone Company, the Queen City Telephone Company, the Fitzsimmons Company and the Interstate Company.

TELEPHONE POLES IN HIGHWAY.—The New York Supreme Court, Appellate Division, Third Department in the case of Gray et al, versus York State Telephone Company, has held that (1) The erection of telephone poles in a rural public highway is an added burden to the owners of the adjoining land, who own the fee in the highway, the right to impose which must be obtained either by consent of the owners or by condemnation proceedings. (2) The owners of the fee of a highway may prevent the erection of telephone lines thereon for permanent use by injunction.

ST. LOUIS ELECTRIC LIGHT CONSOLIDATION.—Morgan Jones, of Denver, Col., has brought suit in the United States Circuit Court to set aside the consolidation of the Missouri Electric Light & Power Company, the Union Electric Light & Power Company and the Citizens' Electric Light & Power Company, of St. Louis. These companies are constituents of the North American Company, of New York. Mr. Jones alleges that the merger was effected by fraud and asks for an injunction to restrain the officers of the consolidated companies from a further use of funds and for the appointment of a receiver to take charge of the Missouri-Edison Company's property.

HOUSE MOVING AND TELEPHONE LINES.—The Supreme Court of North Dakota has decided an interesting and novel case, on appeal, as follows: 1. A person licensed to move houses in the city of Grand Forks is legally liable for damages done by him while moving a house, such damage being done to the wires and property of a telephone company, duly authorized by ordinance to establish a telephone system in said city and maintained therein. 2. By the passage of such ordinance, which gave the city benefits, and its acceptance by the company, and its expenditures thereunder, a contractual relation was created between the company and the city, which became a vested right that could not be impaired by subsequent action of the city directly or indirectly annulling it for purposes not public, and for purposes of a personal or private nature. 3. The use of a street for moving houses is an extraordinary use thereof. Such use may be permitted, but not so as to destroy the use of the street for travel or necessary public purposes, and cannot be legally done in destruction or impairment of vested rights. The building moved was 7 feet higher than the highest telephone circuit in question.

FORFEITURE OF TELEPHONE GUARANTEE.—In the Supreme Court of Michigan in the suit of the City of Detroit vs. the People's Telephone Co., of Detroit, the decision of the lower court forfeiting $1529 with interest was affirmed last March on the ground that where a telephone company pursuant to its franchise had deposited with a city a sum of money as guarantee that its system should be in operation within a certain time, to be forfeited in case of failure, the entire sum was forfeiture by failure and not merely such portion as would compensate the city for the damages suffered. Upon the trial the evidence showed that the company had commenced the construction of the plant within the required time, and had procured 3500 bona fide subscribers, as required. But the evidence of the defendant also showed that it had not operated the system put in by it, with the exception of some 30 telephones placed in an interior exchange at the Parke, Davis & Co. plant, and also that they were not in position at the time of the trial to supply any more patrons with telephones. The contention of the defendant was that for any breach of the conditions imposed by section 10 the city was only entitled to such compensation and damages as it could be shown that it suffered by reason of the default of the telephone company, and that, as no such damages were shown, the defendant was entitled to offset the $5000 and interest, and recover the balance above plaintiff's claim. The circuit judge held otherwise, and directed a verdict for the plaintiff for the full amount claimed.

OBITUARY.

MARTIN D. WOOD, who was for 35 years local manager of the Western Union Telegraph Company at Kansas City, Mo., died there April 6, aged 60 years. He was a veteran of the civil war.

MR. THEODORE E. THEBERATH, who was formerly engineer for the San Francisco District agency of the Stanley Electric Mfg. Company, died at his home in San Francisco, March 29, after a brief illness. He was a native of New Jersey and 40 years of age. Mr. Theberath of late years was in the employ of the California Gas & Electric Corporation, his last work being as superintendent of the construction of the DeSabla water power electric plant. The funeral took place on April 1. His wife survives him.

MR. R. WELLS.—A special telegram from Glens Falls, N. Y., of April 9, says: Raymond Wells, a civil engineer in the employ of the Hudson River Water Power Company, received a shock from an electric wire carrying 30,000 volts at the Spier Falls power house of the company late yesterday, and was so badly injured that he died from the effects at midnight. He was on the roof of the power house making some measurements, and accidentally touched with a steel rod he was carrying a wire heavily charged with electricity.

MR. J. L. WEEKS, general manager of the American Steam Gauge and Valve Co., Boston, Mass., died in that city on April 2 after an operation for appendicitis the day previous. Mr. Weeks was well known in the electrical and steam engineering fields throughout the country, and it was principally due to his energetic and persistent efforts that the business of the company he managed was brought to the prominent place it occupies amongst steam specialty manufacturers. The remains were taken to Chicago for burial. Mr. Weeks was only 37 years of age.

MR. CHARLES WATSON.—We regret to note the death of Mr. Charles Watson, a gas pioneer, more lately identified also with electric lighting, etc. He died at Camden, N. J., March 30, aged 73. He was born at Portland, Me. He was one of the organizers of the Camden Gas Light Company in 1854, and served as its secretary and treasurer for over 25 years. He resigned from its service when the company was absorbed by the South Jersey Gas, Electric and Traction Company. At the time of his death he was a director in the Public Service Corporation of New Jersey, and was actively connected with many other important financial and commercial enterprises of South New Jersey. Among the pallbearers were John J. Burleigh and Judge Armstrong, of the National Electric Light Association.

MR. J. W. HINKLEY.—Mr. James W. Hinkley, president of the United States Casualty Company of New York, and for a number of years prominent in Democratic State politics, died suddenly on April 11 at Poughkeepsie, N. Y. Mr. Hinkley had not been in good health for a year. He was born in 1850 at Port Jackson, Clinton County, N. Y., and was educated at the Smith and Converse Academy and at the West Point Military Academy. He went to Poughkeepsie and became owner of *The News Press*. Later he purchased and assumed editorial control of *The New York Daily Graphic*, which brought him in contact with prominent men of each of the political parties, but particularly with the leaders of the Democratic party in this State. Mr. Hinkley was very successful in business and quite active in electrical affairs. He was president of the Poughkeepsie City and Wappingers Falls Electrical Railway Company, president of the Walker Electric Company, of Cleveland, Ohio; a director of the Poughkeepsie Trust Company, and of several New York banks. Mr. Hinkley is survived by his wife and eleven children, one of whom is Capt. J. W. Hinkley, Jr., stationed at Fort Washington, Md.

PERSONAL.

MR. DWIGHT C. CLOUGH has been appointed city electrician of Long Beach, Cal.

MR. C. C. CRAFTS, of the New York export department of the Westinghouse Electric interests, has returned from a four weeks' trip to Mexico.

MR. F. D. PHILLIPS, formerly with the Electric Appliance Company, is now identified with the Crescent Company, of Chicago, of which he has recently been elected vice-president.

MR. F. A. PICKERNELL, chief engineer of the American Telephone & Telegraph Company, has been in the West on a tour of inspection. He was in Salt Lake City at last reports.

MR. W. MURRAY CRANE, ex-Governor of Massachusetts, and largely interested in the Bell telephone system, and Clarence H. Mackay, president of the Commercial Cable Company, have been elected directors of the Manhattan Trust Company.

MR. W. J. HAMMER.—The handbook on radium by Mr. W. J. Hammer is one of the "Best Fifty" books voted as desirable this year for a village library, in connection with the list submitted to librarians of New York by the New York State Library.

MR. CHARLES MAUTNER, well known in electrical circles in and around New York, has assumed the general management of the newly organized Switchboard Company, of New York, which will manufacture a full line of switches, switchboards and panel boards.

CLARK & MACMULLEN, INC., electrical and consulting electrical engineers, have moved their Pittsburg office to the Farmers' Bank Building, that city.

MR. W. S. ACCLES, European representative of the Miles-Bement-Pond Company, is now on a short visit to this side.

MR. EDMUND ALO, the Swiss hydraulic engineer expert who was recently commissioned by the New Zealand government to ascertain the possibilities of local rivers for generating electric current, is to take up his abode permanently in the Antipodes, as consulting engineer in electricity and hydraulics.

MR. W. F. WARDEN, president and general manager of the Burt Manufacturing Company, sailed for Europe in the Celtic April 15, where he will visit agents of his company in England, France, Germany, Belgium, Norway, Sweden, Denmark, Russia, and, if time permits, in Switzerland, Greece and Spain.

MANAGER WICKHAM, of the Hongkong (China) Electric Company, is at present in the United States. He will visit some of the principal power stations and electric manufacturing plants in the East and Middle West. He is now in Pittsburg, but will be in New York early next week at the Hoffman House.

MR. LE ROY W. STANTON, the well-known electrical engineer, of Cleveland, Ohio, will read a paper on "Modern Telephone Engineering" before the International Electrical Congress, which will be held at St. Louis next September. He has just opened a branch office in Chicago, in the Monadnock Building, in charge of Mr. Byron B. Carter.

MR. ROBERT L. WARNER has been relieved of the detail duties of the management in connection with the Boston office of the Westinghouse Electric and Mfg. Co., and appointed New England manager. He will have general charge for that section, and Mr. D. E. Manson will assist him, with the position of manager of the Boston office.

MR. RALPH G. ARNOLD, treasurer of the Arnold Electric Power Station Company, was married recently at Brooklyn, N. Y., to Miss Hazel McLain. The wedding was at the house of the bride, those present being members of the immediate families. After a short trip in the East, Mr. Arnold and his bride will take up their residence in Chicago.

PROF. A. G. BELL has decided to give a public exhibition of his famous tetrahedron kite, until now seen by no one but the men who helped him to construct it and to fly it at Cape Breton Island over a year ago. The exhibition is to be given before the National Geographical Society at an open-air meeting and exposition, to be held on Saturday, April 30, at Washington.

MR. JOHN D. HIBBARD and Mr. Paul Flatchford have been re-elected as president and secretary respectively of the Chicago Metal Trades Association. This association of employers has done much to improve a very troublesome labor field, and these two men have won the respect and esteem of the labor union officers while bringing about more harmonious relations with their employees.

MR. CHARLES F. FOSTER has been appointed chief operating engineer of the power plant of the Louisiana Purchase Exposition. Mr. Foster was the chief mechanical engineer at the World's Columbian Exposition in 1893. He is vice-president of the National Supply Company and a member of the American Society of Mechanical Engineers, the St. Louis Engineers' Club and the Western Society of Engineers.

MR. E. R. CARICHOFF, formerly chief engineer of the Otis Elevator Company, and now with the International Steam Pump Company, is installing for that company a very complete lighting and power distribution plant at the Harrison Works. The generating plant is of 1000-kw. capacity, with space reserved for future enlargement. All tools will be driven by electric power, many having individual motors.

MR. J. D. ROCKEFELLER has made a contract with the Cleveland and Southwestern Traction Company for delivering by freight trolley to his summer home at Forest Hill, near Cleveland, a large amount of fine washed gravel for making roadways and walks in his private park. He bought a gravel bank at Wellington, 45 miles from Cleveland, and the material will be screened and washed and delivered to Forest Hill in bags at night.

MISS SARAH FARMER, daughter of the late Prof. Moses G. Farmer, has just sustained a severe and irreparable loss in the destruction by fire of the old homestead at Greenacre, on the Piscataqua River, near Eliot, Me. The house was full of relics of the family and of her father's electrical inventions and studies, and these of course can never be replaced. The American Institute of Electrical Engineers had a meeting there in the summer of 1897, and enjoyed generous hospitality at Miss Farmer's hands.

THE GENERAL ELECTRIC ENGINEERING SOCIETY, of Lynn, Mass., recently held its annual election of officers with the following result: President, C. M. Green; vice-president, A. E. Hayes; secretary, G. E. Sanford; treasurer, F. D. Bartlett, executive committee, E. E. Boyer; technical committee, R. Fleming, chairman, G. H. Pickney and J. M. Davis; membership committee, H. J. Arnold, chairman, C. A. Stanley, J. Walsh, R. W. Douglas and E. M. E. Humphries. On April 22 Mr. D. B. Rushmore will speak on "Alternator Design."

MR. G. MARCONI.—A dispatch from Rome, Italy, says: People who think of Marconi only as the inventor of the wireless telegraph do not know the scope of his talents. He has a fine tenor voice and has been chosen by the Abbe Perosi, the leader of the Sistine chapel-masters, to sing one of the principal parts in his new oratorio, "The Universal Judgment." The Pope recently had an interview with this future interpreter of his favorite contemporary musical authority. Marconi offered even to sing for him, but his Holiness said he did not wish to take advantage of the latter's willingness to oblige. He asked Marconi in what church he would sing, and when the latter replied that he would not sing in a church, but at the Costanza, the Pope sighed a little, as if he found the bounds of the Vatican very narrow.

SIR OLIVER LODGE has ideas in religion as well as in electricity. A controversy over the Sacred Scriptures has arisen recently in England, in which he takes a hand, advocating a reinterpretation of Christian doctrine. He regards the "doctrine of atonement in its concrete form as a survival from barbarous times," repudiating the belief in "an angry God, appeased by the violent death of Christ," and maintaining that human nature now is "rising to the conviction that we are part of nature and so part of God. In this sense the union of divinity is what science some day will tell us is the inner meaning of the redemption of man."

MR. ARTHUR WILLIAMS, general inspector of the New York Edison Company, receives an extraordinary tribute at the hands of the *New York Commercial*, in its rather vigorous discussion of rates and charges. It says that it is almost worth being overcharged to gain the privilege and interview with this "highly gifted conversationalist" and adds: "What salary the company pays Mr. Williams is unknown; but whatever it be, it is not one-half of what he earns. To have such a perennial fount of the milk of human kindness, qualified with just a dash of blarney, welling forth in the complaint department of an electric light company, calming the perturbed spirit of its exasperated, not to say murderously-inclined patrons with honeyed gush is worth a deal of money to the corporation." It might be noted that Mr. Williams's topic was the Thomson wattmeter, whose merits the daily newspaper man was not quite ready to admit.

Trade Notes.

CHANGE OF ADDRESS.—The DeForest Wireless Telegraph Company has moved its headquarters from 100 Broadway to 42 Broadway, New York.

THE BUFFALO BOX FACTORY, Buffalo, N. Y., which was recently destroyed by fire, will be rebuilt and equipped with an electric power plant.

CARLETON-CHASE ELECTRIC CO., New York, has moved to 37 Warren Street, where all orders will be promptly filled and business carried on as usual in spite of the recent fire in its old quarters.

LARGE METER.—The Duncan Meter Company, of Lafayette, Ind., is making a meter for the new Chicago postoffice, which, it is said, will be the largest meter ever built. It will register 42,000 16-cp incandescent lights.

THE CRESCENT COMPANY, Chicago, has found it necessary to equip its factory with electric drive in order to take care of its constantly increasing orders for the Crescent soldering sticks and Crescent soldering paste.

THE MAXFIELD-FRANCKE CO., representing the Francke four-ported engine, has removed its offices to the Electrical Exchange Building, 136 Liberty street, New York City, where it will be glad to receive visitors and inquiries.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that its sales on Packard lamps during the winter just past have far exceeded all previous records. This, the company states, is no phenomenon, but merely a result of the maintained efficiency of the high-class Packard product.

NUERNBERG CARBONS.—We are advised that after careful and exhaustive tests, the Louisiana Purchase Exposition Company of St. Louis has given a contract to Mr. Hugo Reisinger, of Bowling Green Building, New York, for his "Electra Highest Grade Nuernberg" carbons for its entire requirements of carbons. This means that the World's Fair grounds and all the buildings, so far as the arc lighting is concerned, will be illuminated exclusively by these carbons.

REFLECTORS.—The National X-Ray Reflector Co., Chicago, manufactures a complete line of X-ray sterling silver plated glass reflectors for electric and gas lighting. In a neat catalogue just issued these goods are well illustrated, the variety of designs being the most conspicuous feature. These reflectors are corrugated spirally or radially, or both, which arrangement insures powerful reflection of the light. Mr. C. J. Purdy, 26 Cortlandt street, is the manager of the company's New York salesrooms.

THE V. R. LANSINGH COMPANY, of Chicago, is equipping the entire large booth of the Singer Manufacturing Company in the Manufacturer's Building at the St. Louis Exposition with Holophane globes. This company is also equipping the Singer Manufacturing Company's Sixth Street store in St. Louis with Holophane globes throughout. The jury room in the Electricity Building and the offices of Prof. Goldsborough, chief of the Department of Electricity, are to be equipped with Holophane globes and pagoda reflectors.

THE YALE & TOWNE MFG. CO. has made preparations to install a very extensive exhibit at the Louisiana Purchase Exposition, showing chain blocks, overhead carrier systems and labor-saving appliances in actual use, and demonstrating the vast economies represented by up-to-date hoisting and transferring methods as compared to old methods. The exhibit will contain some entirely new features in the way of improved hoisting equipment, and will be of especial benefit to engineers interested in economical handling and transferring of material.

STANLEY SYSTEM SYNOPSIS.—We have received from Mr. Ray D. Lillibridge, 170 Broadway, a copy of the "Synopsis of the S. K. C. System," which he has just issued for the Stanley Electric Manufacturing Company, of Pittsfield, Mass. This compendium, of about 48 pages, covers virtually all the products of this progressive concern, and contains the pith of a great many bulletins already issued, and gives all the facts and data in a more condensed form, but still illustrating profusely. In case the larger bulletins are desired, a numbered list of them is given.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, is receiving a large call for its new "never failing" self-restoring drop, not only for complete switchboards for new exchanges and re-equipping plants, but for extending boards of other makes. Its combination jack and self-restoring drop is arranged in strips of five and can readily be mounted on any other make of switchboard, and has the jack ferrule constructed to fit any size plug. The spring jack being designed so as not to depend on the ferrule for a connection, makes a positive and reliable plug contact at all times.

"MACHINE TOOLS" is the title of a very massive and handsome catalogue in quarto form just issued by the Niles-Bement Pond Company, of New York. It contains 713 pages, nearly every one of which is illustrated with a large well-made half-tone cut. The engravings are printed in black and the type matter is in brown ink. There are hundreds of cuts, of machine tools and parts, as well as several fine pictures of factories, medals, diplomas, etc. One section deals with electric traveling cranes which are fully illustrated and described. The cover is a brilliant red cloth and the end papers carry the repeated initials of the concern, as a device.

U. T. HUNGERFORD BRASS & COPPER CO.—The Waterbury Brass Co., No. 122 Centre Street, New York, has closed its New York store, and the entire stock has been purchased by U. T. Hungerford Brass & Copper Co., 497-505 Pearl Street, New York. This addition will, it is said, give the last-named company a larger and more varied stock (about two million pounds) of brass, copper, etc., in various forms, than was ever before under one roof. The increasing business of the Hungerford Company has rendered necessary the erection of another building adjoining its present commodious quarters, which will be ready for occupancy about April 15.

"IMPERIAL SOLDERENE" is a new and convenient preparation for soldering purposes, particularly in electrical work. It is a pure, high-grade solder, ground and mixed with special, quick-acting fluxes, and compressed into hexagonal stick form. It requires but a very low temperature in actual use, but when set a high temperature makes little or no effect. The heat applied first melts the "carrier," which requires about 180 degrees, and the carrier then becomes a conductor of heat and is volatilized as the comminuted solder fuses and adheres. Samples of work shown us are very satisfactory and complete. It is made up and put on the market at low price by W. Green & Co., Maiden Lane, New York City.

THE EUREKA ELECTRIC COMPANY, of Chicago and Genoa, Ill., is now running its factory overtime and reports a most successful spring outlook for business. Its factory has been extremely busy for the past 10 weeks, and orders are coming in very heavily on its new switchboard apparatus, which is securing a very high endorsement of all who have seen the same. The company will be pleased to send its latest 1904 bulletin and printed matter describing its well-known line of apparatus to any company desiring the same. The company has also issued a novel little folder, being a miniature facsimile of its model 99 telephone set in natural colors, showing its front appearance and the interior. It is circulating some 250,000 of these among the trade.

PLATINUM and its allied metals, which depend almost entirely upon the Ural Mountains for their crude supply, have already felt very decided results of the Russian-Japanese war, owing to heavy withdrawals of forces from this mountain district by the Russian government, the effect of which has naturally caused an advance in current rates. For some time, there has been an increasing demand for platinum and its alloys in the electrical and chemical fields, which is constantly being supplemented by the increasing use of gas engines, automobiles, and various new electrical appliances, having platinum contacts and attachments. This growing demand, with doubtless a long continuance of the present situation in Russia, would strongly point to a further advance in a very short time.

AN ECHO FROM THE BALTIMORE FIRE.—There is a boy in Baltimore who thinks that the recent fire was not such a bad thing after all. While snooping among the ruins, he came across what the fire had left of a small Crocker-Wheeler motor. He gathered up the castings and wrote to the manufacturers describing his find and closing thus: "Can I wind the armature so as to use it as a direct-current series-wound dynamo? If so, what size and how much wire must I use on the field magnet and armature? How many coils must I divide the armature into? . . . . Thanking you very much for the information you can give me," etc. Many a collector of souvenirs has carried useless things away from the scene of the fire, to be placed in curio-cabinets and on rural mantel shelves, but this young Franklin knows a trick worth two of that.

B. F. STURTEVANT Co.—Since the removal of the foundry and pattern departments from the B. F. Sturtevant Co's. plant at Jamaica Plain to its extensive new quarters at Hyde Park, Mass., the moving of the other departments has progressed in earnest. The fan, heater and electrical departments have already been moved, the engine and galvanized iron departments are in process of removal, and the erection of machines in the machine shop is well under way. These machines, as well as all the others throughout the works, will be of the most modern type and with the systems of cranes and industrial railways will enable the work to be turned out accurately, rapidly and at a minimum cost. The handsome office building is rounding into shape. The headquarters are still at Jamaica Plain, but in a few months the entire plant will be moved.

NATIONAL ELECTRIC COMPANY.—The National Electric Company, successors to the Christensen Engineering Company of Milwaukee, has recently completed and is now occupying a handsome new office building adjoining its shops. The company is about to adopt a plan of providing free dinner for its officers, employees in the executive and the engineering departments, and the heads of the various other departments. Two pleasant dining rooms, a butler's pantry and a kitchen have been fitted up in the new office building. One dining room will be for the officers of the company and its guests. The second will be for the employees of the offices and the engineering department. The new office building is 200 by 66½ feet, three stories in height, the outer walls being of large cement blocks which were manufactured at the plant. The building is absolutely fire proof. Six hundred men are now employed at the works.

BEEBE & BENNETT.—Messrs. Murray C. Beebe and Edward Bennett have, under the above firm name, established general engineering and contracting offices in the Farmers' Bank Building, Pittsburg, Pa. Mr. Beebe was until recently with the Nernst Lamp Company as chemist and technical superintendent, from which company Mr. Bennett has recently severed his connection as chief electrician. Associated with the firm are engineers having a wide experience in the design and construction of railway, light and power plants. The firm is prepared to act as consulting and supervising engineers for the construction of railway, light and power plants, or to contract for the complete erection of such installations. It will examine and report on the mechanical equipment and the methods and systems in use in factories, and submit complete lighting plans for large installations. Examinations and reports will be made of the value of apparatus, properties, or systems.

THE STANDARD UNDERGROUND CABLE COMPANY announces the recent opening of a branch office or headquarters in the Security Building, St. Louis, Mo., in charge of Mr. W. A. Caldwell, who was formerly connected with the Chicago office of the company, but more recently with the home office at Pittsburg. Mr. Caldwell had a number of years' experience with the company in both the construction and sales departments. This company has now seven district or branch offices throughout the country, covering it from Maine to California, namely: The northeastern sales department, Delta Building, Boston, Mass.; the eastern sales department, 56 Liberty Street, New York City, N. Y.; the southeastern sales department, Betz Building, Philadelphia, Pa.; the central sales department, Westinghouse Building, Pittsburg, Pa.; the western sales department, the Rookery Building, Chicago, Ill.; the southwestern sales department, Security Building, St. Louis, Mo.,

WESTINGHOUSE MOTORS.—The Westinghouse Electric & Manufacturing Company has just issued two circulars, Nos. 1077 and 1078, the former relating to type L motors, direct current series wound, and the latter to No. 91 single-phase railway motor and car equipment. The type L motor is widely used for hoisting and other intermittent service requiring large torque. It is well suited for work in mills, foundries and other manufacturing plants. Different applications of this motor are well illustrated, and the principal features of design and construction described. Various curves show the efficiencies, torque, speeds, etc., of different sizes of this type of motor. At the back is a list of the company's circulars in force March 1. The No. 97 single-phase railway motor is described and illustrated in a similar manner in circular 1078, and diagrams show the connections of the apparatus. This motor was described and illustrated in our issue of February 20, last. The advantages of this single-phase railway system are briefly pointed out. Copies of these circulars can be had on application.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, is continually adding to its list of Exide battery depots, the list now including twelve cities. These Exide stations instituted for the purpose of the prompt delivery and care of batteries have proven to be of great convenience to the public, and the rapidly increasing demand for batteries has necessitated the opening of new depots at central points. Each of these depots is under the care of an experienced storage battery man, and being stocked with a full line of battery material, users of electric vehicles, equipped with the Exide battery, have at convenient points the same facilities for attention, and procuring supply parts, as they would have if they were at the factory of the company. These stations are located in New York City, 8th Ave. & 49th St.; Philadelphia, 250 North Broad St.; Pittsburg, 5905 Centre Ave.; Buffalo, 200 Pearl St.; Chicago, 204 East Lake St.; Denver, 1510 Court Place; Boston, 39 Stanhope St.; St. Louis, 809 Walnut St.; Rochester, 150 South Ave.; Toledo, 715 Jefferson Ave; Detroit, 265 Jefferson Ave; Columbus, 4th & Gay Sts.

HAULING-IN CABLES.—The Knickerbocker Construction Company, 15 Cortlandt Street, New York, which makes a business primarily of the hauling of heavy electric cables into underground conduits, has acquired the right to use the Grinnell hauling machine, which is a marked improvement on previous devices for this purpose. The apparatus is such that it is easily loaded on cars, and the company is prepared to go anywhere in the United States where the work warrants. It has in its organization competent skilled men in all its branches capable of doing the particular kind of work they will be called upon to do. In addition to the hauling-in of a cable the company makes where necessary the splices in accordance with any specification. It also will lay the conduits, build the manholes, and in short, do the work of complete construction from the excavation and laying of the ducts including manholes and carrying out all details, including drainage to the sewers, gas proofing, etc. Mr. J. W. Cushing, secretary and treasurer of the company, is a Massachusetts Institute of Technology man, and Mr. Whieldon, vice-president and general manager, is a member of the American Institute of Electrical Engineers.

THE BRILLIANT ELECTRIC CO., Cleveland, Ohio, manufacturer of incandescent lamps, has started a novel idea by founding a correspondence course such as would enable anyone taking it thoroughly to operate with efficiency an electric light plant. The company does not propose to issue any text books, but the student is at liberty to buy anywhere for himself such as are recommended. The instruction will consist of reference to standard text books, and answers to personal difficulties as they arise with the individual student. The company says: "The student who obtains valuable information free can certainly not object to our using the backs of letters, etc., for advertising purposes; and it is our intention to give such information in our letters that they will be permanently kept for reference, thus preserving our advertising and bringing it continually to the notice of the engineer." As to the relation of this ingenious plan to its business, the company says: "Incandescent lamps are something that are unfortunately very easily juggled with, but as the buyers or users become more familiar with them, the less opportunity there is for misrepresentation. We base our claims for patronage wholly on the quality of our product; hence our desire to educate the buyer so that he can intelligently discriminate between the good and the poor." The course will be given, however, whether the student purchases Brilliant lamps or not.

THE STANDARD VITRIFIED CONDUIT COMPANY, of 39-41 Cortland Street, New York, completed recently its plant at South River, N. J. Owing to the great demand for conduit manufactured by this company, its plant has run continuously since beginning operations in 1902. In this time an enviable reputation has been gained by its promptness in delivery of a strictly high-grade material. Under patents of Mr. R. W. Lyle, this company is manufacturing multiple duct conduit. It also furnishes free to its customers, with the single duct, its own patented mandrel for laying single duct, which yields great economy in construction. Ample stock of both standard and special sizes together with fittings, kept on hand for delivery on short notice, enables this company to hold its independence in the trade. Forty million feet of conduit annually can be produced by its factories. Among the largest buyers of the Standard vitrified conduit are: The Bell Telephone Co., New York, Boston and Southern States; Rapid Transit Subway Const. Co., (New York tunnel); Manhattan Elevated, Met. St. Ry. Co., Consolidated Tel. & Elec. Subway Co., New York Edison Co., Brooklyn Edison Co., Brooklyn Rapid Transit Co., Boston Elevated Railway Co., The Philadelphia Edison Co., The Philadelphia Rapid Transit Co., New York Tunnel Co., Westinghouse, Church, Kerr & Co., United Engineering & Const. Co., Western Electric Co., Standard Underground Cable Co., Safety Insulated Wire & Cable Co., Pennsylvania Railroad Co., Baltimore & Ohio R. R. Co., New York Continental Jewell Filtration Co., Hudson River Water Power Co., Glens Falls, N. Y.; Niagara Falls Power Co. The Company's illustrated catalogue, which is a work of art, can be had on application.

CABLE PROTECTION WITH "NIAGRITE."—Electrical power houses carry their currents away from the buildings through conduits or tunnels, and rest the cables on arms or branches usually one branch or arm above another. The over-heating of the wire in the cable sometimes melts the insulating compound and brings two uncoated wires together. This creates a short circuit with the consequent burning and fusing of the wires. This sets fire to the insulation as well as to the outer coating or wrapping, which is usually of cotton braid. The fire is thus communicated to the next cable, which may have been intact, until this trouble set in. This cable is burned from the outside inward again releasing more energy and setting fire to innumerable cables. To prevent this condition, the H. W. Johns-Manville Co., New York, has devised an insulating covering for the cables, which fire-proof these cables so as to prevent, in case of short circuiting of one, the ignition of the others. It was first used by the Niagara Falls Power Co., hence its name "Niagrite." It is made in the following thicknesses-3-32", 1/8", 1/4", 3/8". It is supplied in strips 36" long and 3" wide, and with them is sent sufficient fire-proof glue in which to immerse and coat the strips ready for application. "Niagrite" is absolutely fire proof. The application is easy, and the expense very nominal compared with the amount of protection afforded. Mr. H. W. Buck, electrical engineer of the Niagara Falls Power Co., was the first man to use "Niagrite." He has given orders for about 50,000 lineal feet, and proposes to finish up the remainder of his plant, which will require about 450,000 feet more. The Falls Power Co., of Buffalo, N. Y., also uses it.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 5, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

756,219. WIRELESS TELEGRAPH RECEIVING SYSTEM; Eugune Ducretet, Paris, France. App. filed Aug. 14, 1903. An oscillation transformer whose primary and secondary windings consists of flat spirals superposed one on the other and means for making electrical connection with various parts of each spiral, whereby the number of effective turns is varied.

756,242. ELECTRIC HEATER; Robert Kuhn, Detroit, Mich. App. filed Oct. 7, 1902. A cooling utensil in the form of a double boiler with the heating resistance wound in the intervening space between the two vessels.

756,275. ELECTRIC SIGNALING DEVICE FOR ELEVATORS; Fred S. Payne, Boston, Mass. App. filed Aug. 11, 1903. Details.

756,316. ELECTROMAGNETIC RAILWAY SWITCH; Rollin A. Baldwin, South Norwalk, Conn. App. filed Dec. 18, 1902. Two solenoids acting upon a single armature to move the switch in opposite directions and cut-outs for automatically throwing the current into the proper solenoid and holding it there until the solenoid has done its work.

756,344. CIRCUIT BREAKER; Leonard L. Elden, Boston, Mass. App. filed June 20, 1901. A plurality of actuating coils and their armatures, one in each circuit liable to be affected by an abnormal current, and tripping mechanism automatically operated thereby for opening the circuit breaker.

756,408. CALL OR ALARM DEVICE FOR HOTELS OR OTHER BUILDINGS; Harvey Reed, Minneapolis, Minn. App. filed Sept. 4, 1902. Details.

756,412. SUPPORT FOR INCANDESCENT ELECTRIC LAMPS; Adolphe Romain and Jean D'Ayguesvives, Paris, France. App. filed Oct. 10, 1902. One or more sockets are attached to a central fixture in which the fuses are located.

756,445. RHEOSTAT; Henry J. Wiegand, Milwaukee, Wis. App. filed June 1, 1903. A base provided with a central projection and a rim, and having an annular recess in which the contact plates and resistance coils are located and covered by a suitable insulating material.

756,541. ELECTRIC SWITCH; Peter Sorensen, Brooklyn, N. Y. App. filed Nov. 23, 1900. A clock-actuated switch capable of a quick break and a quick make of the circuit.

756,547. TROLLEY POLE; Edwin A. Wakefield and George W. Morse, Mechanic Falls, Me. App. filed Dec. 18, 1903. Mechanism for lowering the pole in case it rises above the wire.

756,550. TROLLEY; Charles M. Wilson, St. Louis, Mo. App. filed Feb. 18, 1904. A spiral groove formed at each side of the contact groove of the trolley roller to conduct the wire when displaced back to the center.

756,605. CURRENT REGULATORS; Emil Dysterud, Monterey, Mex. App. filed June 9, 1903. A liquid tank having two compartments and a valve in the separating partition which is moved automatically to vary the body of liquid standing in the opening to vary the current which may travel through the liquid between two electrodes located in the respective compartments.

756,608. ANNUNCIATOR; Franklin H. Elwell, Chicago, Ill. App. filed July 9, 1902. Details.

756,627. INSULATOR; John A. Hanson and Albert F. Lambert, Davenport, Wash. App. filed June 14, 1902. A two-part insulator block between the parts of which the conductor is confined and which are held in position by a straddling staple driven into the supporting wall.

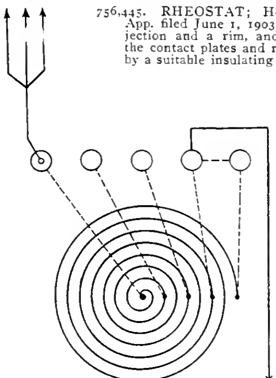
756,665. APPARATUS FOR TESTING THE INSULATION OF THE COILS OF ELECTROMAGNETS; James Lindsey, Fall River, Mass. App. filed Feb. 1, 1904. An electric buzzer for determining by means of the resulting difference in sound, the comparative quality of the insulation of a coil with that of a standard sounding coil.

756,676. WAVE RESPONSIVE DEVICE; Frederick W. Midgley, Philadelphia, Pa. App. filed Nov. 10, 1902. The device comprises two masses of similar or dissimilar composition, one of them having a coating of oxide, while the other is burnished.

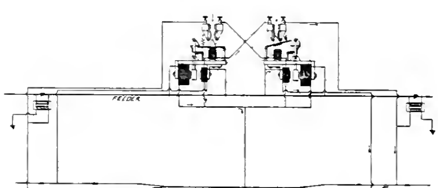
756,711. ELECTRIC CONTROLLER FOR ALTERNATING CURRENTS; Robert P. Rukenbrod, Turtlecreek, Pa. App. filed Jan. 26, 1903. Details.

756,718. WIRELESS SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed Aug. 9, 1902. A system for receiving wireless signals which depends upon the change of resistance of a conductor due to the heat produced in it by the arriving energy.

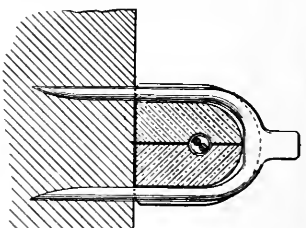
756,719. SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed Aug. 19, 1902. A method patent relating to the subject of the preceding patent.



756,219.—Wireless Telegraph Receiving System.



756,511.—Electric Railway.



756,627.—Insulator.

756,460. ELECTRIC ARC LAMP; Andre Blondel, Paris, France. App. filed Nov. 10, 1902. The fumes produced by mineral electrodes are carried away by suitable ventilating passages to prevent their access to the lamp mechanism.

756,511. ELECTRIC RAILWAY; Thomas D. Lovell, Beverly, Mass. App. filed Nov. 3, 1903. A safety system for single track roads in which the entrance of a car to a block automatically cuts off current from a section of the trolley wire at the opposite end of the block to prevent a car entering from the opposite direction.

756,516. AUTOMATIC ELECTRIC CUT-OUT; Guy Milburn, Baltimore, Md. App. filed March 31, 1903. Details.

756,523. AUTOMATIC POWER CUT-OUT FOR ELECTRIC RAILWAYS; Harry F. Pieper, New York, N. Y. App. filed Jan. 5, 1904. An arrangement of circuits and apparatus by which a car on a block using either power current or lamp current will prevent the entrance of another car to the same block from behind, by taking current therefrom.

756,534. CIRCUIT CONTROLLER; Jacob L. Schureman, Jr., Chicago, Ill. App. filed Jan. 11, 1904. The arm of a rheostat has a lost-motion connection with a dash-pot, permitting it to quickly close the circuit on the first point and thereafter move slowly over the succeeding points to cut out the resistance.

756,720. WIRELESS SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed June 25, 1903. The invention consists in supplying to a freely oscillating circuit, direct current energy and employing the energy of the high frequency oscillations resulting in the oscillating circuit for any purpose whatsoever.

756,724. INSULATORS; John C. Snodgrass, Steubenville, Ohio. App. filed Aug. 26, 1903. An insulating block having a V-shaped projection partially entering a similarly shaped orifice to hold a stretched conductor in a deflected condition within the insulator.

756,757. THIRD RAIL ELECTRIC RAILWAY SYSTEM; John D. Wilkins, Chicago, Ill. App. filed July 24, 1903. A covering for a third rail consisting of a string piece made in two longitudinal sections bolted together.

756,777. ELECTRICAL ANNUNCIATOR; Albert Carliss, Chicago, Ill. App. filed Oct. 5, 1901. Details of construction.

756,782. CIRCUIT BREAKER; Leonard L. Elden, Dorchester, Mass. App. filed Dec. 10, 1903. Details of construction of the tripping mechanism.

756,793. ELECTRICAL INDUCTION MACHINE; Hans Lippelt, New York, N. Y. App. filed Jan. 13, 1903. A construction of machine intended to avoid sparking at the collectors.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, APRIL 23, 1904. No. 17

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office.

In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, APRIL 23, 1904.

CONTENTS.

THIRD RAIL IN WINTER.

Although snow is hurtling past the windows while we write this little item, it is fair to assume that the winter approaches its end, and that although the snowdrifts are still quite heavy up the State and the tinkle of the sleighbell is still heard in the land, New Yorkers at least are likely now to enjoy several months respite from the severe discomforts of the Arctic regions such as they have been enduring lately. It is certainly a matter for congratulation that during the strenuous period from last October down to the present moment, the Manhattan Elevated system has, on the whole, proved itself so thoroughly adequate, technically considered, to the great burden of travel thrown upon it. Time and again during the winter street car travel has been seriously impeded and delayed, not because the cars were unable to run, but because, owing to the amount of snow and ice on the ground, all other vehicles and traffic stuck closely to the car tracks. Hence, people in street cars have frequently abandoned them in order to take to the elevated road, and whenever this has been done they found the cars there in full operation making usual headway with commendable speed and regularity. In one day last January the road carried without any kind of trouble 1,046,000 passengers. Three times this month the number has exceeded 1,000,000, and on the first Monday of this month 1,063,000 fares were paid. It is possible that even since we noted these facts the record of April 4 has been eclipsed.

Be that as it may, it would certainly appear that the third-rail system, in spite of all its drawbacks, has been made a remarkable success. The Manhattan Elevated management is transporting the population of this city more swiftly and more comfortably than ever before, and it is only fair that words of praise should be expressed. We are the more ready to extend our congratulations to the officials in view of the reasonable dissatisfaction which we uttered a year ago and in view also of the tremendously severe winter, during which the company has now made this wonderful record. It seems to us that the third-rail system has inherent defects and difficulties of its own, but these the company is not responsible for, and it would doubtlessly welcome improvements more promptly than anybody else. Nor is it fair to hold the company responsible for the crowding which is still a concomitant of the situation. The road has more cars in operation than ever before, and, in fact, the trains are so thick in the rush hours they are beginning to cut down the headway again, and thus offset some of the advantages of rapid acceleration. Mr. W. B. Parsons, chief engineer of the Subway Road, has said that the growth of traffic in New York City is so great that virtually a new subway system is needed every four years to keep the transportation facilities abreast of the demand on them. This being broadly true, we think it must be conceded that the Manhattan Road, under the régime of electricity, is doing remarkably well, and that there is ample encouragement for the further extension of transportation lines on this island.

WORLD'S FAIR ELECTRIC RAILWAY TESTS.

Elsewhere we print the reports of two of the four advisory engineering committees appointed by the Electric Railway Commission, under whose authority comprehensive tests of electric railway apparatus and systems will be conducted at the St. Louis Fair. The result of the programme adopted by the committee should be of unique value, and no small part of the success which may be confidently anticipated will be due to the admirable organization of the work and the excellent judgment displayed in the selection of the personnel. As previously outlined in these columns, the commission is composed of five members who were selected for their prominence in various departments of the electric railway industry. Four committees were named by the commission to draw up programmes of tests to cover, respectively, city and suburban, interurban, heavy traction equipments and new electric railway systems. For carrying on the actual work of test another committee has been appointed which will be assisted by a staff of electrical engineering students graduating the present year. These young gentlemen during the remaining part of their college technical course will be specially instructed in the details of the testing work with which they are to deal. Finally, an advisory committee representing the manufacturers whose apparatus is to be tested, has been appointed. We repeat the above details of the organization for the reason that we desire to give prominence to what appears an ideal solution to what in the past has been found a difficult problem in connection with world's fair tests. The exceptional opportunities for this class of work at international expositions have heretofore yielded but meagre results and largely, we believe, on account of lack of proper organization of programme and of insufficient thought being given to the important matter of selection of personnel. The plan worked out in the present instance might well be adopted as a model for other tests that may be undertaken at the St. Louis Fair, and its success will undoubtedly have an important effect in directing more active attention than has in the past been given to the great desirability of taking full advantage of the opportunities offered by international expositions for the collection of engineering data.

Telegraph and Telephone.

There have been one or two curious and interesting symptoms and indications of late, of a closer drawing together of telegraph and telephone men. Some of our readers have been quite surprised at the revelations in Mr. Stanton's recent article in our pages, detailing the extent to which telegraphy is now done over the independent telephone circuits of the Middle States, and intimating that such work is likely to go a good deal further. That, however, is but one chapter in the development at the present time. Some of the financial journals do not hesitate to suggest an impending merger of telegraphic and telephonic interests on a large scale, and even foreshadow an approaching consolidation of Postal and Bell Telephone systems. As a guess this may not be far out of the way, and does but repeat gossip noted by us quite frequently during the past year or two. Now we are informed that a "deal" of this kind would save the telephone company alone not less than $2,000,000 in operation and $20,000,000 a year in construction. It is just as well to make the figures large while you are about it.

Incidentally, there are suggestive side lights on the situation, as, for example, the fact of Messrs. Mackay and Murray Crane becoming fellow directors in a big New York trust company, which might help in the financial negotiations. Another incident is the dinner this week given by the Magnetic Club of telegraphers to the telephonic leaders around New York, and probably including Prof. Bell. We can but admire such a rapprochement, and if it helps the cause along well and good. In past days telegraphers have let the telephonists drift a long way from them, and a little hearty hospitality is certainly timely by way of indicating, in any respect, the reunion and harmony of the two branches of the family. We are glad to note the dinner and shall await with interest the other developments, if there be any beyond the simple exchange of sentiments of mutual esteem and good will.

The Elementary Principles of Transformer Design.

Transformers have now been in commercial use for over twenty years, and a great variety of structures and arrangements have been tried in their development. There is but little chance left for their improvement in efficiency, since in very large sizes the full-load efficiency is known to be about 98 per cent. Consequently, only a margin of loss amounting to 1.3 per cent. at full load remains for future discoveries to save. Nevertheless, there is always a wide field open for cheapening the construction, improving the pressure regulation, compacting the apparatus, increasing the dielectric strength, etc. The design of a transformer, like that of any other electromagnetic apparatus, is a struggle for ascendancy among a number of desiderata, effecting a final compromise. A designer aims for low cost of construction, low weight, high efficiency at the mean load, small excitation current, small temperature elevation, compactness, good pressure regulation, high dielectric strength and convenient shape. Many of these desiderata are in mutual opposition. If the designer is directed to lay particular stress upon one particular requirement, the design will be changed to suit the favored protégé. In general, a compromise between all the requirements, in some relation to their mutual relative importance is aimed at.

It is probably impossible to obtain a general equation in which all these different factors enter, and from which a solution, for any assigned values of all the factors, may be evaluated. If this were a physical possibility, it would probably be a mathematical prodigy, and the labor involved in solving the equation would, perhaps, exceed that necessary for computing the elements of a solar eclipse. Nevertheless, the behavior of a transformer is subject to rigid physical laws, and the design of a transformer should be shorn of empiricism, if progress in the art is to continue. It is important that the theory should be so far developed that for each and every design that may be suggested, the corresponding practical results in each direction may be capable of computation. Moreover, the relatively much simpler processes of computing the dimensions of a transformer for maximum efficiency alone, or for minimum weight alone, or for minimum cost alone, may profitably be studied by electrical engineers. The article by Prof. Thomas Gray, the first part of which appears on page 765, deals mainly with the problem of maximum efficiency.

Electricity and the Weather.

Whenever a fire occurs in a building that has once been wired for electric lighting, it is very convenient, in cases where the origin of the fire is not immediately apparent, to attribute the outbreak to a cross between the electric wires. This satisfies the imagination, calls for no defense on the part of the householder, and covers a multitude of sins. If the electric light company dares to protest against the indictment, it should not be credited, because it is a wicked corporation operated for selfish greed. Something of like looseness of thought and expression is suggested by a paragraph recently appearing in a prominent daily newspaper giving a telegraphic account of the foundering of the late Russian battleship *Petropavlovsk*. After describing the terrible explosion, the account went on to say that the vessel foundered owing to having "lost her center of gravity." Whether the missing center of gravity was blown out of the ship by the explosion, or was accidentally dropped overboard by one of the sailors during the immediately subsequent excitement, is, unfortunately, not stated in the telegram. Curiously enough, the vagaries of the weather are not usually attributed to electricity. In the popular mind it is usually the other way, and manifestations of electricity are commonly attributed to the weather. It is a grateful and comforting reflection that the weather is one of the few things for which crosses between wires are not made responsible.

In the annual summary, however, of the Monthly Weather Review for 1903, recently issued by the United States Weather Bureau, there is an interesting section devoted to the subject of seasonal or annual forecasts. Not only are weather men becoming expert at foretelling the weather a day ahead, but they are evincing ambitions to let us know our troubles a year ahead. Some day who knows but that the Nautical Almanac, which is computed four years ahead, and printed three years ahead, eclipses and all, will have an extra weather column, giving the weather at all parts of the globe for each date. At all events, the section above referred to very clearly and logically points out that changes in the weather of the sun precede long changes in the weather, or seasonal changes on the earth. The desirability of more closely studying the electromagnetic action of the sun upon the earth, as one of the factors in the maintenance of solar influence, is pointed out. In reality, the variations in the electric and magnetic influences of the sun are at the present time more clearly capable of being detected and measured than variations in its radiated heat, or in the solar climatology.

WIRELESS IN WAR.

The strenuous manifesto of the Russians against the use of wireless telegraphy by neutrals within the zone of hostilities is timely and to the point. It has, to be sure, a pungent flavor that will hardly commend it to the representatives of the daily press, but it is well that we should understand that modern war is neither a golf match nor a yacht race, and that whosoever intrudes upon it does so at his peril. We presume that there will be protests about the liberty of the press, the rights of neutrals, and Muscovite barbarism; but the fact remains that although the introduction of wireless telegraphy has introduced a new and important feature into war correspondence, Russia is apparently well within the rights insured to belligerents by the ordinary precedents, or absence of them, which make up the body of international law. That the protest has come from Russia rather than Japan is simply an indication that the former, under the sting of defeat and disaster, feels more acutely the necessity for it. We should much dislike to be on board a press boat which had been warned off from dogging the fidgety fleet of the genial and versatile Admiral Togo. There has been no proclamation, but a twelve-inch projectile is quite sufficiently exterminatory, and it is not always easy to distinguish signals in a bad light. In point of fact, the Japanese regulations for war correspondents are quite as drastic as the Russian, and neither are unusually or objectionably severe from the standpoint of international law. They are stricter than those in vogue here during the Spanish fracas, but one of the weakest points in our military and naval system is the undue weight given to impertinent and incompetent "public" opinion.

Let us look a little into the status of wireless telegraphy, and see what are the precedents by which it must be determined. It is, of course, a new method of transmitting intelligence, but in its results it is the same so far as the interests of the belligerents are concerned. Its long range gives it unusual powers, good or ill, which must be taken into consideration. Now to begin with, a wireless telegraph outfit on its merits as merchandise, would unquestionably be held to be contraband of war if consigned to a belligerent and would be subject to seizure like any other contraband article even upon the high seas. It is no less contraband if found actually in use to the advantage of a belligerent, even if in the possession of a neutral and upon the high seas. As to the full personal responsibility of the users, no question can properly be raised under the rules and usages of war. To quote from our own Articles of War: "Whosoever shall be convicted of holding correspondence with, or giving intelligence to, the enemy, either directly or indirectly, shall suffer death, or such other punishment as shall be ordered by the sentence of a court-martial." And in time of war a court-martial is fully recognized as having complete jurisdiction over violaters of this article whether they owe allegiance to the United States or not. No man who circulates about in the zone of hostilities collecting and disseminating information with a hand ever so impartial, can be excused on the ground that he is a neutral, or that he is gathering news for the general benefit. If his acts are such as are in themselves calculated to convey even indirectly, information concerning one belligerent to the other, he must, if caught, take his chances of noose or bullet, for he is trespassing on the playgrounds of Death, and doing it knowingly. Nor can he escape because his operations within the zone of hostilities chance to be upon the high seas, which are not neutral territory, but merely the common highway of nations on which belligerents are accorded paramount rights. It will be interesting to watch the action of the American Government in the premises.

A wireless press message sent from the seat of war to neutral territory endangers the rights of belligerents peculiarly for two reasons. First, it is at best intended for general publication, which implies conveying news of the acts or intentions of one belligerent to the other. Second, it may by accident or pre-arrangement be directly intercepted. In either case the sender is clearly in the position of giving information forbidden by the usages of war. Even when the zone of hostilities is upon the high seas, neutral vessels enter it, unbidden, at their peril, and cannot act as spies or conveyers of information except at their own risk. Even war vessels of neutral nations upon the scene for purposes of private observation with the acquiescence of the belligerents, must be extremely circumspect in their acts. We do not think we overstate the case in saying that for a war vessel of a neutral power to send wireless dispatches for publication to a neutral port giving information to all the world of the movements of belligerents, would properly be considered an unfriendly act by the injured belligerent and would constitute a justifiable *casus belli* if repeated. We have all sympathy with the hard and dangerous task of a war correspondent; it is in every way desirable that neutral powers should learn of the progress of hostilities, but it is well within the rights of belligerents to determine in how far it is safe to allow their movements in the zone of hostilities to be made public, to regulate the transmission of news from within their own lines and throughout the region in which they are operating, and to suppress, if need be by extermination, the injurious acts of spies, eavesdroppers and busybodies, within the entire zone of hostilities. Trespassers in that zone must remember that their rights there are secondary to those of the belligerents, and that no professions of neutrality will excuse them in hostile acts, in which category the unauthorized sending of wireless messages must certainly be placed. There is no international law forbidding it, but it is done at the sender's imminent peril. And even if some dictum or precedent in international law could be adduced apparently favorable to the opposite view, it would not avail against the principle of self-preservation, which in affairs of nations can always be appealed to as paramount. In fact, lacking a tribunal for its interpretation with command of bodily means for its enforcement, the so-called law of nations may be likened to the "gentlemen's agreement," of which the keeping depends on self-interest—especially the self-interest of the stronger party. Meantime, Russia will go slow and as a matter of electrical technique we are heartily glad to see such splendid work done with wireless telegraphy, in messages hundreds of words long—and with American apparatus at that, in American hands.

International Electrical Congress.

We are informed that the following papers are promised for Section A—the section on "Theory"—of the Congress, of which Prof. E. L. Nichols is chairman and Prof. H. T. Barnes secretary:

FOREIGN.

Prof. Dr. Paul Drude, "Metallic Conduction"; Prof. Dr. W. Jaeger, "Electrical Standards"; Sir Oliver Lodge, F.R.S., "Ions"; Prof. H. Nagaoka, "Magneto-Striction"; Prof. Dr. J. J. Thomson, F.R.S., subject to be announced; Prof. J. S. Townsend, F.R.S., "The Theory of Ionization by Collision"; Mons. J. Violle, "Secondary Standards of Light"; Mr. C. T. R. Wilson, F.R.S., "Condensation Neuclei"; Prof. P. Zeemann, "Magneto-Optics."

AMERICAN.

Prof. H. T. Barnes, "The Mechanical Equivalent of Heat as Measured by Electrical Means"; Dr. Carl Barus, "Atmospheric Neuclei"; Dr. Louis A. Bauer, "The State of Our Knowledge Regarding the Earth's Magnetism"; Prof. D. B. Brace, "Magneto-Optics"; Prof. H. S. Carhart and G. W. Patterson, Jr., Ph.D., "The Absolute Value of the Electromotive Force of the Clark and Weston Cells"; Prof. C. D. Child, "The Electric Arc"; Dr. K. E. Guthe, "Coherer Action"; Prof. E. P. Lewis, "Electrical Discharges in Gases"; Prof. L. T. More, "Electro-Striction"; Prof. E. Fox Nichols, "The Unobtained Wave Lengths Between the Longest Thermal and the Shortest Electric Waves yet Measured"; Prof. E. L. Nichols, "Standards of Light"; Harold Pender, Ph.D., "Magnetic Effect of Moving Charges"; Dr. M. I. Pupin, "Electrical Theory"; Dr. Edward B. Rosa, "Alternating-Current Measurements"; Prof. E. Rutherford, "Radioactive Change"; Prof. J. C. McLellan, "Radioactivity of the Atmosphere"; Prof. J. Trowbridge, "Electrical Discharge in Gases"; Prof. A. G. Webster, "Electrical Theory."

A meeting of the Congress Committee on Organization is scheduled for April 23 at 1.30 P.M., in New York. All Congress officers have been invited to attend. The meeting will be at 95 Liberty Street, New York, at the offices of the American Institute of Electrical Engineers.

Acceptances of membership in the Congress number over 1,300, up to the present time, and 150 papers have been promised in all. The following societies have all promised to hold conventions at St. Louis during the Congress week, and to hold conventions with one or more sections of the Congress:

The American Institute of Electrical Engineers, American Physical Society, American Electro-Chemical Society, American Electro-Therapeutic Association, International Association of Municipal Electricians. The British Institution of Electrical Engineers has also arranged to co-operate under some plan, the details of which have not yet been determined.

The following bodies have promised to co-operate by sending delegates. The Société Internationale des Électriciens, National Electric Light Association, Association of Edison Illuminating Companies. Co-operation is expected from various other societies.

United Engineering Building.

The Conference Committee on the United Engineering Building having selected its six architects as already announced, has now completed arrangements with Prof. W. R. Ware to act as its professional adviser in the matter of the architectural competition. His preliminary report on the subject is to be made to the committee during the present week, when a programme of competition will be agreed upon and put in final form for distribution. In addition to the selected firms, other architects will be invited to enter a free competition open to all in good standing and four equal prizes will be awarded for the four best designs. Prof. Ware has had a wide experience as a professional adviser in large competitions of this character, and is most highly regarded throughout the country for his educational and architectural record. He was for several years professor of architecture at the Massachusetts Institute of Technology, and from 1881 until quite recently was professor of architecture at Columbia University in New York City. The committee considers itself happy in having the benefit of his advice and experience.

A Gas Episode at Mt. Vernon, N. Y.

What might have been a frightful disaster, in the attendant loss of life, was narrowly averted at Mount Vernon, a suburb of New York City, on Sunday night, April 17. Had the incident occurred later in the evening the many narrow escapes reported would have been fatalities. To the quick action of Police Sergeant Walter Grant in sending in an alarm of fire, the commendable efforts of the telephone girls in arousing two thousand subscribers by violently ringing their telephones, and the inspection of every house by firemen and police, the 25,000 people of Mount Vernon and the 5,000 residents of Pelham and North Pelham and Pelham Manor owed their escape from asphyxiation by gas fumes. A valve cock on one of the big mains, it is alleged, which supplies Mount Vernon with gas broke and the gas went out for a few moments. Then the Westchester Lighting Company apparently turned the gas on again through the open jets. Many families had retired, leaving their gas burning in the sleeping rooms or else had gas logs and radiators burning to keep warm in lieu of furnaces, and the gas, it is said, made more than 100 persons ill. The arc lights on the streets saved the town from utter darkness. It is said that pandemonium was let loose in the efforts to wake people up in the 5,000 houses that constitute the suburb. The noise was kept up till 2 A.M. with a siren steam whistle and all the fire engine gongs.

A Ukase Against the Wireless.

Last week we gave some very interesting details about the enterprise of the London *Times* in equipping a small steamship and land station at Wei-Hai-Wei with the De Forest wireless telegraph system, by means of which that dashing correspondent, Col. James, has been sending brilliant and unique dispatches from around Port Arthur to that journal and the New York *Times*. Immediately following upon that article came the news that at Washington, on April 15, the Cabinet discussed a communication received by the State Department from Count Cassini, the Russian Ambassador, which apparently means that the Russians intend, if they capture any press correspondent using wireless telegraphy either near land or on the high sea, to treat him as a spy and hang him. It is understood that similar communications were made to the Foreign Office of other nations. The note received by Secretary Hay is as follows:

"I am charged by my government, in order to avoid all possible misunderstanding, to communicate to your Excellency that the lieutenant of his Imperial Majesty in the Far East has just made the following declaration:

"'In a case in which neutral steamers having on board correspondents who might communicate war news to the enemy by means of perfected apparatus not being yet foreseen by existing conventions would be arrested near the coast of Kwan-Tung or in the zone of operations of the Russian fleet the correspondents will be looked upon as spies and the steamers furnished with wireless telegraphy seized as prizes of war.'"

This action has created a sensation and is now under vigorous discussion on both sides of the Atlantic. It is referred to editorially by ourselves in this issue. According to advices from London, the communication from the Russian Government to the British Foreign Office intimates that Russia does not contemplate any immediate action in the matter.

N. E. L. A. Preparations.

The programme for the 27th convention of the National Electric Light Association is taking definite shape. Papers and reports ready are as follows: "Wrinkles," edited by Chas. H. Williams, of Madison, Wis.; "Report on District Heating," E. F. McCable, chairman; "Report on Purchased Electric Power in Factories," W. H. Atkins, chairman; "Report on Advertising," Le Rue Vredenburgh, reporter; "Report on Decorative and Sign Lighting," Arthur Williams, reporter; paper entitled "The Sale of Electrical Energy," by W. F. White; "Practical Notes on Steam Turbines," by Francis Hodgkinson; "A One-Hundred-Mile Transmission Line," by Robert Howes; "Economy Test of 5,500-hp Engine and Generator," by Messrs. J. D. Andrews and W. F. Wells; "The Remote Control of Electrical Apparatus," by W. H. Cole. It has been decided to hold the meeting for four days, the last day to be reserved largely for entertaining, etc.

Electric Distribution to Small Manufactories at Sant Mortier, France.

By Franz Koster.

The French Jura, adjoining Switzerland, near Lake Geneva, is one of the richest departments in France in manufacturing industries, being replete with factories and workshops of many descriptions. The principal industries are watchmaking, the manufacture of tobacco pipes, especially at St. Claude, products of woodturning, bric-a-brac and diamond polishing, all of which are carried on in many small ateliers and shops. The demands for electricity of these numerous small consumers, who had been using hand, steam or water power, caused the Union Electrique to install a water power plant, which has recently been completed and occupies a station on the right bank of the Ain in the vicinity of Sant Mortier.

The Ain is a small river which rises in the Jura and has a tortuous but swift course through a rocky country to its juncture with the Rhone. Like all mountain streams, the water flow of the Ain varies greatly with the season. In low water the volume is 14 cu. ft. per second, while at high water it is 25 cu. ft. At Saint Mortier, with a fall of 62 ft., this latter flow would only give a horsepower of 600, which would, of course, have been insufficient. For this reason Lake de Chalain, 28 miles up the river, was tapped for the additional volume of water needed. This lake has an acreage of 5,014 and a depth of 111.5 ft. Its bottom is 104 ft. higher than the river Ain at this point, and an underground tunnel through alluvial earth, of a length of three-quarters of a mile connects the two, piercing the side of the lake. Lake de Chalain is a natural reservoir fed by springs and small streams and its level varies about 32 ft. during the year. It has a capacity of 70,000,000 cu. ft. and furnishes a flow of 565 cu. ft. per second, the year around. Thus the normal volume, if utilized, at the Sant Mortier power house, where the fall is 60.3 ft., would produce 3,000 hp; 2,500 hp is the minimum and this is at a fall of 43.5 ft. during high water, when the loss would be larger but for the equalization caused by a greater volume of water.

All the concrete work and excavation, including the canal, tunnel and plant building was done by M. Yoanny. The turbines were manufactured by Piccard, Pistet & Co., of Geneva, while the entire electric installation, including the distributing system, was furnished by the Maschinenfabrik Oerlikon.

As stated above, an underground tunnel connects the lake and the river and the flow of this tunnel is regulated by sluices near the lake. The smaller river is dammed in a narrow defile, 174 ft. wide, by a concrete dam 33 ft. high and 110 ft. in width at the top, with a slope against the water of 1 to 10, so that the greatest water pressure is only 85 pounds per sq. in. This dam rests upon solid rock. On the right side of the dam are three sluices for admitting water to the supply canal, while on the other side of the dam is a driftwood canal 754 ft. long, parts of it of half tunnel section blasted in the rock of the mountain. It is 36 ft. wide and has a pitch of 1 to 25.

Fig. 2.—View of Exterior of Power House.

The supply canal, which has a length of 4,920 ft., is of rectangular cross-section, 14.76 ft. wide and 8.36 ft. deep. For 410 ft. of its length it is of tunnel construction. The whole canal is of concrete. It is provided with several overflow sluices for conducting away surplus water, which runs into the canal from the sides of the mountain. Two overflows are placed near the dam. The whole canal may be cut off by three sluice gates which work vertically against rolls. To the sluice gates at the sides of the canal are attached ⅛-in. sheet-iron strips or angles, which are pressed against the wall by the water, thus making a close joint. The canal empties into a small basin at the power house and the bottom of this basin lies 26 ft. above the machine room floor level of the plant. From one side lead to the turbines four penstocks 5.5 ft. in diameter, three of ⅜-in. thick riveted steel plates.

The erection of the power house on the mountain slope was accomplished with difficulty, owing to the restricted area and the frequent flooding of the building site. The power house, which is 147

Fig. 1.—View of Interior of Power House, Showing Wheels and Generators.

ft. in length and 47½ ft. in width, has space for five hydro-electric units, four of which are at present in place. The foundations are of concrete, as is also the floor, which is surfaced with tiles except along the dynamos, where a roomy trench for cables to the switchboard is covered with checkered steel plates, as shown in the illustration. A crane of 15-tons capacity is in position. The roof is of steel construction with tiles resting on wooden sheathing.

The turbines are horizontal and of the inward-flow radial type and furnish 700 hp with 60.3 ft. fall and 250 r.p.m., while at high water with a fall of 43.5 ft. their capacity is reduced to 500 hp. The turbine shaft is 23 ft. above low water level and the turbines are provided with Jonval draft tubes, the ends of which remain well submerged even at low water. There are for each turbine two such draft tubes 3.6 ft. in diameter symmetrically placed axially with the shaft, while between them is the turbine chamber, into which empties the penstock. All these portions are of riveted steel plates.

On the shaft of the turbines are mounted two distinct water wheels of equal size, each 2.6 ft. wide and of 4.5 ft. in diameter and each discharging into its own draft tube. They are of cast iron and have five rows of blades or cells in one casting. A hub for each water wheel is mounted on the shaft and the blade ring is bolted to this. The four outer rows of the blade ring are calculated for normal flow, while the more numerous blades at sharper angles of the inner or fifth row are for high or low water. A sliding jacket of steel plate construction operated from a mechanical servo-motor by means of bevel, screw and nut, regulates the admission of water. The Piccard governing system is in use on each turbine.

The dynamo shaft is connected with the turbine shaft by an elastic insulating coupling of the Raffard system. The dynamos of the Oerlikon three-phase alternating inductor type, develop 7,500 volts with a phase voltage of 4,330, since the armature winding is star-connected. The current strength is 50 amp. per phase. At 250 r.p.m., with 20 poles, the frequency is 50 per second. The magnet wheel frame is of cast steel and is bolted to a cast-iron hub of six spokes. The outside diameter of the wheel frame is 6.19 ft., its width is 3 ft., and its thickness 5 in. Twelve laminated poles are bolted by dove-tailing to the circumference of the magnet frame, or a total of 24, the members of each pair being placed opposite and 17

FIG. 3.—VIEW OF DAM AND SUPPLY CANAL.

in. apart. The height of each pole is 5¾ in., the width 9 in. and the thickness 8¾ in. The outside diameter of the magnet field is 7.18 ft.

In the space between the opposite poles are built up in two parts the magnet coils, connected in series, in copper bars 2½ in. x 3/32 in., to a total number of 160. The weight of the entire revolving portion of the dynamo is 7.0 tons, while the weight of the magnet copper is 1¼ tons.

The dynamo frame which carries the inductive windings, is in two parts, a bottom and an upper section, and twelve large openings are provided in the outside periphery, as shown in the illustrations, for ventilation. This frame is in cross-section a trapezoid of a thickness of 12 in. and a width of base of 2.9 ft. The outside diameter is 10.3 ft.

Like the magnet wheel, the armature is arranged in corresponding parts. The segments of each part are held together by bolts and two cast-iron rings, one of which is removable. The bore of the magnet field is 7.23 ft., while the depth is 6½ ft. and the width is 10 ft. Each side of the armature has 72 slots, each of which contains two coils of machine-formed windings insulated by mica and secured by fibre wedges. Each coil contains 33 turns of two parallel conductors of ⅛-in. wire. The coils of each phase are connected in series, corresponding to the phases of the armature parts.

The weight of the armature copper is .6 ton, and the weight of the

FIG. 4.—SUPPLY CANAL AT TUNNEL ENTRANCE.

entire stationary frame, including armature, is 15.4 tons. The normal exciter current is 90 amp., with a power factor of 0.8 and 50 amp. per phase. Under these circumstances the voltage drop is 25 per cent. Running free the exciter current is 56 amp., while on short-circuit it is 31 amp. At normal load and $\cos \phi = 0.8$, the efficiency is 93.5 per cent. The loss is divided as follows: Friction loss, 24,300 watts; heat loss in the armature, 10,300 watts; heat loss in the magnet wheel, 1,810 watts, or a total loss of 36,410 watts. The exciter dynamo field is bolted to a bracket of the bearing, its armature being on the overhanging end of the shaft. It is a four-pole, shunt-wound machine and develops 3,600 watts at 30 volts.

On account of the great number of distribution wires and the limited space at the north wall, a two-story switchboard has been erected in closet form. The upper portion contains the measuring apparatus and is reached by iron stairways, the floor, which serves as the roof of the lower portion being 9 ft. above the main floor. The switchboard is 21.9 ft. long and is 13.9 ft. deep from the lower face to the wall and 4.8 ft. deep from the upper face to the wall. This part is 7.3 ft. in height. The whole switchboard is of steel construction and the portion bearing the measuring apparatus is faced with marble and is divided into five panels, four for machine groups and outside circuits, the middle panels bearing the general voltmeters. Behind the upper portion are the distribution wires and lightning arresters; the lower portion, which may be entered from either end, and which is enclosed by finely perforated sheet iron almost as transparent as gauze, is divided by an aisle lengthwise and contains high-tension switches for the machines, the machine fuses, rheostats, auxiliary transformers, cable connections from the machines and cross connections. The portion against the wall contains the fuses of the outside circuits, and over the aisle are arranged the high-tension switches for these circuits, being operated by levers from the balcony, or operating platform. All the switches and fuses used are of special construction, and so made that at the moment of breaking in a chamber the admission of air and the creation of an arc are prevented. The high-tension safety fuses are constructed on the same principle. They are vertically mounted and closed at the top and in case of a short-circuit the gas escapes through a comparatively small opening at the bottom.

The cross connections are of aluminum. All wires are carried on porcelain insulators.

Four main distribution branches of high-tension wiring lead from the power house at Sant Mortier. One proceeds to St. Claude, 16.2 miles in length, of two circuits, of three 8-mm. diameter conductors each. A second to Nantua is 12 miles in length, of which the first 5.5 miles are of 8-mm. wires, while the remainder to Nantua are of 6 mm. diameter, with a branch from the end of the first 5.5 miles to Viry of 4 mm. From different points on the latter circuit small branches lead to Oyonnax, Belignat, Montreal and Marchon, each of three-wire 4-mm. diameter. The third main is exactly 5 miles in length and leads to Arinthod and is of three 4-mm.

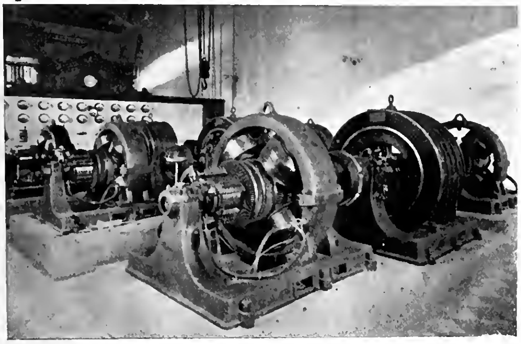


FIG. 5.—INTERIOR OF ST. CLAUDE SUB-STATION.

wires. The fourth main is to Oernon, and, after a course of 3.12 miles has a branch of 6.25 miles to Moiran, both circuits being of three 4-mm. wires.

The total length of the high-tension circuits is 65.4 miles. The wires are mostly carried on 33-ft. poles, of which there are 3,940.

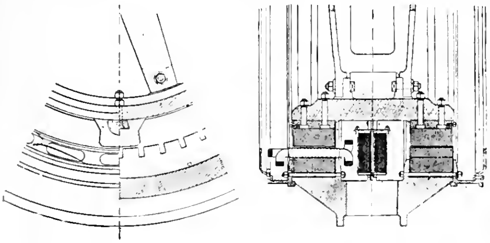


FIG. 6.—DETAILS OF 700-HP GENERATOR.

These poles are in straight stretches 98.4 ft. apart, while in curves 82 ft. is the usual distance. The greatest distance apart in any place is 246 ft. All poles are saturated either with copper sulphate or zinc chloride. They are fitted on top with pointed cast-iron caps or pro-

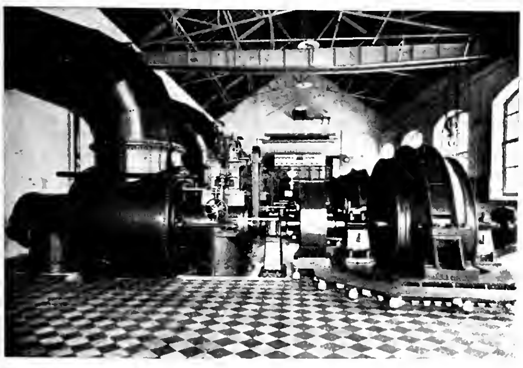


FIG. 7.—INTERIOR OF POWER HOUSE, SHOWING DRAFT TUBES.

tecting heads and a 4-mm. copper wire leading to the earth and ending in a coil, for lightning protection. All poles are wound with barbed wire for protection against boys and on curves iron loops are mounted on the poles in such a manner that if an insulator is broken the wire does not fall, but remains supported in the loop. Where the wires are carried over railroads, braced pairs of double poles are erected. Over streets there is underneath the span a steel wire netting. In towns the high-tension wires are insulated with cables, while elsewhere the wiring is bare.

There are 18 isolated transformer buildings of brick, each containing one transformer, except at St. Claude, where there is a sub-station in which there are four transformers of 70 kw each.

The electrical outfit for a transformer house consists of a three-pole switch for high-tension circuit, a three-pole switch for the low-tension circuit, fuses and lightning arresters for the high and low-tension circuits, and a transformer of the Oerlikon type.

The sub-station at St. Claude is of two stories, in the upper one being placed three motor-generator groups and the switchboard. There is also a 7-ton hand crane. Each transformer group is composed of three machines, a three-phase, high-tension motor, the shaft of which is coupled at each end by means of an insulated elastic coupling with a direct-current dynamo, as shown in the illustration.

The Oerlikon motor, of 150 hp makes 590 r.p.m. and its ten poles are fed at a pressure of 200 volts. The stator is provided with 150 slots, each containing one conductor of 14 parallel bare copper wires of 3.8 mm. diameter. The rotor has 180 slots with one conductor each, of 6 parallel bare wires 4 mm. in diameter each.

The Oerlikon direct-current dynamos develop 75 hp at 590 r.p.m.

FIG. 8.—REAR OF SWITCHBOARD IN POWER HOUSE.

and a voltage of 200. The armature has 117 slots 1/4 x 1 1/8 in., containing two conductors of three parallel 4-mm. bare wires each. The commutator consists of 117 copper segments.

The four coils of the magnet field are connected in series. Each has 2,450 windings of 1.8 x 2.2 wires. The efficiency of the transformer groups by actual test is from 85.5 per cent. to 86.8 per cent.

The different portions at the rear of the switchboard are accessible from an aisle along the middle. At the back are four transformers which feed the three-phase motors of the generator groups, as are also the high-tension switches, safety fuses and lightning arresters of the high-tension circuit. At the front are the switches of the secondary three-phase and the direct current, the first mentioned for general commercial consumption and the latter for municipal and private lighting at St. Claude.

Below each switch is the fuse for the circuits. The same room contains switches for the machines, carbon cut-outs, rheostats, etc. The apparatus room is separated from the machine room by a white marble switchboard upon which are mounted the usual measuring devices and switching levers.

The small manufacturers are supplied with 200-volt, three-phase motors of from 1/2 to 35 hp, there already being 58 such motors installed with a total capacity of 684 hp. The alternating-current service is from a 120-volt circuit, while the direct-current service is at 200 volts. There are 5,200 incandescent lamps of 58,000 total cp, of which 2,000 are on three-phase circuits in different towns, the 3,200 direct-current lamps being in use in St. Claude, the latter place alone having direct current.

Horse Power of Steam Engines.

By Irving A. Taylor.

It is often desirable to be able to figure the power of an engine from its dimensions and other apparent data. Usually this task is not as simple as it appears at first blush. One starts out with the theoretical mean effective pressure, and reduces it to practical conditions as best one can.

It is the object of what follows to give a handy and fairly simple method of arriving at an approximate result, correct in ordinary cases to within 5 or 10 per cent. It is not possible to give a general solution of much greater accuracy, on account of the variable character of the sources of loss.

Engine builders vary to some extent in their rating, but generally they rate rather high for practical conditions. In non-condensing engines, for example, the usual rating is made on a basis of atmospheric pressure in the exhaust—a condition seldom holding in practice, and allowance for wire-drawing in the valves is generally absent.

Two of the greatest difficulties in the way of obtaining accurate results in figuring power are, first, the variable and often large loss of pressure occurring in the steam and exhaust piping; and, second, the same loss occurring in the ports and valves of the engine itself. The writer sometime ago saw cards taken from large modern engines running on 28-in. condenser vacuum, which showed only 15-in. vacuum on the low-pressure exhaust line. Needless to say, such a loss reduces the power and efficiency to an extent difficult to figure, except on the cards themselves.

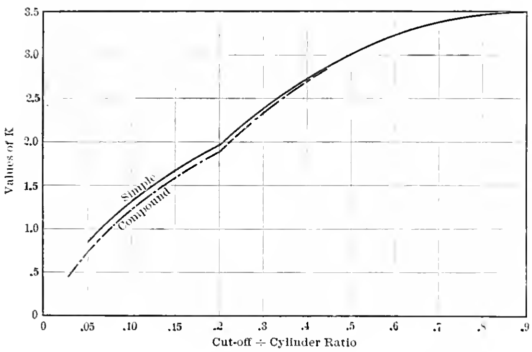
The following equations and the curves of the accompanying figure curves show the method of figuring the power:

$$H.P. = \frac{P \times diam.^2 \times stroke'' \times revs.}{1,000,000}$$

$$P = (steam\ gauge\ pressure + 15)\ K - (68\ or\ 20).$$

The constant, 68, is used for non-condensing, and 20 for condensing engines.

For single-acting engines the horse-power will be one-half that given by the equation. The diameter in the equation for horse-power is in inches, and in compound engines is the diameter of the low-pressure cylinder.



CALCULATING THE HORSE-POWER OF STEAM ENGINES.

The values of K may be found from the curve when the cut-off is known. The following cut-offs represent approximately the proper rating, the cut-off in the compounds being equal to the cut-off in the high-pressure cylinder divided by the ratio of low to high-pressure piston areas:

	Simple.	Compound.
Non-condensing	.25	.125
Condensing	.15	.075

The point of maximum cut-off in the high-pressure cylinder divided by the cylinder ratio determines the maximum output which the engine is capable of giving. In simple engines it is usually $\frac{5}{8}$ to $\frac{3}{4}$ stroke, and in compounds $\frac{3}{4}$ stroke, though occasionally $\frac{7}{8}$ stroke.

The equations are based on 24-in. vacuum for condensing engines, or 17 pounds absolute pressure in the case of atmospheric exhaust.

The following examples illustrate the method of application:

SIMPLE ENGINE.

22 in. diameter x 18 in. stroke, 220 revolutions, 80 pounds steam.

NON-CONDENSING.

Rated with cut-off at $\frac{1}{4}$ stroke.

$$P = [(80 + 15 = 95)\ 2.2 = 209] - 68 = 141.$$

$$H.P. = \frac{141 \times 22^2 \times 18 \times 220}{1,000,000} = 270\ H.P.$$

Maximum power with cut-off at $\frac{5}{8}$ stroke:

$$P = [(80 + 15 = 95)\ 3.27 = 310.5] - 68 = 242.5.$$

$$H.P. = \frac{242.5 \times 22^2 \times 18 \times 220}{1,000,000} = 465\ H.P.$$

CONDENSING.

Rated with cut-off at .15 stroke:

$$P = [(80 + 15 = 95)\ 1.7 = 161.5] - 20 = 141.5.$$

$$H.P. = \frac{141.5 \times 22^2 \times 18 \times 220}{1,000,000} = 271\ H.P.$$

Maximum power with cut-off at $\frac{5}{8}$ stroke:

$$P = [(80 + 15 = 95)\ 3.27 = 310.5] - 20 = 290.5.$$

$$H.P. = \frac{290.5 \times 22^2 \times 18 \times 220}{1,000,000} = 557\ H.P.$$

COMPOUND ENGINE.

18 in. and 32 in. diam. x 26 in. stroke, 116 revs., 125 pounds steam.

$$Cylinder\ ratio = \left(\frac{32}{18}\right)^2 = 3.16.$$

NON-CONDENSING.

Rated with cut-off at $\frac{1}{3}$ stroke in the high-pressure cylinder:

$$\tfrac{1}{3} \div 3.16 = .1056\ cut\text{-}off$$

referred to the low-pressure cylinder.

$$P = [(125 + 15 = 140)\ 1.24 = 173.5] - 68 = 105.5.$$

$$H.P. = \frac{105.5 \times 32^2 \times 26 \times 116}{1,000,000} = 325.7\ H.P.$$

Maximum power with cut-off at $\frac{3}{4}$ stroke:

$$\tfrac{3}{4} \div 3.16 = .237\ cut\text{-}off$$

referred to the low-pressure cylinder.

$$P = [(125 + 15 = 140)\ 2.06 = 288.4] - 68 = 220.4.$$

$$H.P. = \frac{220.4 \times 32^2 \times 26 \times 116}{1,000,000} = 680\ H.P.$$

CONDENSING.

Rated with cut-off at $\frac{1}{4}$ stroke:

$$\tfrac{1}{4} \div 3.16 = .0791\ cut\text{-}off$$

referred to the low-pressure cylinder.

$$P = [(125 + 15 = 140)\ 1.01 = 141.4] - 20 = 121.4.$$

$$H.P. = \frac{121.4 \times 32^2 \times 26 \times 116}{1,000,000} = 374.6\ H.P.$$

Maximum power with cut-off at $\frac{3}{4}$ stroke:

$$\tfrac{3}{4} \div 3.16 = .237\ cut\text{-}off$$

referred to the low-pressure cylinder.

$$P = [(125 + 15 = 140)\ 2.06 = 288.4] - 20 = 268.4.$$

$$H.P. = \frac{268.4 \times 32^2 \times 26 \times 116}{1,000,000} = 828.6\ H.P.$$

The examples given show that there is always a considerable margin of power in engines above their normal rating; so, if an engine builder overrates his machines somewhat, he is not likely to get into "deep water" on account of it.

The accompanying curves give the values of K in terms of the cut-off divided by cylinder ratio. Makers usually rate power with the figure 60 instead of 68 in the equation for P, and with K from 1 to 1.1 times that shown in the curves. Simple engines having very restricted port areas may have values of K, but .9 of that shown, while for compounds, under the same conditions, K is .75 to .9 of that shown. First-class engines, with sufficient port areas, will have values of K approximately as given in the curves, though the best Corliss valves or equivalent may give 5 to 10 per cent. greater, as may also abnormally large clearances in ordinary types.

The Elementary Principles of Transformer Design—I.

By Prof. Thomas Gray.

THE following paper is, in a somewhat expanded form, part of the notes on a course of lectures on transformers which have been used for sometime by the writer at Rose Polytechnic Institute. The treatment is brief, the object being to give, in moderate space, an outline of a method of treatment which may be followed with advantage in making an original design for a transformer. The forms of section and so forth used, in the development here given, were chosen with a view to simplicity of algebraic expression, no particular attention being given to details of manufacture or shop conditions. It will be found easy for any one who understands the conditions of manufacture and who has an elementary knowledge of mathematics to modify the formulæ to suit particular cases. It may be remarked, besides, that considerable departures from the theoretically best form does not usually mean great sacrifice of efficiency.

The methods commonly recommended for use in the design of transformers are, to a large extent, based on empirical rules, derived either from forms already in use and known to give fair efficiency of from a process of trial and selection. In the latter case a number of different forms are tried and those that give the best calculated efficiency selected as the best types. Such a method of proceeding is both wasteful of time and unsatisfactory. The prevailing idea seems to be that a purely theoretical method is either impossible or is, at least, excluded from consideration because of its difficulty. The reason given is the number and conflicting character of the variables involved.

It appears from the following discussion that the proper size and form of a transformer of any particular type can be accurately predetermined if sufficient data be available as to the magnetic properties of the iron and the working conditions. In order to obtain brevity of treatment a comparatively simple form and arrangement of the parts has been chosen in the examples here given, but the determination of the proper formulæ for any of the ordinary types and relative arrangements of the iron, coils and insulation can be readily made.

The problem which presents itself is to obtain the form which will give the requisite output of activity with the minimum input. In other words, which for a given capacity will dissipate the smallest amount of energy in a given time. One important condition has to be complied with, namely, that the energy dissipated shall not raise the temperature too high. This puts a limit on the diminution of the radiating surface. The form of cross-section of the interlinking rings must, of course, be such as can be satisfactorily and economically manufactured. Only one type of section is discussed, namely, the rectangular. It may appear that some advantage is obtained by rounding the corners of the links and of the sections, and the first of these is common practice. The second can only be done at the expense of some inconvenience in manufacture, but it must be remembered that the proper ratio of the relative dimensions may be considerably changed by such modifications of form. This is referred to and illustrated by a few examples further on.

TWO-LINK TRANSFORMERS.

Consider first the case of two closely fitting rectangular links, as shown in Fig. 1, in which one end of each link is assumed to be

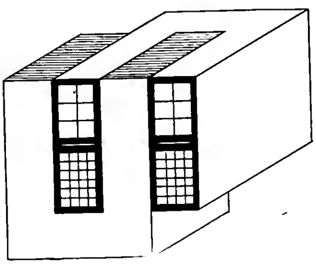


FIG. 1.—TWO LINKS.

cut off. In this case one of the links is of iron, while the other is made up of the primary and secondary coils and their insulation. Let the dimensions of the cross-section of the iron link be a_1 and b_1, and let l_1 be its mean length. Similarly let a, b and l be the corresponding dimensions of the coil link. Putting A_1 and A for the areas of cross-section of the iron and of the coils, the following equations hold:

$$ab = A \qquad (1)$$

$$a_1 b_1 = A_1 \qquad (2)$$

$$l = 2(a_1 + b_1 + 2a) \qquad (3)$$

$$l_1 = 2(a + b + 2a_1) \qquad (4)$$

$$lA = 2ab(a_1 + b_1 + 2a) = v \qquad (5)$$

$$l_1 A_1 = 2a_1 b_1 (a + b + 2a_1) = v_1 \qquad (6)$$

Equations (5) and (6) give the volumes of the links and it is evidently desirable to have as large a section and as small a volume as possible. It is clear that as far as the coil is concerned the least value of l for a given value of A and A_1 would be got if $a_1 = b_1$ and b were made very large, while the product ab remained constant. This condition would give a large value for l_1 and consequently for the volume of the iron. The question as to whether the iron link or the coil link should have the greater volume depends on a variety of circumstances, such as the relative cost of the two per unit volume, the relative energy economy of different proportions, the cost of energy, the relative time that the transformer is on the circuit, loaded and unloaded and so forth.

Consider first the case in which A, A_1 and v_1 are constant and let the problem be to determine the relative values of a, b, and a_1, b_1, so that l shall be minimum.

From equations (1) and (4) the value of a_1 is

$$a_1 = \frac{l_1}{2} - a - \frac{A}{a},$$

and from (2) and (5)

$$l = 2\left(a_1 + \frac{A}{a_1} + 2a\right)$$

Substituting for a the value of l becomes

$$l = 2\left\{\frac{l_1 a - 2(a^2 + A)}{4a} + \frac{4a A_1}{l_1 a - 2(a^2 + A)} + 2a\right\} \qquad (7)$$

Differentiating this equation, putting the result equal to zero and educing,

$$l_1 = 2\left\{a + b + 2\sqrt{A\frac{A - a^2}{A + 3a^2}}\right\} \qquad (8)$$

This equation, when compared with (4), shows that

$$a_1^2 = A_1 \frac{A - a^2}{A + 3a^2} = a_1 b_1 \frac{b - a}{b + 3a}$$

$$\therefore \quad \frac{a_1}{b_1} = \frac{b - a}{b + 3a} \qquad (9)$$

It follows, of course, that

$$\frac{a}{b} = \frac{b_1 - a_1}{b_1 + 3a_1} \qquad (10)$$

The relations here obtained for the ratio of the two dimensions of the iron section, if those of the coil section are known, and vice versa, are clearly independent of the magnitudes of the sections, and, therefore, hold for all cases of two closely interlinking rectangular rings. Equation (8) can, of course, be used for the determination of a, and hence by means of (7) the minimum value of l obtained. This is not in itself important, and the problem just given is a particular case of the following more general one:

The areas of the sections A and A_1 being assumed known, what should the ratios $b \div a$ and $b_1 \div a_1$ be so that $v + v_1$ shall be a minimum?

Here

$$v + v_1 = A\left(a_1 + \frac{A_1}{a_1} + 2a\right) + A_1\left(a + \frac{A}{a} + 2a_1\right)$$

and when A and A_1 are constant,

$$\frac{d}{da}(v+v_1)=\frac{da_1}{da}\left\{1-\frac{A_1}{a_1^2}+2\frac{A_1}{A}\right\}+\frac{A_1}{A}\cdot\frac{a^2-A}{a^2}+2,$$

which must be zero for the minimum value of $v+v_1$. This is satisfied when

$$1-\frac{A_1}{a_1^2}+2\frac{A_1}{A} \text{ and } \frac{A_1}{A}\cdot\frac{a^2-A}{a^2}+2$$

are both zero, and this also satisfies the condition imposed by the result stated in (9) and (10). The result is:

$$a^2=\frac{A A_1}{A_1+2A} \text{ and } b^2=A\,\frac{A_1+2A}{A_1} \qquad (11)$$

$$a_1^2=\frac{A A_1}{A+2A_1} \text{ and } b_1^2=A_1\,\frac{A+2A_1}{A} \qquad (12)$$

These equations apply to any case where the areas are of given size and serve under such circumstances to determine the shape. It is easy to show that equations (11) and (12) include (9) and (10).

Should it be considered more desirable to use a given ratio of volume instead of the ratio of sections it is easy to express the volume ratio in terms of the section ratio and hence of course the section ratio in terms of the volume ratio.

Let $v_1=n\,v$ and $A_1=x\,A$.

Then $n\,A\,(a+b+2a)=A_1\,(a+b+2a)$.

Substitute for a_1, b_1, etc., in terms of A_1 and A and

$$n\,A\left\{\sqrt{\frac{A A_1}{A+2A_1}}+\sqrt{A_1\frac{A+2A_1}{A}}+2\sqrt{\frac{A A_1}{A_1+2A}}\right\}$$
$$=A\left\{\sqrt{\frac{A A_1}{A_1+2A}}+\sqrt{A\frac{A_1+2A}{A_1}}+2\sqrt{\frac{A A_1}{A+2A_1}}\right\}$$

Hence,

$$n=\frac{(x+1)\sqrt{1+2x}+x\sqrt{x+2}}{(x+1)\sqrt{x+2}+\sqrt{1+2x}}$$

This is a cubic equation for the determination of x in terms of n, and hence it is more convenient to assume values of x and calculate the corresponding values of n, then either show relative values by means of a curve or tabulate the results. The graphic method is the more convenient and a set of curves showing the values of the quantities expressed by the above equations in terms of n, and, of course, indirectly in terms of x is given in Fig. 2. For convenience

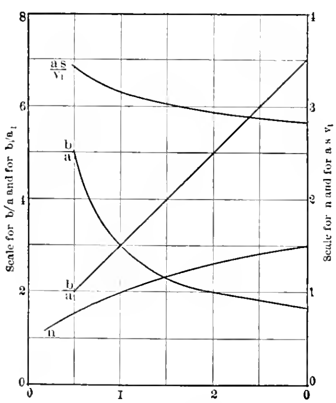


FIG. 2.—CURVES.

in the application of these equations to transformer design a curve showing the ratio of the total exposed area multiplied by the linear dimensions, a, to the volume of the iron link is included in this figure. The use of this curve is illustrated below.

So far as efficiency is concerned, without reference to relative cost of material, conditions of operation, etc., it is easy to see that the best results will be obtained when the heat dissipated in the coils is equal to that dissipated in the iron. Let the heat dissipated in the iron be H_1 and that in the coil $M\,C^2R$, where C is the current in the primary coil. Then the efficiency is

$$e=\frac{M_1E\,C-M\,C^2R-H_1}{M_1E\,C}$$

Hence,

$$\frac{d\,e}{d\,C}=\frac{M\,C^2R-H_1}{C^2}$$

which, when equated to zero, gives $M\,C^2R=H_1$.

Again the heats dissipated in the coils and in the iron are each proportional to the volume of these parts. Hence, if there be no

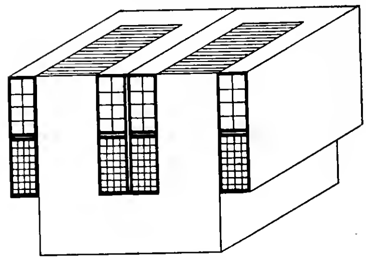


FIG. 3.—THREE LINKS.

preference as to which volume should be greatest the total volume may be taken as constant while v and v_1 are varied so as to give the least total heat dissipation. This gives the following equations:

$a\,v=a_1v_1=$ heats dissipated in coils and iron respectively,

$a\,v+a_1v_1=H=$ total heat dissipated,

$v+v_1=V$, a constant.

Hence, it follows that $a=a_1$ and $v=v_1$ for greatest efficiency. When this is the case the links become both equal and similar. It follows from equations (9) and (10) that

$$\frac{a_1}{b_1}=\frac{b-a}{b+3a}=\frac{a}{b}$$

hence,

$$b^2-2a\,b-3a^2=0,$$

or

$$b=3a=3a_1=b_1.$$

It appears, therefore, that for a given volume of iron and copper, supposed equal to each other so as to obtain the highest electrical efficiency, the ratio of length to breadth of cross-section should be 3 in the two-link type when rectangular links are used.

The total exposed areas of two links of the kind here assumed and fitting closely to each other is

$$(2a_1+b_1)\,(4a_1+2a+b)+(2a+b)\,(4a+2a_1+b_1)$$
$$+\,4\,(a_1b_1+a\,b)$$

When $b=3a=b_1=3a_1$, this becomes $114a^2$. The volumes of the same two links under the same condition is found by substitution in equations (5) and (6) to be $72a^3$. Hence, if S be the exposed surface,

$$\frac{S}{v}=\frac{114a^2}{72a^3}=\frac{57}{36a}.$$

When full load is taken as that which gives the greatest efficiency experience shows that this ratio should be from 60 to 70 times the number of watts dissipated in heat in the iron links. This condition, therefore, determines the intensity of the magnetic induction in the iron and consequently the best total activity for a transformer of this two-link type and of any given linear dimension, a. Similar data can be readily obtained for any relative value of cross-sections or volumes of the links. As stated above, this data is given in the form of a curve in Fig. 2.

THREE-LINK TRANSFORMERS.

There are two distinct types of three-link class, namely, "core" and "shell" transformers. In the first there is a single iron link and two coil links, while in the second there is a single coil link and two iron links. The general form is indicated in Fig. 3, one end of each link being assumed cut off to show the section.

Core Transformers.—Consider first the "core" type. Let a and b be the dimensions of the rectangular opening in the iron link. This will, evidently, for a close fitting arrangement, be the same as the sum of the coil sections. The total coil section will thus be the product $a\,b$. Let l be the mean length of the turns of each coil, which will be assumed the same as if the wires were uniformly distributed across the section. Also let a_1, b_1 and l_1 be the corresponding dimensions for the iron link. Then

$$a\,b = A \text{ and } a_1 b_1 = A_1, \tag{13}$$

$$l = 2\,(a_1 + b_1 + a) = 2\left(a_1 + \frac{A}{a_1} + a\right) \tag{14}$$

$$l_1 = 2\,(a + b + 2a_1) = 2\left(a + \frac{A}{a} + 2a_1\right) \tag{15}$$

where A represents the sum of the sections of the coils and A_1 the section of iron. Following the same order of discussion as before, assume A, A_1 and l_1 to be constant and find the proper ratios, $\frac{b}{a}$ and $\frac{b_1}{a_1}$, so that l shall be a minimum. In this case

$$4a_1 = \frac{a\,(l_1 - 2a) - 2A}{a}$$

$$\therefore l = 2\left\{\frac{a\,(l_1 - 2a) - 2A}{4a} + A_1\frac{4a}{a\,(l_1 - 2a) - 2A} + a\right\}$$

Differentiating, with respect to a and equating to zero, it is found that

$$l_1 = 2\,\frac{a^2 + A}{a} + 4\sqrt{A_1\frac{A - a^2}{A + a^2}}$$

Hence, by comparison with (15),

$$a_1^2 = A_1\frac{A - a^2}{A + a^2}$$

and, therefore,

$$\frac{a_1}{b_1} = \frac{b - a}{b + a} \tag{16}$$

and

$$\frac{a}{b} = \frac{b_1 - a_1}{b_1 + a_1}. \tag{17}$$

These equations only differ from (9) and (10) in having a instead of $3a$ in the denominators. In the two-link case the links could be made exactly similar and remain close fitting, so that equality of volumes corresponded to equality of sections and corresponding linear dimensions. In this case the links cannot be exactly similar and remain close fitting. Equality of sections does not, therefore, imply equality of volumes.

When the sections of the coils and of the iron are given and the problem is to find the relative dimensions of the sections which give the least total volume for the three links the equations are

$$A\,(a_1 + b_1 + a) + A_1\,(a + b + 2a_1) = v + v_1;$$

and, therefore,

$$\frac{d\,a_1}{d\,a}\left\{A - \frac{A_1 A}{a_1^2} + 2A_1\right\} + A + A_1 - \frac{A\,A_1}{a^2} = 0;$$

$$\therefore \quad a^2\,(A + A_1) - A\,A_1 = 0, \text{ or } a^2 = \frac{A\,A_1}{A + A_1}.$$

Hence, also,

$$a_1^2\,(A + 2A_1) - A\,A_1 = 0, \text{ or } a_1^2 = \frac{A\,A_1}{A + 2A_1};$$

$$\therefore \quad a^2 = \frac{A\,A_1}{A + A_1} \text{ and } b^2 = \frac{A\,(A + A_1)}{A_1}, \tag{18}$$

$$a_1^2 = \frac{A\,A_1}{A + 2A_1} \text{ and } b_1^2 = \frac{A_1\,(A + 2A_1)}{A}. \tag{19}$$

It may be observed in passing that equations (19) are identical with equations (12), and hence that the relative dimensions of the single link are the same in the two-link and three-link types when the sections have the same relative values.

When the volumes are to have a definite relative value, let $n\,v = v_1$ and the corresponding relative value of the areas be $A_1 = x\,A$. Then

$$nA\,(a_1 + b_1 + a) = A_1\,(a + b + 2a_1).$$

Substituting from (18) and (19) and reducing, the value of n in terms of x is found to be

$$n = \frac{(1 + 2x)^{\frac{3}{2}} + 2x\,(1 + 2x)^{\frac{1}{2}}}{2\,(1 + x)^{\frac{3}{2}} + (1 + x)^{\frac{1}{2}}} \tag{20}$$

A set of curves showing the values of the ratios $\frac{b}{a}$, $\frac{b_1}{a_1}$, x and the ratio of the exposed surface multiplied by a to the volume of the iron, in terms of the ratio of the volumes n is given in Fig. 4.

Shell Transformers.—In the shell type of transformers the formulæ just developed for the three-link core transformer apply if the symbols for section, linear dimensions and so forth be interchanged.

The single link becomes in this case the coils and the double link the iron. The iron may in this case be continuous through the two links, as in several well-known forms, or two separate iron links may be built up. The curves given in Fig. 4 apply in this case, when

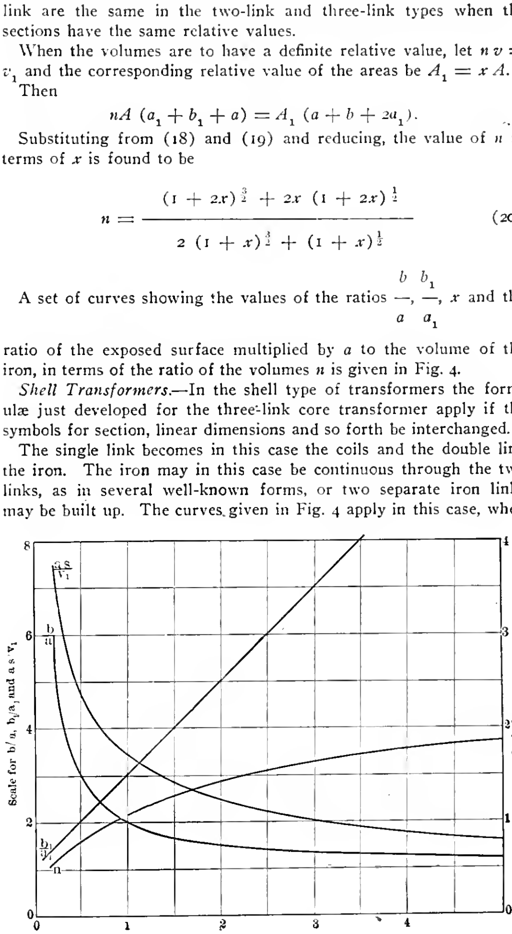


FIG. 4.—CURVES.

the proper interchange is made, with the exception of that for Sa/v_1, in which v_1 should now be the volume of the double link. It is easy, as is done below, to so modify the formulæ for practical applications that the curve given can be used and hence no separate curve has been added.

Short Rations.

The Commercial Pacific cable staff, at Midway Island, in the Pacific Ocean, ran short of food recently owing to the inability of the United States transport *Buford* to land two tons of stores on account of the rough sea. The stores were carried to Manila and were sent to Midway Island by another boat.

The Prevention of Crosses Between Signalling and High Voltage Circuits.

By Howard S. Knowlton.

THE applications of modern science to large industrial enterprises are always more or less complex. Fundamental principles may be simple enough, but their commercial use on a large scale is quite another story. This often applies to small pieces of apparatus as well as to large systems. The familiar electric push button, elementary as its function is, furnishes a case in point. Designed simply to bring two pieces of metal together, thereby closing the connected circuit, it consists of no less than fifteen parts: base, knob, cap, two springs, four washers and six screws. Similar multiplication of details may be seen in the telephone receiver, and found to occur in the parallel development and mutual relations of specialized branches in any given field of engineering.

During the past fifteen years the transmission of power at high voltages has advanced with tremendous strides. Only a few years ago the Niagara Falls-Buffalo line, operating at 11,000 volts and carrying power some twenty-six miles, was considered one of the electrical wonders of the world. To-day we talk of power sent 200 miles at 60,000 volts with little concern—unless we operate such a line, or try to telephone safely over the same right of way. This does not mean that the Niagara transmission and its plant have suffered in interest at the hands of electrical engineers, for it is one of the great industrial triumphs of the nineteenth century, and in its adoption of double the original voltage of transmission, its remarkable switchboard control and its growth to meet the needs of heavy power consumers it is as worthy an object of study as any installation that could be named.

Signalling circuits of all kinds have been multiplying meanwhile throughout the country, but the great bulk of telephone and telegraph wires which tie its communities together was planned, located and constructed prior to the advent of the transmission lines. The increasing number of circuits carrying high-potential currents has greatly complicated the signalling question, and in many instances it has introduced dangerous elements into the safe and reliable transmission of intelligence. It is important to consider some of these dangers and the methods of preventing them.

It is unnecessary here to specify in detail what may happen if a high-voltage line and a signalling circuit come in contact with one another. It is not pleasant to consider the possibilities of fatal shock, personal injury and destruction of apparatus and property through fires which such a calamity entails. It is easy to picture the consequences of letting a 25,000-volt current loose upon a telephone line designed to withstand but a few hundred volts at the outside. It is hard to find a case where an ounce of prevention is more evidently worth a hundred tons of cure.

Standard protective devices like fuses, circuit-breakers and lightning arresters have generally proved adequate in the event of crosses between telegraph, telephone, fire alarm circuits and wires carrying foreign currents at potentials up to about 2,500 volts. Beyond this limit of potential protection is problematical, and the need of extraordinary precautions becomes of vital importance. It is naturally impossible to lay down hard and fast rules applying to all cases met in practice, but there is one general requirement which must be perpetually kept in mind—*under no circumstances whatever should signalling and high-potential wires come in contact.*

Whenever new lines are laid out the hazard in question should be kept in mind so that the near approaches of signalling and power wires may be made as infrequent as local conditions permit. On existing lines wherever there is a liability of contact, the route should be changed by mutual agreement between the parties in interest whenever possible. In open country this should not be difficult to accomplish, if the right of way is flexible.

Mountainous regions frequently interpose almost insurmountable obstacles to the proper separation of high-potential and signalling circuits. Great chasms, narrow trails of appalling steepness, impassable gorges and rocky precipices demand types of line construction utterly different from that required in level or rolling country. Special forms of iron braces adapted to each individual case, the placing of signalling circuits underground at crossings with power lines, and the use of most substantial poles, double cross arms and guys are imperative if safe, continuous service is to be maintained. Avalanches of snow and rocks usually render the best of precautions valueless if the power and signalling lines are located in the direct path of the slide as it plunges down the mountains. About the only known preventive of such lines coming together in cases like this is to spend prohibitive sums of money in crossing the mountain ranges by entirely different routes, if the locations cannot be separated otherwise. It is a serious problem when one is asked to carry a number of telephone circuits and a 60,000-volt transmission line safely through a cañon perhaps a hundred feet wide, with almost perpendicular walls of rock 2,000 ft. high, towering above a turbulent river at the bottom. Something more than "paper engineering" is demanded in the solution. Nothing short of a careful investigation on the ground is likely to be of much use.

In open country the simplest way to prevent contacts of power and signalling circuits is, of course, to run the two lines sufficiently far apart so that if either one falls down it will in all cases clear the other. Such lines should not approach one another nearer than the distance equal to the height of the taller pole line. Telephone and telegraph wires should be kept off the cross arms or poles of the power line, excepting the private signalling circuits of the power company. Even these open up the possibility of serious shock, a noisy private telephone line and the burning out of buildings if the construction is not maintained in excellent condition, and it is an open question if such circuits are not better off on a pole line of their own. Whenever high-tension and signalling lines approach

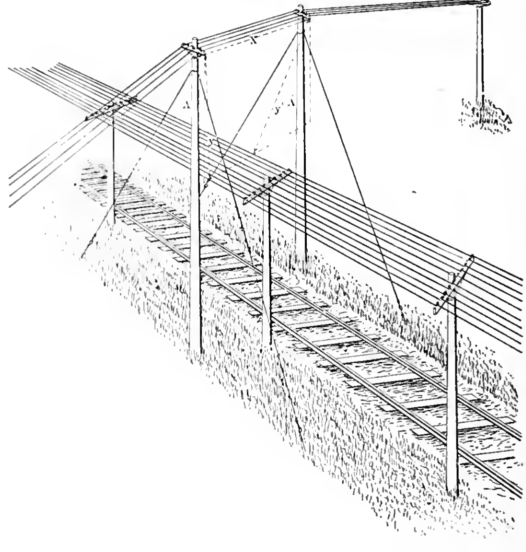


FIG. 1.—TELEPHONE WIRES UNDER HIGH-POTENTIAL WIRES.

one another nearer than the height of the taller poles, the damage may be reduced by bracing or guying the poles of the taller line with extra care. When it is absolutely necessary to carry signalling lines on the same poles with power circuits, extra precautions should be taken to reduce the liability of a break-down to a minimum, such as the use of wires of ample mechanical strength, widely spaced cross arms, short spans, double or extra heavy cross arms, extra heavy pins, insulators and poles carefully supported. The high-potential wires should be at least three feet above the telephone or telegraph line.

At times it becomes necessary for high-potential and signalling circuits to pass over or under one another en route. Extraordinary precautions are necessary to prevent crosses in such cases. The poles supporting the cross over span should be specially selected, braced and guyed, and the wires of the crossover span should be strung with more than the usual sag in order to render breakage less liable when the wires are loaded with sleet. When the high-tension wires are considerably fewer in number and greater in tensile strength than the telephone or telegraph wires, it is generally advisable to put the high-potential line overhead in making the crossing. Whenever it is feasible, end insulator guards should be placed on the cross arms of the upper line. To prevent the case of a wire breaking on either side of the crossover span, overhauling and sagging into contact with the line below, the wires at each end of the crossover span should be dead-ended to double-grooved or standard transposition insulators, and the line completed by loops fastened to the main wires. The danger of contact should still be further lessened by constructing a specially proportioned span or by guard wires.

Fig. 1 illustrates such a crossing as would be reasonably safe under most conditions of practice in open country. Here a two-phase, four-wire, high-potential circuit passes over a telephone lead: The height and length of the crossover span is made such that the distance, *Y*, between the nearest, and in this case, the only, cross arms of the upper line and any wire of the lower line is greater than the length of the crossover span, *X*. Thus, a wire breaking near one of the upper pins would not be long enough for its free end to reach any wire of the telephone line. In building this crossing the construction would be made still safer by the use of double cross arms and double-grooved insulators on the power line, with the addition of a standard ten-pin arm to each power pole in the cross-over span. These ten-pin arms should be bolted or lag-screwed into the power poles parallel to the telephone line and at about the same height above the ground, so that if a power wire should break on the outside of the crossover span, it would be difficult or impossible for it to curl up underneath the telephone line in a path perpendicular to it and thereby cause a cross. When telephone or telegraph poles are guyed near high-tension lines, care should be taken to include one or two powerful strain insulators in the guy wire, in case it is necessary to run the guy wire underneath the bare transmission line, or within range of its fall. Even if the guy is grounded the soil may be dry and a cross on the transmission circuit cause a bad burn-out on the telephone line, especially in the case of an underground construction where twisted pairs run down the pole near or adjoining the guy wire. In such cases safety may be attained by the use of a wooden strut or brace in place of the conventional galvanized-iron guy wire.

Fig. 2 is a sketch of a crossing where the telephone line runs overhead. In its essential features of protection it is similar to Fig. 1.

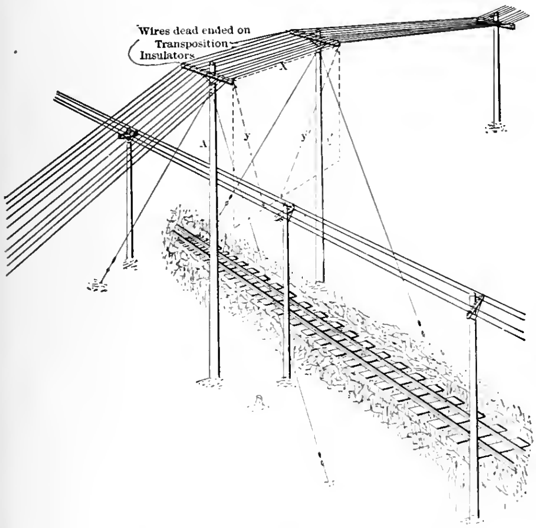


FIG. 2.—TELEPHONE WIRES CROSSING HIGH-POTENTIAL WIRES.

Here also added safety would be attained by the use of double cross arms, transposition insulators and extra cross arms on the telephone pole sides.

Another method of protection consists in the erection of a joint pole at the crossing point, the high-potential wires being supported on this pole at a distance of at least three feet above the telephone or telegraph wires. Mechanical guards or supports should then be provided, so that in case an upper wire breaks, it will be impossible for it to come in contact with any of the lower wires. Such liability to contact may be prevented by the use of suspension wires, similar to those employed for suspending aerial telephone cables, which will prevent the high-pressure wires from falling in case they break. These suspension wires should be supported on high-potential insulators; they should have ample mechanical strength and ought to be carried over the high-potential line for one span on each side of the joint pole; or where suspension wires are not desired guard wires may be carried above and below the lower wires for one span on each side of the joint pole, and so spread that a falling high-pressure wire would be held out of contact with the lower wires. Such guard wires ought to be either supported on high-potential insulators or else well grounded. When grounded they should be large enough in size to positively carry to ground any current which any of the high-pressure wires may deliver, and the construction should be such that the guard wires will not be destroyed by any arcing at the point of contact likely to occur under the conditions existing.

Fig. 3 shows still another method of making a crossing. Here the high-voltage line is above the telephone circuit, and a screen

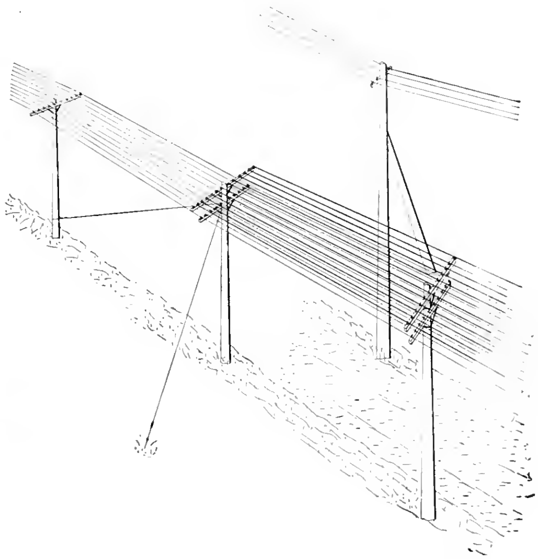


FIG. 3.—SCREEN FOR PROTECTING TELEPHONE AND OTHER WIRES.

of wires is interposed between the two lines at the crossover. This screen should always be supported on high-tension insulators or else grounded, and should be so constructed and mechanically strong enough to prevent the upper wires from coming into contact with the lower ones. The same conditions as to carrying capacity should be laid down as were previously indicated.

A type of crossing which has recently come into use in the Rocky Mountain regions is much in favor where the telephone lines are few in number, and form parts of local circuits. This is the "underground crossing" previously mentioned, and it is made by dead-ending the bare telephone wires on the usual bracket insulators; connecting these with one or more twisted insulated pairs of wires which run down the pole or tree into the ground. These twisted pairs then cross the aerial transmission line by a small underground trench three to five inches deep, reappearing and run up a pole or tree on the other side of the power line, connecting at the bracketed insulators with the metallic overhead telephone line again. In wooded country or on high, steep trails where the cost of labor and material is large, this scheme offers an attractive solution to the problem of protection. Care should be taken to run the twisted pairs on porcelain insulators in passing down or up the poles; in setting the poles far enough from the transmission line to avoid all chance of contact in case either line goes down, and lastly the twisted pairs in earth should be protected against dampness and mechanical injury by running them through a vitrified conduit or moisture-proof pipe.

Where both high-tension and telephone wires are carried underground, the cables of the high-potential lines should never occupy the same manholes or handholes, or the ducts of the same underground conduit as do the cables of the signalling system.

After the crossings in any territory have been made safe, it is advisable that they be kept so. To this end and also in order that any new or proposed crossings may be forestalled or made safe at the outset, a card catalogue record of every high-potential crossing in a company's system is an advantage. In order that all the information available in the territory under consideration may be gathered and properly filed, the signalling company should prepare printed blanks containing the following questions to be answered by its representatives in the field:

EXISTING CROSSINGS.

1. Location of crossing.
2. Name and address of company owning and operating high-potential lines.
3. Type of crossing—aerial or underground.
4. Which line is uppermost, the signalling or power wire?
5. Voltage of high-potential line.
6. Is the high-potential line direct current, single, two or three-phase?
7. For what purpose is the high-potential line used?
8. Do the crossing lines run on private rights of way?
9. When was the crossing built?
10. Which line was installed first, the signalling or power line?
11. Has the crossing ever proved defective? If so, in what way?
12. Has either the power or signalling line ever fallen to the ground in the vicinity of this crossing?
13. What precautions are taken to prevent accidental contact of signalling and high-tension circuits?
14. At what points in your territory do high-potential and signalling circuits run dangerously close to one another?
15. What precautions are taken to prevent accidental contacts at such points?
16. What changes from previous construction have been made at the crossing to promote safety?
17. State any suggestions as to the elimination of this particular crossing.
18. Note any comments which occur as not covered in the foregoing.

PROPOSED CROSSINGS.

1. Name and address of company or individual operating or proposing to operate the high-potential line.
2. Voltage of high-potential line.
3. Proposed or existing route of high-potential line.
4. Proposed or probable location of crossings with signalling circuits.
5. Has the high-potential right of way been secured?
6. In what cases, if any, will an established high-potential line be crossed by signalling circuits?
7. In what cases, if any, will an established signalling line be crossed by high-potential wires?
8. What crossings can be avoided?
9. State any suggestions as to the method of accomplishing this.
10. What plans, if any, are taking shape as to the method of making each crossing?
11. Does the proposed route of the high-potential line bring the signalling and power circuits into dangerous parallel runs?
12. When will construction begin on any proposed high-voltage line or crossing mentioned above?
13. For what purpose is the high-potential line to be used?
14. Is the high-potential line direct-current, single, two or three-phase?
15. State the number of signalling and high-voltage wires which are likely to cross at each crossing.
16. Specify briefly the route of signalling circuits which may be affected by crossings with high-potential lines.
17. Note any comments which occur as not covered in the foregoing.

It will be seen that certain detailed engineering information is lacking in the required answers to the questions enumerated. If the general data asked for is supplied, it is an easy matter to secure the engineering data, in case the difficulties of any situation demand it. The satisfactory solution of the whole high-tension crossing proposition depends upon the harmonious action of both signalling and power companies, and in so far as the various parties in interest agree just so far will signalling science be advanced, the transmission of power honored and the public protected.

A New Push-Button Voltmeter Switch.

By CHARLES L. FITCH.

THAT the portable voltmeter for switchboard work is a nuisance will, we believe, be admitted by all. At least it has always seemed so to the writer, as he has picked it up with its attendant plug and cord, and tramped back and forth, when cutting in a new generator on a direct-current switchboard.

The switchboard with its equipment has been so much improved that it would hardly be recognized by its original prototype; but the plug and cord still remain with us, or at best are only replaced by the multi-point voltmeter switch, which is just about as bad, so far as the tramping goes.

It has always seemed as though the voltmeter should form an in-

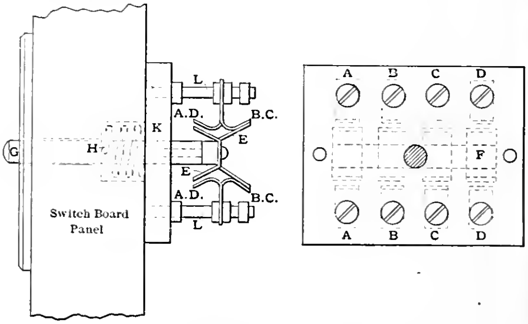


FIG. 1.—SECTION ELEVATION AND BASE PLATE.

tegral part of the switchboard, and all of its connections be of a permanent character like those of the other instruments; that it should be hung out upon brackets, so as to be visible from any point down the line, and normally register bus-bar voltage; and that each generator panel should be provided with a spring-actuated fly-back switch, by which the voltmeter is made to read across the terminals of that particular machine when the switch is operated, automatically returning to its bus-bar reading as soon as the switch is released. This would do away with all of the tramping, and is just what is accomplished through the little device illustrated herewith.

The switch itself, which is the essential feature, is of the push-button type, and has its moving parts all behind the board. It is

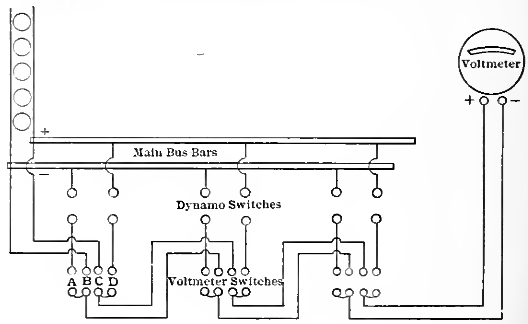


FIG. 2.—DIAGRAM OF CONNECTIONS.

essentially a double-pole, double-throw switch, but is made with eight contact points, as shown, for mechanical reasons, and because it is desirable to break contact at more than one point at once, to avoid the possibility of arcing.

The switch, as here constructed, has four pairs of contacts, *A*, *B*, *C* and *D*, two of which, *A* and *D*, open toward the front, and the other two toward the back. Each pair of contacts is arranged to be closed by one of four V-shaped plugs, *E*, which are carried on a cross-bar, *F*, operated from the front of the board by the push-button, *G*. A spiral spring, *H*, serves to hold the switch in its forward position with the contacts *B* and *C* closed, until the button is pressed, when *B* and *C* are opened and *A* and *D* are closed. When the button is released, the switch immediately returns to its original position.

The push-button rod, cross-bar and base plate, *K*, are of hard rubber, while the contacts are of red bronze. The steel rods, *L L*, which support the contacts, are threaded throughout their entire length, and are screwed through the base plate. They are provided with jam nuts, by moving the position of which the contacts may be accurately adjusted.

As may be seen from the drawings, the switch is very simple to make, its range of motion is quite small and there is nothing to get out of order.

In the diagram of connections shown, we indicate three of these voltmeter switches, as if mounted on three several generator panels of a direct-current switchboard. Above each voltmeter switch is shown the main dynamo switch of that panel, to the machine side of which the voltmeter switch is connected. The remainder of the diagram speaks for itself.

A set of these switches has been for a year past in daily operation on the switchboard of the generating plant of the Grand Union Tea Company, at Front, Pearl and Water Streets, Brooklyn, N. Y. This plant has a capacity of 1,000 hp and was designed by the writer. Its switchboard has five generator panels and one storage battery panel, all of which are provided with "push buttons." An inspection of them there will show how perfectly they work and how really convenient they are.

Recent Electrochemical Developments.

ELECTROMETALLURGY OF GOLD.

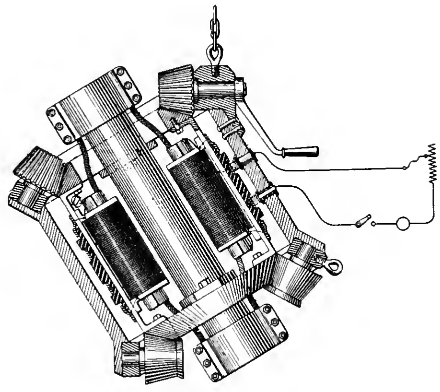
A patent was granted on April 5 to Mr. Charles Butters, who has been one of the most active workers in the introduction of the Siemens & Halske process for electrolytic precipitation of gold from cyanide solutions in South Africa, and who has modified this process in recent years in various plants in this country and in Mexico. In the original Siemens & Halske process the gold was plated upon the cathode and the anodes were of iron. The iron was gradually attacked, with the formation of prussian blue, and for this reason the iron anodes were covered by canvas or the like. Andreoli substituted lead peroxide for the iron anodes, with the result that the anode became practically undistructible. This enabled the use of a higher current density, but the gold is then no longer plated upon the cathode, but is deposited in a loose powdered or slimy form and may be easily wiped up from the surface, so that it is comparatively easy to collect the gold from the cathode. However, with the former cathode used, a difficulty was then experienced, for an iron cathode rusts and produces a rough surface, while aluminum cathodes become brittle and fall to pieces. Mr. Butters has found that a cathode of tin or of tinned iron is most suitable. He places the cathodes and anodes opposite to each other and passes the solution between the electrodes in an upward or downward direction, using a current density of 0.5 amp. per sq. ft. of cathode. The gold deposits in a loose slime form on the tin surface and may then be easily removed. Some very interesting details concerning this development on an industrial scale were recently given in a paper by E. M. Hamilton (*Electrochemical Industry*, April), who gives an account of the practical working of this modified Siemens & Halske process in various plants in this country and in Mexico.

Prof. S. B. Christy, of Berkeley, Cal., who has been quite active in the past in the development of the theory of the cyanide process, points out in a patent granted on April 5, that in the solution of potassium aurocyanide the cation is potassium, while the anion is complex and represented by the formula $AuCy_2$. This has been known since Hittorf, but the importance of this fact for practice has not been sufficiently appreciated. As a consequence of this fact, any current which passes through the solution deposits primarily potassium upon the cathode, and the deposition of gold is a secondary action. The current tends to bring the gold over to the anode. On the other hand, in order to get a gold deposition on the cathode it is of the greatest importance to have the solution rich in gold near the cathode, and the importance of good circulation is, therefore, evident. The author sends the current from a storage tank through the electrolytic cell and back again. In the cell he employs perforated anodes and cathodes alternately arranged. The solution is forced through the holes in the plates. The inventor claims that the speed of the deposition is greatly increased and that nearly the whole gold contained in the solution is taken out of it.

A patent granted to Mr. E. Fahrig, of Philadelphia, on April 5, relates to arrangements for winning the precious metals from low-grade ores and tailings by electrolysis. The finely-ground ores or tailings are mixed with water and a suitable electrolyte so as to form a pulp, which is then passed by gravity between a series of pairs of inclined anode and cathode plates arranged in tower fashion one below the other. The cathode plates are removable so that the deposited metals may be scraped off. The partially extracted pulp is then passed through a riffle trough into a leaching tank. Finally, the partially extracted pulp is subjected to filtration or decantation and the liquor is heated and subjected to electrolysis.

ELECTRIC FURNACE INVENTION.

A patent was granted on April 12 to Mr. Henry Noel Potter, of New York City, who has for some time been engaged in developing a convenient tube furnace. He uses a carbon tube lined and coated externally with fused magnesia which, under such conditions, does not shrink under the action of heat. The tube is also well jacketed by some good heat-resisting material, such as calcium oxide. The present patent relates to mechanical details of the arrangement for revolving the furnace and for supplying the current to the furnace. It is shown diagrammatically in Fig. 1. The furnace is provided with one or more transformers, the secondary of which feeds metallic



POTTER ELECTRIC FURNACE.

split rings forming the terminal connections of the furnace. The method of revolving the furnace is clearly shown in the illustration, and it will be seen that the material to be heated is passed in from the upper end and the rotation of the furnace causes the charge to feed regularly the lower end.

A patent granted on April 12 to Dr. G. Erlwein, of Berlin, Germany, relates to the manufacture of calcium cyanide from mixtures containing either calcium oxide and charcoal or calcium carbonate and charcoal, in the electric furnace, while nitrogen is conducted either over or through the mixture. It is stated that it is not necessary to employ theoretically correct proportions of the mixture, and that one may add to good advantage more charcoal or organic substances containing carbon, such as sawdust, pitch, tar or the like.

PRODUCING CHEMICAL COMPOUNDS FROM CALCIUM CARBIDE.

The chemical activity of certain metallic carbides is well known. A patent granted to Mr. J. J. Griffin, of Washington, D. C., relates to an interesting method of utilizing the chemical activity of calcium carbide for the production of various chemical compounds. He employs the calcium carbide as the material for the electrodes in an electrolytic cell. This is possible because, according to the inventor, calcium carbide conduits electricity like a metal. As an example of what happens in such a process, the electrolysis of an aqueous solution of sulphuric acid with calcium carbide electrodes in a diaphragm cell may be given.

The water of the solution reacts on both electrodes to give acetylene. At the cathode two atoms of hydrogen react on one molecule of acetylene to give ethylene, and four atoms of hydrogen react on one molecule of acetylene to give ethame. The ethylene so produced further reacts on the sulphuric acid in solution to give ethyl sulphuric acid. At the anode two atoms of oxygen react on one molecule of acetylene to give glyoxal, and four atoms of oxygen react on one molecule of acetylene to give oxalic acid. The inventor mentions quite a number of compounds which can be produced in this way, but does not give distinct directions how to obtain a certain desired pure compound in each case.

ELECTROLYTIC BLEACHING.

A patent granted on April 5 to Mr. A. A. Vogelsang, of Dresden, Germany, relates to apparatus for the bleaching of cotton yarn and other textile materials in large quantities, say a ton and upwards. The material is first treated with a solution of caustic soda, then with one of bleaching liquor, and finally with a weak solution of sulphuric acid. The apparatus comprises tanks for the preparation and reception of these solutions, an electrolyzer, vats for the bleaching operation and accessories. A special feature is the construction and preparation of the bleaching vat.

BATTERY INVENTION.

A patent granted on April 12 to Mr. G. W. Frost relates to mechanical details of construction of a storage battery grid. The grid comprises a rectangular frame, a series of retaining strips extending between the sides of the frame at each face of the grid, the strips of the two series being relatively staggered; and a horizontal web extending from each strip substantially through the grid.

Mr. C. B. Schoenmehl patents details of construction of primary cells with a depolarizer like copper oxide. In order to insure a uniform and thorough consumption of the depolarizer, he puts it into a receptacle whose breadth is greatest at the top.

Mr. E. Whitman patents a battery cell comprising a cylindrical member of carbon, surrounded by a coating of glass. The glass permeates the pores of the carbon in a similar way as when paraffin is used.

Messrs. A. F. Swan and A. W. Rose patent details of construction of a dry cell intended to get a large number of cells in as small a space as possible, and to render the switching operations easy.

New Telephone Patents.

THE TELEPHONE REPEATER.

Again the telephone repeater has been brought forward by the issuance of two patents to J. Trowbridge, of Cambridge, Mass., which describe respectively new repeating methods and means. For our purposes it would seem best to consider these patents together. The repeating apparatus is shown in Fig. 1 and consists of a granular

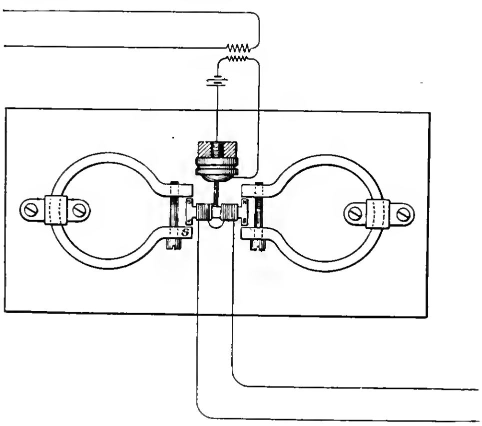


FIG. 1.—TROWBRIDGE TELEPHONE.

carbon transmitter button, secured to the middle of a diaphragm (not shown) in the usual manner and a motive apparatus, controlled by the received voice current, and actuating the diaphragm in response thereto. At *M M* are two permanent magnets, between the respective poles of which project the ends of a soft-iron armature piece. This latter carries at each end a coil, these being so connected together as to assist each other in the magnetization of the armature. As will be seen, the receiving line, *L*, is connected to the armature coils, while the transmitter button by means of a battery and induction coil, introduces repeated currents upon the line, *R*. The inventor finds that the receiving part of his instrument, in which the magnetic pull is balanced by the mechanical rigidity of the diaphragm, is very sensitive to minute received currents, the degree of sensitiveness being controllable by adjustment of the pole span of the permanent magnets. The use of a diaphragm as a support for the moving systems seems to be of advantage as a tell-tale for the inspector in charge of such instruments, in that it audibly repeats received currents, if the instrument be operating satisfactorily.

SELECTIVE SIGNALLING.

Selective signalling continues to be the subject of many patents, there being at hand for consideration three newly patented systems. The first of these to which attention will be given is the invention of B. Stryker, of Washington, D. C. This is a modification of the selective signalling system now standard with the Bell companies, the primary object being to overcome certain deleterious effects of earth potentials. In the system as previously adopted, a relay controlling by its contacts the bell circuit, is bridged across the line at each station, a condenser having first been introduced into its circuit. The various bells, sensitive respectively to either positive or negative impulses alone, are then connected through the relay contacts from the line to ground, one bell of each kind being used for each side of the line, or four in all. Now, when considerable and variable potential differences exist between the various station bell grounds, at times the direct currents in consequence thereof flowing through the bells will completely overpower the selective signalling currents and either cause failure of action or false signals. Mr. Stryker's scheme for overcoming the defect is shown diagrammatically in Fig. 2. It will be at once seen that the relative position

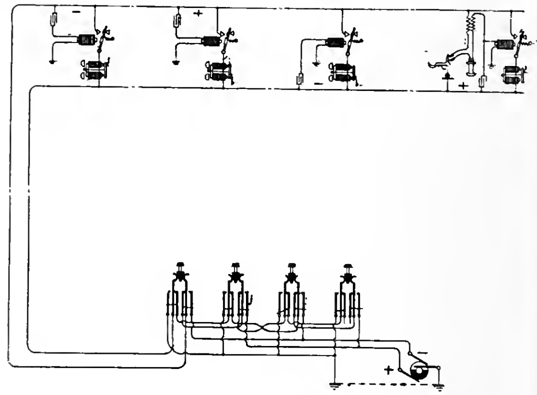


FIG. 2.—STRYKER SELECTIVE SIGNAL SYSTEM.

of bell and the relay and condenser, have been changed, the relay circuit alone being grounded. As the relays at all stations must operate on both impulse currents, whether positive or negative, the presence of a condenser in the relay circuits is of no effect, except to overcome entirely the flow of direct currents due to earth potentials. The bell-controlling relays may be any one of several special types which have been heretofore described in these columns. The American Telephone & Telegraph Company has been assigned the patent for this system.

A second system is that of Messrs. N. S. McKinsey and A. R. Nelson, of Susanville, Cal. This is what might be called an automatic step-by-step system, for all the various operations of selecting and calling a desired subscriber follow automatically the natural events of instituting a connection. Thus, the removal of a calling subscriber's telephone from the switch-hook at once so manipulates the apparatus at all other stations, if the line be not busy, as to give him absolute control. The depressing of a push-button moves synchronously all selective switches, and in addition connecting the stations to the line one after the other. In addition a dial apparatus indicates automatically just which subscriber is connected to the line at any instant. When the indicator shows the desired line, the release of the push-button stops all selectors and rings automatically the desired subscriber, while his response by lifting his receiver stops the ringing and completes the talking circuits. As soon as the conversation is completed, the apparatus all restores to normal upon the return of the calling subscriber's telephone to the switch-hook. It seems rather too bad that such a comprehensive system must depend for any of its functions upon a spring-driven clockwork.

Mr. Robert Hamilton, of Milton, Mass., is the patentee of the third selective device, his invention being directed principally to means for clearing out a line arranged for step-by-step selection. The return of the receiver to the hook at the calling station restores at once all selectors.

TELEPHONE CABINET.

Mr. W. B. Altick, of Lancaster, Pa., has patented another type of sliding-front telephone booth in general cross-section somewhat similar to his last preceding one. As in that roof, floor, backboard and half side pieces are provided rigidly fixed together, while the whole front may be slid away to permit of entrance. In this latest design there is laid out a spiral track on both roof and floor, this track having a length of approximately one and one-third circumferences, with the overlap in the rear of the booth. The sliding front, in two parts, is curved, so that it may easily slide in the track, from the rear of the booth, where the two parts overlap, to the front, where they abut. Packing pieces of flexible material secured to the forward edges of the stationary sides help to seal the booth to make it more impervious to outside noise.

SECRECY SYSTEM FOR COMMON BATTERY SWITCHBOARDS.

Many telephone users hesitate about mentioning confidential matters over the telephone because of fear lest the operators overhear them. It is evidently with an idea of reassuring such persons that a secrecy system, patented by E. H. Smythe, of Freeport, Ill., has been brought out. The system in its present form is adapted to cord circuits on the common battery system, wherein two supervisory signals are used, and the exclusion of the operator from the circuit during the existence of a conversation is accomplished by a differential relay. The tops to the operator's set are carried from the listening key through the contacts of the relay, which is of the two-circuit "cut-on" type; that is, when energized the contacts are closed. Of the differential relay windings, one is associated with the answering plug supervisory and one with the calling plug. Therefore, when both supervisories are out, as during conversation, the operator's connection to the listening key is severed by the de-energization of the relay, and again when both lamps are lighted, showing both parties to have hung up their receivers. When, however, one lamp only is lighted, the condition during the completion of a connection, the relay will be energized, its contacts closed, and the operator able to respond to the subscriber. The Western Electric Company has obtained this patent by assignment.

A NEW STRIP SPRING JACK.

Mr. Merritt S. Conner, of Chicago, has produced a spring jack strip quite novel in that no supporting plate is used, the front thimble supporting strip and the rear spring supporting strip being held together solely by the thimble connection strips. These latter are, of course, of extremely strong construction and the spring supports are built up upon them to form a rigid whole. With his type of construction Mr. Conner is able to readily space his jacks upon 5/16-in. centers on 5/16-in. strips, the jacks being designed for three-wire cord circuits.

SOME TRANSMITTER IDEAS.

Magneto transmitters are, of course, rather out of date. Nevertheless, a patent for one of new design has recently appeared, the inventor being M. C. Burt, of Chicago. In this transmitter a series of concentric cores and coils is used, forming together a compound electromagnet. In order to regulate the intensity of the generated telephone currents, a controller is provided, by means of which one or more coils may be switched from the circuit.

J. A. Williams, of Cleveland, Ohio, has introduced a spring within the casing of his transmitter, which is of the granular carbon, inertia type, to hold the back electrode flexibly to the annular support of felt upon the rear of the diaphragm. He has patented his invention and assigned the patent to the Williams Telephone & Supply Company.

A speaking tube extension for telephones forms the subject of a patent granted to J. J. Nye, of Brookfield, Vt. This is a speaking tube apparatus terminating in one end in mouthpieces designed to receive a telephone bell, a transmitter and a receiver. If a signal arrives on the bell it will be heard wherever the speaking tubes extend, while it is the idea of the inventor that response to the transmitter and the sounds from the receiver may also be made and heard, respectively through the same means.

SANITARY ATTACHMENT.

A book of perforated paper sheets, each of which is adapted to be placed over the mouth of a transmitter, forms the basis of a patent granted to H. L. Thompson, of Waterbury, Conn. The sheets are rectangular in section and the corners are ruled diagonally, so that they may be easily folded to grip the transmitter mouthpiece and thereby retain the paper sheet across its face.

TELEPHONE SUPPORT.

Another receiver supporting arm has appeared in a patent issued to G. Königstein, of San Francisco. This support has the now usual mechanical attachments to the hook switch to manipulate it when the receiver is not in use. Moreover, an additional manually-operated lever for manipulating the switch-hook is provided.

PEARNE TRANSFER PLUG.

A few weeks since we had occasion to notice a patent granted to F. D. Pearne for a switchboard plug containing within its shank a mercurial switching device. In the absence of detailed information, it was suggested in our comment that such switching device was probably for the control of supervisory lamp circuits. This we have learned from the manufacturer of the plug was erroneous, in that the lamp which is controlled is that of a transfer, for which type of circuit the plug is primarily designed. It was also suggested that the use of four strands in that very vulnerable part of the switchboard, the connecting cord, and the dependence upon a mercury contact might prove of serious disadvantage. Both of these suggestions were based upon experience in telephone operating. We are glad to hear, however, that no troubles of this kind have been found by the manufacturer in his experiments with the plug, which we understand have extended over a period of one year.

Radium in Treatment of Blindness.

The following is from the European edition of the New York *Herald:*

"About a month ago the German press announced that Prof. London was occupied in St. Petersburg in ascertaining the effects of radium rays on blind eyes, and that he had hopes by this means of restoring the power of sight. As the Emperor William evinced considerable interest in the professor's researches, the Minister of Public Instruction requested Prof. Greeff, director of the eye clinic at La Charité, to study the effects of radium on healthy and diseased eyes and report thereon.

"In the last number of the *Deutsche Medicaler Wochenschrift,* Prof. Greeff describes his experiments. As regards the effect of radium on healthy eyes, he shows that this is first apparent when the radium preparation is brought within about 10 cm. of the eye. The eye then suddenly becomes aware of a strange, faint, pale green luminosity which gets dimmer as the preparation is withdrawn. The patient is unable to say whence the rays proceed. At the beginning of the illumination the retina is not immediately affected by the rays —the effect of light is created by the fact that certain parts of the eye, especially the crystalline lens, are rendered fluorescent by the radium, and of this the retina becomes conscious. In regard to the action of radium rays on blind eyes, says Prof. Greeff, we must, before all, take into consideration their condition—whether completely sightless or still in possession of some remnant of vision. The latter are generally classed as blind because their powers of sight are so limited that they are, for all practical purposes, the same. Physiologically, however, there is a considerable difference in so far as in one case there is a consciousness of light, in the other none.

"Prof. London neglected to test the patient's consciousness of light in each case, whence it followed that the blind persons whom he tried with radium rays furnished negative or contradictory data. If by chance he fell upon a patient who still possessed a vestige of sight, the patient was able to perceive the effect of the radium. Prof. London then tried, by presenting shadow pictures, letters, etc., on a transparent screen illuminated by radium to bring these objects within comprehension of the blind patient. By this means the eye of a blind man still able to distinguish light from darkness gained the sensation of being able to see large objects. This sensation—and this is the decisive factor—can be also obtained by the substitution for the radium and the fluorescent screen of a petroleum lamp and a dark shade. He has, therefore, come to the conclusion that radium rays have no specific effect."

CURRENT NEWS AND NOTES.

RADIUM IN COINS.—A special dispatch from London of April 16 says: "The amount of radium to be procured in London to-day is less than a grain, according to the *Pharmaceutical Journal,* which suggests that chemists follow the example of one who obtained a small tube of five milligrams of radium bromide series out of half a crown in an hour." This has a rather apocryphal sound.

SHADOW CLOCK.—To Prof. Hirth, of Munich, Bavaria, is attributed the invention of an ingenious clock for night use. The invention consists of a lamp, which, on a button being pressed, throws upon the ceiling an optical representation of a small watch lighted by electricity. The figure is sharp and distinct and is enlarged to the size of a church clock. Such a device would find especial application in the sick room.

LATEST POPULATION FIGURES.—The United States Bureau of the Census has decided to make annual population estimates and has just issued a bulletin for 1903 for 438 cities and towns. These figures are useful for many statistical purposes. The total population was estimated to be just short of 80,000,000. New York City alone is estimated to have 3,716,139 inhabitants, or about 280,000 more than it had three years ago. To Chicago, which in 1900 contained 1,698,575 inhabitants, 1,873,800 are at present attributed. St. Louis, which had 575,238 in 1900, has since managed to pass the 600,000 mark, and Boston has nearly reached it with 594,618—about 34,000 more than it had three years ago. If such suburban towns as Cambridge (98,444) and Somerville (68,000) were incorporated with the city, the population of Boston would be not far from 800,000.

CITY OWNERSHIP IN CHICAGO.—In his message to the Chicago City Council, after the recent referendum vote favoring municipal ownership of the street railways, Mayor Harrison advised strongly against an immediate trial of city management and against the proposition to take up the business of the Chicago Passenger Railway Company, whose franchises are expiring. If the comparatively small mileage of that company could successfully be conducted by the municipality, the properties of the Union Traction Company and of the Chicago City Railway Company could then be taken over when their franchises lapse. But Mayor Harrison objects wisely to this and says: "If the idea be by this means finally and effectively to inaugurate general public ownership of all the traction utilities of the city, the suggestion is utopian rather than practical." He proposes as more sensible a new contract with the traction companies calling for the surrender of rights claimed under a legislative act of 1865 granting ninety-nine-year franchises, and providing that the money received as compensation be turned into a sinking fund. At the end of ten years this sinking fund is to be used in the purchase of the lines.

GOVERNMENT TELEPHONY IN PARIS.—A cable dispatch from Paris of April 16 says: "The telephonic war in Paris is causing no end of excitement, and for the moment every one has forgotten the war in the Far East. It is notorious that Parisians are at the mercy of the telephone service. They have worn the yoke of imposition and oppression so long they have almost ceased to complain. The 'Hello Girl' of New York is a dream of perfection compared with the article in Paris. The subscriber is very small fry in the latter's estimation, not worthy of consideration. But at last the worm is showing a disposition to turn, and the time seems to be at hand when the 'man who pays the freight' can hope for better treatment. In the first place the subscriber must buy his instrument outright. It costs him about $40. Then he is required to pay a quarterly rental of $20 in advance. As an instance of the treatment generally received by subscribers the case of Mlle. Sylviac, a well-known French actress, may be cited. She was breakfasting a few days ago with a friend at her own home when she found it necessary to use her telephone. She called for three-quarters of an hour before 'central' responded. Mlle. Sylviac rebuked the girl and the latter gave the actress an insolent reply. Thereupon she called up the superintendent and reported the 'hello girl.' The superintendent defended the employee. The actrss said the girl had talked to her in language like that of a vulgar milkmaid. The next day Mlle. Sylviac received notice that she could no longer have the use of the telephone unless she apologized to the telephone girl. The actress discovered later that the number for which she had asked had not been called up at all. She immediately instructed her lawyer to begin an action against the government to compel it to restore her telephone rights. She is backed by all the Paris newspapers, one of which says editorially to-day that it is a wonder the public does not resort to an axe instead of language in rebuking the insolent employees of the government staff."

LETTERS TO THE EDITORS.

Reciprocating vs. Turbine Engines.

To the Editors of Electrical World and Engineer:

SIRS:—We are certainly much indebted to Mr. Seymour for the valuable data presented in his article entitled, "The Economy of the Reciprocating Engine at Light Loads," appearing in your issue of April 2, particularly in relation to the losses in a high-grade engine type unit at various loads. The results which are shown are of great interest, and represent an excellent performance justly gratifying to any engine builder. It would seem, however, that a little more light thrown upon the above interesting subject from so authoritative a source would be generally appreciated. From the title of the article it was naturally expected that specific data upon actual performances might have been presented, rather than that conclusions should have been drawn from performances of other engines, the test conditions of which are not presented, especially as a rigid comparison has been made with a specific certified test of a turbine unit under loads ranging from less than 1/6 load to 60 per cent. overload.

Although the data given appear to be authoritative in every respect, it is, nevertheless, unfortunate that more than two observations were not given from which the character of the water rate curve might be determined, especially its extremes corresponding to overload and underload, which are in reality the object of the discussion. It is true that in Fig. 2 total losses have been given based upon tests of a similar engine unit, but *these losses are expressed in terms of total losses at full load,* instead of in terms of indicated horse-power, so that no information is at hand concerning the indicated steam consumption of the engine from which the general form of the water rate curve under half load might be determined. Much information might also be derived from the curve of total water consumption, from which observed results should be given as well as derived results.

Mr. Seymour states that his water rate curve is plotted from acceptance tests by Messrs. Moulthrop & Curtiss, and later that the results of No. 8 engine have been excluded "on account of conditions which prevented correct economy of the engine from being obtained." The average economy of the two engines tested by Messrs. Moulthrop & Curtiss was 12.15 pounds per indicated horse-power, which is not as good as that quoted in the article—11.54 pounds per indicated horse-power—although the curve shown is said to be based upon the former independent tests.

For electric lighting engines with ratios of approximately one to four, the lowest steam consumption per indicated horse-power usually occurs at about .75 to .8 full load. On curve C the point of lowest steam consumption per electrical horse-power appears about .7 load, from which we would gather the point of lowest steam consumption per indicated horse-power would occur at about .63 load. The rating is stated to be upon a basis of 165 pounds pressure and 27-in. vacuum, whereas the tests were made under 160 pounds pressure and 25.6-in. vacuum. As the lowering of the vacuum 1.4 in. and the pressure 5 pounds will lower the power of the engine for a given cut-off by about six pounds, or 2¾ per cent. of the pressure, it would be of interest to know the basis upon which the curve C has been plotted, as this materially affects its position with reference to the scale of abscissæ.

The object, however, for which we particularly beg space in your columns is to correct some inferences that might be gathered from the remarks Mr. Seymour has made regarding the steam turbine.

At the outset Mr. Seymour states "that the ideal engine should expand to back pressure, but to do this in an actual engine would load it much below its economical point." This is true, but it is a small part of the story. Were the engine to expand to the pressure of the vacuum, the increase in bulk and in losses, due to friction and cylinder condensation, would more than nullify the increase in internal economy, due to greater expansion ranges. In practice, the reciprocating engine for power purposes does not expand below 5 pounds, or 1/3 vacuum, whereas the turbine readily expands down to condenser pressure.

In his comparison, Mr. Seymour has missed an important feature of the turbine—that it may be run at full load with its best economy —whereas the engine must be run at about 25 per cent. underload to secure its best economy. He says:

"Central station managers will hardly consider it practical to run steam turbines at their most economical loads without a greater overload capacity than it is proposed to give them where the station load is a fluctuating one."

The published results from which he draws his conclusions show that the turbine under consideration carried 60 per cent. overload when operating under the lowest vacuum at which the machine was tested, and at this overload its economy was only 5 per cent. higher than at full load. All Westinghouse-Parsons turbines are capable of carrying overloads considerably beyond the capacity of the generator when operating under their usual conditions, and they will also carry full load when operating without vacuum. Moreover, in the turbine unit, the points of best efficiency of turbine and generator coincide, while with the engine unit the generator operates considerably below its point of best efficiency when the engine is giving its best economy. If, then, the turbine under consideration possesses an overload capacity commensurate with the engine and one that is suitable for the most exacting demands of fluctuating loads, why, then, should not the points of best efficiency of engine and turbine be more nearly superposed for proper comparison of water rate curves?

From the form and position of the curve C, it would appear that the engine under discussion is somewhat overrated. Furthermore, Mr. Seymour states, "In the case of a turbine, a very high vacuum is necessary in order to maintain either its capacity or its economy."

Although this may be said of some types of turbines where surface friction constitutes one of the most important sources of loss, it is not true of the type of turbine under discussion, as shown by the tests given by Mr. Mattice and by others. Naturally, the capacity and economy of the turbine is reduced by a lowering of the vacuum in precisely the same manner as the reciprocating engine. A reduction of boiler pressure would result similarly, but in the Westinghouse-Parsons turbine, the losses due to these sources are not so serious as might be inferred from Mr. Seymour's remarks; for instance, the economy will not fall more than 3 per cent. or 4 per cent. for each inch of vacuum down to a reasonable limit, say 25 in.

Pittsburg, Pa. Francis Hodgkinson.

Output of Rotary Converters.

To the Editors of Electrical World and Engineer:

Sirs:—An editorial in your issue of April 9 takes up the subject of rotary converters and their increased output over that of corresponding direct-current machines. It refers to the fact that this increased output is due to conditions existing in the rotary which keep down the armature losses, and incidentally mentions Messrs. "Steinmetz, Child and others" as having investigated this subject, the mention being made in a manner which seemingly credits the gentlemen named with being the first investigators along these lines.

In the issue of your paper for June 15, 1895, is an article written by myself in which the output of polyphase (including single-phase) generators and rotary converters is discussed relative to the armature copper losses, or heating, and with particular reference to the manner in which such losses vary when different numbers of phases are employed. This paper is, to the best of my information, the earliest published discussion of the subject with which it deals. The ground which it covers has been gone over in subsequent articles, in many cases employing an analysis practically identical with mine, but giving me no credit whatever. It seems only fair that your attention should be called to this fact, as some of the papers mentioned have appeared in the columns of your journal.

Out of the investigation on which my paper was based resulted my invention of the six-phase rotary in which the output is greatly increased over that of a three-phase rotary by the simple and comparatively inexpensive expedient of using three additional collector rings. A number of patents embodying variations of this invention have been issued since mine, but my original scheme is, to the best of my belief, the one now most generally used. It may be pertinent to add in this connection that the device further mentioned in your editorial and in the article by Mr. Baum of using artificial reactance in the compounding of rotaries, was also patented by me and under my patent it is controlled in this country to-day.

New York. Ralph D. Mershon.

The Inventive Faculty.

To the Editors of Electrical World and Engineer:

Sirs:—Your valuable and well-composed editorial in the issue of March 19 has been considered. Mr. Dooley once observed that the Supreme Court decided:

1st. The prisoner is guilty. 2d. The prisoner is not guilty.

I well remember the decision to which you referred. Condensed, it might read: 1st. Claims 2, 3 and 10 are void because not exhibiting an exercise of the inventive faculty. 2d. We cannot define what constitutes an exercise of the inventive faculty.

It is plain to me that the court lacked inventive faculty, if it could not render a better decision than that. I generally admire their opinions, but that one was too much for me. It is about as if they should decide: 1st. The man is guilty because he lied. 2d. We do not know what a lie is.

To come to the practical point, which is of definite value to the many well-known inventors among your readers, some of our brightest engineers are often puzzled as to whether their invention is of a patentable nature or not. The question of inventive faculty only presents itself when the construction is on the dividing line between engineering design and patentability. There are many definite principles of invention, some of which are as follows:

1. The accomplishment of a result previously thought practically improbable. Examples: The telephone, wireless telegraphy, the Pupin choking magnet system, and in general any pioneer invention creating a new art.

2. A construction saving labor, time, material or anything that is valuable. Examples: Micanite, which makes use of scrap mica; dies for stamping out blanks, instead of cutting them by hand, and Matthew's photometer, which saves the time of calculating.

3. Succeeding commercially in accomplishing what others attempted. Examples: Incandescent electric lamp and Nernst's lamps, Tesla motor, etc.

4. Simplifying. Examples: Doing away with overmuch mechanism, as in electric regulators, meters and other devices which are continually improved in this respect.

5. Converting manual into automatic devices. A high type of invention. Examples: The penny-in-the-slot machines, electric cutouts and typewriters.

6. Detail improvements. This is the most prolific field of all. Examples: The thousands of devices now in use are more truly improvements than pioneer inventions. It is the improvement that puts an invention on the market, makes money and often promotes comfort. Those that are becoming ripe for a new field are steam and gas turbines, wireless telegraphy, polyphase-current regulators; X-ray apparatus, now that tumors and cancers are being treated and often healed; photometers, etc. Just when we think a device is about perfect, behold, a new and valuable improvement appears.

There are several other rules I have thought of, but I will not take more of your precious space, as my object was to remind your inventors that the Supreme Court decision, as is often the case, related to an invention on the dividing line, where naturally patentability is more a matter of opinion than evidence. Consequently, the court is usually not unanimous, and the several judges of the lower courts have made all the claims alternately void and valid, and so on, indefinitely, from court to court. There are thousands of money-making patents that have never even appeared in the courts, because they are not on the dividing line. Although there are worthless patents, yet the general rule is that the patent is valuable if the invention is valuable, provided, of course, the claims in the patent properly protect the invention. The claims are the heart of the patent. They are highly technical definitions of the invention as distinguished from the device, each one progressively subordinate to some other one of the same group, and all interwoven upon predetermined and complex forms.

New York. Edward P. Thompson.

Individual Motor Drive.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with great interest the discussion of "Individual Motor Drive" in your issues of March 12 and 26, by Mr. W. Cooper and Mr. H. H. Cutler, and have been greatly impressed by the forcible argument of the former and the sensible argument of the latter gentleman.

It would clearly appear from the article of Mr. Cutler that the variable-voltage system has no advantages over the variable-flux system of speed variation as to the size of the frame of the motor used. The writer thinks that Mr. Cooper has taken his stand with the utmost sincerity in the article of March 26, but even the most sincere belief may sometimes be wrong.

The three principal conditions of designs to meet the requirements of variable speed by variable flux are, namely, good efficiency and absence of sparking and heating. These conditions are only to be met by careful design. A standard motor generally has too high normal speed to permit of its being speeded up to any such extent as, say, 3½ : 1. We will take, for instance, a 220-volt, 15-hp motor running at 700 r.p.m., which is a standard with a certain prominent company, with core dimensions of 11 in. x 9 in. This motor has a peripheral speed of 2,000 ft. per minute at 700 r.p.m. and the speed variation of 3½ : 1 would make a peripheral speed of 7,000 ft. per minute, which would be excessive. However, a speed variation of 2 : 1 would be permissible and is very readily given with the standard machine. We may, however, reduce this speed from 700 to say 450 r.p.m., and with 3½ : 1 ratio, the maximum speed of 1,570 r.p.m. would not be excessive.

Now, according to Mr. Cooper, this motor would only deliver 2¾ hp with the flux reduced to bring the speed to 1,570 r.p.m. and could not be made to maintain 9.6 hp from 450 r.p.m. to 1,570 r.p.m. without sparking or without giving unsatisfactory operation in general. Now, as a matter of fact, this motor with armature designed to reduce the speed to 450 r.p.m., and with constants for variable flux design, has, from actual test on a 220-volt, two-wire system, given 10 hp at 450 r.p.m. and 10 hp at 1,570 r.p.m. without sparking, heating or having poor efficiency and, I may add, without the use of any hypnotic influence brought to bear on the motor whatever. The temperature rise of the parts of the motor in question after a six-hour run with full load (10 hp) and full field was as follows: Armature, 26° C.; commutator, 23° C.; frame, 20° C.; pole tips, 28° C.; field, 28° C., with efficiencies as follows: Lowest speed—¾ load, 81 per cent.; full load, 84.5 per cent.; 1¼ load, 86 per cent. Highest speed—¾ load, 86.5 per cent.; full load, 88.7 per cent.; 1¼ load, 89.2 per cent.

The slowest speed of a motor of this kind represents the maximum heating and minimum efficiency condition of the machine, as the temperature of the parts and the total loss are greatly reduced as the speed of the motor is increased. This represents the actual results obtained from tests of a motor of this type designed by the writer.

Now, if it is desired to get a 4 : 1 ratio of speed variation, it would be necessary only to reduce the speed still lower and the horse-power correspondingly, which reduction of speed and horse-power would be equally true when using the variable-voltage system. But it would be necessary to give an increased number of armature conductors to the armature in the variable flux machine to lower the speed and would give a corresponding reduction in horse-power output, as in the variable-voltage system; the difference in the two systems being that the variable-voltage system increases the horse-power with the increase of speed, while the variable-flux system keeps the same horse-power for all speeds, the frame of the machine remaining the same. For instance, if in the variable-voltage system it is wished to get, say, 7½ hp at 350 r.p.m., the armature of the machine would be designed for 30 hp at 1,400 r.p.m., 220 volts under the normal flux. By having the voltage reduced on the armature to 55 volts, it would then give 7½ hp. Now, with the variable-flux system, the armature would be designed for 7½ hp at 350 r.p.m. and be speeded up by means of field resistance to 1,400 r.p.m., maintaining 7½ hp at the different speeds.

There is a point in favor of the latter system which may or may not have been brought out before, and it may be here stated to advantage. In changing the voltage to the next higher step on the variable-voltage system, the motor responds to the change in applied voltage by a jump, which is rather hard on gears and pinions and on the cut being taken by the tool. The surge of current is hard on the controller, to say nothing of continual rack on the machine tool.

The change in the speed of the machine tool by the variable-flux system is smooth, for when the resistance is inserted in the field the motor does not immediately jump to the new speed, as the flux does not immediately respond to the removal of a part of the magnetizing force, but meets the new conditions without jar or jerk and the increments of speed made as desired by the number of steps of the field rheostat.

I believe Mr. Cooper admits, however, the superiority of the variable-flux system for speed variation, providing satisfactory motors can be built. These motors, while they are comparatively easy to design, must be made with very good sparking constants, which constants must be calculated at the maximum speed as the extreme condition, then the heating and efficiency calculated at the minimum speed. When a motor satisfies the two extreme conditions, it clearly will be satisfactory between the two limits.

MILWAUKEE, WIS. WM. J. HENSLEY.

Technical Education.

To the Editors of Electrical World and Engineer:

SIRS:—Your editorial of March 26 on "British Technical Education," and Mr. Del Mar's letter in your issue of April 9 somehow seem to reopen an old and much-worked field for discussion.

Mr. Del Mar's experience with that "M. I. T." graduate is rather unfortunate, inasmuch as Mr. Del Mar appears to have arrived at the conclusion that the course at Technology is essentially practical —which it is not. The school is primarily for the education of the specialist, and the courses are devoted very largely to the theory of each particular field. No technical school can pretend to turn out finished engineers. They are the great preparatory courses for the school of experience which is, and must always be, the most important part of education.

I well remember some words spoken by the late Dr. Walker to a Freshman class. They were to the effect that "Technology" did not and could not, nor could any other school, "turn out" finished engineers. "We try," he said, "to give you the tools with which to learn your profession. We try to train your minds to so grasp the meaning of phenomena that you may turn it to practical account, so that the experiences with which you hereafter meet and which will constitute your engineering education—these actual working facts—will have for you a significance that they cannot have for the untrained mind."

This, and this alone, constitutes the meaning and value of a technical education. The degree a school confers means no more than that its recipient is ready to learn. The field of his mind is plowed and fertilized and ready to receive the seed of practical experience. The possession of a degree does not, however, mean that a man is capable of eventually becoming an engineer. He may make a more or less futile attempt—witness the crowds of the Ph. D's and B. S's in our draughting rooms; men plugging away year in and year out for a pitiful pittance. These men, one finds, usually lack that vital quality of soldierly confidence, the quality of push and hustle, the quick-wittedness which is the supreme gauge of the human race.

It is this very point of quick-wittedness which our schools should seek to develop—to train a man so that his mind can act in many fields; to keep him out of a rut; to broaden him so that he may appreciate and harvest up the salient facts in every work with which he comes in contact.

Teach him broadly first. Let him study languages, literature, history, botany, music—whatever he likes. Give him a chance to learn and know of the great thoughts and great minds that have made our world a half-way decent place in which to live. Then, if you like, the essential laws that govern all engineering, provided he has still retained the thought that he would like to be an engineer. Bring him in contact with everything he can grasp. Because he particularly likes electricity, is that any reason he should not have some surveying? No one ever knows when he may need it, even if ever so elementary a knowledge. His experience in other things will teach him how to build on this.

The trouble with nine-tenths of us is that we have got between two walls of the densest ignorance which cut off all our horizon and make life a despicably little path that leads to nothing—for the future is nothing. It is right here, right now, that we must live, and the man who is free to roam the fields and look abroad, who gets the tone of the picture and worries not too much over the quality of the paint, is the man who succeeds in life. The world is a place in which we work to live and do not live to work.

Is it not interesting that the men who hold positions of trust—the great men of the world—are and always have been men of the broadest education?

You will say, perhaps, that but few men are suited for this general education. At school we know men cut, and as far as possible reduce to a minimum, all subjects extraneous to their specialty. Well, make our professional schools elective, at least in part. Broadness in education is essential for the best work, and give the men who appreciate this an opportunity to spread out. Start by cramping and the man is stunted for life.

There is all together too much haste in our engineer factories. They manage this thing better in the law and in medicine, where a man must have a preliminary education of some scope before he can gain admission to the professional school. But in engineering we find white-faced boys fresh from their A, B, C's, who know absolutely nothing of life or of the serious side of work and who treat the whole problem as more or less of a spree. How in the world is such material in the short space of four years to be taught the wisdom of Solomon?

New York. Bassett Jones, Jr.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Electric Resistance of Bearings.—Zorawski.—A communication referring to an article of Kennelly and Adams, published in Electrical World and Engineer, February 7, 1903 (Vol. 41, page 231). These authors had tested the resistance of bearings of the usual self-oiling type, with two revolving brass oil rings in each, and had found that the transition resistance between shaft and pedestal was practically zero when the motor was at rest, but became very high when the motor was revolving. A 6-kw Edison dynamo of 1,800 revolutions was found to have at 100 revolutions a resistance of bearings of 4.4 megohms. The present author remarks that these results seem to be in disagreement with the fact that several firms in Continental Europe build three-phase induction motors with a similar type of bearings with only two slip rings, while the terminal of the third winding is connected to the axle and the terminal of the corresponding starting resistance to the motor casing. The author has himself made experiments with a 16-hp, three-phase induction motor of this type, and the transition resistance was found to be 0.00121 ohm when the rotor was at rest and 0.00158 ohm at a speed of 960 revolutions, the dimensions of the bearings being diameter, 42 mm.; length, 110 mm. The author suggests that the reason of the discrepancy may be in the kind of oil used. In the machine tested by him ordinary mineral oil of high fluidity was used. —*Elek. Zeit.*, March 31.

Rotary Converters.—Lincoln.—An illustrated article in which the author discusses in a very simple way the voltage regulation of rotary converters. A series coil on a rotary converter has the effect of automatically changing the ampere-turns applied to the field. Varying the field ampere-turns means varying the magnetizing element of the alternating current delivered to the collector rings, causing the current to become leading when the ampere-turns are more than normal and lagging when the ampere-turns are less than normal. The voltage across any inductance in circuit tends to subtract from the generator voltage when the converter current lags and tends to add to the generator voltage when the converter current leads. The conditions for rotary converter compounding are, therefore, (*a*) a series winding on the rotary converter connected so as to assist the shunt, (*b*) inductance between the generator and rotary converter. The series field coils in a rotary converter do not increase the voltage directly as in a direct-current generator, but indirectly, through co-operation with inductance in the supply circuit.—*Elec. Club Jour.*, March.

Rated Speed of Motors.—Esson.—A communication criticizing some points in the paper of Hobart recently abstracted in the Digest on the rated speed of electric motors, as affecting the decision whether direct-current or induction motors should be employed for a given speed. The author agrees with Hobart's conclusions concerning the case for alternating versus continuous current as regards the motors, but he points out that, in deciding in favor of one system over another, it is also necessary to take into account the cost of generators, wiring, stators and of other equipment. Which side the consideration of these further factors would favor depends on circumstances. Most installations have a mixture of big and small motors, several different sizes running at different speeds, and this, together with the presence or absence of the necessity for speed variation, would influence the decision as to what type of motor should be installed.—Lond. *Elec.*, April 1.

Sine Currents.—Ruedenberg.—In order to produce pure sine currents, it has formerly been suggested to make the pole shoes of the field magnets of such a shape that the curve of field induction, as a function of the points of armature circumference, approaches as much as possible a sine curve. The e.m.f. which is produced in the armature wires while they pass through this field is then also a sine wave. However, when the machine is loaded the sine curve is distorted. The author, therefore, suggests a different method, which is independent of the load of the machine. By developing the wave mathematically in form of a Fourier series, he shows that a certain number of the higher harmonics can be made zero simply by properly choosing in advance the type of winding of the machine. However, in such machines the utilization of the material is less favorable, yet the method should be useful in special cases in which the production of pure sine currents is of importance.—*Elek. Zeit.*, March 31.

Induction Motors.—Behn-Eschenburg.—The conclusion of his long paper on magnetic dispersion in induction motors, and its influence on the design of this machine. The author gives a basis for the design of induction motors and suggests that for a rapid determination of the characteristic curves of the motor, five cases should be discriminated which correspond directly to five points on the load curve, and which suffice in general to characterize the motor with certainty. The formulæ for these five points are given and two numerical examples are added.—Lond. *Elec.*, April 1.

Heating of Induction Motors.—Punga.—A mathematical article in which he gives formulas for calculating the Joulean heat developed in squirrel-cage rotors.—*Zeit. f. Elek.* (Vienna), March 27.

Commutator.—A communication with detailed drawings of a former for copper connectors for commutator bars.—*American Machinist*, April 7.

Power.

Gas Versus Electric Power Distribution to Sub-Stations.—Smith.—A paper read before the Birmingham Section of the British Institute of Electrical Engineers. The author compared the two following systems: The first is the transmission of electricity from a gas engine station, situated under favorable conditions, at a distance of five miles from the center of the city, and its subsequent distribution by means of sub-stations. The second problem is that of a central gas producer station situated on the same side as the producer and electric station in the first case, with transmission of gas to sub-stations containing gas engines coupled to electric generators. A city of the size of Birmingham is made the basis of the estimates. The result at which he arrives is that gas transmission, in such a case, does not necessarily cause much more than one-half the cost of electric transmission by means of underground cables. Should his figures be compared with those for a steam engine station, and the probability of the gas mains being used for transmitting gas for heating purposes be considered, the advantages of using producer gas are yet more striking. The paper was discussed at some length and the opinion was expressed that many of the author's conclusions are based on absolutely theoretical figures, and that his estimates at best are only a sort of "pious hope" as to what might be accomplished with gas. It was also thought that the difficulties of transmitting high-pressure gas over long distances were not sufficiently appreciated.—Lond. *Elec.*, April 1.

The Use of the Earth as Return Conductor.—Pionchon.—A description of experiments made in the Isere Valley on the use of the earth as return conductor. The experiments were made with a six-pole, 250-kw, 600-volt, direct-current generator in a hydroelectric plant in Lancy. This machine was connected by a 8-mm. isolated copper wire with a receiving apparatus in the open air at a distance of 1.7 km., near Crolles. The negative pole in Lancy was connected by means of a 19-meter long and 8-mm. thick copper wire to the water pipes of the turbine installation. The earth connection at the receiving end in Crolles was made by means of cast-iron tubes of 2.9 meters length, 16.5 cm. external diameter and 10 mm. wall thickness. With their whole length they were buried in the earth in a vertical position. A set of ten such tubes, arranged in a circle of 30 meters radius, formed one earth connection and another set of ten tubes were buried at a distance of 10 meters between each other and arranged in a straight line. Switches were arranged which enabled one to connect in series or parallel or disconnect several tubes at will. It was found that the resistance of a single tube was 10.75 ohms and the conductivity 0.092 mho. By adding a second, third, etc., tube, the conductivity is not doubled or tripled, etc., but is smaller than one would expect. If the conductivity of a tube is calculated as the mean of the conductivity of a set of five tubes one gets $0.3082 \div 5 = 0.061$ mho. In other tests the distribution of the potential in the earth was investigated; still other tests were made with alternating currents in order to determine the influence on telegraphic lines. There were no disturbances of such size that the regular operation of the telegraph lines was interrupted for a moment. Nevertheless, some disturbances were observed, but it was not quite clear that they were due to the use of the earth as return in the alternating-current transmission line. Further experiments in this direction are to be made.—*Elek. Zeit.*, March 31.

REFERENCES.

Gas Power.—Gow.—An article in which, after a brief discussion of the use of natural gas, illuminating gas, blast furnace gas, coke oven gas, and oil gas for limited applications of power purposes, he discusses at greater length the making of producer gas. He emphasizes that a gas engine and a producer plant to produce gas from any grade of fuel have passed the experimental stage; they are not engineering possibilities, but engineering achievements.—*Elec. Club Jour.*, March.

Electricity in Mines.—Guarini.—The first part of what appears to become a long illustrated serial on the various applications of elec tricity in mines. In the present installment the author discusses electric signalling and use of electric power for ventilation.—*L'Eclairage Elec.*, April 2.

Cranes.—Kann.—The conclusion of his illustrated description of various new types of cranes built by the Austrian Union Electric Company. A crane built for the Lloyd ship works in Triest, which is able to lift loads of 120 tons, is described in detail.—*Zeit. f. Elek.* (Vienna), March 27.

Wire Ropes.—Nearly the whole number is filled with various articles on the construction and uses of wire rope, especially in mining and metallurgical plants.—*Mines and Minerals*, April.

Traction.

A Single-Phase Railway Motor.—Bell.—A communication in which the writer deplores the action of the Westinghouse Company in recommending only 1,000 volts for its single-phase railway system. He believes it perfectly feasible to use much higher voltages than this, especially outside of cities. Referring to a former article of Renshaw, he states that a high power factor in a single-phase motor does not necessarily mean high efficiency—in fact, there may be a high power factor and a very low efficiency. To prove this he cites a case where he designed two induction motors. One of these had very poor iron and gave the higher power factor, although having a much lower efficiency than the other motor.—*St. R'y Jour.*, April 9.

English Electric Railway.—In a continuation of the description of the Liverpool-Southport Electric Railway, the method of train control is described in detail and profusely illustrated. The trains have a motor car at each end and generally two trailers between them. No multiple-unit system is used, but a direct system of control is obtained by coupling a few main cables from one end of the train to the other. This is called the dual method of control. A diagram shows in detail the controller, motor and reversal connections. One set of four couplings connects the motors and reversing switches on the rear motor car to the front controller, and the other set of couplings connects the front motor car to the rear controller. When the couplings are disconnected the two motor cars are independent, and nothing further than this is required for running them separately with any desired number of controllers.—Lond. *Elec.*, April 1.

Evansville & Princeton Traction System.—A description with map of this 47-km. interurban line built in Southern Indiana. Bracket construction is used in the country and span wire in the cities and towns. The electrical equipment consists of two 400-kw, 360-volt, three-phase generators. The two 30-kw exciters employed are also used to light the building. There is also one 300-kw rotary converter and three 125-kw, 400-11,000-volt transformers. The sub-station contains a 300-kw rotary converter and three 125-kw transformers.—*St. R'y Jour.*, April 9.

France.—A report on recent developments in French tramways and referring to the large amount of construction work now being carried on by the Metropolitan Railway. The Nice Tramways will build a new double line between Villefrance and Beaulieu, using 20 cars equipped with the multiple-unit control system—the first application of this system on French tramways. The Oporto Tramways has asked for estimates covering the cost of converting its system from direct current to alternating current. The East Parisian lines, which are operated principally by the surface-contact system, are in a very bad way, and it is very doubtful whether any more franchises will be given for surface-contact systems in Paris.—*St. R'y Jour.*, April 9.

REFERENCES.

Berlin.—Schiff.—The first part of a long and profusely-illustrated article on the construction and equipment of the cars used on the Berlin electric elevated and subway roads. The third-rail system is used with multiple control.—*Elek. Bahnen*, March, No. 6.

Los Angeles.—Another article in the serial on electric railways in and about Los Angeles, Cal. The present installment deals with the system of the Los Angeles Railway Company, which is purely a city system, embracing over 200 km. of track. Many details are given and illustrated concerning the rolling stock, car houses and operating methods.—*St. R'y Jour.*, April 9.

Installations, Systems and Appliances.

Architectural Design of Electricity Works.—A long editorial with reference to a paper read by Peach before the Royal Institute of British Architects. It is thought that the size of central stations is such that it is a great mistake to erect a building for them devoid of any architectural ornament. Peach even advocates the ornamentation of the chimney and showed among other photographs the elaborate chimney of the power station at Munich and the chimney of his own design in an English plant. The latter is 260 ft. high and of square section, 18 x 18 ft. inside, and a fairly heavy ornamentation in blue brick has been adopted for the upper part, the lower portion being left quite plain. "In the architectural treatment of the upper part an attempt has been made to take advantage of the iron bands which sooner or later are required round the upper part of all shafts, and of the recesses formed by placing the set-offs, when the brick work is reduced in thickness, on the outside instead of the inside of the wall. By these means some relief is obtained, and the upper part is designed as an enriched feature, which, in contrasting with a plain wall below, forms the whole composition." The question of external appearance is even of more importance in the case of large sub-stations in the center of a populous district. In England it has been the custom to have all the plant with the exception of the switchboard on the ground floor, and Peach still favors this plan. The small space occupied by turbine-driven machinery, however, renders it necessary to modify existing designs in the case of works employing this class of machinery. The foundations for the generating sets should have broad bases, large in comparison with the height of the foundation, and many recommend that the sides should slope upwards considerably, so that the area of the top is much less than the base. This concentrates the effect of the load towards the side of the block and prevents vibration about an edge, as frequently happens when the foundation is of plain square shape, like a brick set on edge.—Lond. *Elec.*, April 1.

REFERENCE.

British Central Station.—An illustrated description of the new electric station of West Ham. Originally current was used only for lighting, but the rapid growth in the demand for this purpose and the recent introduction of electric traction necessitated considerable additions. An entirely new station has been erected; the single-phase system of supply already in use for lighting has been retained, but a direct-current system has been installed for traction There are at present installed nine dynamos of an aggregate capacity of 6,300 kw. For lighting 2,000-volt, single-phase current is generated at a frequency of 50 periods per second, with a 110 and 200-volt distribution network.—Lond. *Elec.*, April 1.

WIRES, WIRING AND CONDUITS.

REFERENCE.

High-Tension Wires.—A note on the use of overhead high-tension wires in Californian cities, with a photograph of a street in Sacramento. Some remarks are copied from a Sacramento newspaper on the dangers of this policy and the demand is made to put the wires underground.—*Eng'ing News*, April 7.

ELECTRO-PHYSICS AND MAGNETISM.

Conductivity in Gases.—MERRITT AND STEWART.—An account of an experimental investigation of the conductivity produced in rarefied gases by an incandescent cathode. The incandescent filament discharged negative electricity even in the highest vacuum the authors could get. It seems probable that the electrons by which the charge is carried come from the incandescent body rather than from gases in contact with it. There is a striking resemblance between the behavior of an incandescent cathode and an illuminated cathode. In each case the phenomena are primarily due to the emission of negative electrons by the surface. In one case it is light, and more especially ultra-violet light, that acts as the agent to bring about the emission of the electrons. In the other case the high temperature of the surface produces the same result. At high vacuua the cathode ray particles are the sole carriers of the current.—*Phys. Rev.*, April.

Radioactivity.—STRUTT.—A Royal Society paper giving the results of tests of various minerals of North Carolina, Norway, Cornwall and Brazil. The method used was to heat the crude mineral and to examine the rate of decay of the emanation which it gives off. Each emanation has a characteristic time constant of decay, and by determining this we can identify it. He also examined the mineral water of Bath and found it highly active. He estimates the quantity of radium annually delivered by the spring to be about ⅓ gram. The volume of gas which the spring delivers is about 100 cu. ft. per day. About 1/1000 part of this is helium, so that about three liters of helium is given off daily, or about 1,000 liters per year.—Lond. *Elec.*, April 1.

REFERENCE.

Resonance.—TAYLOR.—An article, illustrated by diagrams, in which the author describes a simple method for attaining resonance in systems subject to electric oscillations of high frequency, and also describes some interesting lecture room demonstrations of phenomena peculiar to such systems.—*Phys. Rev.*, April.

ELECTRO-CHEMISTRY AND BATTERIES.

Capacity of a Lead Accumulator per Unit of Weight.—LOPPE.—A theoretical article in which the author calculates the very highest ampere-hour and watt-hour capacities which the lead accumulator can have per kilogram per total weight. The calculations are, of course, based upon the amounts of material required for the chemical action according to Faraday's law, and the following assumptions are further made: The "practical capacity" of an accumulator is two-thirds of the "total capacity" (the latter being the capacity, if the discharge is driven down until the e.m.f. becomes zero). For the ratio of the weight of active material to the total weight of the plates the high value 0.8 is assumed. For the calculation of the weight of the electrolyte he assumes that at the end of the charge the electrolyte has a density of 1.285 and at the end of a discharge 1.125. For the ratio of the weight of the total cell to the weight of plates and electrolyte together the low value of 1.15 is assumed. All these assumptions represent conditions under which the utilization of the active materials in the accumulator would be extremely high, so that the results at which he arrives represent maximum figures which one has to strive at in practice rather without hoping to attain them. He finds that under these conditions a total weight of 35.57 grams per ampere-hour capacity is required. This weight is the sum of that of the electrodes, 15.38 grams; electrolyte, 15.55 grams, accessories, 4.64 grams. For the maximum capacity per unit mass of a lead accumulator he, therefore, finds 28.1 amp.-hours per kg. and 53.39 watt-hours per kg.—*L'Industrie Elec.*, March 25.

Decomposition of Lithium Chloride.—PATTEN AND MOTT.—A very long account of an investigation of the decomposition curves of lithium chloride and the electrodeposition of lithium. The authors have discovered and used new classes of solvents for the electrolytic separation of alkali metals (such as lithium, sodium, etc.) and alkaline earth metals (such as magnesium, calcium, strontium, etc.), and other metals not easily obtained from aqueous solutions. They have found such organic solvents to be suitable which fulfill the following two conditions: First, there should be present in the solvent not less than three carbon atoms; second, one or more of these carbon atoms should be the center of a carbonyl group, or have bound to it an hydroxyl group. From their investigation of the decomposition of lithium chloride it appears that the process of electrolysis is essentially the same for all current densities. The residual current verges into the steady current because of the increased rate at which the solute is decomposed with increasing current density; the alkali metal, similarly, deposits on the cathode when the rate of decomposition of solute exceeds the rate of solution of the alkali metal. The low polarization in alcoholic solutions at moderate current densities is strong evidence that the alcohol is not decomposed by the current simultaneously with the lithium chloride. The solute is decomposed before the solvent, but it does not necessarily follow that the solvent takes no part in the conduction. These considerations, developed for non-aqueous solutions, are applicable to aqueous solutions as well. The single potential of lithium has been determined as 2.41 volts. The alloying effect of the cathode used—platinum—is a minor factor in decomposing alkali metals from solution, and the solvent which acts to a considerable degree upon the metal may be preferable to one which corrodes slowly, with the formation of a high-resistance film, as for example pyridine. High current density and consequently good conductivity are essential in so far as they may be needed to balance the solvent action of the solution upon the metal. High boiling point and latent heat of vaporization are more desirable in a solvent than very high heat of formation.—*Jour. Phys. Chem.*, March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Phase Meter.—GRAU.—If an alternating-current wattmeter can be so arranged that for varying load the current, i, in the movable coil and the current, J_1, in the fixed coil are constant, the instrument would be suitable, not for measuring the power, but for determining the power factor. For this purpose the arrangement shown in Fig. 1 is used. The fixed wattmeter coil is made of manganin so as to represent a distinct resistance of a temperature coefficient practically

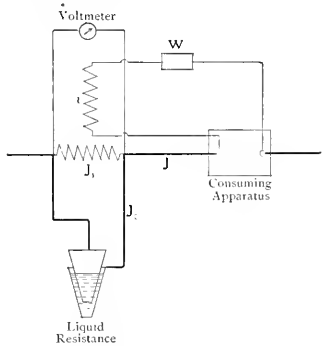


FIG. 1.—PHASE METER.

equal to zero, and its terminals are connected to a voltmeter for control. Since the resistance of this wire is constant within wide limits, the reading of the voltmeter may be used for determining the current in the fixed coil; if this reading is constant, the current, J_1, is also constant. In order to make J_1 constant and independent of the current in the consuming apparatus (motor, electric furnace, etc.), a liquid resistance is connected in parallel with the fixed instrument coil. By regulating the liquid resistance it can be accomplished that the current, J_1, remains constant while the current, J, changes. The current, i, in the movable coil is held constant by means of the rheostat, W, in series with it. Under these circumstances the reading of the wattmeter is directly proportional to the power factor, so that the phase difference may be easily found.—*Elek. Zeit.*, March 31.

Frequency and Slip Meter.—BIANCHI.—A note on a new device for measuring the slip of induction motors. The whole apparatus is self-contained in a box of small size. A small electromagnet, with a polarized armature, is connected in shunt to the line through a contact-breaker. The latter consists of a disc of insulating material having (for a bipolar machine) one metal contact piece on its periphery, the disc being directly rotated by the rotor of the induction motor to be tested. Every time this contact piece passes beneath the brush, the shunt circuit referred to is closed and the electromagnet is energized. Since the frequency corresponding to the speed of the rotor is lower than the frequency of the line, it follows that contact is made each time at a different point of the primary wave. Each successive contact corresponds to a slightly advanced value of the line wave. The electromagnet is, therefore, energized by a current wave of the frequency v, equal to the difference of the frequency of the line and the frequency corresponding to the rotor speed. Since the armature of this electromagnet is polarized, it will be actuated in accordance with this wave of comparatively low frequency. The number, N, of the revolutions of the rotor is recorded by a speed counter and the frequency, v, is recorded by means of the electromagnet. The slip in per cent. is calculated from the equation:

Slip $= 100\, v \div$ the sum of $v + \dfrac{p\,N}{60}$; and the impressed frequency is $v + \dfrac{p\,N}{60}$. In these equations $2\,p$ is the number of poles. If the induction motor has more than two poles, the rotating disc must have more than one contact; in fact, the number of contacts must be equal to the number of pole pairs. In Bianchi's apparatus, six different contact rings are provided, allowing motors with nearly every number of poles between 2 and 36 to be tested.—Lond. *Elec.*, April 1.

Measuring Self-Inductance.—DUANE AND LORY.—An article on the use of a "differential telephone" as a means of measuring a self-inductance with an accuracy of about 0.02 per cent. A differential telephone receiver is one, on the bobbin (or bobbins) of which two coils, $A\,A'$ and $B\,B'$, are wound side by side, as indicated in Fig. 2.

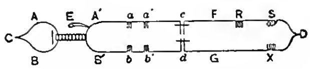


FIG. 2.—MEASURING SELF-INDUCTANCE.

By suitable means these coils are adjusted so as to have equal self-inductances and equal resistances, and so that the magnetizing effect of a current flowing through one coil from A to A' is exactly annulled by that of an equal current flowing through the other coil from B to B'. A variable self-inductance standard, S, is joined in series with coil $A\,A'$, and the coil of unknown self-inductance, X, in series with coil $B\,B'$. A non-inductive variable resistance, R, is inserted in series with S or X, according as the resistance of X is greater or less than that of S. The two entire circuits are then joined in parallel and an alternating e.m.f. is applied to the branch points, C and D. By varying R and S values can be found easily such that no sound is heard in the receiver. When this is the case the two parallel currents must be equal to, and in phase with each other, and, therefore, the self-inductance of X must equal that of S. Before the instrument is ready for use, three adjustments are necessary, but these may be made once for all; first, the equalization of the magnetic effects of the two receiver coils and second and third the equalizations of the resistances and self-inductances of the coils. In comparing the self-inductance of a coil, X, with that of a standard S, two balances must be made. The resistance of the parallel circuits must be made equal to each other by varying R, and the self-inductances equal to each other by varying S; one of these balances does not depend upon the other. If the divisions of the resistance box, R, are not small enough, the final balance of the resistances may be made by means of the sliding contacts, c and d.—*Phys. Rev.*, April.

Weston Cell.—BARNES AND LUCAS.—An account of an investigation of various types of Weston cells. From the results of their experiments it follows that cells with a solution, saturated at 0° C., have practically no temperature coefficient; that cells with a saturated solution of constant strength have a temperature change of 0.0038 per cent. per degree; that cells with moist crystals and a 13 per cent. amalgam have a temperature change of 0.0055 per cent., and that cells with moist crystals with a 14.7 per cent. amalgam have a temperature change of 0.008 per cent. per degree. The ratio of the Clark cell at 15° C. to the Weston cell at 20° was found to be 1.40666, which is coincident with the value found by Jaeger and Lindeck, of the Reichsanstalt, which is 1.40665. The authors think that it is a matter of small moment which cell, the Clark or the Weston, is adopted as an official standard, since the ratio of the one to the other is known so closely. Both cells have points to recommend them for different types of work, but it is evident that the Clark cell with its high temperature coefficient will retire more completely into the laboratory as time goes on, leaving to the Weston cell the more active part of a general working standard.—*Jour. of Phys. Chem.*, March.

Standardization of Notation.—STRECKER.—A very long paper read before the Berlin Electrical Society on a uniform notation of physical quantities. In the introduction the resolutions of the Chicago Congress, based upon the system of Hospitalier, are discussed. It is said that this system is well designed and has been found useful in electrical engineering, but that it does not meet the justified needs of the mechanical engineer. It is urged that in introducing a uniform notation no system whatever should be attempted, but freedom in the voice of the notation and consideration of existing usage should be the main points. The Berlin Electrical Society had sent out inquiries to their members with a request of making suggestions and the replies received are classified at great length. Finally the following list is given of such quantities about which there was the greatest uniformity of opinion: Length, 1; mass, m; time, t; angle and arc, $\alpha\,\beta$ . .; speed, v; number of revolutions, n; work (Arbeit), A, efficiency, n; pressure (force divided by surface), p; momentum of inertia, K; temperature, T; intensity of magnetization, T; magnetic field intensity, H; magnetic induction, B; magnetic permeability, μ; magnetic susceptibility, K; coefficient of magnetic hysteresis, n; e.m.f., E; current, J; quantity of electricity, Q; electric capacity, C; eddy-current constant, β; electric energy, A. This list is to be considered only as a proposition. A second list is then given concerning which the opinions were much more different, and which is, therefore, still more a proposition only. All representatives of pure and applied natural science of all countries are invited to participate in the discussion.—*Elek. Zeit.*, March 31.

REFERENCES.

Testing.—WORKMAN.—Continuations of his illustrated serial on factory testing of electrical machinery. He now deals in detail with direct-current machinery and discusses the methods for determining the copper, iron and friction losses, and gives an example of working out the results. He then takes up the special case of testing series motors.—*Elec. Club Jour.*, March and April.

Localization of Breaks in Submarine Cables.—An article giving critical notes on a former article of Davidson with several numerical examples.—Lond. *Elec.*, April 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy Receiver.—KARPEN.—A note presented to the French Academy. Between two cylindrical vertical armatures, a,

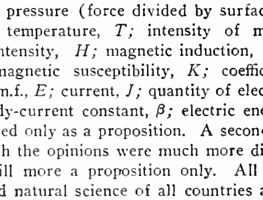


FIG. 3.—WIRELESS TELEGRAPH RECEIVER.

a needle is suspended by a wire; it carries at its ends two cylindrical parts, a', which are metallically connected, as shown in Fig. 3. The armatures, a, are connected by a coil of thick wire, S, with a convenient self-inductance. The one terminal of the apparatus is connected to earth, *T;* the other to the vertical wire, *A.* When electric waves touch the latter, an alternating potential difference is impressed upon the terminals of the apparatus, of a frequency equal to that of the wave. Under these conditions the needle turns around its point of suspension, *o*, so as to increase the capacity of the system. When the waves cease to arrive the needle returns to its position of equilibrium on account of the torsion of the wire. He made some experiments over a transmission distance of 10 meters, with a length of vertical wires 2 meters, spark length 0.25 mm., wave length 12 meters, number of sparks per second, 80. Under these conditions the permanent deviation observed is 80 mm.—*L'Ind. Elec.,* March 25.

REFERENCE.

Calculator Board.—Raymond-Barker.—The conclusion of his article, illustrated by diagrams, in which he discusses practical examples for the use of the calculator board for various purposes, especially in submarine cable practice.—Lond. *Elec. Rev.,* April 1.

New Books.

Die Herstellung der Akkumulatoren. Ein Leitfaden. Von F. Grunwald. Halle: Wilhelm Knapp. 158 pages, 91 illustrations. Price, 3 marks.

This is a small book of convenient size to be carried in the pocket, and has found many friends among accumulator engineers in Germany. It contains in very concise form almost everything that one should know in connection with storage battery engineering. It is, of course, more intended to be used by engineers who employ storage batteries than by those who build them. Nevertheless, the author has endeavored to be up-to-date even in those parts in which the theory and the manufacture of the storage battery are discussed. The American engineer may read with interest the German laws regulating the conditions of working in storage battery factories and the safety regulations of the German Institute of Electrical Engineers.

Les Chemins de Fer Electriques. By Henri Marechal. Paris: Ch. Beranger. 599 pages, 516 illustrations.

This book is, like the author's treatise on electric tramways, a general review of the whole subject under consideration. It appears to attempt a differentiation between street railways and other roads, especially such as would hitherto, under the older régimé, have been operated by steam. As a matter of fact, however, the treatment is rather more general and comprehensive, as one finds included such diverse topics as electric locomotives for mining purposes, and the moving sidewalk at the Paris Exposition and Chicago, as well as brief references to elevators and traveling stairs.

While one cannot speak of any special feature of novelty in Mr. Marechal's work, it has value, particularly as a résumé of the subject. Chapter 4, for instance, has quite a collection of third rails and shoes, in perspective and section, and illustrates the wide variety of practice in this country and abroad. Systems of train control are also summed up in an interesting manner. When it comes to motors, the author has not had an easy task in making a distinction between those for railways and those for trolley lines. Perhaps the broad, fundamental difference would consist in locomotives *per se* and in self-propelled cars carrying passengers; but even here the same motors can be used.

It seems to us that such a work as this should have given considerable space to the work at Zossen, bringing in the question of high speeds and of other contacts than the third rail. Zossen is referred to, it is true, but very briefly, and yet its lessons are uppermost to-day in the minds of engineers. We do not find much about interurban systems, nor anything about the recent single-phase work, although this is possibly too near at hand to get into the books. The volume would be greatly improved by a good index; in fact, it is a crime to issue such an excellent treatise without one.

Electricity and Matter. By Prof. J. J. Thomson. New York: Charles Scribner's Sons. 162 pages and 22 illustrations. Price, $1.25 net.

This very interesting and suggestive little book comprises Prof. Thomson's lectures under the Silliman foundation at Yale University, by which they are copyrighted as the first in the series constituting a memorial. The lectures were delivered in May, 1903, since when the views they embody have become well known in the domains of physics and electricity. The chapters follow apparently the lines of the lectures and deal with the representation of the electric field by lines of force; electrical and bound mass; effects due to the acceleration of Faraday "tubes"; the atomic structure of electricity; the constitution of the atom, and radioactivity and radioactive substances. Here we are, indeed, on the firing line of physical research. Perhaps after a reading of these lectures, the intelligent public may be willing to accept Prof. Thomson's terse statement that "We know, in fact, more about the 'electric fluid' than we know about such fluids as air or water." The chip which Prof. Thomson thus boldly puts on his shoulder may be as difficult to dislodge as the little chip of electricity, which he puts on the shoulder of his hydrogen atom. It is interesting, to say the least, that these lectures should have been delivered in New England, a region built up, one might say, by the negatively charged human corpuscles of the early migration, each puritan and pilgrim father bearing his eternal negative and protest against the constitution of things on the other side, where the great conservative majority of his race stayed. In the above statement, however, Prof. Thomson simply repeats what he said in the *Popular Science Monthly* in 1901, viz.: "The electric fluid is much more amenable to experiment than an ordinary gas, and the details of its structure are more easily determined."

The closing chapter on radioactivity is full of interest, though of course a great deal has happened in the year since it was given out. We note the reference to water from wells, which created a stir at the time and has been followed up with striking results, including "liquid sunshine." It is a great pity Prof. Thomson could not come over again and give a few more such lectures, embodying the latest theories as to rays and corpuscles.

The Truth About the Trusts. By John Moody. New York: Moody Publishing Co. 540 pages; charts and maps. $5 net.

It can safely be asserted that no economic subject occupies greater attention at the present time than the industrial consolidations or combinations known generally as the "trusts." These organizations have come to play such a prominent part in national life and national affairs that the whole social mechanism seems to have been thrown out of adjustment by their existence, and a large part of American legislation and conversation is taken up with discussion of them—their restriction, regulation, influence, future, remedies, justification, etc. At such a time, therefore, a book that will present the data as to the trusts is both timely and valuable, and Mr. Moody has done a public service in making this remarkable compilation of facts. Granted that some of the material is rather crudely massed or handled, it is there; and in view of the many difficulties surrounding the task, and the possibility of early improvement in later editions, Mr. Moody can congratulate himself on his work.

The trusts are classified in this volume and the first part is devoted to seven "greater industrial trusts" with a capitalization exceeding the vast sum of $2,660,000,000, which at current market quotations is perhaps worth about half that figure. These include the corporations associated with copper and steel. Then follow the "lesser industrial trusts," which include the General Electric Company, dubbed here "The Electric Supplies Trust," and the Westinghouse Companies. Next come the "greater franchise trusts," and here we strike telegraph and telephone companies, local lighting companies, street railway companies, etc. With this section goes a very interesting "family tree" chart showing the close relationship of the New York franchise corporations to the Standard Oil or Rockefeller group of financiers.

So far as we can determine, the data are set down carefully and accurately, so that a student can do a good deal of his own compiling and analyzing. Here and there are slips due to haste, possibly, or some unfamiliarity with the subject. For example, on page 373 it is set forth that the Bell telephone system has 1,500,000 exchanges, while the graphic chart facing page 376 compares 3,660,000 Bell instruments with 2,000,000 in the hands of the "independents." As a matter of fact, the Bell system had last year about 1,500 exchanges, 1,800 branch offices and 1,800,000 sets, or to be exact, some 1,300,000 stations. The error arises from the pernicious old Bell habit of rating the instruments separately, viz.: the transmitter as one and the receiver as one. Many people count each of these as a subscriber or station, as was done only this month by a well-known weekly electrical journal, which should certainly have known better.

After all is said and done, the perusal of such a book as this helps toward a calm survey of the field, and tends to strengthen the connection that when everything is said and done success in the biggest enterprise as in the smallest depends on a sound foundation, on able management, on wise capitalization and on public respect. Recent events have shown that the state can easily control its own creations, and that these, if bad in conception and worse in execution, soon go to pieces. Meantime, no one yet has been able to offset or gainsay the economic advantages of operation on a large scale.

World's Fair Electric Railway Tests.

As has previously been noted in these columns, an important work that will be done at the World's Fair is the testing of electric railway equipments. This work has been placed with a Railway Test Commission, which has appointed four engineering committees to report on the detail tests for different classes of service. Later a committee was appointed which will have direct charge of carrying on the work of the tests as outlined by these several committees. The chairman of the latter committee is Prof. W. E. Goldsborough and under his supervision the tests will be conducted by Prof. H. H. Norris, of Cornell University, who will be assisted by several electrical engineers not yet named and by ten students from the present engineering graduating class of Cornell; the latter have commenced a special study of test details preparatory to their work. The commission has also appointed an advisory committee to oversee the tests and represent the manufacturers, consisting of Mr. A. H. Armstrong, of the General Electric Company; Mr. Clarence Renshaw, of the Westinghouse Electric & Manufacturing Company, and Mr. Ward S. Arnold, of the Bullock-Allis Chalmers interests.

Twenty of the committees on details of tests have already reported. The committee on tests of heavy traction equipment, consisting of Messrs. F. J. Sprague, B. J. Arnold, W. J. Wilgus and F. R. Slater, present their outline under ten heads, as follows:

(1) Each party submitting apparatus for test shall furnish a complete written description thereof, setting forth clearly the special features of the design and calling attention to any points that are considered new. The description shall also explain the controlling mechanism, designating its applicability to direct or alternating current, with proposed working voltage, and if for alternating current, stating the frequency and phase desired for most successful operation.

(2) All tests shall be conducted upon the track designated by the Electric Traction Commission and conducted under actual operating conditions.

(3) No tests shall be made upon electric locomotives or other apparatus of less than 500 normal hp unless especially permitted by the commission. It is assumed that the term "Heavy Traction" applies to locomotives or motor cars of a total capacity rated on an hourly basis of 500 hp or more.

(4) The tests will be conducted with the locomotive or motor cars running light and also when pulling trains, with the purpose of studying the following features: (*a*) Motor capacity in various conditions of operation; (*b*) acceleration; (*c*) coasting; (*d*) braking; (*e*) heating. The following curves and diagrams shall be prepared: (*f*) Speed time curves; (*g*) distance time curves; (*h*) voltage and ampere time curves; (*i*) kilowatt input and distance curves; (*j*) draw-bar pull diagrams made when attached to a fixed anchor and also with dynamometer coupled between locomotive and trains operated under running conditions. If alternating-current motors are used the following additional curves shall be prepared: (*k*) Real kilowatt time curves; (*l*) apparent kilowatt time curves.

(5) The tests shall include the determination of heating and the distribution of same in the field, armature and commutator under various loads at different rates of speed. The heating of the bearings shall also receive consideration.

(6) The tests of the methods of control and comparison of hand and automatic acceleration shall be made as bearing upon the elements of (*a*) safety; (*b*) convenience; (*c*) economy; (*d*) smoothness of operation; (*e*) ability to group into two or more units.

(7) The tests of the method of control shall also be considered as bearing on: (*a*) Smoothness of acceleration; (*b*) variation of economical speeds; (*c*) reversibility; (*d*) action with one or more motors cut out; (*e*) relation of starting to running current under different rates of acceleration.

(8) The equipment will be considered as to: (*a*) General construction; (*b*) weight and distribution of same on drivers under static and hauling conditions; (*c*) relative weights of electrical and mechanical parts; (*d*) number and size of drivers; (*e*) acceleration of working parts; (*f*) influence on track.

(9) Tests will be made upon each locomotive or motor car submitted, to ascertain: (*a*) Watt-hours per ton-mile with locomotive running light at various speeds; (*b*) watt-hours per train ton-mile, exclusive of locomotive; (*c*) watt-hours per ton-mile with locomotive load and with train under various weights and acceleration.

(10) Methods and detail conditions for conducting the tests shall be agreed upon by those who have immediate charge of the tests before the commencement of the trials. These conditions shall be satisfactory to the representatives of those furnishing the apparatus. It is understood that all tests shall be made under similar conditions when possible. When these conditions are necessarily dissimilar due allowance shall be made in compiling the results, so as to place all apparatus upon the same plane of comparison.

The committee on tests to be conducted upon new electric railway systems at the St. Louis Exposition, consisting of Messrs. B. J. Arnold, Paul M. Lincoln and W. B. Potter, report as follows:

Each party furnishing apparatus to be tested shall submit a written or printed description setting forth clearly and fully the salient points in the system, and the principal advantages claimed for it. He will also completely describe the motors and controlling apparatus, stating whether the system is designed for direct current or alternating current, or both, and if for alternating current, whether for single-phase, multiphase, series, repulsion, inductive, synchronous, or other type of motor, and state in any case the most desirable voltage to use in the motor, and if alternating the preferred frequency.

In testing any new system we have assumed that the tests should be divided into two principal parts as follows: 1st. Motors, including car equipment. 2d. Line, including all sub-station apparatus and other translating devices interposed between the power house bus-bars, and the trolley wheel or contact shoe of the locomotive or car.

Schedule of motor tests to be made with apparatus running stationary upon testing blocks: (*a*) Test motors to determine efficiency, power factor (if alternating), torque, speed, horse-power output under various conditions as to voltage, frequency (if alternating) and current, to be met in the service for which the system tested is intended. (*b*) The one-hour rating of motors to be determined according to the standards outlined by the American Institute of Electrical Engineers. (*c*) Test motors under constant loads to determine rate of heating during continuous operation.

Schedule of tests to be made on equipment when operating upon experimental track: (*a*) Acceleration tests on single cars and multiple-equipped trains. (*b*) Braking tests of single cars and multiple-equipped trains. (*c*) Coasting tests of single cars and multiple-equipped trains. (*d*) Motor heating tests on single cars and multiple-equipped trains.

The following curves are to be prepared: (*e*) Speed time curves; (*f*) ampere time curves; (*g*) volt time curves; (*h*) real kilowatt time curves; (*i*) apparent kilowatt time curves (if alternating); (*j*) distance time curves; (*k*) tests and curves to determine car and train friction.

Schedule of tests to be made upon line and auxiliaries: Determine (*a*) Ohmic resistance; (*b*) inductive reactance; (*c*) power factor; (*d*) efficiency.

The determination of data of the copper and iron portions of line, separately and jointly, is to be made under the following conditions: 1st. When the electrical energy is delivered from the power house bus-bars to the working conductor without translating devices. 2d. When electrical energy is delivered from the power house bus-bars to the working conductor through supplemental transmission lines or translating devices. If supplementary transmission lines or devices are used in case No. 2 each element shall be tested separately as well as in conjunction with the line as a whole as outlined above.

Tests upon each system shall be made to determine the following: (*a*) Watt hours per ton-mile at car; (*b*) watt hours per ton-mile at sub-station bus-bars (in case sub-stations are used); (*c*) watt-hours per ton-mile at power house bus-bars.

All tests to be under like conditions, and when conditions are necessarily unlike, due allowance shall be made to reduce the apparatus tested to a fair basis for comparison.

The watt-hours per ton-mile, as stated above, to be determined from the summation of the specific tests hereinbefore outlined, and checked by integrating wattmeters placed on the power house bus-bars, sub-station bus-bars (if sub-stations are used), and the car.

100-Ton Double Trolley Alternating Current Crane.

By W. W. Briggs.

The Southern Pacific Company has recently completed at Los Angeles, Cal., the construction of one of the best-equipped and most modern railroad repair shops in the West. When the subject of

FIG. 1.—GENERAL VIEW OF CRANE.

crane equipment was under consideration by the officials of that company, the question as to whether the motors for operating cranes should be alternating or direct current was thoroughly canvassed.

Provided they could be operated successfully, it was desirable to use alternating current, for the following reasons:

First, on account of the fact that there was a large and reliable source of alternating current available at favorable rates, from the lines of the Pacific Light & Power Company, one of the long-distance power transmission companies of California. Second, the saving in wear and tear on motors, owing to the absence of commutators and brushes. Third, the increase in efficiency gained by elimination of transformers and rotary converters, or motor-generator sets for converting the alternating-current supply into direct current. Fourth, the considerable saving in first cost of converting apparatus.

A majority of the crane builders were opposed to the use of alternating motors for this service as they hesitated to take the responsibility of recommending an alternating-current equipment on a crane of this size, principally "because it had not been done before in this size equipment." Further, when the opinion of a number of Eastern railroad master mechanics was asked, the consensus of opinion was in favor of direct-current motors, mainly for the same reason advanced by the crane builders.

After carefully considering the matter, the officials of the Southern Pacific Company, with their characteristic courage and determination that everything in the way of new equipment should be of maximum efficiency, decided to "make history" with reference to this much mooted question, and take advantage of the many desirable features of alternating-current motors. Accordingly they placed their order for a crane equipment using that class of motors, which is one of the largest now in use.

The crane was built by the Niles-Bement-Pond Company and is of the double-trolley, double-girder class. The girders are double-webbed or box section form with end carriages of structural steel, each girder weighing 17,400 pounds. The crane span is 37 ft. 5 in., lift of main hook 16 ft. 6 in. Each main trolley or hoist has a capacity of 50 tons, one main trolley being equipped with an auxiliary hoist of 5-tons capacity.

Each main hoist is driven by a 50-hp (nominal) alternating-current crane type motor and is fitted with electric brakes. The main hoists are moved on the bridge by a 10-hp (nominal) motor. A motor of the same rating is also used on the auxiliary hoist. The bridge is driven by a 50-hp motor.

The operating speeds are for the main hoist, full load 10 ft. per minute, 20 ft. per minute light load; trolley, full load 80 ft. per minute, 100 ft. per minute light load; bridge, full load 175 ft. per minute, 225 ft. per minute light load.

The motors are three-phase, 440-volt, 50-cycle, Westinghouse variable-speed induction motors built with special reference to the duty required. Speed control of the motors is secured by using for each motor a three-phase Westinghouse crane type controller in connection with auto-transformers, but one set of two transformers being used for all the motors. The controllers are fitted with preventive resistances on contact arms which effectively prevent sparking at controller contacts. The use of auto-transformers allows of variable voltages being applied to the motors without the losses incident to rheostats.

The installation of this crane has been completed, and on test it has proven an unqualified success. Each main hoist has been tested with a load of 65 tons and handled that weight with ease and delicacy. The crane was run full speed down the shop, and when under full headway was reversed full speed in the opposite direction. This was accomplished without the slightest apparent straining or racking of gears, the action of the induction motors being much smoother than probably could have been secured with direct current.

The successful operation of this crane has afforded the management of the Southern Pacific Company much satisfaction and reflects credit on the company's engineers for having the courage of their convictions in making such a radical departure in shop practice. Doubtless the example will be followed by others and alternating-current motors for crane service will soon receive the recognition to which they are entitled.

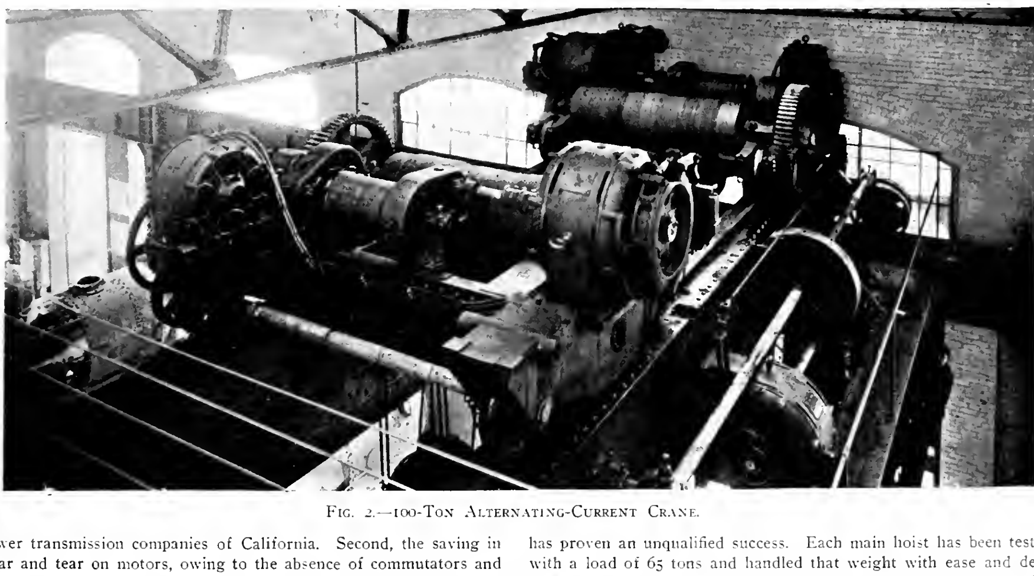


FIG. 2.—100-TON ALTERNATING-CURRENT CRANE.

New Westinghouse Railway Motor.

We illustrate herewith a new Westinghouse railway motor, known as No. 85, which is particularly adapted for suburban and interurban service, and comprises a number of features of advanced construction. The motor is rated at 75 hp nominal, and has a continuous service capacity of 60 amp. at 300 volts, or 55 amp. at 400 volts, these voltages being selected as representing a fair average of the voltage at the motor terminals under usual conditions. Conditions of service differ so largely, however, and so many elements enter into the problem of a given case that the nominal rating of a motor can only be regarded as a rough approximation; that the real criteria are the characteristic curves, which are here given in Fig. 5. In ordinary railway service the manufacturers recommend the motor as being able to carry safely any load within the range shown on the performance curves, provided the integrated heating effect does not

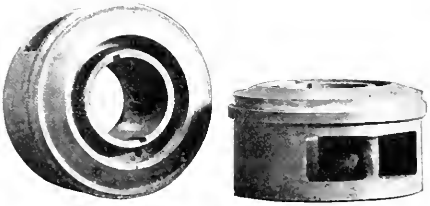


FIG. 1.—ARMATURE BEARINGS.

exceed that caused by the continuous application of either of these currents at the corresponding potential.

With a load of 60 amp. at 300 volts, or 55 amp. at 400 volts carried continuously during a shop test, the rise in temperature of the motor windings, as measured by thermometer, after ten or twelve hours, or after a constant temperature has been reached, will not exceed 75° C. With equivalent load under a moving car the temperature rise should not exceed 55° C. Heavier loads may be carried for shorter periods, as indicated by the time temperature curve. If, for example, the motor has been working at a load of 60 amp. at 300 volts, and has reached a temperature of 75° C., it may then carry a load of 72 amp. at 300 volts for one and one-half hours, with additional rise in temperature not exceeding 20° C. Speed, tractive effort, efficiency and power developed are also indicated for different gear ratios and under conditions ranging from currents of 30 to 240 amp. at the normal potential of 500 volts.

The frame of the motor is made of cast steel divided horizontally in two parts, forming a field which is wholly iron clad, and approx-

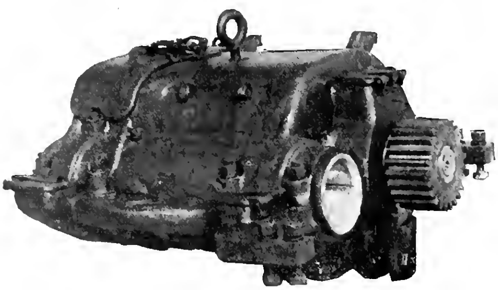


FIG. 2.—MOTOR AND PINION.

imately cylindrical in shape. The design is such that when mounted on the truck the holding bolts may be withdrawn and the upper field lifted off. To this end the suspension lugs and projection for the support of the gear case are cast with the lower field. A large opening with a spring-locked cover permits access to the commutator and brushes. Hand-holes are provided in convenient locations about the motor frame. The four pole pieces are built up of soft steel punchings riveted together between end plates of wrought iron and are held to the motor frame by bolts. The poles project radially inward at angles of 45° with the horizontal. The bolts holding the pole pieces in place do not penetrate the pole face, but terminate in heavy rivets inside the pole made for this purpose. A smooth and unbroken pole face is thus presented to the armature. The poles are made with projecting tips, which properly distribute the magnetic field, and also serve to retain the field coils, which are held firmly in place by steel spring washers. The coils are wound with asbestos-covered wire. They are heavily taped and are treated with specially prepared insulating compounds, which render them practically moisture-proof.

The armature core is formed of circular punchings of soft steel, built up upon a cast-iron spider. Ventilating spaces are provided in the core at right angles to and parallel with the shaft. The spider is pressed on and keyed to the shaft. The commutator also is

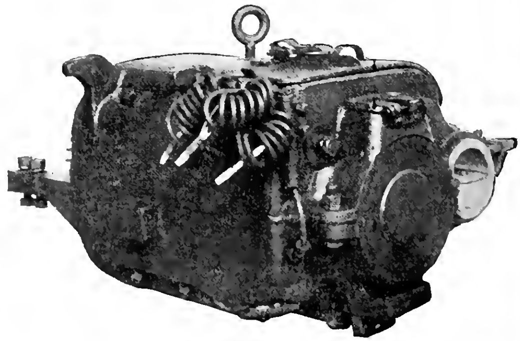


FIG. 3.—ANOTHER VIEW OF MOTOR.

mounted on the same spider, and the shaft can thus be taken out and renewed, should this be necessary, without disturbing any other part.

The armature is wound with machine-formed coils imbedded in rectangular open slots and held in place by band wires sunk in grooves. It is, therefore, wholly iron-clad, and the winding protected against mechanical injury. Canvas caps protect the winding at both ends, completely covering the parts of the windings outside of the armature core. The end plate at the pinion end is provided with a bell-shaped flange upon which the windings rest. This flange also holds the ends of the coils rigidly in place. The ends of the coils and the back of the commutator are thoroughly protected from carbon and copper dust. The complete armature is 15¾ in. in diameter. Wiper rings pressed upon the shaft outside the armature revolve in spaces in the motor frame inside the bearing boxes and prevent oil working its way along the shaft to commutator or winding. Oil thrown off by these rings is drained through suitable openings.

The commutator consists of 117 hard-drawn copper segments with short necks, separated by prepared mica sheets, built up upon a cast-iron bushing and clamped between two V-shaped surfaces, from which they are insulated by similarly shaped rings of moulded mica. The complete commutator measures 12 in. in diameter by 4¾ in. in width, and has a wearing depth of approximately 1 in. It is pressed on and keyed to the armature spider.

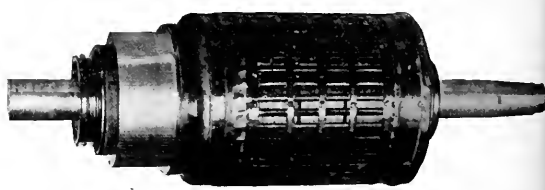


FIG. 4.—ARMATURE.

The brush holders are of the sliding shunt type, and are mounted on cast brass arms, which are secured to the motor frame by vulca-beston headed bolts. These arms admit of radial adjustment to compensate for wear of the commutator. The tension springs may be thrown back and fastened out of the way, facilitating the inspection of the brushes. Each arm carries two carbon brushes ½ in. by 2 in. section. The tension springs for each brush are independently adjusted. Flexible leads of rubber-insulated cable are brought out through bushings of semi-hard rubber set in the motor frame.

The motor is designed for either nose or Baldwin-Westinghouse suspension. Before leaving the works each motor is run under load and the insulation is submitted to an alternating potential of 3,000 volts. This final running test supplements a long series of tests and inspections of each and every part during construction.

The motor, complete with gear and gear case, weighs approximately 4,500 pounds. The motor alone, without gears and gear case, weighs approximately 4,000 pounds. The complete armature, with commutator and shaft, weighs approximately 995 pounds. The weight of a complete double equipment, including motor, controllers and the usual details, is approximately 10,780 pounds, and that of the corresponding four-motor equipment approximately 21,640 pounds.

The operating characteristics of this motor are clearly indicated

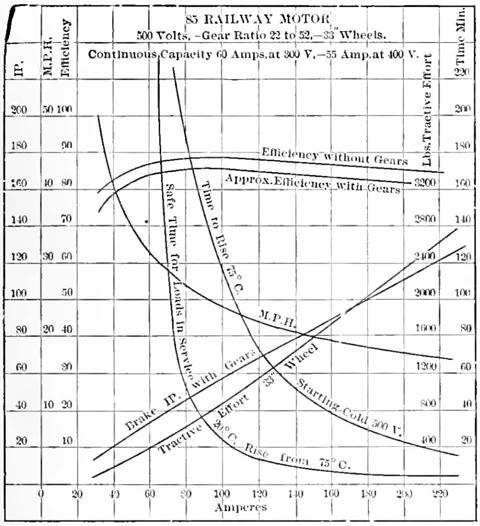


FIG. 5.—PERFORMANCE CURVES.

by the performance curves, one of which, for a gear ratio of 22 to 52, is shown in Fig. 5. A quadruple equipment is well adapted to the operation of a car of from 20 to 25 tons (without equipment or load) at a schedule speed of approximately 25 miles per hour, with stops at intervals of 1½ to 2 miles. With 36-in. wheels and gears of standard ratio, a maximum speed of 45 miles per hour may be maintained.

Equipment for Jersey City Printing Plant.

The Jersey City Printing Company is following close in the lead of other operators of large press plants in having extensive changes made in the power plant and transmission system. The entire machinery of the plant, including the high-duty presses and auxiliary machinery used for printing the New York Telephone Company's directories, will be operated by motors directly attached to the printing presses.

The motors will be 75 in number, ranging in capacity from ½ hp to 35 hp. They will be built by the Crocker-Wheeler Company.

Some novel features in the mechanical application of the motors will be introduced, particularly in the Cutler-Hammer controlling and starting devices, the question of manipulating the high-pressure current with absolute safety of fire risks receiving special attention. All the circuits are to be of specially high tension. The insulated wire will run in armored conduit and the starting boxes and auxiliary controllers will be steel-incased, affording the same kind of protection as the street car controller type of apparatus. The voltages used in the plant will be 500, 250 and 10, the low tensions acting principally for the purpose of operating solenoid controls for automatic stops, etc.

A new power plant will be installed of 200-kw capacity. There will be a 150-kw also a 50-kw Westinghouse generator, three-wire, 500-250-volt direct-current type. The engines will be of Harrisburg build of 225-hp and 75-hp capacity, respectively. Mr. Watler Kidde, 95-97 Liberty Street, New York, designed the equipment. This is but another instance of the manner in which the large new printing offices are adopting electrical equipment wholesale. The *New York Times* is a further case in point.

Fort Wayne Single-Phase Wattmeter.

The accompanying illustrations illustrate the integrating induction wattmeter for single-phase alternating-current circuits made by the Fort Wayne Electrical Works, and known as Type K. As indicated by the engraving, this wattmeter is very compact in form, requiring a space of only 6¾ x 8⅞ x 6¾ in. for installation. The cast aluminum case is put on directly from the front and requires but one screw, shown at the top, to securely fasten it. It is seated in a deep felt-lined groove in the frame, making a dust and insect-proof joint.

The series coils of the meter are clamped on brass spiders mounted on the back wall of the base and connected directly to binding posts above. The shunt armature coils are held by brass clamps mounted on the armature core, which is clamped to the back wall of the base. The adjustable starting device is mounted on a bracket on the lower part of the base, this bracket also carrying the permanent magnet, which is adjustable in position for varying the drag on the armature. The impedance coil in the shunt circuit is located in the base of the frame and is covered by a cap on the back of the meter fastened from the inside.

The rotating parts consist of a slender steel shaft having a shoulder to receive a stamped aluminum disc. This shaft is supported by a lower jewel bearing and guided by a top bearing stud. By the removal of the registering mechanism the rotating parts of the meter can be removed, thus exposing the interior of the instrument, as

FIG. 1.—WATTMETER.

FIG. 2.—ALL MOVING PARTS REMOVED.

shown in Fig. 2. The jewel bearing is mounted in a screw which is adjustable vertically; it rests on a coil spring within this screw, which is of such strength as to support the rotating parts flexibly, thereby preventing any wear on the jewel that might be caused by vibrations of shocks from the rotating parts. The jewel screw can be raised or lowered and mounted in position after the proper adjustment is made. A guide screw provides means for raising and supporting the shaft from the jewel when the meter is not in service. The top bearing for the shaft consists of a brass stud held by a set screw in the bracket which supports the registering mechanism. The shaft is accurately ground to a microscopic finish. While the motion of the integrating train of gears driven by a worm on the armature shaft is comparatively slow, to reduce friction to its lowest turns, both the gears and worms are cut as accurately as watch gears and then given a microscopic finish and inspection.

The permanent magnet is held in position on the front of the lower bracket by a brass clamp, and is adjustable vertically for varying the drag on the aluminum armature. The upright position of the magnet and its distance from the series coils prevents magnetic disturbance from any excessive current in the coil caused by short-circuit or sudden overload. In the manufacture of the permanent magnet, use is made of the most refined methods known to the art, these methods having been developed through years of experience and study.

To compensate for static friction an adjustable starting coil is connected in the shunt circuit of the meter, the coil being mounted on a small laminated iron core or arm. By a proper disposition of the end of this arm with relation to the core of the main shunt coil, the meter may be adjusted and set by screws *A*, *B* and *C* for starting with the smallest commercial load. Such adjustment is very sensitive and easily made without affecting any of the other adjustments.

A feature claimed for this type of wattmeter is its ability to accurately measure overloads, both inductive and non-inductive, of any character and to carry continuously and measure accurately such loads without injury. The meter is so constructed that no high temperatures are attained when operating under such conditions, thus obviating any damage to the installation or otherwise affecting the meter. All meters are constructed for use on either 60 or 133-cycle circuits, only a slight change that can be made in a moment's time being necessary to adapt the meter for use on either circuit. On the outside of the impedance coil in the base of the meter are the ends of two wires which, when soldered together at *D*, introduce suitable impedance in the shunt circuit to lag the meter for use on a 60-cycle circuit. For use on 125 to 140-cycle circuits these ends are separated to obtain the proper impedance for lagging with a high frequency.

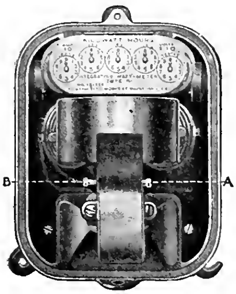


FIG. 3.—FRONT VIEW OF INTERIOR.

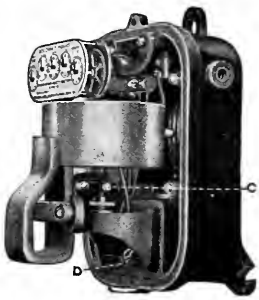


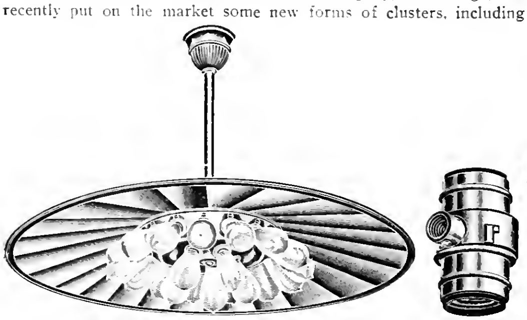
FIG. 4.—SIDE VIEW OF INTERIOR.

The meter is designed to measure accurately the energy of the circuit, regardless of variations found in wave forms in commercial service, and will not show appreciable error when subjected to most radical changes in wave form.

The counter of the meter is arranged to eliminate the constants or multipliers in obtaining actual energy ratings. In all sizes the dials are made direct-reading by using different combinations of gears in the counters. To prevent the introduction of these changes in the counter from producing excessive friction or drag and causing large errors on light loads, the values of the dials on large capacity meters are relatively increased. To further assist in rapid and accurate reading, the dial plate is made of a steel-finished porcelain, thus eliminating any reflection tending to obscure the dials.

Incandescent Lighting Clusters.

The Benjamin Electric Manufacturing Company, of Chicago, has recently put on the market some new forms of clusters, including



FIGS. 1 AND 2.—INCANDESCENT LIGHT CLUSTERS.

two forms of large-sized clusters, one of which is made in 8, 10 and 12 lights, and the other in from 15 to 20 lights. The latter form is illustrated herewith in connection with a large reflector, Fig. 1. The cut shows a 20-light cluster having 15 lights in the outer circle and 5 lights in the inner circle. These clusters are made up of sheet metal shell with suitable openings, in which are attached porcelain receptacles of special design. The receptacles have terminal plates inside of the shell and are easily connected as desired. By means of this receptacle, which is shown herewith (Fig. 2) it is possible to construct a large variety of forms and designs with any number of lights, such as hemispheres, etc.

A full line of the Benjamin products will be exhibited by the company at the St. Louis Exposition, Section 25, Electricity Building.

Curtis Turbines, etc. for Japan.

Contracts have been let for a number of Curtis turbines and other American electrical equipment for installation in Japanese electric light and mining plants.

The Yokohama Electric Light Company has ordered through the Japanese house of Mitsui & Co., 445-447 Broome Street, two Curtis turbines of 500-kw capacity each. The Tokio Electric Light Company has also contracted for a 500-kw turbine. These two companies are extending their plants. A contract for four 1,500-kw Curtis turbines is expected to be closed within the next week or two.

The power plant at the Kosaka Copper Mines is to be doubled in capacity. The existing equipment is of General Electric build. An additional 500-kw generator will be installed, together with a 165-kw motor-generator, three 200-kw transformers and a small direct-current moderate-speed generator as exciter. All the generating machinery will be built by the General Electric Company. The Kosaka plant is hydraulic and another Leffel water wheel will be installed with a capacity of 850 hp on a 104 head.

The Sumito Copper Mines will also be equipped with additional American machinery. Two 150-kw General Electric generators to be direct-connected to McIntosh-Seymour engines, have been requisitioned, also three General Electric transformers of 120-kw capacity each.

Reinsulation of Aerial Lines.

An interesting and ingenious device has been brought out recently for the reinsulation of aerial cables. It can be used for the application of water-proofing to all sizes of wires and cables for electric lighting, railways, power circuits, telephony, etc. It is shown in Fig. 1 and in use in Fig. 2. The device is composed of a cylindrical chamber arranged with a detachable section, whereby the apparatus may be fitted over the wire which is to be reinsulated. The insulating compound is introduced into the chamber from the top, and the

FIG. 1.—REINSULATOR.

FIG. 2.—REINSULATOR IN OPERATION.

device is held in an upright position on the wire by means of a weight. It is then drawn back and forth from pole to pole, giving the wire a uniform coat of insulation. This device has been brought out by the insulating varnish department of the Standard Varnish Works, 20 Broadway, New York City, and Mr. John C. Dolph has taken up its introduction in the east in connection with compounds manufactured for the insulation of aerial wires and cables.

Blue Printing With Enclosed Arc Lamps.

Within a comparatively recent period the work of blue printing in drafting offices has been revolutionized by the introduction of the

FIG. 1.—BLUE-PRINTING MACHINE.

electric light. Formerly it was necessary to depend upon sunlight, but at present most of the large drafting offices are fitted with an electrical outfit that enables blue prints to be made entirely inde-

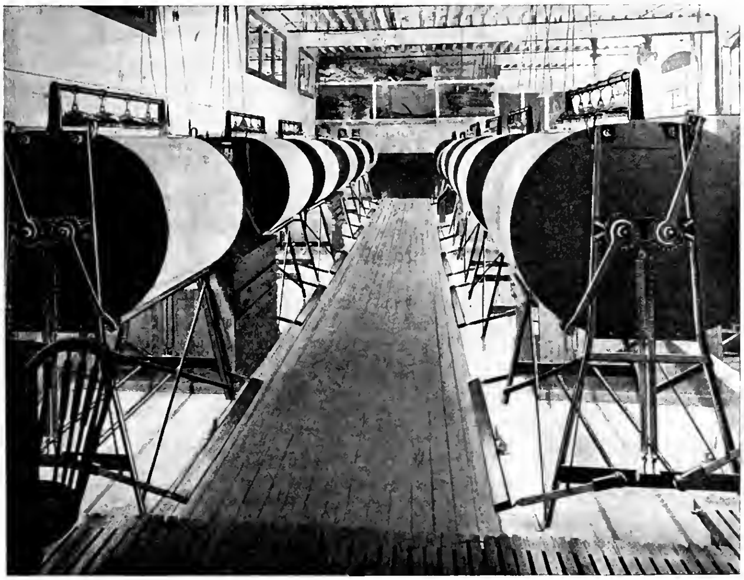


FIG. 2.—BLUE-PRINTING ROOM.

pendent of the state of the weather or hour of the day. Fig. 2 shows the interior of the General Electric Company's blue printing department, which is supplied with twelve four-arc lamp printing frames. During the month of January of the present year no less than 110,000 prints were made with this equipment without the aid of solar light. Ordinarily excellent prints are obtained in from one and a half to three minutes, though in exceptional cases as long as five minutes are required to obtain good results.

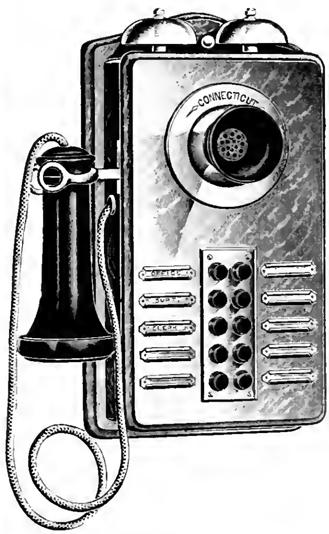
Fig. 1 shows one of the four-arc lamp outfits. The sides of the frames are made of curved plate glass against which the tracings and blue prints are placed, where they are held in position by canvas curtains operated by means of a foot lever. This arrangement holds the tracing firmly against the glass and insures a good contact between the tracing and the blue prints. The electric current is automatically turned on and off by means of a foot lever. The frame is constructed of angle iron and sheet steel, thus insuring lightness and at the same time strength and durability. The frame can easily be moved from one place to another to meet any emergency. By means of thin metal bands placed horizontally and vertically across the glass to hold the tracings, it is possible to make as many as thirty-two 8-in. x 10½-in. prints at one time.

Either direct or alternating current may be used. Four enclosed arc lamps with clear globes are employed as the source of light. While the blue-print apparatus was primarily built for use in the large blue-print department of the General Electric Company, the outfits are regularly sold.

Automatic Switchless Intercommunicating Telephone.

The Connecticut Telephone & Electric Company, of Meriden, Conn., has recently placed upon the market a new type of automatic switchless intercommunicating telephone. This instrument is a new departure, very simple in mechanical construction, and is covered by existing patents and other patents pending.

In designing this instrument the company have an ideal construction for cable connections, which are all made through the back of the instrument and on hard rubber. If any changes are desired it is not necessary to remove the telephone from the wall after it is once placed in position, as all parts are readily accessible, when the cover is removed. The company has done away with cables crossing hinge joints, crowding of parts, etc. The instrument is strictly automatic, and it is not necessary to remove the receiver before calling. With this instrument the call is accomplished and automatically made by pressing down the button of the station wanted. When the receiver is returned to the hook after using, all connections are automatically restored. The company has embodied in this instrument many valuable improvements such as are used in modern long-distance telephones.



INTERCOMMUNICATING TELEPHONE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull with a declining tendency as a result of the firm stand assumed by the Hill-Morgan and Harriman interests in connection with the renewed litigation over the Northern Securities complication. Easy money and better reports of the condition of the iron trade created a demand for prime stocks at concessions, the market, however, being depressed in tone, the only strength being in specialties. The unfavorable April crop report and the continued bad weather in the Northwest and other sections also contributed to the general depression. Nor are railroad earnings considered to be satisfactory; and the backwardness of trade received some attention. United States Steel stocks were relatively firm as a result of the continued demand for iron and steel. The curb market was irregular with a smaller volume of business. Electric and traction securities do not show any activity of note, trading in all, excepting Brooklyn Rapid Transit being light. Of this latter stock, 135,800 shares changed hands at prices ranging from 45⅝ to 48⅜, the closing price being 46¼, a net gain of ⅞ point. Metropolitan Street Railway lost 3¼ points net on the week's trading, the range of prices being 113 to 117¼. The closing quotation was 113¾. General Electric was firm, closing at 164½, which was ½ below the highest figure of the week, the lowest being 163¾. The net result was a gain of ⅞. Westinghouse lost 1½ points net, closing at 161. Western Union closed at 88⅞, which is ⅛ less than the last previous quotation. American Telephone & Telegraph closed at 126, this being the ruling figure throughout the week, and an advance of 3 points. American Telegraph & Cable closed at 86¾, a net gain of 2 points. Following are the closing quotations of April 19:

NEW YORK.

	Apl. 12	Apl. 19		Apl. 12	Apl. 19
Allis-Chalmers Co.	7¼	6¾	Electric Vehicle	7	5¾
Allis-Chalmers Co. pfd	40	40	Electric Vehicle pfd.	10	9
American Tel. & Cable	84	85	General Electric	164	163½
American Tel. & Tel.	126½	126	Hudson River Tel.	..	..
American Dist. Tel	23	23	Metropolitan St. Ry.	115¼	111¼
Brooklyn Rapid Transit	46⅝	44¾	N. Y. & N. J. Tel.	..	..
Commercial Cable	165	170	Marconi Tel.	..	..
Electric Boat	20	24	Western Union Tel.	88¾	88¾
Electric Boat pfd	50	57	Westinghouse com	160	159
Electric Lead Reduction	¾	½	Westinghouse pfd	175	175

BOSTON.

	Apl. 12	Apl. 19		Apl. 12	Apl. 19
American Tel. & Tel	126½	..	Western Tel. & Tel. pfd.	86	..
Cumberland Telephone	113	..	Mexican Telephone	1½	..
Edison Elec. Illum.	237½	..	New England Telephone	121	..
General Electric	..	..	Mass. Elec. Ry.	20¼	..
Western Tel. & Tel	8	..	Mass. Elec. Ry. pfd	75	..

PHILADELPHIA.

	Apl. 12	Apl. 19		Apl. 12	Apl. 19
American Railways	43	44	Phila. Traction	96	95⅞
Elec. Storage Battery	57	57	Phila. Electric	5¾	5⅝
Elec. Storage Battery pfd.	57	57	Phila. Rapid Trans.	13¾	13⅝
Elec. Co. of America	8	8			

CHICAGO.

	Apl. 12	Apl. 19		Apl. 12	Apl. 19
Central Union Tel.	..	..	National Carbon pfd.	100	100
Chicago Edison	150	..	Metropolitan Elev. com.	15	15
Chicago City Ry.	160	155	Union Traction	5½	5¼
Chicago Tel. Co	..	115	Union Traction pfd.	30½	30¼
National Carbon	28	28			

*Asked

CABLE REAL ESTATE PURCHASE.—Ex-Congressman Jefferson M. Levy has sold out his interest in the Commercial Cable Building Company, New York City, to Clarence H. Mackay, leaving Mr. Mackay practically in sole control. The company owns the Commercial Cable Building at 20 Broad Street, running through to New Street, adjoining the Stock Exchange. Just what was the extent of Mr. Levy's ownership in the property is not known, but he is generally understood to have held about a one-half interest, having been the former owner of the site upon which the building was erected. The structure is twenty stories in height and covers a plot of about three city lots, although the company's holdings were increased two years ago by the purchase of adjoining property on New Street and Exchange Place. The site of the present building was transferred to the Commercial Cable Building Company on August 22, 1895, for an expressed consideration of $1,126,300. The value of the property to-day, ground and building, is believed to be in the neighborhood of $3,000,000. It is assessed for taxation this year at $1,850,000. Through the purchase by the Commercial Cable Building Company of the diminutive lot at the northeast corner of Exchange Place and New Street, owned by William F. Havemeyer, what had promised to be a long-drawn-out real estate war at that point bids fair to be ended. Mr. Havemeyer's parcel measures 34.5 by 26.10 ft. and is now covered by a little old three-story building. The Commercial Cable Company is said to propose an addition on it.

GENERAL ELECTRIC BUSINESS.—The *Wall Street Journal* has the following: "General Electric orders for electric apparatus have fallen off the past six months by between 5 and 10 per cent. Factories are working in many departments overtime on old orders, but new orders not forthcoming for electric construction in volume equal to a year ago. It is understood that General Electric the past year has done about $36,000,000 of gross, of which it is said that $12,000,000 has been wire, repairs and small material. It is not expected that the business of the present year will equal that of the year just ended. The General Electric Company is in strong financial position and never again expects to have to wrestle with debts whatever may be the size of any industrial depression. This is why it will sell stock even to take care of such a small matter as the $3,000,000 of debt inherited from the Stanley Electric Company. The General Electric Company could throw away all its three great plants at Schenectady, N. Y., Lynn, Mass., and Harrison, N. J., and pay $100 per share to its stockholders from its net treasury assets."

ALLIS-CHALMERS POLICY.—The better to put itself in position to make adequately the changes in its equipment for electrical and turbine manufacturing, etc., the Allis-Chalmers Company has passed the quarterly dividend on its preferred stock. The company is understood to have net working capital of considerably over $7,000,000, but proposes to strengthen its position and resources in every way. The Allis-Chalmers Company has $16,000,000 of 7 per cent. cumulative preferred stock and $20,000,000 common stock. It has no funded debt. No dividends have been paid on the common stock. The preferred dividend has been paid quarterly since the formation of the company, three years ago. In the first year's operation the company reported net profits of $1,442,259. Last year it reported $1,653,576. In the first year its balance sheet showed cash on hand, $4,514,167; in the second year, $1,628,009. The latest sales of the preferred have been around 43 and of the common at 7⅞. The balance sheet of April 30, 1903, showed also net current assets of $7,871,342.

INDIANA UNION TRACTION.—Indiana Union Traction Company reports results for the calendar year 1903 as follows:

Gross earnings	$1,118,951
Operating expenses	620,136
Total net receipts	$498,815
Fixed charges, including interest, taxes and licenses, and dividends on preferred stock of Union Traction Company of Indiana	358,511
Net income for the year, applicable to rental payments	$240,304

DIXON CRUCIBLE COMPANY.—The Joseph Dixon Crucible Company, of Jersey City, held its annual meeting April 18. These directors were elected: E. F. C. Young, John A. Walker, George T. Smith, Edward L. Young, William Murray, Joseph D. Bedle and George C. Long. The directors subsequently elected Edward L. Young president, John D. Walker vice-president and George C. Long secretary and treasurer.

MARCONI COMPANY.—At a meeting of the Marconi Wireless Telegraph Company, held in Jersey City on April 18, James W. Pike, J. P. Cotton and G. Marconi were elected directors to serve terms of five years, and H. H. McClure to serve until 1907. One of the directors outlined the work accomplished and the rapid strides with which the work of wireless telegraphy is being carried to a successful issue.

DIVIDENDS.—The Chicago Edison Company's directors have declared the regular quarterly dividend of 2 per cent., payable May 2. The National Carbon regular quarterly 1¾ per cent. preferred dividend is payable May 14. The directors of the American Gramophone Company have declared the regular 1¾ per cent. preferred quarterly dividend, payable May 15, to stockholders of record May 2.

W. U. BONDS.—The governing committee of the New York Stock Exchange has listed Western Union Telegraph Company $1,000,000 additional 4½ per cent. funding and real estate mortgage fifty-year coupon bonds, making the total amount listed to date $17,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade are not as satisfactory as they should be for this season, the chief reason being the unseasonably cool weather, which has a retarding effect along all lines. Business, as a result, was irregular, but the feeling is hopeful, the advent of warmer weather being the only factor lacking to instill new life. Foreign trade returns were more favorable to manufacturing than to agricultural interests. The industrial situation is not entirely favorable. The cotton goods industry is steadily curtailing production, but there is increased production, consumption and demand from various sources for iron and steel, coal, coke and lumber. Other industries are lagging. Notwithstanding the disappointing condition of spring trade in general, several markets report good orders for future delivery. Collections are not improved. Trade on the Pacific Coast is affected by backward weather, and in San Francisco labor conditions are very unsatisfactory. Iron was quieter. Finished products are in good demand, but manufacturers are buying merely to fill requirements. Some heavy transactions in cars are expected, there being a call for nearly 10,000 of them by several roads. The copper market, while firm, remains practically unchanged as to prices, Lake being quoted at 13⅝ to 13⅜c.; electrolytic, 13⅛ to 13¼c., and casting stock 12⅞ to 13⅛c. Transactions were on a limited scale as far as home consumers are concerned. The business failures for the week ending April 14, according to *Bradstreet's*, numbered 198, against 201 the week previous and 160 the corresponding week last year.

SOME CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company, through its New York office, under the management of F. B. De Gress, has secured a contract for a 100-kw engine type generator, to be direct-connected to a Ball & Wood engine for the Clear Creek Mining Company, Arbacoochee, Ala. The machinery will be used for general power purposes. The C. Martens Company, which operates a large bakery in Jersey City, has ordered four motors ranging from 3 hp to 15 hp. The Solvay Process Company, Syracuse, N. Y., has requisitioned for eight 12-hp motors for driving cranes. The Ansonia (Conn.) O. & C. Company has ordered a 50-kw belted generator for installation in its corset fittings factory. The New England Engineering Company, of New Haven, Conn., has ordered for the fifth time a number of small motors, which are to be used for ventilating apparatus in Yale University. The Eolian Company has called for three motors ranging up to 10 hp for its plant at 157 East Thirty-second Street. The Belvedere-Stratford Hotel, at Philadelphia, is to be installed with two small motor dynamos for the bell service; and C. S. Robinson & Co., of Princeton, N. J., have ordered some motors for their printing plant. Mr. De Gress reports that the amount of business handled through the New York offices this year has been on a par with that secured up to a similar period in 1903, large as that was.

STILWELL-BIERCE & SMITH-VAILE COMPANY.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, has taken a lease of the extensive ground floor and basement at 93 Liberty Street, now being vacated by Stanley & Patterson, and will take possession about May 1. A very large stock of standard size pumping machinery—power, steam and marine—also Victor turbines, air compressors, feed water heaters and other specialties, will be carried. A full line of pumps and spare parts will also be on hand. The present New York offices of the company, in the Washington Life Building, will be removed to the new premises. The local sales organization of the company will be considerably strengthened. Six new men are now being engaged. Each machinery department will be under separate supervision and machinists will be on hand to erect and overhaul machinery. The management of the New York end of the company's business will, as heretofore, be in charge of G. W. Neff, the Eastern manager.

WESTINGHOUSE EQUIPMENT FOR CERRO DE PASCO MINES.—The Cerro de Pasco Mining Company, in which J. B. Haggin is the leading spirit, and of which Frank Klepetko, Battery Park Building, New York, is the consulting engineer, has awarded the contract to the Westinghouse Electric & Manufacturing Company for the electrical equipment to be installed at its huge copper smelter, etc., now under construction at Cerro de Pasco, Peru. The generating equipment will be of 350-kw capacity—one unit. This machine will be direct-connected to a cross-compound engine to be built by the Nordberg Manufacturing Company, of Milwaukee, Wis. Fourteen Westinghouse motors varying in capacity from 10 hp to 100 hp will be used for driving machinery in the foundry, sampling mill and machine shops.

150,000 LIGHTS FOR CONEY ISLAND.—The Wonderland Company has organized recently under the laws of the State of New York with a capital of $1,200,000, to operate a huge amusement resort entitled "Dreamland," in Coney Island, in which electricity will play a most important part. There will be upwards of 150,000 lights, the ballroom alone using 15,000. Ex-State Senator Reynolds is president of the company. Others largely interested are P. B. Purdy, J. H. Wythe, W. G. Groves and George E. Hall. The chief engineer of the company is C. C. Harley, an old Brooklyn Edison man. Power will be furnished by the Brooklyn Edison Company. Stanley & Patterson, 93 Liberty Street, have secured a contract reported to be valued at more than $50,000, for furnishing various supplies, etc.

EQUIPMENT FOR NEW BABBITT SOAP FACTORY.—B. T. Babbitt, the soap manufacturer, of 64-84 Washington Street, New York, is to construct a large plant at Granton, N. J., which will be electrically operated throughout. Howard R. Barton has been retained as consulting electrical engineer in the matter. He is now engaged in drawing up the plans, etc., and contracts for the necessary equipment are expected to be let inside of 30 days. The capacity of the plant will be about 500 hp. There will be two generating units of 150-kw capacity each. Fully fifty motors will be employed ranging in capacity from 1 hp to 20 hp. They will be operated mostly in groups.

THE ALLIS-CHALMERS COMPANY has lately sold to the Interborough Rapid Transit Company a surface condensing outfit to be used in connection with a 5,500-kw steam turbine, which is to be installed at the Manhattan power station, Seventy-fourth Street and East River, New York. This surface condenser has been especially designed for use with steam turbines to give the high vacuum which is required for this class of work, and will be built at the Allis-Chalmers works at Scranton, at which place a condensing machinery department has been established, and where the company intends to build condensers to meet every condition.

ELECTRIC CRANES FOR PERU COPPER PLANT.—The Alliance (Ohio) Machine Company has been allotted an interesting contract for electric cranes to be installed in the converter plant being built by the Cerro de Pasco Mining Company, Peru, for which Frank Klepetko is consulting engineer. There will be a 40-ton alternating-current crane fitted with two auxiliary hoists of 15-tons capacity each. The motors will be of Westinghouse type F build. They will be of 75-hp, 15-hp and 10-hp capacity. A 10-ton crane with two auxiliary hoists to be operated by Westinghouse motors—three of 20 hp each, has also been ordered.

EQUIPMENT FOR DRESSED BEEF PLANT.—The United Dressed Beef Company, First Avenue and Forty-third Street, New York, let a contract recently for the complete electrical equipment of its plant. The capacity will be 300 hp. There will be a 200-kw engine type generator of Crocker-Wheeler build direct-connected to a Fitchburg engine. The motor equipment will consist of eleven machines aggregating 170 hp and varying in capacity from 5 hp to 35 hp. The plant is to be installed under the supervision of A. G. Koenig, chief engineer of the United Company.

SHAW ELECTRIC CRANE ORDERS.—The Shaw Electric Crane Company, of Muskegon, Mich., has secured a substantial contract for cranes to be installed in the new locomotive shops at Spencer, N. C., of the Southern Railway. The contract calls for two 60-ton cranes and one each of 10-tons and 5-tons capacity. The 60-ton cranes will have 10-ton auxiliary hoists. The Indianapolis Light & Power Company has ordered a 50-ton crane with an auxiliary hoist of 10-tons capacity for installation in its new power station at Indianapolis.

LIGHTING EQUIPMENT FOR HALL OF RECORDS.—A 450-kw lighting equipment is to be installed in the new Hall of Records. The C. L. Eidlitz Company, 1168 Broadway, secured the contract. There will be two 150-kw and one 100-kw Crocker-Wheeler generators, also a 50-kw machine of same build. The engines for the larger generators will be Brown Corliss, while a Watertown engine will drive the 50-kw machine.

1,800-KW PLANT FOR NEW WANAMAKER STORE.—An 1,800-kw electric generating plant is to be installed in the new Wanamaker store to be constructed at Eighth and Ninth Streets and Broadway, by the Thompson-Starrett Company, 51 Wall Street. The contracts for the electrical equipment, consisting of six units of 300-kw capacity each, will be sub-let by Mr. Babbitt, the electrical engineer of the company.

TELEPHONE SUPPLY MANUFACTURING.—Various rumors are floating about in Chicago regarding the formation of an independent telephone manufacturing company to be controlled on a co-operative basis by independent telephone exchange companies. Nothing definite seems to have materialized. The name of Mr. James E. Keelyn has been mentioned in connection with the enterprise.

GOUBERT HEATERS FOR JAPAN.—The Goubert Manufacturing Company, Singer Building, New York, has a number of orders in hand for its specialties to be installed in Japanese electric plants. The Hanshin Electric Railway Company has ordered Goubert heating apparatus and one of the largest copper mines will also have Goubert heaters in its electric power plant.

SHELLAC is advancing again in price and is quoted now at 51 cents a pound. Stock are light, due, it is said, to a drought in India, from which it will take a long time to recover.

POLICE TELEGRAPH SYSTEM WANTED.—The city of Johnstown, Pa., is in the market for a police telegraph system and correspondence is solicited.

General News.

THE TELEPHONE.

CAMDEN, ARK.—The Ouachita Telephone Company of this city has been incorporated with a capital stock of $25,000, of which $10,000 has been subscribed. M. A. Joy is president; H. P. Snead, vice-president, and W. P. Ritchie, secretary and treasurer.

WATERBURY, CONN.—The Southern New England Telephone Company is planning to install a complete system of underground subway for its main lines in this city.

COEUR D'ALENE, IDA.—The Rocky Mountain Bell Telephone Company will extend its system within a few months in all directions from this point throughout the county.

CARTHAGE, ILL.—The Mississippi Valley Telephone Company has been formed here.

HARDIN, ILL.—The Farmers' Telephone Company will extend its line from Hardin southward to Meppin.

ARCOLA, ILL.—The Arcola Grain, Coal & Telephone Company has increased its capital stock from $5000 to $8000.

TREMONT, ILL.—The Tremont Independent Telephone Exchange has incorporated with a capital stock of $20,000. Mr. A. J. Davis is president.

UPPER ALTON, ILL.—A farmers' mutual telephone company has been organized east of this place by 35 farmers. They have decided to apply for a franchise to install a private telephone system in Upper Alton.

PEORIA, ILL.—Telephone and telegraph communication between here and Tazewell County points was entirely shut off by the fall of part of a bridge over the Illinois River at this city on April 4, caused by the undermining of two piers by the floods.

CHICAGO, ILL.—Miss Mary Schultz, who was an operator for the Chicago Telephone Company, was given a verdict of $15,000 against the company for an accident while employed at the switchboard, which, it is alleged, caused deafness in her left ear. It is said that she received an electric shock from the receiver.

MARION, IND.—The Roann Telephone Company is making preparations to extend and enlarge its plant.

INDIANAPOLIS, IND.—The Waupecong Home Telephone Company, of Waupecong, Miami County, has been incorporated. M. D. Hensler heads the board of directors.

GREENFIELD, IND.—The Cleveland Telephone Company, of Hancock County, has been incorporated. The incorporators are: E. H. Thomas, I. L. Sample, E. L. Furry and others.

INDIANAPOLIS, IND.—The city council at a special meeting passed an ordinance permitting the New Telephone Company to transfer its franchise and holdings to the Indianapolis Telephone Company.

WABASH, IND.—The city council has granted a franchise to the Central Union Telephone Company. The company has been doing buisness without a franchise for more than a year, during which time the council and company have been wrangling over the matter.

SUMMITVILLE, IND.—The Delaware and Madison County Telephone Company has begun the work of changing instruments and installing its switchboard at Summitville to replace the one formerly operated by the Central Union Company, and which was owned by R. M. Inglis. The Central Union will now operate only a toll station line.

GREENFIELD, IND.—The Blue River Telephone Company, of Hancock County, has increased its capital. The company was organized a year ago to furnish the farmers of Blue River township with reliable telephone service. The demands for telephones and the necessity for extending the 'lines has been so steady that an increase of capital was necessary to provide a new switchboard and other material. The improvements will be made at once.

EVANSVILLE, IND.—A permanent injunction against the Municipal Telephone Company, of Evansville, preventing it from doing business under the franchise granted some time ago by the city council, was issued April 8 by Special Judge W. D. Robinson, of the Indiana Appellate Court. This action creates a peculiar situation here. The Cumberland Company has been declared franchiseless. The city is now in a position to obtain the best advantage in the matter of granting a franchise.

RUSHVILLE, IND.—The annual meeting of the stockholders of the Rushville Co-operative Telephone Company was held last week. The secretary-treasurer's report showed the receipts for the year to be $15,404.19. Rentals for stockholders for residences were raised from 75 cents to $1, and for business houses from $1.25 to $1.50. H. E. Barrett, W. D. Root, B. L. McFarlan and T. M. Green were elected directors.

POCAHONTAS, IA.—The Pomeroy-Palmer Telephone Company has been formed here to build a rural line.

STUART, IA.—The Lincoln & Stuart Telephone Company will build an exchange here.

TAMA, IA.—The Tama Telephone Company has been incorporated with a capital stock of $150,000.

STORY CITY, IA.—The Gilbert & Story City Telephone Company has been formed to build a rural line.

DUNCOMBE, IA.—The Duncombe Telephone Company has applied for a franchise to install an exchange here.

DES MOINES, IA.—The Mutual Telephone Company will remodel and reconstruct its exchange and install entirely new equipment at a cost of $250,000. A new switchboard, having a capacity of 10,000 lines, is included in the new plans. It is stated that Stromberg-Carlson apparatus will be used.

SEMIWAY, KY.—The Cumberland Telephone Company is building a line from Rumsey to this place.

MIO, MICH.—Mio Telephone Company has been incorporated with a capital stock of $2000.

DETROIT, MICH.—It was reported recently that the People's Telephone Company had sold its Detroit property to the Michigan Telephone Company for $175,000. This report, however, is denied by Mr. J. B. Corliss, who has the disposal of the People's Telephone Company property.

HANSKA, MINN.—The Hanska Rural Telephone Company has been formed here.

LAKE CITY, MINN.—The Dwelle Telephone Company will extend its lines this year.

WINONA, MINN.—The Winona Telephone Company will build several branch lines this spring.

OWATONNA, MINN.—The Northwestern Telephone Exchange Company will rebuild its local exchange.

AITKEN, MINN.—The Aitken & Grand Rapids Telephone Company has been organized here and will soon build a line.

COTTONWOOD, MINN.—The Home Telephone Company has been incorporated with a capital stock of $10,000. The directors are: L. S. Reishus, Chas. Catlin and others.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange will make extensive improvements to its system in the twin cities, extending the subway system and installing considerable cable.

RENVILLE, MINN.—The Renville Rural Telephone Company has been incorporated with a capital stock of $20,000 and will connect a number of towns under 2000 inhabitants by means of rural telephone lines. The incorporators are: A. E. Carver, A. E. Rieke, S. W. Smith, Paul Albrecht and C. W. Parsons, of Fairfax, and O. W. Harris and R. E. O'Keefe, of Franklin.

PELICAN RAPIDS, MINN.—The Pelican Telephone Company has been incorporated with a capital of $25,000, and has purchased the rural lines of the Fergus Telephone Company in this vicinity. The officers are: J. P. Wallace, president; C. M. Carr, vice-president; N. P. Moen, secretary; C. L. Ward, treasurer; C. D. Haugen, Knuts Steenerson and O. J. Morrison, directors.

PARIS, MO.—The Mutual Telephone Company is building a line from this place to Long Branch.

MEXICO, MO.—The telephone managers in Audrain County are making an effort to form an independent union of all the smaller companies in this section. A telephone franchise in this city will be applied for.

ST. LOUIS, MO.—Mr. L. W. Stanton, the consulting telephone engineer of Cleveland, Ohio, is supervising the installation of an all-cable telephone plant of between two and three hundred telephones, for the Controller Company of America, on the World's Fair Grounds, St. Louis. All the telephones used will be of the measured service type, manufactured by the Controller Company of America.

ALEXANDRIA, NEB.—The Farmers' Telephone Company has been incorporated with a capital stock of $5000.

ELBA, NEB.—The Howard County Telephone Company has been incorporated with a capital stock of $25,000.

PASSAIC, N. J.—The New York Automatic Telephone Company has been incorporated here with a capital stock of $50,000. The incorporators are: Charles R. Newman, George Roegnes and A. C. Gilgen.

MIDDLETOWN, N. Y.—The Scotchtown Telephone Company has been incorporated with a capital stock of $2000. The directors are Herbert Mills, M. H. Santee and others.

ALBANY, N. Y.—The Ulysses Co-operative Telephone Company, of Jacksonville, N. Y., has been incorporated with a capital stock of $7200. The directors are: S. W. Meckell, F. A. Miller and others.

HAMLIN, N. Y.—The Hamlin Telephone Company has been organized by local business men to build a line from Hamlin to Morton. The officers of the company are: President, D. R. Singleton; vice-president, Christopher Rath; secretary, H. F. Newman; treasurer, Charles Baase.

SOMERVILLE, OHIO.—The Hamilton Home 'Phone Company has secured a franchise from the village council.

COLUMBUS, OHIO.—The Albany & Vails Mills Telephone Company has reduced its capital stock from $10,000 to $1000.

FULTON, OHIO.—The Fulton Telephone Company has been incorporated with a capital stock of $5000 by E. E. Jackson and Chas. Feldon.

ENGLEWOOD, OHIO.—The West Milton Home Telephone Company will install new exchanges at Laura and Englewood and make other improvements.

LAMARTIN, OHIO.—The Dining Fork Telephone Company has been incorporated with a capital stock of $10,000. The directors are: E. H. Kennedy, J. Harrison and others.

TROTWOOD, OHIO.—The Trotwood Home Telephone Company has been incorporated with a capital stock of $10,000. The directors are: S. A. Blessing, W. L. Bosler and others.

MANCHESTER, OHIO.—The Brown Telephone Company has been incorporated with a capital stock of $20,000 by O. E. Bare and others. The lines of this company will connect several towns in this vicinity.

WILLAMETTE FALLS, ORE.—The W. W. Telephone Company has been incorporated with a capital stock of $10,000 by Guy Cross, C. G. Huntlet, G. H. Rogers and C. Baker. It is proposed to build a line from Willamette to Stafford.

GRIP, PA.—The Farmers' Union Telephone Company has been incorporated with a capital stock of $5000.

SCRANTON, PA.—The Pennsylvania Telephone Company has refused to furnish the fire alarm service after July 1. The city may have to issue $50,000 in bonds to intsall a system of its own.

BUFFALO, GAP, S. D.—The Cheyenne River Telephone Company has been incorporated with a capital stock of $10,000.

ABERDEEN, S. D.—The Dakota Central Telephone Company will expend a large amount of money in extensions and improvements this summer.

BROWNSVILLE, TEX.—W. H. Johnson and Mrs. J. M. Ellis contemplate establishing a local telephone exchange here. They will also build long distance telephone lines.

SAN ANTONIO, TEX.—The San Antonio Telephone Company is preparing to make improvements to its local system here to the amount of $100,000. D. A. Walker, of Columbus, Ohio, is president of the company.

HOUSTON, TEX.—The switchboard of the Southwestern Telegraph and Telephone Company's exchange in this city was damaged by fire April 2. The fire started either by lightning or a cross with an electric light wire. Four thousand telephones were affected.

SALT LAKE, UTAH.—The Southern Utah Telephone Company has been incorporated with a capital stock of $5000. R. C. Lund and E. H. Snow are among the directors.

SUSSEX, VA.—The Sussex and Southside Telephone and Telegraph Company has been incorporated with a capital stock of $5000.

CHETEK, WIS.—The Dunn County Telephone Company will establish a local exchange here.

GREEN BAY, WIS.—The Wisconsin Telephone Company will install an underground system here.

CADIZ, WIS.—The Cadiz Central Telephone Company has been incorporated with E. L. Divan as president.

BLACK RIVER FALLS. WIS.—The Central Wisconsin Telephone Company has increased its capital stock from $5000 to $50,000.

IOLA, WIS.—The Iola Telephone Company has been incorporated with a capital stock of $5000. The directors are: N. H. Johnson, F. W. Black and others.

ROBERTS, WIS.—The Roberts Telephone Company has been incorporated with a capital stock of $5000. The directors are: G. W. Turner, A. J. Walker and others.

MONDOVI, WIS.—The Mondovi Telephone Company has been incorporated with a capital stock of $24,000. The directors are: B. S. Lockwood, S. H. Hubbard and others.

VANCOUVER, B. C.—The International Telephone Company has completed arrangements whereby Vancouver and other places on Vancouver Island will be placed in telephonic connection with points on the main land as far south as Portland, Ore. The company is an amalgamation of the long distance telephone companies operating in British Columbia and is about to traverse the American islands in the Gulf of Georgia at the mouth of Puget Sound. The new company is capitalized at over $150,000.

ALBUQUERQUE, N. M.—It is reported that the Colorado Telephone Company, with headquarters at Denver, Col., will extend its lines to this place.

ELECTRIC LIGHT AND POWER.

JACKSON, ALA.—B. H. Warren is interested in an electric light plant for Jackson.

MORRISVILLE, ALA.—Louis J. Morris, of the Morris Mfg. Company, at Morrisville, it is stated, has signed a contract with the Talladega Light and Power Company for the construction of a dam at Choccolocco Creek to cost $25,000. The dam will be used to generate power for an electric plant.

BERKELEY, CAL.—The Berkeley Electric Co. has secured the contract for lighting the city for 2 years beginning April 1 for 160 lamps at $6 each.

VICTOR, COL.—Citizens are considering the building of a co-operative electric light plant. They are dissatisfied with the rates charged by the existing two companies.

WOODBURY, CONN.—It is proposed to establish an electric light plant here. E. S. Boyd can give information.

DOVER, DEL.—The Water and Light Committee of the town council has recommended that $8,500 be expended for improvements to the water and lighting plant.

JACKSONVILLE, FLA.—A 500-kw generator is wanted for the city electric light plant.

GREENSBORO, GA.—The council has granted T. B. Rice, of Greensboro, and R. L. West, of Atlanta, a franchise for an electric light plant.

COLUMBUS, GA.—The council has accepted the proposition of the Columbus Railway Company to furnish street lighting for 1905 at $60 per arc light per year.

BOISE, IDAHO.—The Idaho Brewing Company has installed electric power apparatus for the operation of its plant.

OTTAWA, ILL.—It will cost $8,000 to install an electric light plant in Ottawa according to estimates.

RIDGEFARM, ILL.—A new company has been organized by C. O. Linn and Wm. Henderson to construct an electric light plant.

CHICAGO, ILL.—The Commonwealth Electric Co. has purchased property on Chicago River adjacent to its works, and it will be used for extensions.

PICKNEYVILLE, ILL.—Bids are wanted May 2 for constructing an electric light plant and for power for the city water works pumping station. A franchise will be granted to the operating company for a term of 15 years. Thirty-five arc lights are required for city lighting. Peter J. Hamm is city clerk.

CHICAGO, ILL.—The North Shore Electric Railway has increased its capital stock from $750,000 to $1,250,000, for the purpose of taking over the electric light plants at River Forest, Elmhurst, Melrose Park and Maywood. This will make 16 villages included in the operation of the company, extending from Waukegan down to Evanston and out near the Desplaines River along the western limits of Chicago. A bond issue will also be made in the near future.

EVANSVILLE, IND.—The Jasper Ind., town board, April 13, purchased the electric light plant of that place and it will be operated by the city.

BICKNELL, IND.—The county commissioners have granted J. H. Barr & Co. a franchise to construct an electric light and power plant in Bicknell.

FT. WAYNE, IND.—The Ft. Wayne Electric Light & Power Company has completed its organization and will at once begin the reconstruction of its plant.

BOONVILLE, IND.—The City Light & Power Company, of Boonville, has been incorporated. J. F. Katterjohn, Jno. F. Hepp and S. W. Hart and others are the incorporators.

INDIANAPOLIS, IND.—The Indianapolis Light & Power Company has filed amended articles of incorporation whereby the company's powers are broadened. The amended articles allows the company to mine coal, equip coal mines and other cities with apparatus for electric light and power.

MASON CITY, IA.—The citizens have voted to construct an electric light plant.

FRANKFORT, KY.—The Princeton Electric Light & Power Company, of Caldwell County, has been incorporated with a capital stock of $25,000.

WICKLIFFE, KY.—Bids are wanted May 2 for furnishing one 60-kw alternator; 60-cycle, single-phase engine type alternator, to be connected to and operated by an engine of sufficient proper size; also alternating service system of 25 arc lamps complete, with regulating transformers, 17 arc lamps of 6.6 amp. capacity, etc. G. P. Prentis is chairman of the light committee.

WICOMICO, MD.—The Wicomico Electric Power Co., composed of Chas. R. Disharoon, Jesse D. Price, Thos. Perry, and others, will apply for a charter.

BALTIMORE, MD.—Chief Engineer Phelps has received authority from the electrical commission to make extensions of the house-to-house subway system.

ROCKVILLE, MD.—The Mayor and council of Kensington, this county, have abandoned the idea of bonding the town for $50,000 for the purpose of establishing an electric light and water plant. A bill was prepared to be sent to Annapolis, but met with strong opposition on the part of taxpayers. It was decided by the council to defer the matter indefinitely.

GREENFIELD, MASS.—A committee has been appointed to secure estimates on the cost of installing an electric plant.

WESTFIELD, MASS.—At the annual town meeting April 4 $10,500 was appropriated for installing and operating a municipal power plant. Owen E. Parks is town engineer.

BAY CITY, MICH.—The citizens have voted to issue $50,000 bonds to enlarge the city lighting station for commercial lighting.

IONIA, MICH.—The plant and buildings of the Ionia Electric Light Co. at Wagar's dam, 4 miles east of here, were washed away on March 25. The loss is about $15,000.

ANN ARBOR, MICH.—The Michigan Milling Company and Frank Cornwell are interested in the construction of an electric light and power plant to cost about $150,000.

MARQUETTE, MICH.—It is stated that the municipal electric lighting plant shows a net revenue of nearly $13,000 for the fiscal year just closed with all interest charges defrayed, a liberal allowance for depreciation, bond payment of $5000, etc. It is expected that the plant will ultimately pay off its bonds and reimburse the city for the amount originally invested.

BIRD ISLAND, MINN.—L. A. Tinnes has petitioned for a franchise for an electric light plant.

ATWATER, MINN.—The question of establishing water works and an electric light plant is under consideration by the council.

NEW PRAGUE, MINN.—Bids are wanted April 18 for furnishing and installing an engine, boiler, etc., in the city power house. Albert J. Rynds is city clerk.

ST. PAUL, MINN.—G. S. Edmondstone, 518 Globe Bldg., chief engineer Cannon River Electric Company, writes that the company is preparing to build a dam and power house and install hydraulic and electric machinery for the development of 2000 kw on Cannon River, near St. Paul.

ST. LOUIS, MO.—Application was made in the United States Court to have the Farmington, Mo., electric light and ice company declared bankrupt. The petition was presented by various creditors.

CHARLESTON, MO.—The Southwet Missouri Ice, Light & Power Company has been incorporated with a capital stock of $100,000. The incorporators are Handy Moore, J. E. Armstrong and R. B. Boyce.

MOBERLY, MO.—At a special election April 15, it was voted to grant the Moberly Light, Power & Fuel Company the right to construct, maintain and operate an electric and gaslight, power and fuel plant in Moberly, also to legalize a contract for ten years with the said company.

OSYKA, MISS.—The citizens have voted to issue $15,000 bonds for water works and an electric light plant.

LINCOLN, NEB.—It was voted April 5 to issue $65,000 bonds for the construction of an electric light plant. T. H. Pratt is county clerk.

ATLANTIC CITY, N. J.—The Brigantine Transportation Company, which supplies electric lights to Brigantine, N. J., is to be sold out by the receiver, Mr. R. D. A. Parrott. There is no electric light plant in Brigantine.

MIDDLEPORT, N. Y.—The Albion Electric Light and Power Company has secured the contract for lighting the city by electricity at $60 per lamp per year.

ALBANY, N. Y.—A bill has been introduced in the legislature providing for a commission to investigate the various methods of electric canal boat propulsion and report to the Governor and Legislature early in 1905.

UTICA, N. Y.—The Utica Gas & Electric Company has elected the following-named officers: President, Anthony N. Brady, of Albany; vice-president, William E. Lewis; secretary, W. J. Cahill; treasurer, George H. Stack.

WATKINS, N. Y.—The Watkins Consolidated Gas & Electric Co., Watkins, N. Y., was recently sold by Mr. A. L. Sweeney to the Consolidated Electric Light & Traction Co. of Philadelphia. Mr. Sweeney says that the election which was held in the village recently, at which time municipal ownership was voted for, is undoubtedly illegal in view of the light in which the courts have viewed other similar elections occurring about the same time.

FREMONT, N. C.—The council has under consideration the construction of an electric light plant.

KENMARE, N. D.—F. W. Amsler and A. B. Kerlin, of Devil's Lake, have secured a franchise for an electric light plant.

FREMONT, OHIO.—The Fremont Power & Light Company has been incorporated, with a capital of $350,000, by capitalists of this city, Chicago, Waterloo and Auburn, Ind.

COLUMBUS, OHIO.—A bill has been introduced in the Legislature providing for the appointment of a State franchise commission to control street and interurban railways, artificial gas, electric light, heat, power and water companies.

ST. MARYS, OHIO.—The city council has been asked for an appropriation for the improvement of the water works and electric light plant. It is proposed to purchase two water tube boilers of 300-hp each, one heater and purifier of 600-hp capacity, a smoke-stack, a dynamo, 100 enclosed arc lamps, an air compressor; drilling 3 wells, repairing and extending water mains and electric light lines.

LEWISTOWN, PA.—The contract for arc instead of incandescent lights has been awarded to the Lewistown Electric Light Company at $65 per light.

NEW FREEDOM, PA.—W. H. Lowe, town secretary, writes that it is proposed to construct an electric light plant at a cost of $13,600. Bids will be received April 30.

CRESSON, PA.—The Cresson Electric Light Co. has started operations since the installation of a new power house. Light was formerly supplied from a transmission line at 6000 volts from the Galletyin Electric Light Company's plant, 3 miles away. This line is still maintained for emergency at either end.

LAWRENCEBURG, TENN.—The city council is investigating the cost of establishing an electric light plant.

COLUMBIA, TENN.—Bids are wanted April 23 for furnishing 60 arc lights for a term of 10 years. W. A. Dale is chairman of the committee.

SHERMAN, TEX.—The Sherman Light and Power Company has been organized with a capital stock of $100,000. The incorporators are: J. Lobit, of Galveston; E. P. Bomar, of Gainesville; W. P. Brents, M. B. Pitts and C. N. Roberts, of Sherman.

LOGAN, UTAH.—The citizens have voted to issue $12,000 bonds to complete the municipal electric light plant.

BURLINGTON, VT.—The Northern Electric Co. has been incorporated with a capital of $20,000.

RICHMOND, VA.—C. E. Bolling, superintendent of the water works in his annual report, estimates the cost of constructing an electric light plant at about $150,000.

MILWAUKEE, WIS.—The citizens voted April 5 to issue $500,000 bonds for municipal lighting plant.

CLINTON, WIS.—There is no electric light plant in this place, gas being now the only medium of illumination.

LADYSMITH, WIS.—The Ladysmith Light & Power Co. proposes to re build its power house, recently burned, to cost about $3000.

ANTIGO, WIS.—Mr. W. L. Elliott, proprietor of the electric light plant in this place, died last January and the estate is now in probate. Mr. John Wright is manager.

LAKE GENEVA, WIS.—The Lake Geneva Water & Light Company supplies 27 arc lights for street lighting and 15 for private use. The company runs on the moonlight schedule and until midnight, the city paying $75 per year for its lights.

ORILLIA, ONT.—The town of Orillia is now practically without light and power, the big concrete dam of the municipal electric plant at Ragged Rapids, on the Severn River, having given way on April 7. The repairs to the dam will probably cost upwards of $10,000. The town's old steam pumping plant will keep up the supply of water and a limited amount of light in the meantime, while the various industries, dependent on the municipal electric plant for their light and power, will put in temporary steam plants.

THE ELECTRIC RAILWAY.

LEWISTON, IDAHO.—Judson Spofford and associates have asked the city council for a franchise for an electric street railway. The petitioners represent the Lewiston & Southeastern Electric Railway Company, which has completed a survey and is now ready to promote the building of an electric railway between Lewiston and Grangeville, with a branch line running to Nez Perce.

KEWANEE, ILL.—The Galesburg & Kewenee Railway Company has announced that a number of improvements will be made soon, among them the completion of the line to Galva.

GALESBURG, ILL.—Plans are now being made by the promoters of the Western Illinois Traction Company for the taking up of the construction work on the lines in this city and on the interurban right of way between Monmouth and Galesburg, where it was left last fall.

INDIANAPOLIS, IND.—The Indianapolis & Northwestern Traction Company re-elected the present officers. A number of extensions will probably be made to the system this season.

EVANSVILLE, IND.—The Evansville & Eastern Electric Railway Company has incorporated to build an electric railway from Evansville to Rockport. The officers are: J. C. Haines, president; J. W. Fuquay, vice-president; M. S. Sontag, treasurer; L. C. Frick, secretary; W. I. Rudd, F. W. Reitz and W. L. Sontag, directors.

TRIPOLI, IA.—A company is being organized here for the purpose of building an electric railway from Anamosa to Tripoli, and up the river to Nashua and Mason City.

IOWA CITY, IA.—The citizens of this city, April 8, voted a twenty-five-year franchise to the Muscatine, Iowa City & Davenport Electric Railway Company. The surveys for the line have been completed and a large portion of the right of way acquired.

ANNAPOLIS, MD.—A bill has been introduced in the House to incorporate the Stewartstown & Susquehanna Railway & Power Company. The incorporators are: Thomas Mackenzie, Harry M. Benzinger, Joseph W. Galbraith, Clarence B. Hight, E. E. Mackenzie, Harry E. Kerr and Thomas H. Robinson. The capital stock is $10,000, with privilege of increasing it to $500,000.

BOSTON, MASS.—The Hartford & Springfield Street Railway has voted to purchase the property, franchise and rights of the Somers & Enfield Electric Railway Company for $165,333.33.

TRENTON, N. J.—Colonel Michael Hurley, of Trenton, has been awarded a contract to build the electric railway from Lakewood to Point Pleasant. This is part of the system to connect this city with towns along the Atlantic coast.

BUFFALO, N. Y.—Fire last week destroyed the paint shop and about thirty trolley cars belonging to the International Railway Company at Cold Spring in this city. The loss is estimated at from $100,000 to $150,000.

LONG ISLAND CITY, N. Y.—The electrical committee of the Long Island Railroad Company has passed resolutions directing the purchasing agent of the road to buy material for two or three of the sub-stations, one at Hammells and one at Woodhaven. This is the beginning of the work of introducing electric power on the Long Island road between Long Island City and Far Rockaway.

FARGO, N. D.—Contractor James Kennedy has been authorized by the Fargo & Moorhead Street Railway Company to purchase materials and supplies for the construction of the system.

CLEVELAND, OHIO.—The council of the village of Euclid Heights has granted a franchise to the Shaker Lakes & Boulevard Street Railway Company.

DAYTON, OHIO.—The Dayton & Western Traction Company is erecting an addition to its main power station at West Alexandria, Ohio, and will install two 450-hp Hamilton Corliss engines, two 250-kw generators and two 250-hp Babcock & Wilcox boilers. The additional equipment was made necessary by the recent extension of the road to Richmond, Ind.

TOLEDO, OHIO.—At the annual meeting of the stockholders of the Toledo & Indiana Railway it was announced that a bonding concern had submitted a proposition for financing the proposed extension of the line from Wauseon to the Ohio and Indiana State lines. The matter of a location for the power house, and the other improvements will be acted upon as soon as the financial deal has been disposed of. The Arbuckle-Ryan Company, of Toledo, is preparing preliminary plans for the new power station.

MONONGAHELA, PA.—A new trolley line is to be constructed from Monongahela to Ellsworth by way of Bentleyville by a company known as the Monongahela, Bentleyville & Ellsworth Street Railway Company. The road is to be 15 miles long.

LANCASTER, PA.—The directors of the Mount Joy & Lancaster Street Railway Company have elected Charles B. Keller president to succeed W. B. Given. The committee on rights of way reported that nearly all the rights of way along the Marietta pike could be secured.

CONNELLSVILLE, PA.—A Pittsburg syndicate plans to build an electric railway from Connellsville to Ohiopyle and develop the water falls at the latter place. With 1250 ft. of tubing a fall of 90 ft. can be secured. Power will also be supplied to other railways and industries in Western Pennsylvania.

DOYLESTOWN, PA.—Application has been made to the Court of Common Pleas of Bucks County, Pa., for the appointment of a receiver for the Doylestown & Willow Grove trolley road, on the ground that the road was sold without warrant under foreclosure proceedings to Messrs. Widener & Shelmerdine for $50,000.

ALLENTOWN, PA.—The Mauch Chunk, Lehighton & Slatington Street Railway Company, now in a receiver's hands, was sold at public sale here April 12, under foreclosure proceedings brought by the West End Trust Company, of Philadelphia, for $150,000, to Thomas Keck, of Orange, N. J.; J. M. Dreisback, of Mauch Chunk, and Sol H. C. Trexler, of Allentown, a committee representing the bondholders.

ALLENTOWN, PA.—It is expected that the reorganization plan of the Lehigh Valley Traction Company, now in the hands of receivers, will soon be developed. It is probable that the Easton Consolidated Electric Company will be allowed to revert to its original owners. The reorganization plan contemplates the erection of a central power house, and this will bring the cash requirements up to about $1,500,000.

MONTREAL, QUE.—The Montreal Terminal Railway Company intends to make extensions in the northern counties of the Province of Quebec. A bill is now before the Dominion Parliament to grant power to the company to extend its system.

TORONTO, ONT.—Messrs. Royce and Henderson, of Toronto, have given notice of an application to the Legislature for power to extend the Toronto Suburban Railway through Hamilton, passing though the counties of Wentworth, Lincoln, and Welland to Niagara Falls, in or to some point on the Niagara River. The company also wants permission to build to Vaughan Township, and to Brampton, in Chinouacousy Township.

New Industrial Companies.

THE NORTHERN ELECTRIC COMPANY, of New York, has been incorporated, the capital stock being $10,000. The directors are: T. J. Ryan, L. Barnes, Jr., and G. A. Schriefer, of New York.

THE MARINE MAGNETIC CONTROL COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $100,000. The incorporators are: Albert Graham, Edward Pfuhler and Arthur J. Raymond.

THE KINETIC ENGINEERING COMPANY has been incorporated in New York with a capital stock of $10,000, the directors being R. P. Elliot and Georgiana Elliot, of New York, and J. G. Blerck, of Philadelphia.

THE CALDWELL & OSTERHOUDT CORPORATION, of New York, has been incorporated to deal in electrical supplies. Capital, $5,000. Directors: R. L. Caldwell, Summit, N. J.; H. B. Osterhoudt and P. A. Overbaugh, Brooklyn.

THE MICHAELSON INSTRUMENT COMPANY, of Jamestown, N. Y., has been incorporated to manufacture electrical instruments, the capital being $25,000. The incorporators and directors for the first year are: J. Michaelson, C. Jacobson, of Warren, Pa., and J. B. Fisher, of Jamestown, N. Y.

THE TELEPHONE ELECTRIC TOLL BOX COMPANY has been incorporated at Trenton, N. J., for the purpose of manufacturing telephone boxes and apparatus. The capital stock is $125,000 and the incorporators are: Chas. L. Walton, Romeo B. Haziett, of Trenton; Eli H. Chandler, Atlantic City.

Legal.

CHICAGO TELEPHONE RATES.—The Chicago Telephone Company has lost an important suit. Judge Mack has decided that the maximum price of telephones applies to all districts annexed to Chicago since the original franchise. This cuts out all toll charges and increases the gross receipts on which the company pays the city three per cent. compensation.

CITY OWNERSHIP IN CONNECTICUT.—The Supreme Court of Connecticut has upheld the constitutionality of the law providing for municipal ownership of lighting plants in instances where the citizens vote to purchase an existing private corporation. At the same time the court has decided that the city of Norwich must buy the Norwich Gas & Electric Company at a cost of $590,000, plus the value of supplies on hand, this figure having been made by a committee on appraisal, or must pay the company $190,000 and leave the property in the hands of the bondholders. The amount of the bonds of the company is $400,000, secured by a mortgage. The value of the supplies on hand is about $20,000.

SELF-RESTORING DROP PATENT.—A further decision has been given in the Fisk patent, No. 521,461, granted June 19, 1894, relative to the self-restoring or "Express" type of telephone board drop. In June, 1897, the Western Telephone Construction Co., owners of the patent, brought suit in the United States Court against the American Electric Telephone Co., P. C. Burns, W. C. Meissner and others. The complainant company passed through troubles, and was reorganized under the name of the Western Telephone Mfg. Co. in the fall of 1902. Thereupon a more vigorous prosecution of these suits was undertaken and within another year Judge Kohlsaat gave a decision, holding that the patent was good and valid, but that defendants did not infringe it. The Western Telephone Mfg. Co. appealed to the United States Court of Appeals, which latter heard the oral arguments on Jan. 20, 1904, Judges Jenkins, Grosscup and Baker sitting enbanc. The lawyers on both sides presented elaborate arguments, briefs and testimony. Mr. C. W. Bulkley was attorney for the defendants and Mr. Josiah McRoberts for the complainant. On April 12, Judge Baker rendered the opinion of the Court, reversing the lower Court with directions to enter an order for an injunction and an accounting in favor of the Western Telephone Mfg. Co.

DEATH FROM TELEPHONE WIRE.—In a decision for the Texas Telephone Company, the Court of Civil Appeals of Texas held: 1. As liability for wrongful death is created alone by statute, and limited to carriers, a telephone company is not liable for a death resulting from negligence of its employee. 2. In an action for death caused by deceased having come in contact with a live wire owing to the alleged negligence of defendant, plaintiff requested an instruction applying the law to the alleged negligence of defendant in selecting its inspectors and lamp trimmers. The instruction included two servants, and, while there was evidence tending to show negligence on the part of one of them, there was no testimony tending to show negligence on the part of the other, and no evidence tending to show negligence on the part of defendant in employing them. Held, that the instruction was properly refused. It was shown that John H. Fisher's death was caused by an electric shock received by him from a telephone wire which he saw hanging in a tree, and voluntarily reached up and caught hold of. The testimony tends to show that the wire referred to carried a dangerous current, resulting from the fact that at a place some distance from where the accident occurred the telephone wire was in contact with an electric light wire owned by the gas company. The undisputed testimony shows that several hours before the accident the deceased's son received an electric shock near where the deceased met his death; that deceased had been apprised of that fact, and he and the person who informed him were then engaged in searching for the live wire, the informant having warned him that the wire was dangerous. While engaged in the search, the deceased saw a telephone wire hanging in a tree, reached up and caught it, and received the shock which caused his death.

TELEPHONE RATES.—In the appeal of the Maryland Telephone & Telegraph Company against a decision as to telephone rates in Baltimore, the Court of Appeals of Maryland has filed a decision of which the gist is as follows: 1. Acts 1892, p. 535, c. 387 (Code Pub. Gen. Laws 1903, art. 23, §§334-338), limits the rates of charges for the use of telephones, and defines "telephone" as used in the act. Acts 1894, p. 260, c. 207 (Code Pub. Gen. Laws 1903, art. 23, § 339), provides that contracts may be made for such special form of telephone service at such rates as may be agreed on, provided the obligation of telephone companies to furnish, at the rates mentioned in the former act, the kind of telephone service now provided by the Chesapeake & Potomac Telephone Company at such rates, shall not be impaired. Held, that an ordinance limiting a company's rates of charges for telephone service is not, by these statutes, restricted in its application to the kind of telephone described in them. 2. Where an ordinance limited the rates a company might charge for telephone service, the defense, in a suit to enjoin it from charging higher rates, that in view of the conditions existing when the ordinance was passed it should be construed as applying to a particular kind of service different from that furnished to the complainants, cannot be set up by demurrer, but only by answer. 3. Under Code Pub. Loc. Laws, art. 4, § 819a, providing that the mayor and city council of a city shall have power to regulate the use of the streets for telephone poles and wires, they have authority to impose on a company, as a condition of such use, limitations of its rates of charge for telephone service. 4. After a telephone company has accepted an ordinance imposing limitations of its rates of charge, it is estopped to deny the validity of the ordinance on the ground that the rates fixed are not reasonable. 5. Where an ordinance limits the rates of charge by a telephone company, an individual may maintain a suit to enjoin it from charging him higher rates than those fixed by the ordinance. 6. A bill by several parties to enjoin a telephone company from charging them higher rates than a city ordinance permits is not multifarious, though it alleges a contract by each of them with the company.

Obituary.

MR. F. W. SANGER.—We regret to note the sudden death from pleuro-pneumonia of Mr. F. W. Sanger, general manager of Madison Square Garden and theatre. He was a well-known actor at one time, afterwards a manager, and about 1893-4 became connected with the Garden. During his tenure of office he made many friendships among electrical men and automobilists, who met him at the various exhibitions.

MR. F. W. SABOLD.—Frank W. Sabold died at Albany, N. Y., on April 16, aged 47 years. He was considered one of the best telephone and telegraph men of his day. When the American-Union Telegraph Company was organized he was made manager of the Indianapolis (Ind.) office. The Western Union Telegraph Company absorbed the American-Union in 1882, and Mr. Sabold was made manager of the Albany office. In 1890 he became manager of the Westchester Telephone Company. After its absorption by the New York Telephone Company he became superintendent of the Westchester division. Since 1902 he had been contract agent for the Hudson River Telephone Company.

Personal.

MR. FRANK SUTTON, consulting electrical engineer, etc., has removed his offices in New York City to rooms 801-804 Nos. 91-93 Wall Street.

MR. C. H. MACKAY, president of the Commercial Cable Company, etc., has been elected a trustee of the New York Life Insurance Company in place of the late W. R. Grace.

SARGENT & LUNDY, of Chicago, announce that about May 1 they will occupy new quarters on the seventeenth floor of the Railway Exchange Building, Jackson and Michigan Boulevards.

MR. F. SARGENT, the consulting engineer, of Chicago and New York, has just reutrned from Europe, where he has spent some weeks, chiefly with a view, it is said, of studying up steam turbine and central station development there.

PRES. B. J. ARNOLD, of the American Institute of Electrical Engineers, opened the Pittsfield chapter on April 18, assisted by Dr. F. A. C. Perrine and Messrs. Pope, Rushmore, Dodd, Andrews and others. There was a large and enthusiastic attendance.

MR. J. F. LAWLESS, manager of the San Francisco Gas & Electric Company, has tendered his resignation to take effect at once. He was appointed in October, 1903. There are rumors of internal friction. It is reported that Mr. S. L. Napthaly, in charge of the electrical department, may succeed him.

MR. PUTNAM A. BATES, who resigned as sales manager of the Crocker-Wheeler Electric Company just before going abroad, has returned from a holiday trip of several weeks, nearly all of which was spent in England, where Mr. Bates has many friends. He is much improved in health by the rest and change.

MR. T. M. MESTON, secretary of the Emerson Electric Mfg. Company, of St. Louis, was in New York City some time last week, at the Eastern headquarters. He reports the outlook as excellent for both the company's direct and alternating current motors, etc. During his stay, Mr. Meston was a visitor at the Engineers' Club.

MR. G. W. DAVENPORT, vice-president of the Niagara Power Company, was in New York City last week, and attended the meeting of the Institute Committee which is making elaborate preparations for the reception of foreign guests this year at the time of the Electrical Congress. Mr. Davenport has guaranteed to turn on the Falls when the visitors reach his bailiwick.

MR. SAMUEL INSULL, president of the Chicago Edison Company, has sailed for England with his family, and will take a well-earned vacation in that country until early in June. The work of the last year or two has been very exacting, while the responsibilities connected with his great new turbine plant on the Chicago River have been of an unusually novel and onerous character. The fact that Mr. Insull now indulges in a brief vacation shows that he considers the station to be an unquestionable engineering and financial success.

MR. C. E. BROWN, electrical engineer of the Canadian Electrothermic Commission, on the manufacture of iron and steel by electricity, has returned from Europe, and is now at Ottawa at work on the findings of the Commission, whose report is awaited with great interest.

MR. G. L. CROSBY has opened an office at 426 Williamson Building, Cleveland, Ohio, for the Weston Electrical Instrument Company, and will handle the "G-I" Company's circuit breakers. Mr. Crosby will cover a territory comprising western Pennsylvania, Ohio and Michigan, and having previously handled similar lines for about one and a half years, is thoroughly familiar with the circuit breaker and instrument business in that territory.

LIEUT. G. C. SWEET, U. S. N.—By May the new system of wireless telegraphy at Mare Island, California, will be in full operation. Lieutenant G. C. Sweet, United States Navy, is at Vallejo, Cal., superintending the installation of the system. It is understood that when Lieutenant Sweet finishes the installation of the Marconi system at Mare Island and at the Yerba Buena naval Training station in San Francisco bay, he will be sent to Guam and the Philippines by the Naval Bureau of Equipment to supervise similar work at the naval stations there.

MR. F. E. DRAKE, president of the Lanyon Zinc Company, of St. Louis, the largest producer of spelter, etc., in this country, has been visiting New York City the past week, in order to attend and hold the annual meeting of the company. He has scored a notable victory recently in patent litigation, in sustaining the right of his company to use mechanically operated ore roasting furnaces, with means for stirring and advancing the ore. The case had originally been decided against the company, but Mr. Drake appealed it and has won out, as to all the points in contest.

MR. E. P. THOMPSON has been very much interested to see the manner in which his suggestions as to the effect of rays on the insect world have been taken up in the scientific and popular press. He hopes to make some experiments in that field. As a striking illustration of the manner in which members of the American Institute of Electrical Engineers may be ranked as inventors, it is very interesting to note the fact that Mr. Thompson himself has appeared before the U. S. Patent Office on behalf of no fewer than 48 full members and 25 associates. This little fact in itself is good evidence of the mental activity characterizing that body.

MR. W. RUTHERFORD, general manager of Dick, Kerr & Co., the great English electrical and street railway contractors and engineers, is now in this country on a brief trip, accompanied by his wife. He is visiting various parts of the country, including Montreal and Chicago. Mr. Rutherford may be said to have won his electrical spurs on this side, as electrical engineer for the Canadian General Electric Company, for whom he did some pioneer electric railway work in the Dominion, including the famous road along the Niagara Gorge from Chippewa to Queenstown. He went back to England some years ago, and his rise in the profession has been both brilliant and rapid.

REAR ADMIRAL MELVILLE.—The well-known artist of *Punch*, Mr. E. T. Reed, drew a special sketch for the menu of a dinner tendered to Rear Admiral George W. Melville, U. S. N., retired, at the Hotel Cecil, in London, on April 14, by the Institute of Naval Architects. The sketch showed a bust of Admiral Melville overlooking the polar sea, with one or two bears and ships enlivening the ice and seascape. His bust stood on a pedestal draped with the British and American flags, and beside the pedestal John Bull and Uncle Jonathan, depicted in Mr. Reed's best manner, were clinking glasses. The proceedings were more or less private and informal. About 40 persons sat down to dinner, among them being Lord Glasgow in the chair, who had Admiral Melville on his right hand and Mr. Henry White, of the United States Embassy, on his left. Lord Selborne, First Lord of the Admiralty; Admiral Sir John Dalrymple Hay, Lord Graham, Admiral Sir John Hopkins, Major Beacon, the United States Military Attache; Mr. George Westinghouse, Mr. W. I. Buchanan, of the British Westinghouse Company, and Sir John Thorneycroft. Rear Admiral Melville, spoke during the proceedings, which wound up with a conversazione.

EDUCATIONAL.

COLUMBIA UNIVERSITY, N. Y.—The heads of the departments of civil, mechanical, electrical and mining engineering and of metallurgy have been assigned to seats in the Faculty of Pure Science. This important step was taken upon the joint recommendation of the Faculties of Applied Science and of Pure Science, and marks the recognition of research work in the various technological fields as on the same plane with research work in the various departments of what is ordinarily known as pure science. Hereafter all graduate work for the degrees of Master of Arts and Doctor of Philosophy at Columbia, when taken in any branch of science, will be under the jurisdiction of the Faculty of Pure Science. The Faculty of Applied Science will remain a strictly technological Faculty.

Trade Notes.

THE MAGNET WIRE COMPANY has removed its New York offices from 80 William Street to 42 Broadway.

THE WHEELER CONDENSER & ENGINEERING CO. has moved its local quarters from 120 Liberty Street to 42 Broadway, New York.

SHEPHERD ENGINEERING COMPANY, of Franklin, Pa., has opened a branch office in the Witherspoon Building, Philadelphia, with Mr. Edward D. Skidman in charge.

AUTOMATIC SWITCH CO., of 131 Liberty Street, New York City, notifies us that the officers of the concern are: President, G. H. Whittingham; treasurer, C. K. Harrison; secretary, W. H. Judd.

H. T. PAISTE CO., of Philadelphia, has issued three very neat and attractive blotters in regard to its brass cap P.K. fuseless attachment plug, flush wall box receptacle, etc. Each blotter has a little calendar down in the right-hand corner.

STANLEY & PATTERSON are vacating 93 Liberty Street in order to secure more commodious premises at 40 Cortlandt Street, where they will occupy the first floor, ground floor and basement. The factory will remain at 35 Vesey Street, New York.

COVINGTON MACHINE CO., Covington, Va., will engage, we are informed, in the manufacture of a complete line of high-grade self-oiling steam engine on which it holds the patents. It will give special attention to the electrical field. The engine is designed for direct connection. It will also build a medium speed automatic Corliss engine which has already had from 12 to 14 years' service and is therefore well tested.

JAMES S. BARRON & CO., West Broadway and Franklin Street, New York City, have had to leave that address on account of the fire that destroyed their building and all its contents on April 8. The damage, amounting to $185,000, was fully covered by insurance. They are again in running order at 339 Greenwich Street, corner of Jay, and expect to remain there until the completion of their new building on the old site, about May 1, 1905.

THE TOLEDO STORAGE BATTERY AND ELECTRIC COMPANY, Toledo, Ohio, has been organized to manufacture the new Miller storage battery and to deal in general electrical supplies. It is stated that by the Miller process a superior quality of battery plate is produced. The officers of the company are: Mark H. Griffin, president; L. A. Alexander, vice-president; G. J. Miller, general manager; Chas. R. Clapp, secretary, and J. T. Greene, treasurer.

THE INTERNATIONAL TELEPHONE MFG. COMPANY, Chicago, is having a constantly increasing demand for its new self-restoring drop switchboard equipment. In the International drop, the shutter is automatically restored by a small trigger mounted between the jack springs in the path of the plug. The operator's answering plug, not coming in contact with the shutter, it is claimed, makes this one of the most positive mechanical self-restoring drops on the market.

BATTERY FLUIDS.—Franklin H. Kalbfleisch Co., 31 Burling Slip, New York, has issued a neat pamphlet entitled "Eleven Years of Progress" and dealing with its specialties as manufacturing chemists, including sulphuric acid, muriatic acid, nitric acid, pure electrolytes, distilled water, battery solutions of all kinds, electropoin fluid, chromate salts, etc. The pamphlet is illustrated with views of its various factories and gives an excellent idea of its wide range of output.

THE WARD LEONARD ELECTRIC COMPANY has invented a resistance unit to replace tubular resistance lamps. This unit has, it is said, all the advantages of an enclosed, hermetically sealed resistance and the added advantages that the resistance wire has a practically zero temperature coefficient, and does not deteriorate due to passage of current. It is a permanent resistance, smaller than a tubular lamp and very strong mechanically. The resistance wire is wound upon a porcelain tube and enamelled. Telegraph and telephone companies are using this type of resistance in large quantities.

DODGE & DAY.—The New Haven Manufacturing Company, New Haven, Conn., of which Mr. Leslie Moulthrop is general manager, has had Dodge & Day, modernizing & contracting engineers, Philadelphia, Pa., go over its entire equipment with a view of bringing it up to date in every respect. Complete interior arrangement of the shops is contemplated, and it is probable a number of the old machine tools will be replaced by modern apparatus. Dodge & Day have also been commissioned by the Meadville Vise Company, Meadville, Pa., to re-design a number of its machine tools. Mr. Dodge, who is now making an extensive trip through the New England states, in response to numerous received, reports a growing improvement in the machinery trade throughout the country.

WESTERN ELECTRIC CO. has issued Bulletin No. 2015 of March, 1904, devoted to its Type L direct driven generators for lighting and power. These are of large size and have the field frame divided vertically, so that the yoke can be drawn apart horizontally allowing the armature to be easily withdrawn for removal or inspection. The laminated pole pieces are carefully built up. The armature is of the iron-clad type, the core being thin discs of doubly annealed sheet steel. The coils are solid bars of specially drawn copper enlarged in cross section at the ends. The brush holder ring is carried in supports projecting from the yokes the entire device being moved around the commutator by means of a hand wheel at the side. By means of eccentric insulated bushing, each individual arm may be adjusted to obtain perfect uniformity of spacing. The machine is illustrated in perspective and by diagram and dimensions are given for a variety of sizes at 125 and 250 volts.

ELECTRICITY IN VAUDEVILLE.—Few people have an idea of the extent to which the development of the vaudeville or continuous performance houses has been of benefit to the various applications of electricity. The manager of a circuit such as the Proctor theatres, consisting of 7 houses in 4 different cities, has at his command an army of no small proportions. Those actually employed in the stage performances average forty each week. To this must be added the property men, scene shifters, clearers, electricians, stage and assistant stage managers. All the houses are electrically lighted. There are from thirty to forty men throughout the auditorium to cater to the comfort and convenience of the patrons, possibly ten more employed as door keepers and ticket sellers, a business staff of from five to eight, and an orchestra of ten players. In addition to this there are three complete shifts of scenic artists employed in New York City on the paint bridges at the Fifth Avenue Theatre, Fifty-eighth Street and One Hundred and Twenty-fifth Street Theatres, a staff of fifty house painters and decorators, who are constantly going over the houses and keeping them in good condition; a dozen char women, and a host of advertising men, booking agents and others. These are all necessary in the presentation of a complete and perfect performance, and yet Mr. Proctor finds it profitable to present expensive bills at trifling admission fees, while paying the salaries of more than twelve hundred employees each week.

THE F. BISSELL CO., Toledo, Ohio, has recently issued two bulletins for its perpetual calendar. No. 27 relates to field regulators, theatre dimmers, etc., and No. 37 to house goods, such as annunciators, bells, pushbuttons, etc.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, of Niles, Ohio, has established its New York office at 19 Park place, and not 19 Park Row, as recently stated in this column.

CRANES.—In a recently issued catalogue the Northern Engineering Company, Detroit, Mich., gives several full-page half tone illustrations showing actual installations of its traveling cranes in power houses, shops, etc. The company also makes cranes for foundries, machine shops and industrial plants.

THE NERNST LAMP COMPANY has recently removed its Boston office from 131 State Street to No. 501 Atlantic Avenue. The office will, as heretofore, be in charge of Mr. Geo. C. Ewing as district manager, and will carry a complete stock of Nernst lamps and supplies, insuring prompt service to customers.

CEILING FANS.—Messrs. E. B. Latham & Co., 39 Vesey street, New York, have issued a pamphlet, giving illustrations, prices and other information regarding Tuerk alternating current ceiling fans. These fans are made with two and four blades, with and without electrolier attachment. This list refers to the 1904 model of fans.

THE LAHMEYER ELECTRICAL COMPANY, Ltd., 109 Oxford street, London, Eng., has issued an illustrated price list of its controllers and other apparatus for electrically driven cranes, hoists, lifts and other variable speed machines. Various types of controllers are illustrated, and many diagrams give the dimensions of the different sizes.

THE FARR TELEPHONE AND CONSTRUCTION SUPPLY COMPANY, Chicago, recently issued some illustrated and descriptive matter regarding some of its goods. The sheets are indexed in a unique manner, to facilitate ready reference. The line of goods represented includes batteries, linemen's tools, transmitters and receivers, line supplies, switchboards, etc.

AMERICAN STREET RAILWAYS.—Poor's Railroad Manual Company, New York, has just reprinted as a separate volume the section of its Manual of Railroads devoted to city and suburban electric and other surface and elevated railways. It is brought out under the title "Manual of American Street Railways," and contains much information relating to mileage, equipment, capitalization, etc.

ELECTRIC SIGNS.—The Federal Electric Company, Chicago, is distributing sets of its bulletins of its electric signs, bound with McGill fasteners. New bulletins can be readily added to the set. Its signs are all metal and waterproof, and are especially adapted for out-of-door displays. The company also manufactures a combination clamp shade for incandescent lamps, which is described and several designs illustrated.

THE INTERSTATE ELECTRIC COMPANY, LTD., Baronne & Union Sts., New Orleans, La., has just let the contract for the erection of what it claims will be one of the largest buildings in the United States used for the electrical supply business. The building will be 100x100 ft. and five stories high. Mr. P. Stern is general manager of the company, which does construction work as well as carrying on a general supply business.

HEATING AND VENTILATION.—Mr. W. H. Carrier, M. E., read a paper before the convention of the American Foundrymen's Association at Milwaukee in June, 1903, on the subject of heating and ventilation of factory buildings. This paper has been reprinted in pamphlet form by the Buffalo Forge Company, of Buffalo, N. Y. This company's system is used in the locomotive repair shops of the New Jersey Central Railroad at Elizabethport, N. J. The reprint is illustrated.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., has recently issued two neat booklets referring to "Buffalo Disk Wheels" and "Buffalo Improved Ventilator." The disk wheels deliver air in a direction parallel to the axis of rotation, and for this reason are well adapted for many situations. Copies of these booklets can be had on application.

ZINC.—The Lanyon Zinc Company, of St. Louis and New York, has issued a handsome brochure bearing the title, "Two Stories of Zinc," which will be found of especial interest to those who would know the processes of zinc manufacture from ore to merchantable product. The first section treats of the first stage of manufacture, ending in spelter as a product; and the second of the various steps in the making of sheet zinc. The processes are described in much detail, and with the aid of a number of excellent engravings.

NAME PLATES.—The Crowe Metal Manufacturing Company, Chicago, has recently issued a catalogue giving many facsimile reproductions of name plates manufactured by it. There seems to be no limit as to the design of these plates, many of them being of very artistic get-up. The gilding against the black sets off the illustrations very effectively. Among the plates illustrated we notice the names of the Ewing-Merkle Electric Company, St. Louis; Western Electric Company, Moore Telephone and Cabinet Company, Caro, Mich.; the Cutler-Hammer Manufacturing Company, Milwaukee, and several other well-known electric concerns.

CHICAGO & ALTON CARS.—The Chicago & Alton Railway was the first line to run Pullman sleeping cars, dining cars and chair cars. The C. & A. was also the first line to establish a modern surgical system and the first, and so far the only line, to equip all of its locomotives with electric headlights. This leading thoroughness is to be immediately supplemented by the equipment of all cars in all trains with electric lights. Mr. C. A. Goodnow, the "Alton's" new general manager, has ever been regarded as the exponent of electric lighted trains, and has selected for the "Alton" a system by which the current is produced by a dynamo driven by the axle during the run of the train.

THE BURT MANUFACTURING COMPANY, Akron, Ohio, has received recently among other large foreign orders, one from its agent in Durban, South Africa, for 30 gross of Cross oil filters, and another from its agent at St. Petersburg, Russia, for oil filters for the Russian government. The company is sending out an interesting picture showing a 30-inch exhaust head, recently made by the Jones and Laughlin Steel Company, of Pittsburg. The head is 10 ft. high, 9 ft. 4 in. in diameter, and weighs 2700 pounds. Mr. W. F. Warden, president of the company, sailed April 15th on a trip to Europe, where he will visit the numerous agencies there of his company. In his absence Mr. J. Asa Palmer, secretary of the company, will have full direction of its affairs.

LAMP SOCKETS.—We have received the following from Mr. J. L. Yost, general manager of the Yost Electric Manufacturing Company, of Toledo, Ohio, under date of April 2: "We note the appearance of the Perkins Electrical Switch Manufacturing Company advertisement in several of the electrical publications advising the buyers generally, or the sellers of Yost sockets that suit has been decided against J. F. Buchanan & Co. for selling Yost sockets and that the sellers of Yost sockets are infringers on their patent '626,927.' This is not true. The Yost Electric Manufacturing Company never made this socket on which J. F. Buchanan & Co. were sued for infringement, and are not making it now. It is not the Yost socket, but was known as the Dixon Socket, made by the Yost-Miller Company, and not by this company at all."

MURRAY CORLISS ENGINES.—Another example of the modern trade publication which embodies the highest expression of the printing and engraving arts is a recent publication of the Murray Iron Works, Burlington, Ia., describing the Corliss engines and high-pressure boilers that have made the works of this company perhaps better known throughout the country than any other manufacturing establishment in Iowa. That the wide recognition is well merited will, we believe, be evident to the reader of the description given of the design of the Murray Corliss engine, both with respect to valve details and frame construction. Well-tried improvements over the old Corliss type are embodied in almost every part of the engine; and the clear descriptions with accompanying engravings bring out forcefully the merit of the improvements.

TELEPHONE INSTALLATION DIAGRAMS.—Bulletin No. 149 of the Holtzer-Cabot Electric Company, Boston, Mass., is of more than ordinary value and interest. It opens with a general discussion on the wiring and installation of interior telephones. Three systems are considered, viz.: intercommunicating, speaking tube and central switchboard, each illustrated with wiring diagrams of exceptional clearness. There are 19 of these diagrams, and they will be of much value to those interested in and installing Holtzer-Cabot apparatus. The concluding pages give very clear directions for the installation of the apparatus. The Holtzer-Cabot Company evidently appreciates the fact that a clear illustration conveys more information to the mind than pages of cold type, and has made the best of this knowledge in this instance. This bulletin will be well worth careful preservation, and a copy of it should be in the hands of all practical telephonists.

HABIRSHAW WIRES AND CABLES.—A handsome and quite original illustrated catalogue, compiled by Mr. T. J. Hall, has just been issued by the India Rubber & Gutta Percha Insulating Company, with regard to its well-known and widely-used Habirshaw wires and cables, made at the Glenwood Works, Yonkers, N. Y. The catalogue is in quarto form and all the illustrations of cables, testing apparatus, etc., are actual photographs carefully inserted into the descriptive tests. These cables are in great variety, and belong to some of the most important installations in the country, such as Niagara Power, Manhattan Elevated, New York Edison, U. S. Signal Service, Telluride Transmission, heavy telephone cable, etc. Full data are given as to these, each exemplifying some distinct type of work. At the end is a list of some typical plants wired with Habirshaw wires and cables, such as the White House, Washington, or Marshall Field's store, Chicago. The cover is stiff boards, in white, lavender and dark blue—altogether a perfect specimen of quiet good taste.

"BETTERMENT REPORTS."—A unique circular has been issued by Dodge & Day, modernizing engineers, Nicetown, Philadelphia, Pa. It is a "report" on their "Betterment Reports." Betterment reports are made on shop conditions and deal with the numerous factors which, together, make up the complete manufacturing plant. This "report" consists of an outline of the firm's methods of investigating and studying existing conditions and developing plans for their betterment. Shops and businesses of all kinds are brought up to their highest state of efficiency, all existing weak points being modified to produce the best results. No department escapes the searching scrutiny for leaks and defects The "report" is gotten up in a model form, too. It represents an actual report to a client, being printed in typewriter type, with the usual red ink emphases. There are several illustrations showing typical modern shops, and graphical charts which facilitate the mental comprehension of organization of the different departments of a business, processes in manufacturing, etc. The cover of this "report" gives a good idea of the scope of Dodge & Day's work. The report is well worth careful perusal by any engineer.

FOOS GAS ENGINE CO.—A number of prominent representatives of electrical manufacturing companies recently visited the plant of the Foos Gas Engine Company, of Springfield, Ohio, and were invited to inspect the "Special Electric" gas engine which will be sent to the St. Louis Fair as part of the exhibit of this company. The engines is of 22-hp. capacity and will be equal to 200 sixteen candle power incandescent lights when belted to a generator of standard make. The tests show unusual regulation for small gas engine practice, the character of the lighting being commented on by those present as highly satisfactory for commercial work. The engine is of the four cycle type with a throttling admission valve, making periodical explosions of varying intensities. It is equipped with specially heavy fly wheels of large diameter. There were also dsplayed some 20 commercial engines on the testing floor, and about 100 more ready for stock shipment. The engines of this company cover a range in capacities of four to eighty horse power and the intention is to actively enter the "Special Electric" engine in the lighting field. Among the electric companies represented were: the Jenney Electric Company, by Mr. Chas. L. Jenney, president; the Akron Electric Company, by Mr. F. B. Duncan, general manager; the Ft. Wayne Electric Company, by Mr. C. E. Searler, of Cincinnati, and the Crocker-Wheeler Company, by Hugh A. Brown, Cincinnati representative.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 12, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

756,211. PRECIPITATING METALS FROM SOLUTIONS; Charles Butters, Berkeley, Cal. App. filed Oct. 3, 1902. (See page 771.)

756,223. PROCESS OF TREATING LOW-GRADE ORES AND TAILINGS BY ELECTROLYSIS; Ernest Fahrig, Philadelphia, Pa. App. filed May 9, 1903. (See page 771.)

756,328. RECOVERY OF GOLD AND SILVER FROM CYANID SOLUTIONS; Samuel B. Christy, Berkeley, Cal. App. filed May 20, 1901. (See page 771.)

756,745. APPARATUS FOR ELECTRICALLY BLEACHING MATERIALS; August Alfred Vogelsang, Dresden, Germany. App. filed Sept. 21, 1904. (See page 772.)

756,813. LONG-DISTANCE TELEPHONE SYSTEM; Michael Beck, Minneapolis, Minn. App. filed Nov. 12, 1900. (See page 772.)

756,824. TELEPHONE SELECTING DEVICE; Lawrence E. Brock, Celina, Ohio. App. filed May 13, 1902. (See page 772.)

756,844. BRACKET BLOCK FOR CONDUIT MANHOLES; Guy M. Gest, Cincinnati, O. App. filed Dec. 13, 1902. A frame set into the wall contains a vertical slot in which the brackets supporting the cables have a sliding adjustment.

756,870. ELECTRIC RAILWAY SWITCH; Melbourne A. Marks, Jr., Brookline, Mass. App. filed Feb. 4, 1903. Details of a circuit closer applied to the trolley wire for directing the current into the solenoids that throw the switch point.

756,891. ROTATORY ELECTRIC TUBE-FURNACE; Henry Noel Potter, New Rochelle, N. Y. App. filed Nov. 21, 1901. (See page 771.)

756,941. SPARK GAP FOR ROENTGEN RAY APPARATUS; John T. H. Dempster, Schenectady, N. Y. App. filed June 18, 1898. The terminal balls are kept cool by mounting them upon rotating disks.

756,954. MAGNET COIL SPOOL; Henry Geisenhoner, Schenectady, N. Y. App. filed Sept. 13, 1902. The spool consists of a cylindrical body of sheet metal having end retaining devices formed out of corrugated metal strips.

756,957. ELECTRIC SAFETY SYSTEM FOR RAILWAYS; Jacob Hanna and Charles S. Gilman, Rivera, Cal. App. filed May 7, 1902. Details of a system wherein the brakes of the train can be actuated from the roadside when necessary.

756,959. TROLLEY CATCHER; Montgomery H. Johnson, Utica, N. Y. App. filed July 15, 1903. Details of a spring drum and pawl and ratchet device mounted upon the dashboard to control the cord.

756,960. ROTARY CONVERTER SYSTEM; Edward M. Hewlett, Schenectady, N. Y. App. filed July 24, 1899. A circuit breaker is controlled by any one of a number of rotary converters, an indicator showing which converter operates the circuit breaker.

756,966. PANEL BOARD FOR ELECTRIC DISTRIBUTION; George H. Jones, Chicago, Ill. App. filed Nov. 20, 1903. Means for readily altering the grouping of the different circuits to the meters so that each circuit may be metered individually or any number of circuits may be readily grouped under one meter.

756,976. PORTABLE TESTING AND COMPARING INSTRUMENT FOR ELECTRIC INCANDESCENT LAMPS; Albert McCandlish, George Lane, Bredbury, England. App. filed June 26, 1903. A box containing lamp receptacles for a standard lamp and a lamp to be tested and a meter, all conveniently arranged for testing.

756,979. HANDLE FOR ROTARY SNAP ELECTRIC SWITCHES; Charles G. Perkins, Hartford, Conn. App. filed Oct. 29, 1903. A spring supported handle which holds both the cover and the dial within the cover, in place.

756,980. ELECTRIC RAILWAY; William B. Potter, Schenectady, N. Y. App. filed July 5, 1902. A metallic cover for the third rail made in insulated sections so as to localize any escape of the current into the cover.

756,991. ELECTRIC CONDENSER; Matthew O. Troy, Lynn, Mass. App. filed July 19, 1902. When the sections of the condenser are placed in the supporting frame, their terminals engage with spring contacts carried by the frame.

756,999. OVERFLOW ALARM; Edward M. Weeks, Washington, D. C. App. filed Jan. 20, 1904. A ball float is mounted upon a special frame applicable to a tank and carrying circuit terminals to be engaged by the ball when the liquid reaches a certain level.

757,000. DEMAND METER; Roges S. White, Philadelphia, Pa. App. filed Aug. 15, 1903. A maximum demand meter having mechanism for actuating an indicator, a device responsive to current conditions for releasing the mechanism and means whereby the operation of the mechanism stores energy opposing the action of the releasing device and tending to stop the mechanism.

757,007. LAMP TERMINAL; Howard I. Wood and Ralph C. Robinson, Schenectady, N. Y. App. filed July 26, 1902. A special clamping device for holding the solid terminal in a mercury vapor tube lamp.

757,019. SYSTEM OF MOTOR CONTROL; Frank L. Butler, Schenectady, N. Y. App. filed Sept. 13, 1902. A motor controller comprising a number of separately actuated contacts, each operated by a pneumatic device, and a master controller comprising independent valves controlling said devices individually from a distance.

757,030. SIGNALLING APPARATUS; Ernest A. Faller, New York, N. Y. App. filed June 22, 1903. The employment of a distinct circuit for restarting the transmitter after each group of signals is sent and the employment of a different circuit for transmitting the signals, makes it possible to render continuous the alternate actuation of the receiving station and the transmitting station.

757,031. SEMI-AUTOMATIC TELEPHONE EXCHANGE; Ernest A. Faller, New York, N. Y. App. filed July 1, 1903. (See page 772.)

757,036. PROCESS OF PRODUCING CHEMICAL COMPOUNDS; John J. Griffin, Washington, D. C. App. filed Jan. 16, 1903. (See page 771.)

757,056. MEANS FOR PROTECTING ELECTRICAL MEASURING INSTRUMENTS; Maurice C. Rypinski, Schenectady, N. Y. App. filed July 25, 1901. A conductor of high resistance is normally in series with the instrument for protective purposes but can be shunted out while the readings are being taken.

757,070. RAIL BONDING CONSTRUCTION; Edward G. Thomas, Waltham, Mass. App. filed March 19, 1903. The terminals of the bond are located at extreme diagonal positions with respect to the abutting faces of the joint so that the amplitude of the expansions and contractions of the bond is lessened.

757,079. ELECTRIC ARC LAMP; James J. Wood, Fort Wayne, Ind. App. filed Sept. 4, 1903. Yieldingly supported parts are utilized to avoid the effect of vibrations in an alternating current lamp.

757,107. SAFETY DEVICE FOR ELECTRIC RAILWAY SYSTEMS; George Gibbs, New York, N. Y. App. filed Aug. 26, 1903. The circuit breakers in the feeders are caused to open under abnormal conditions by means of an auxiliary circuit, a terminal of which is arranged in proximity to the working conductor, so that current will be delivered to it in case of a derailment or similar accident.

757,125. ELECTRICAL RAILWAY DANGER SIGNAL; William E. Karns, Parkers Landing, Pa. App. filed Nov. 12, 1903. Signal-controlling circuit wires are stretched along localities where landslides are likely to take place, so that upon such an occurrence, the circuit will be broken and signals displayed.

757,138. THIRD RAIL FOR ELECTRIC RAILWAYS; Patrick T. McGowan, Avoca, Pa. App. filed Dec. 22, 1903. The rail has a brush-engaging surface at the side.

757,164. BATTERY-CELL; Emerson Whatman, Lynn, Mass. App. filed July 2, 1903. (See page 772.)

757,184. MEGAPLEX RELAY; Richard A. Engler, Dubuque, Iowa. App. filed July 13, 1902. (See page 772.)

757,185. MANUFACTURE OF CYANAMID SALTS; Georg Erlwein, Berlin, Germany. App. filed Aug. 16, 1902. (See page 771.)

757,191. DEVICE FOR PREVENTING RAILWAY COLLISIONS; Charles Holtmann and Joseph F. Butler, Pittsburg, Pa. App. filed March 5, 1903. Two trains on the same block will have their air-brakes operated automatically by current traversing the track from train to train and actuating electro-magnet apparatus on each train.

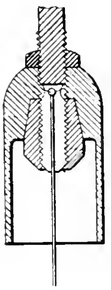
757,192. TIP OR TERMINAL FOR ELECTRIC WIRES; Stephen C. Houghton, San Francisco, Cal. App. filed Dec. 20, 1903. A pin having a hooked end for engaging the wire and a tube passing over the end of the pin and formed with a split ferrule.

757,203. PUSH BUTTON; Charles J. Klein, New York, N. Y. App. filed Nov. 14, 1902. Provision is made for clamping the wires of the circuit in a position where they will be engaged by the head of a circuit-closing plunger.

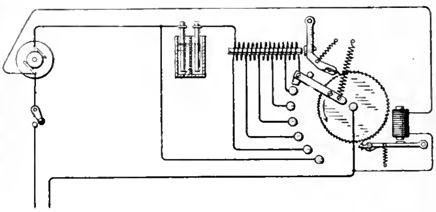
757,257. TELEPHONE-RECEIVER SUPPORT; James Alexander Brown, Warren, Ohio. App. filed Oct. 8, 1903. (See page 772.)

757,264. ELECTRIC RAILWAY; Davis J. Cable, Lima, O. App. filed March 11, 1903. Details of a mounting and covering of a third rail.

757,271. ELECTROMECHANICAL GONG; Frederick W. Cole, Newton, Mass. App. filed Oct. 4, 1902. Details.



757,302. ELECTRIC CURRENT REGULATOR; Newton Harrison, New York, N. Y. App. filed April 21, 1903. The counter-electromotive force or self-induction in a sectional coil is used instead of an ordinary resistance, as



757,007.—Lamp Terminal. 757,302.—Electric Current Regulator.

a starting device. The self-induction is caused by an interrupter in the circuit and the magnetism of the induction coil is utilized to operate a step by step device for cutting out the sections of the induction winding.

757,341. RELAY MAGNET; William Palmer, Jr., Rincon, Territory of New Mexico. App. filed June 14, 1902. Details.

757,346. ELECTRIC SIGNAL FOR RAILWAYS; William B. Ramsay, Hickory, N. C. App. filed May 29, 1903. Details.

757,355. GALVANIC BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed Nov. 22, 1899. (See page 772.)

757,357. DYNAMO BRUSH HOLDER; William Slee, St. Louis, Mo. App. filed Sept. 8, 1903. Details.

757,364. COMBINED LIGHTING AND ALARM DEVICE; John Thorsen, Chicago, Ill. App. filed Sept. 24, 1903. A spring motor is released by an electro-magnet to fire cartridges, turn on a light and ring a bell.

757,377. PRINTING TELEGRAPH RECEIVER; James D. White, London, England. App. filed Aug. 29, 1903. Improvements for increasing the range of characters without increasing the amount of the step by step movement of the mechanism, in that type of machine described in U. S. Patent 751,363.

757,388. LIGHTNING ARRESTER; Garrison Babcock, Chicago, Ill. App. filed Sept. 20, 1902. An insulated fusible strip is inserted between the plates so that when the fuse is melted, the insulation is carbonized and forms a conductor between the plates.

757,396. STORAGE-BATTERY GRID; George W. Frost, Columbus, Ohio. App. filed Feb. 9, 1904. (See page 772.)

757,405. BOOSTER APPARATUS; Lamar Lyndon, New York, N. Y. App. filed Aug. 21, 1902. The motor driving the booster has two field circuits, one of which is in series on the line while the other is provided with a switch for opening and closing it at will.

757,406. BOOSTER APPARATUS; Lamar Lyndon, New York, N. Y. App. filed Aug. 21, 1902. Two field circuits on the motor that drives the booster, are differentially wound and connect to the line in such a way that variations of current strength in the line will cause similar variations in one of the circuits and inverse variations in the other.

757,418. INSULATING AND SUSPENDING DEVICE; Joseph Sachs, Hartford, Conn. App. filed Jan. 5, 1903. Details of construction of an insulator.

757,422. DRY BATTERY; Alfred F. Swan, Bayonne, N. J., and Allen W. Rose, New York, N. Y. App. filed July 22, 1903. (See page 772.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, APRIL 30, 1904. No. 18.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
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NEW YORK, SATURDAY, APRIL 30, 1904.

CONTENTS.

THE SCRAP HEAP.

An interesting note appeared in our columns not long since to the effect that some Jablochkoff lamps had just gone out of service in Calcutta, India, after being in use over twenty years. We doubt whether this record could be equalled in this country for lamps, whether of the make in question or any other. The Jablochkoff lamps in this country had a brief although not particularly inglorious career, and this Calcutta episode is but another proof of the reluctance of our British and European friends to compile a scrap heap as sedulously as we do.

The relative life of electrical apparatus is a subject that is not much discussed, although we fancy there is a great deal of apparatus in service which is still giving a good account of itself after prolonged years of operation. Many of the early street railway motors are in use, we believe, and one frequently encounters primeval lighting apparatus. It does not follow that a plant is "scrapped" when it is exchanged for one of later date, and in fact, our advertising pages frequently give evidence to the healthy and active state of the second-hand market. A curious exemplification of the rage for change may be found in the lawsuit recently settled in favor of the Electric Light Company at Davenport, Iowa, which, after using its direct-current plant for two or three years, was ordered on pain of cancellation of its franchise by the city council, to change over to the alternating current. The courts have now sustained it in its refusal to scrap its apparatus in such a hurry, but there is no doubt that the rapid advance of the art very often brings about, without suspicious compulsion like that just referred to, radical changes in electrical apparatus of all kinds. In fact, it may be questioned whether the life of a telegraph or telephone system is much longer than that of a lighting and railway plant, with the proviso that when the apparatus is scrapped this does not always mean that it is broken up or altogether loses its functions of utility. It is an interesting commentary upon the way in which old material can be worked up that a steel plant at Hamilton, Ont., makes the claim that it has worked over into new material the iron of the original Niagara Suspension Bridge, the iron of the original Victoria Tubular Bridge at Montreal, the hull of the famous old Atlantic liner, the *City of Rome*, and the iron framework of the famous steamship the *Great Eastern*. In like manner, much electrical apparatus is living again to-day in forms that sometimes would hardly be recognized by those who used it when it was first brought out many years ago. We have seen lately some "long-waisted" Edison dynamos that certainly go back to the beginnings of the incandescent art, and we are told that the original Siemens & Halske electric road material, shown at Paris in 1881, is still earning a humble livelihood on the banks of Lake Leman, somewhere in the vicinity of Chillon.

DESIGN OF INDUCTION MOTORS.

Elsewhere we print an article by Mr. Hobart on the design of induction motors, which in a sense is a continuation of his article on the choice of the rotor diameter which we printed in our issue of January 23 of this year. The papers of Messrs. Parshall and Hobart on the design of electric generators for direct current, which appeared several years ago in the English engineering press, showed the critical judgment of these distinguished engineers in the application of formulas and theories to the design of direct-current machines. Intimately connected with the method of calculation of the inductance of the coils under commutation in direct-current generators is Mr. Hobart's correction and amplification of Behrend's well-known formula for the dispersion coefficient, upon which are based the circle diagram, and, with it, the theory of calculation of motors and generators embodying the induction principle.

The working of an induction motor or of an induction generator depends, according to Behrend's theory, primarily on two factors: First, the current which the motor takes while running at synchronous speed; and, second, the current which the motor takes while standing still. These two magnitudes determine the characteristics, such as power factor, torque and slip, of the induction machine, acting either as generator or as motor. The determination of the no-load or magnetizing current is a comparatively simple matter, as it involves only the calculation of the line integral of magnetizing force for the magnetic circuit of the motor, and requiring no constants of leakage or dispersion. This, however, does not apply in regard to the calculation of the current at standstill, the magnitude of which depends altogether upon the leakage and dispersion of the motor. The theory of the induction machine shows that the magnetizing current and the current at standstill are connected by a simple mathematical relation containing a factor which we term by courtesy a "constant," dependent upon the design of the slots, the air-gap, the pole pitch, and the length of the core. Behrend maintains that the constant depends "upon a great many other conditions of which we are still profoundly ignorant," and it is Mr. Hobart's aim to throw light upon this question.

Mr. Hobart's results may be summarized by saying that he shows the dependence of the factor in Behrend's formula on the ratio of the length of the core to the pole pitch, the factor being smaller the greater this ratio, proving the accuracy of his curves by tests on a large number of induction motors. A critical contribution to the literature of designing is most valuable by fixing ideas and dispelling hazy and incorrect notions which lead to superficial judgment and sham knowledge. From the judgment of fact there is no appeal, and we are all indebted to Mr. Hobart for his laborious tables and data to check the assumption of theory.

THE DIFFERENTIAL TELEPHONE.

The last number of the *Physical Review* contains an interesting article by Messrs. Duane and Lory on the differential telephone. Of course, differential telephones have been used for many years in alternating-current laboratories, so that there is no novelty in the instrument itself; but the directions given, in the article, for adjusting the instrument, enable it to attain a much higher standard of sensibility and measurement than would otherwise be possible. In order that a differential telephone may be capable of giving accurate results, it must be wound with mechanical symmetry, the magnetizing actions of the two windings must be well nigh identical, the resistances of the two windings must be almost exactly equal, and their inductances must also be almost exactly equal. To effect these equalities is by no means so easy as it sounds, either verbally or telephonically. The writers claim, for a carefully adjusted differential telephone, a theoretically attainable degree of accuracy, under laboratory conditions, of one-hundredth of one per cent., in the measurement of small ironless inductances, and a practically attainable degree of accuracy of one-twentieth of one per cent., or less. It is very desirable that a research should be made with such an instrument upon the resistivity of electrolytic solutions, with different frequencies of alternating current, throughout a wide range, in order to ascertain what effect, if any, is exerted by the frequency, upon the measurements. It has been asserted that the frequency may have a very appreciable effect, but we know of no measurements yet forthcoming to demonstrate the fact.

ZOSSEN STEAM TRIALS.

The daily papers are printing dispatches of renewed tests on the now famous Zossen line, this time with steam locomotives of weird and fanciful design intended to show to all the world how the best traditions of German express service can be preserved in spite of the threatened irruption of electric motors. Full details of the slow degrees by which the speed was raised to limits hitherto unknown on German government railways are not yet forthcoming, but we presume the earlier trials to stiffen the nerves of the daring experimenters were on hand cars driven by brawny Teutons goaded to desperation by the knowledge that the nearest available beer was at Marienfelde. Be that as it may, a few days ago trial was made of a mighty locomotive weighing with its tender 85 whole tons and using superheated steam and lubricating oil in apparently about equal proportions. To this space-devouring and time-annihilating monster were hitched three German cars and with a loaf of schwartzbrodt chained to the safety valve, and the terrified officials stretched on the floors of the cars hanging on with hands and teeth to keep from rolling off, the whole outfit hurtled through the shuddering atmosphere at 84½ miles per hour! We have searched literature from the time of Cadmus on for a suitable pæan of triumph with which to celebrate this epoch-making achievement, but the only one which seems to fit the case is a sonorous classical fragment in which a mountain and a mouse are the principal figures. O, mighty prophetic soul of Æsop, how hast thy wisdom shone through the mists of centuries to illumine this latest victory of mankind!

The addition of three more cars pulled down and speed of this leviathan of the rails to a scant 80 miles per hour, and we hesitate to imagine what would have been the result of adding still three more. To our benighted American eyes the whole loudly heralded performance looks like M. 1.20. Hardly a summer day passes in which one of the regular trains between New York and Philadelphia does not run off miles in 45 seconds or thereabouts, and there is one record on the Lehigh Valley Railroad of more than 40 consecutive miles run at the rate of 80 miles per hour. There is, too, a run on the Burlington route of 14.8 miles in just 9 minutes—98.7 miles per hour, and of single miles in less than 40 seconds there have been too many to keep account of. And all this has been done without any fuss and feathers by standard express locomotives, for the most part drawing regular trains. There has been no solemn posing about it—a train chanced to be a bit late and the engineer, with a clear track ahead, has merely shaken out a few kinks and arrived on schedule time. In the trials of regular German express engines over the Zossen course none of them is reported as having touched 80 miles per hour even with a three-car train, much less with one of ordinary length. These trials may be amusing to the officials who draw up elaborately sealed reports upon them, and may be more or less interesting to the engine builders; but as demonstrations of the capabilities of steam locomotives they are about as convincing as a press report from Che-Foo. If the Boss of the German railway system (we forget his polysyllabic official title) really wants to chase a few speed records, he had better import a Yankee track boss and a few of our standard engines and get down to business. They can show him more about making time in a week than he will learn at Zossen in a month of Sundays. We have the highest respect for German engineering skill in general, but in the steam railway business it seems to be hopelessly behind the game just at present. And if America as a school of instruction is too distant our Teutonic friends might organize a secret service to pry into the details of the express service of their Gallic neighbors, who in railroading vastly outrank other continental countries, and can give us also a run for our money.

As a mere feat in railroading it is not a difficult matter under favorable conditions to make one or a few miles at a speed of 100 miles per hour or thereabouts. But so long as the locomotive has to be burdened by carrying its own fuel and water and carrying also a large dead weight not directly concerned with power production, its power of sustained high speed is necessarily limited. The strong point of the electric locomotive is that it is not compelled to carry its power station upon its back, but can utilize nearly the full weight necessary for adhesion to the rails for available driving power. Nor is it forced to slow down for taking on fuel or to scoop up water, or to get the fire in condition. It can attend strictly to the business of pulling, first, last and all the time. It can hold the same speed for a long run as for a short one, so long as the track is in good condition. The difficulty with greatly increased running speeds is not in the electrical part of the equipment, but with the track; and more than all else, with the commercial demand for high speed. Conditions of equipment being the same, there is more profit in moderate speed than in very high speed, and so long as there is only nominal competition between railroads there will be no radical improvements in speed. It is only in long runs that very high-speed trains show to the best advantage, which is another obstacle, since the equipment of five hundred or a thousand miles of track for hundred-mile-an-hour work means a very large investment, right of way difficult to be obtained, the abolition of all grade crossings, and fierce opposition from the existing lines threatened. Some day a horoscope favorable in all these points can be cast and then the thing will be accomplished. It is strictly an electrical job, however, and the continuance of these trials at Zossen will only serve to emphasize the fact. They display admirable zeal, but they lead up a blind alley.

The Measurement of Stray Power by Calorimetry.

In the operation of water-cooled transformers, the power wasted in the iron and copper may be determined both electrically and thermally. In fact, while the electric method is commonly regarded as the simpler and more reliable, the thermal method is often employed in addition, as a check. All that requires to be done is to turn on a steady stream of cooling water, and, after a sufficient lapse of time for arriving at a substantially steady thermal condition, to measure the rate of flow of water, together with the difference of temperature between the incoming and outgoing stream. This heat delivery, expressed in watts, corresponds to the power wasted in the transformer. In a paper by Prof. Threlfall, appearing in the last number of the *Journal* of the Institution of Electrical Engineers (London), the same method is described as applied to tests of alternators running in air, the heat delivery in this case being measured in the flow of air circulated by a ventilating fan. A light housing is built over and around the alternator to be tested, so as to enclose the stream of ventilating air. A steady load is applied to the alternator, the power being delivered by the shaft passing through the wall of the housing. After a sufficient lapse of time, depending upon the size of the machine, the rate of flow of air driven through the system is measured, as well as the difference of temperature between the incoming and outgoing air. The flow of heat thus determined, as expressed in watts, measures the power wasted electrically in the copper and iron of the alternator; also the power wasted in windage friction, as well as a considerable part of that expended in bearing friction.

Much more care has to be taken in the measurement of the rate of air-flow in this test than in the rate of water-flow in the corresponding test of water-cooled apparatus, partly because air is a readily compressible fluid, and partly because its thermal capacity is much less than that of water. It takes about 4 joules to raise a gram of water 1° C. (more nearly 4.18). It takes about 1 joule to raise a gram of air 1° C. (0.993 joule). Consequently, by mass, air has only one-quarter of the thermal capacity of water. Moreover, since a gram of dry air at standard temperature and pressure occupies approximately 773 c.c., 1 c.c. of standard air only carries off 1/773 joule in rising 1° C. Consequently, by volume, standard water has about 3,250 times the thermal capacity of standard air, and 3,250 times more volume of standard air must be sent through an apparatus to carry off the heat for a given temperature elevation, than in the corresponding case with water.

The rate of flow of water cooling a large transformer is usually only a few cubic centimeters per second; but the rate of flow of air supplied by a ventilating fan to an alternator of moderate size, in these tests, is measured in cubic meters per second. In order to measure the rate of flow of air through a delivery pipe 21 in. in internal diameter, a Pitot tube was used. This is a well-known simple form of pressure gauge, consisting of a small cup supported in the delivery pipe so as to face the air-stream, and having a small tube leading from the bottom of the cup to a pressure gauge outside. It is shown very interestingly in the paper that with proper precautions, the pressure indications of a Pitot tube are capable of determining with considerable accuracy the velocity of the air-stream in the neighborhood. The effect of friction at the walls of the delivery pipe materially reduces the velocity of air-flow at and near the walls. A correction of about 6½ per cent. has to be made for this effect on the velocity of flow as measured at the center of the pipe. Corrections have also to be made for barometer, hygrometer and mean temperature of the air. It is claimed, however, that after all corrections are made, the method is capable of measuring power losses within a few per cent., and efficiencies within a fraction of one per cent. The advantage of the method seems to be that the apparatus required is comparatively inexpensive, and that it may be employed when no other measure of frictional losses is available. The disadvantages of the method are that it requires a special housing to be built over the machine to be tested, that the load must be kept steadily applied to the machine for several hours, and that many corrections have to be taken into account in the computations.

It does not seem likely, therefore, that this method of testing will come into general use. The ordinary electrical methods for measuring stray losss are so much simpler and swifter that there is no comparison between them and the calorimetric method. It is true that some of the assumptions involved in these electrical stray-loss methods are open to dispute, in regard to accuracy under full-load conditions. Nevertheless, if machines are specified to possess a certain efficiency, when tested by the electrical stray-loss method, the results are at least, comparable with those of other machines tested in like manner. The main value of the paper seems not merely to reside in the working out of a feasible method of measuring the efficiency of alternators, but also in supplying much valuable information concerning the flow of air through straight tubes. It is well known that this is a subject on which much difference of opinion exists, and where empiricism is rampant. In showing how to obtain accurate results from a Pitot tube, the author has contributed much to this subject, quite independently of other considerations. This is one more instance of the indebtedness of engineering to physics. In the discussion on the paper, the theory of the Pitot tube was developed very clearly, showing that the velocity near the cup was the square root of twice the density times the difference of pressure between that at bottom of the cup and at the side walls of the flue. It was also shown why the cup must have thin edges and squarely face the direction of flow; while the pressure at the walls must be found with a very flat-mouthed exit tube.

The Union Engineering Building.

The preliminary work of the Conference Committee on the Union Engineering Building was closed last week after a considerable amount of labor on the part of all interested, and the programme of competition will be placed in the hands of architects during the present week. In this work the committee has enjoyed the advice of Prof. W. R. Ware as professional adviser, and it is needless to say that the programme has been drawn with great care. The plans submitted in the competition by the selected architects and by those who enter the open competition are to be in the hands of Prof. F. R. Hutton, secretary of the committee, by June 15, and it is expected shortly thereafter to arrive at a decision as to the preferable plan. The Engineering Building on Thirty-ninth Street, about midway on the north side of the block, will occupy about 10,500 square feet, exclusive of the 15 feet open space reserved under the city ordinances, the outside dimensions of the land being about 125 feet by 100 feet. To the east of the building Mr. Carnegie has bought and reserved a residence which will be maintained at its present elevation so as to protect the air and light of the building on that side. The general plans of the building have already been outlined in these columns, but it may be stated that there will be at the top of the building three stories held for the use of technical societies invited to participate in the benefits of the building. Three other similar floors will be reserved, one each for the American Institute of Electrical Engineers, the American Institute of Mining Engineers and the American Society of Mechanical Engineers. These floors will make ample provision for offices and each will have a large, handsome reception room as well as board and committee rooms. Below these will come the library, virtually a double floor; although the committee will entertain plans placing the library at the top of the building. Next below will come a large main auditorium floor, which will seat from 1,200 to 1,500 people, with 1,000 on the floor and about half as many additional in the galleries. This floor will preferably be as near the sidewalk as possible, and may have above it or below it a number of smaller meeting rooms having similar purposes, seating audiences of from 500 down to 100. There will be six such rooms and these as well as the large room will all be thoroughly equipped with gas, compressed air, steam, water, electricity, etc., for the conduct of experiments and demonstrations. There will also be lounging and smoking rooms, and provision will also be made for special banquets by outside caterers and the serving of occasional collations. The floor on the street level will be appropriated mainly to administrative purposes with three coat rooms capable of taking care of 1,500 garments at once, a ladies' dressing-room, a bureau of information, public telephone and telegraph offices, the post-office and sales department and shipping and receiving offices for books, publications, etc. Below this floor, from which probably a fine stairway will lead to the auditorium above, will come the basement and sub-basement, with provision for storage purposes, machinery, coal and operative apparatus. There will be three elevators in the building of large capacity, one being able to take care of freight. The library floor will be laid out so as to accommodate not only the present consolidated libraries of 50,000 volumes, but a well-rounded comprehensive collection of six or eight times that number. There will also be a number of reading and reference rooms on that floor. For the purposes of the Engineering Building and the Engineers' Club regarded as separate structures, it is proposed to expend about $1,000,000, leaving the other $500,000 for tearing down of old buildings, excavation, architects' and engineers' fees, machinery, elevators, lighting fixtures and the equipment of the library and auditorium. As to the architecture of both buildings, it is the expressed wish of Mr. Carnegie that it should be simple and dignified, something that will be as good in style a hundred years from to-day as now.

The Engineers' Club, with a frontage of 50 feet and a depth of 100, will front on Fortieth Street and Bryant Park, looking across to the New York Public Library, now partially completed. It is proposed that the club building shall be eleven and a half stories, including also basement and sub-basement, but differing, of course, in all other respects from its near neighbor. The half story will be on the roof and will have the kitchen and some rooms for accommodation of the help, the other part constituting a roof garden with outlook on the little park and Hudson River. The eleventh floor below will be occupied entirely by the main dining-room or banquet hall and its service facilities, and will be one of the finest rooms in the house, looking across to the Park and New York Library. Below this will come the breakfast room floor with a large breakfast and lunch room and several private dining-rooms. Next will come four floors, occupied by bedrooms for members. There will be sixty of these rooms in all and the smallest is to be not less than 150 square feet. There will be generous bath facilities and all rooms will have outside air and light. Below these sleeping accommodations will come the billiard room floor, with a large billiard room across the front of the house and with board rooms, committee rooms, card rooms, etc., in the rear. Next below will come the floor containing the club room or general reception and meeting-room in front and the library in the rear, these being the only two rooms on that floor. The next or ground floor, raised several feet above the sidewalk, will contain the office, large coat rooms, general reception rooms, telephone booths and a large, handsome café. Below the sidewalk will be a basement and sub-basement containing machinery, refrigerating plant, store rooms, wine cellar, steward's rooms and sundry other facilities. There will be three elevators running from cellar to roof, one with capacity for freight. There will also be a main grand ornamental stairway running up to the level of the billiard room floor and there will be service stairways throughout, which can also be used by the members. It is believed that good architectural plans will enable the buildings to present from the Bryant Park front a harmonious and handsome ensemble above the roofs of the private dwellings in the vicinity. A covered areaway across the light well between the two buildings will render intercommunication easy and the committee will also entertain plans throwing a light, artistic bridge across at about the level of the library floor of the Engineering Building.

The six architects selected for the mixed competition have already been named in these columns, and this week the printed programme will be placed in their hands and will also be available for other architects in good standing, many of whom wish to come into the open competition. The selected architects are each to receive $1,000, which is to be charged against the commissions in case of success. The competitors on the open list have the encouragement of four equal prizes of $200 each for the four best designs. The date for the filing of the competitive plans is June 15. The committee hopes to be able thereafter to make a prompt decision and will proceed with the prosecution of the work without delay.

The three societies have been requested recently to appoint members to serve on a special committee which shall at once take the work in hand of unifying and harmonizing the methods of their various libraries, so that when the collections are brought together, they will be ready for co-operative administration.

Telegraphers in the Civil War.

As is well-known, the United States Corps of Military Telegraphers after many years of work, has at last succeeded in securing recognition of the services of the men who worked the key at the front in the Civil War. In a report favoring the extension of pension privilege to the operators who thus served the government, Senator Scott, of West Virginia, has related some interesting incidents of the service which enabled the armies and parts of armies to keep in communication with each other, and which enabled President Lincoln to be in touch with all his generals. Throughout the war there were, all told, 15,000 miles of wire operated by the army telegraphers, and the service cost the government about $3,000,000. Twelve hundred operators were employed.

During the operations in front of Atlanta, in 1864, twenty miles of wire was kept in operation twenty-eight days by almost as many operators, half of whom were exposed to the enemy's fire while at work at their instruments. At New Orleans, says the report, the operators and linemen were not only in danger of being shot, but risked their lives almost daily in the surf in trying to keep the submarine part of their system in working order. The active service of the operators practically came to an end when they rushed a line of wire to Appomattox, over which the news of Lee's surrender was received at Washington within two hours after the event.

President Wilson, of the Society of the United States Military Corps, says of the military telegraphers of the Civil War: "The list of casualties and captures in this little corps, probably aggregating 322, establishes its military character. The 15,389 miles of military telegraph lines constructed and operated in the threatres of the war by this corps, hundreds of whom were within range of the enemy's guns and often under fire, evidences a devotion and bravery that surely make its members worthy of comradeship with others of the army."

The Plant of the Kansas City Home Telephone Company.

By Max Loewenthal, E.E.

THE marvelous development of the electrical industries throughout the United States during the past decade contains no record that can excel the growth of the independent telephone movement. The latest statistics show that of the 212 cities in the United States having more than 20,000 inhabitants, 162 already have independent telephone exchanges, franchises have been granted in 11 additional and applications are pending for franchises in 12 more. There are at present in operation in the United States over 6,000 independent telephone exchanges which operate in round numbers 2,000,000 telephones in exchange service, representing an investment of over $200,000,000. It is interesting to note in this connection that only 4 per cent. of the population of this country are using telephones, while in some sections it is being used by from 12 to 15 per cent. of the population and even more. The education of the general public to the use of the telephone as a convenience has developed its use to an absolute necessity. The independent telephone development in Missouri and Kansas has been so rapid and popular that there are to-day twenty telephones in operation where there was one at the beginning of the movement. All of the independent exchanges in this territory are being rapidly connected by long-distance service.

One of the most perfect types of the modern telephone system is that which has just been completed by the Kansas City Home Telephone Company, in Kansas City, Mo., and Kansas City, Kan., this system having immediate facilities for taking care of 8,200 subscribers, and an ultimate capacity of 34,000. The system will have in operation before the end of the year 1904 about 8,500 private line telephones and has now in successful operation about 6,000 lines, installing new telephones at the rate of twenty a day.

The Kansas City Home Telephone Company was incorporated in November with a capital of $50,000, which was increased in January, 1903, to $3,000,000, of which $1,700,000 have been issued. The balance of the stock and bonds, there being a bonded indebtedness of $1,700,000, is in the treasury for future extensions and betterments. The company operates under a thirty-year franchise

FIG. 1.—MAIN EXCHANGE BUILDING, KANSAS CITY, MO.

in Kansas City, Mo., and a twenty-year franchise in Kansas City, Kan., the two cities having a combined population of about 300,000.

The movement which led to the organization of this company was started about two years ago. The franchise which was originally granted to John Enoch was purchased by the Central Telephone Construction Company, of Toledo, Ohio, which constructed the entire plant. The officers of this company are Ed. L. Barber, president, O. C. Snider, secretary and treasurer, and James S. Braley, Jr., manager. Through the efforts of this company the enterprise was financed by the organization of an underwriting syndicate, managed by the Germania Trust Company, of St. Louis, now a part of the Commonwealth Trust Company. The construction company also had entire charge of the canvass for subscribers and secured 9,000 three-year contracts with comparatively little effort.

Actual work was started in the fall of 1902. Multiple-duct con-

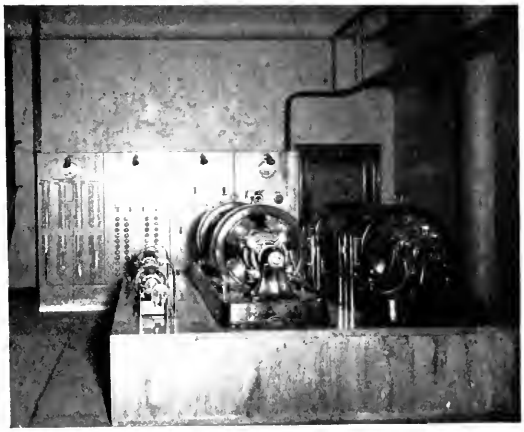


FIG. 2.—POWER PLANT, MAIN EXCHANGE.

duits were laid throughout the entire business section and the company owns at present 750,000 duct-feet of conduit and 260 manholes. All-copper overhead construction has been adopted throughout the residence districts and local distributing poles are located in the alleys throughout the city. So as to distribute efficiently the load on the system it was decided to build one main and three branch exchanges, each serving the section within which it is located. The main exchange building, shown in Fig. 1, is a handsome three-story and basement brick building, with terra cotta trimmings, and is located on Baltimore Avenue, in the very heart of the business district of Kansas City. It is 120 ft. in length and has a frontage of 60 ft., while its width in the rear is but 44 ft., about 8 ft. having been cut off on each side so as to insure ample air and light shafts,

FIG. 3.—MAIN, INTERMEDIATE AND RELAY RACKS, MAIN EXCHANGE.

should buildings be erected on either side of the exchange. The 37 lead-covered cables, each consisting of 200 pairs of No. 19 gauge Roebling dry-core paper-covered wires, enter the building in the basement, where they have been spliced to twice the number of 100-pair cables, which run to the main distributing frame on the floor above.

In the basement also are located the repair and carpenter shops, benches, lockers and [illegible] the outside men, hot water and steam combination boiler and the material room.

On the second floor are the power and distributing frame room, the long-distance tollboard, the kitchen, dining-room, toilets and lockers for the operators. The power plant, shown in Fig. 2, consists of a duplicate set of motor-generators of the Holtzer-Cabot type, for charging purposes, the motor end receiving 114 amp. at 220 volts at a speed of 1,000 r.p.m and the dynamo generating 300 amp. at 60 volts. As there is a duplicate set of batteries, the charging machines are so connected through the switchboard that either set of batteries may be charged by either machine, and the machines are so wound that the batteries may be charged while furnishing current for the exchange without creating noise in any of the talking circuits. They are of sufficient size for the ultimate capacity of the exchange.

The ringing machines, made by Roth Bros. & Co., are equipped with a device for the "busy back" signal for the trunking positions, and for signalling to any subscriber who may have left his receiver off the hook. The generators each have a sufficient output to operate the entire capacity of the switchboard.

The power switchboard, also seen in Fig. 2, consists of four panels, known as the fuse, ringing and two power panels. The board is of Tennessee marble, is 12 ft. long and 8 ft. high. The power panels are provided with Weston voltmeters and ammeters and necessary switches for connecting either machine to the battery or for charging the battery and feed current to the switchboard. Automatic circuit-breakers prevent the current from flowing back from the storage batteries to the generators. The voltage of each individual cell may be read on a special low-reading voltmeter. All circuits leading from the power board are individually fused on the face of the board.

Toward the front of the building in the same room are the main and intermediate distributing and relay racks, shown in Fig. 3. The main racks are built up of structural iron and so braced as to be rigid and substantial. The main rack is provided with terminal

FIG. 4.—BATTERY PLANT IN MAIN EXCHANGE.

clips mounted on hard rubber and is arranged at present for 5,500 lines, but is so designed that it can be extended from time to time until the ultimate capacity of the exchange is reached. It affords the best facilities for the placing and removal of jumper wires.

The intermediate distributing rack, similar in construction to the main rack, is so arranged that any line may be connected to any operator's position without changing the number of the outside line, or the multiple jack. Adjoining this rack is the relay frame on which the line relays are mounted. Sufficient room has been left between the frames and the power plant to provide for the extension of the racks to such an extent as to permit of an ultimate room capacity of 12,000 subscribers.

The duplicate set of batteries is located in a room back of the power board. These batteries (Fig. 4) furnish all the current required for the operation of the exchange and are of sufficient capacity to operate the plant without recharging for 48 hours. Each set of batteries consists of 20 cells and the plates in each cell are placed in lead-lined tanks of such size that additional plates can be added until there are a sufficient number to operate the ultimate capacity of the exchange for 36 hours without recharging the cells.

In close proximity to the power plant is the desk of the wire chief. It is arranged for two positions and each position is equipped with 10 complete cord circuits with listening and ringing keys and 10 order wire keys. Space is provided in each position for an ultimate capacity of 40 line lamps and jacks, the present equipment being for 30 lines, operating automatically on lines leading, one to the monitor's and chief operator's desk, one to the trouble clerk and six to the strip of multiple jacks in the main board. Five jacks terminate in cords and plugs in the keyboard of what is known as the eleventh

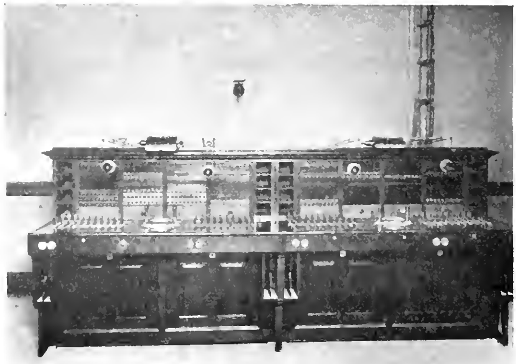


FIG. 5.—LONG-DISTANCE SWITCHBOARD, MAIN EXCHANGE.

and twelfth positions, two in cords and plugs at one of the trunking positions in branch exchange A, two in B and two similarly in branch C. There are five two-way leads which lead to the distributing frames in the various exchanges. All lines are duplicated in the two positions, so that they may be answered or tests made from either or both positions. A double-scale Weston voltmeter is situated between the two positions. All circuits are so arranged and designed that by manipulating the keys all required tests for "opens," grounds, reserves, shorts and all other trouble, both on the line and on the switchboard, can be made from this desk. The desk is also equipped with a key and special apparatus for signalling a subscriber when his receiver is left off the hook. A large number of pigeon-holes for trouble tickets are also provided. In a room adjoining the one described above the long-distance switchboard is located. This board, shown in Fig. 5, is designed for four positions and at present has a 30-line equipment. It is provided with modern incoming and outgoing trunking facilities for the rapid handling of service. The board is equipped with standard calculagraphs for the timing and checking of messages.

On this floor also, separated from the mechanical department by the main hall, is the dining-room for the operators, the kitchen, etc., and the offices of the superintendent of equipment. The main operating room, shown in Fig. 6, is situated on the top floor of the building and embodies every feature tending to mechanical and sanitary perfection. Plenty of light is insured by a large number of windows and artistic skylights, while forced circulation keeps the air pure, a 30-in. ventilating fan pulling the vitiated air out at the floor line.

The full common battery multiple switchboard consists of 19 sections of three operators' positions each. It has a present equipment of 5,500 lines with 160 outgoing trunk lines and 20 desk lines, also 150 incoming trunk lines and 16 desk trunks. Provision has been made in the construction of the board for an ultimate capacity of 12,000 lines, 360 outgoing trunks and 20 desk lines in each section, and 140 answering jacks and lamps in each position. Each of the local, trunk and desk lines is multiplied throughout every section. Each position is equipped with 15 complete cord circuits with listening and ringing keys, supervisory and pilot lamps and a bank of ten order keys.

The framework of the switchboard is built of structural iron. The exposed cabinet work, including all cable boxing in the exchange room, is made of selected mahogany. The rear of the board is enclosed with hardwood doors, which are readily removable. Each operator's position is provided with two pilot lamps, with jeweled caps mounted directly behind the cords and plugs, and just below the answering jacks. One lamp is provided with a white jewel and

FIG. 7.—EAST BRANCH EXCHANGE.

operates in circuit with the line lamp relay and remains lighted until the call is answered. The other lamp is provided with a red jewel and operates in circuit with the answering supervisory relay, and

be operated when either lamp is lighted. All supervisory and line relays are capable of being operated by a telephone through 1,200 ohms line resistance and can withstand twice the normal pressure of the battery without sticking.

All circuits are strictly metallic and perfectly balanced under all operating conditions and arranged so as to produce no cross-talking or other inductive disturbances. In the center of the main operating room, which measures 90 x 40 ft., are the desks of the chief operator, the trouble and information clerks, and all within full view of the entire board.

To the one side of the operating room toward the front of the building is the emergency hospital, equipped with all modern medical appliances for the temporary treatment of operators who may

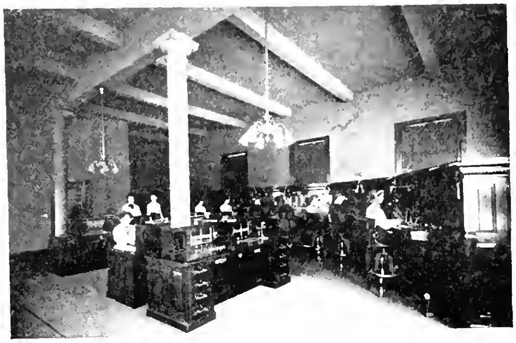


FIG. 8.—MAIN OPERATING ROOM, EAST BRANCH EXCHANGE.

be taken ill suddenly. To the other side is the operator's rest room, which is comfortably furnished and greatly relished by the operators during the two periods of rest of half an hour's duration. A well-

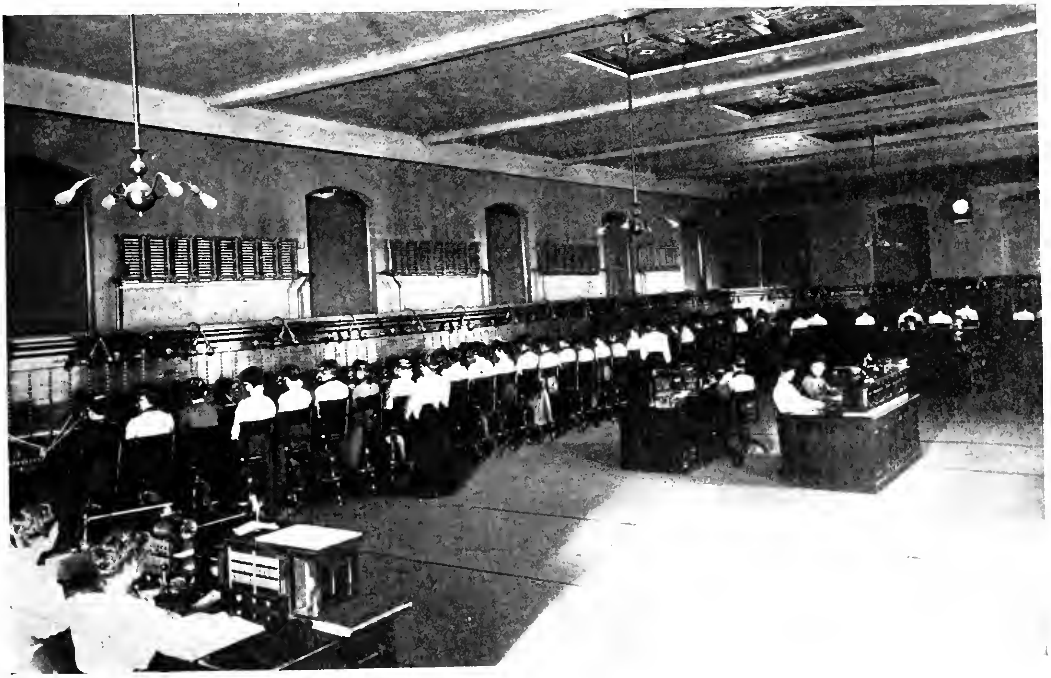


FIG. 6.—MAIN EXCHANGE OPERATING ROOM, KANSAS CITY, MO.

remains lighted until the connection is taken down, after the subscriber who originated the call has restored his receiver to the hook. Both pilot lamps are so connected that a night bell or buzzer may

known authority on the training of telephone operators (Mrs. H. Brown) is in charge of the operators, looking after their comfort and maintaining the strictest discipline, which is the foundation of good service and success. On the first floor of the building are the various offices, auditing and engineering departments and the meeting room of the board of directors.

The three branch exchanges of the company are almost identical in construction and equipment, one of the buildings being shown in Fig. 7. Branch exchange A, known as the East office exchange, is located in the eastern residence portion of Kansas City, Mo. Figs. 8, 9 and 10 illustrate the equipment of this and the other branch exchanges. The east switchboard consists of seven sections of three operators' positions each. It has a present equipment of 1,200 lines, with 120 desk lines, also 100 incoming trunk and 12 desk lines. Provision has been made for an ultimate capacity of 7,200 main lines.

FIG. 9.—MAIN AND INTERMEDIATE DISTRIBUTING AND RELAY RACKS, EAST BRANCH EXCHANGE.

Branch exchange B, known as the South office, is located in the southern residence portion of Kansas City, Mo. The switchboard in this exchange consists of five sections of three operators' positions each, and the present equipment consits of 700 lines, with 80 outgoing trunk and 20 desk lines and 75 incoming trunk lines and 9 desk trunks. Branch exchange C, known as the West office, is located in the business district of Kansas City, Kan. The board at this exchange is at present equipped for 800 lines with 60 outgoing trunk and 20 desk lines and 75 incoming trunk lines and 9 desk trunks. The entire equipment of the exchanges was furnished by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago and Rochester, and the plants were built by the Central Telephone Construction Company, of Toledo, under the personal supervision of the chief engineer of the Kansas City Home Telephone Company, Mr. W. C. Polk.

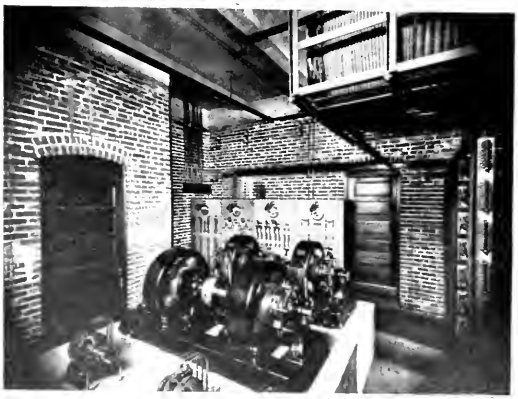


FIG. 10—POWER PLANT, EAST BRANCH EXCHANGE.

It may be of interest to note that the rates fixed by the ordinance in Kansas City, Mo., are $54 for business telephones and $36 for residence telephones, until January 1, 1907, when the company has the privilege of increasing the business rate to $60 per year. In Kansas City, Kan., the business rates are $54 and the residence rates $48 within a radius of 2½ miles from the business district, and the company is entitled to charge an additional $6 per mile per instrument for each additional mile or fraction thereof for extensions beyond this radius. The company has, however, adopted a uniform business rate in both cities of $54 and $36 for residence telephones, furnishing unlimited service between the two cities.

There are under construction and soon to be completed, long-distance lines reaching to Leavenworth and Atchison, Kan., and St. Joseph, Lexington and Sedalia, Mo. These lines will reach all independent telephone systems in their territory, and at their terminals connect with other lines reaching all over the States of Kansas, Missouri, Iowa, Illinois, Indiana, Kentucky, Indian Territory and Northern Texas. A line to Topeka, Kan., is now in service.

The officers of the company are: J. J. Heim, president; Henry Koehler, Jr., first vice-president; O. C. Snider, second vice-president, treasurer and general manager, and Hugh C. Ward, secretary. The directors of the company are: J. J. Heim, O. C. Snider, Hugh C. Ward, Walter S. Dickey and J. J. Swofford, of Kansas City; Max Koehler, Henry Koehler, Jr., Lee Benoist and A. W. Lambert, of St. Louis; Ed. L. Barber, of Wauseon, Ohio; James S. Brailey, Jr., of Toledo, Ohio, and Arnold Kahlman, of St. Paul. The officers of the long-distance company, known as the Western Independent Telephone Company, with an authorized capital of $1,500,000, are: Ed. L. Barber, president; J. J. Heim, vice-president, and O. C. Snider, secretary and treasurer.

Rocky Mountain Bell Telephone System.

The Rocky Mountain Bell Telephone Company, which has its headquarters at Salt Lake City, Utah, operates over the largest territory of any telephone company in the United States, and there are many interesting features connected with its rapid growth of the last few years. The toll line system covers the States of Utah, Idaho, Montana and Wyoming, the total area of which is 409,465 square miles. This area is larger by 90,000 miles than the Pacific Coast States, in which the Pacific States Telephone Company operates, and by way of comparison is 10,000 miles larger than the combined area of all the States lying south of Mason and Dixon's line, and between the Atlantic Ocean and the Mississippi River. This vast territory of the Rocky Mountain Bell Telephone Company is quite sparsely settled except in a few spots, where fertile valleys and mining camps have created cities and well-settled communities. In these four States the company has 6,000 miles of pole lines, with 16,000 miles of circuits, practically all of which are copper. The greatest stretch of connected lines is from the Wyoming-Colorado State boundary to the Washington-Idaho State boundary—a distance of 1,201 miles. The total number of subscribers of the company, including the city subscribers, was 19,000 in January and there were 96 exchanges in operation and 700 towns connected. During the last year 800 miles of new pole line were constructed, while the year's total growth of the company's system over the previous year was 39 per cent., a remarkable growth, but one which is entirely commensurate with the rapid development of the States of the Northwest.

The largest exchange is in Salt Lake City, where the company had 5,300 subscribers in January, an increase of 46 per cent. over the previous year. Butte has the next largest exchange with 1,800 subscribers, and Ogden comes next with 1,400 subscribers. Other good-sized exchanges are located at Provo and Logan, Utah; Pocatello and Boise, Idaho; Helena, Mont; Cheyenne and Laramie, Wyo.

At Salt Lake City during the last year the company has been engaged in putting its wires underground in the business district, and extending the conduit into the residence districts. At the present time there are over seven miles of conduit in the city. Electrolysis-proof paper conduit is used, it being laid in concrete in 8-ft. lengths. About 4,000 ft. of similar underground work has been done at Ogden. Other work of the year includes the erection of a new building in Cheyenne and the improvement of other buildings.

The toll-line system connects with the lines of the Colorado Telephone Company at Cheyenne and with the Pacific States Telephone system at Spokane, Wash.; Lewiston, Idaho, and Huntington, Ore., all three points being close to the western boundary of Idaho. A proposed connection with the Pacific States Telephone system through Nevada will follow the line of the Southern Pacific Railroad around the north end of Great Salt Lake. Still another connection with the Pacific Coast system is proposed through the southwestern portion of Utah, following the general line of the San Pedro, Los Angeles & Salt Lake Railway, which is now nearing completion. A connection with the lines of the Colorado Telephone Company is proposed at Grand Junction in the western part of Colorado.

The company's toll service is very good, that between Salt Lake City and Denver being of special excellence, when the distance, 800 miles, is considered. On this line the company operates through eight exchanges. Knife switches are used as cut-outs, thus giving a practically clean line, the drops being bridged in through 5,000-ohm resistances. The company has six circuits running north of Salt Lake City and five south.

In Salt Lake City, Ogden, Butte and Boise common-battery exchange systems are installed and common battery is used for calling in 16 other stations. Party lines are limited to four parties on one circuit for city subscribers, which adds greatly to the general quality of the service. In subscribers and rural districts 10-party lines are allowed.

The company has had a very satisfactory growth in these party lines in rural communities. One striking example is the Snake River Valley in Idaho, where a district about 10 miles wide and extending for 100 miles along the Snake River has been the scene of a wonderful development in rural telephones. That section with good irrigation and a fertile soil has been rapidly settled and practically every farm the entire length of the valley is now connected with the outside world by means of 10-party telephone lines, No. 9 B. B. Galvanized-iron wire is used with 2,500-ohm bells and $2 a month is charged for the service, the farmers erecting and owning the poles and lines.

The Rocky Mountain Company as yet has not met severe competition and in several instances has added to its system by the purchase of isolated independent plants. Competing companies are now operating at Boise, Idaho; Billings, Mont., and Salt Lake City.

As in the case of the Colorado Telephone Company, whose system was described in the ELECTRICAL WORLD AND ENGINEER in August, 1903, the Rocky Mountain company has to operate and maintain its toll lines through some wild and rugged mountainous country. Some of the greatest trouble it has had, however, has been occasioned by fires and storms in the timber districts. On the line between Missoula, Mont., and Spokane, Wash., the company has had a gang of men at work ever since it was built four years ago, cutting the timber down on both sides of the line. As one expedient to avoid the breaking of the line in case of trees falling across it, the wires were hung underneath the cross arms, so that the line would be carried to the ground in case of storms and still remain in operating condition. Another point at which great trouble has been experienced is the Fourth of July Cañon in Idaho, where for 25 miles the line is frequently put out of service by falling timber, deep snow, heavy winds or floods. The Rocky Mountain Bell Telephone Company is under the energetic and progressive management of Mr. David S. Murray.

Electric Trolleys in Peru.

The first electric railway in Peru was formally opened to the public at Lima, February 17, with ample ceremony and great rejoicing by the populace. The road connects Miraflores, Baranco and Chorillos, summer resorts, with Lima, and is 23 miles long. It really was built in record time. The company applied to the government for a charter to build the road December 9, 1902; the concession was granted January 20, 1903; work began June 11, of that year; the road was completed January 18, 1904, and inaugurated February 17. President Manuel Candamo, of the Peruvian Republic, who is the formal sponsor of the road, replied to the address delivered by its president, Jose Payan, and Archbishop of Lima, Manuel Tovar, invoked divine aid and pronounced the benediction upon the new enterprise. Manuel T. Marca, chief engineer of the city railroads of Lima, is engineer for the new road. W. McLimont is electrical engineer, and Emilio Godoy, manager. The cars and electric plant are of American manufacture.

A few months more will witness the completion of another electric tramway line between Callao and Lima. The road is about 10 miles long, double track. The opening of this road will have a marked effect in drawing Lima and its port, Callao, even more closely together than they are at present.

The Design of Induction Motors with Examples from Recent European Practice.

BY H. M. HOBART.

THROUGH the courtesy of the manufacturers, the writer has had recently placed at his disposal the particulars of a number of interesting English and Continental induction motor designs for large capacities. A tabulated analysis of these designs affords an opportunity of illustrating a useful practical method of carrying through the induction motor calculations. The designs are set forth in Table I in columns *A*, *B*, *C* and *D*. In column *A* is given a motor of Messrs. Brown, Boveri & Co. (Switzerland). The design in column *B* is by Mr. Danielson and is built by the Allmana Svenska Elektriska Aktiebolaget, of Westeras, Sweden. The design in column *C* is that of a motor by the Alioth Company, of Basel, Switzerland. The motor in column *D* was designed by Mr. Zani for Messrs. Dick, Kerr & Co., of Preston, England. In column *E* has been added the less recent but very interesting design by the Alioth Company, for a motor of 500 hp. The range of designs thus extends from 75 hp to 500 hp and the table is arranged in the order of increasing output, thus facilitating the study of the designs:

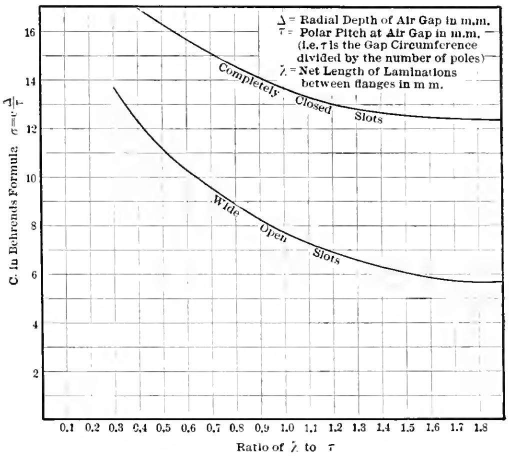


FIG. 1.—DIAGRAM OF CURVES.

The calculations in Table I are thought to be so clear as to require no explanation further than as regards the dispersion coefficient σ.

This has been calculated by employing Behrend's formula in the form

$$\sigma = C\,C^1 \frac{\triangle}{\tau},$$

in which

$\triangle$ = radial depth of air-gap.

and τ = polar pitch at air-gap.

C and C^1 are two constants obtained respectively from the curves of Figs. 1 and 2. C is dependent upon the ratio $\frac{\lambda}{\tau}$, in which λ = core length between flanges. In the curves for C suitable allowance is made for the inductance of the end connections. C^1 is dependent upon $\triangle \times H$, in which H equals the average of the number of slots per pole on stator and rotor. In the curve for C^1 suitable allowance is made for the so-called "zig-zag" dispersion over the heads of the teeth.

The curve of Fig. 2 shows the great importance of employing a high value for $\triangle \times H$, for below 0.75 the curve rises rapidly and generally renders futile any attempt to improve the power factor by means of decreasing the radial depth of the air-gap. This "zig-zag" dispersion is almost negligible with many slots and moderately

TABLE I.

Designation	A	B	C	D	E
Country in which Manufactured	Switz'land	Sweden	Switz'land	England	Switz'land
Manufacturer	Brown, Boveri & Co.	Allmanna Svenska El. Ak.	Alioth Co.	Messers. Dick, Kerr & Co.	Alioth Co.
Designer		E. Danielson	— — —	A. P. Zani	—
Rated hp.	75	100	185	220	500
Number of poles	8	12	14	12	30
Periodicity in cycles per sec.	50	50	50	50	25
Synchronous speed in r.p.m.	750	500	430	500	100
Voltage between terminals	500	500	8,000	5,000	5,000
Connection of stator winding	△	Y	Y	Y	Y
Voltage per phase	500	288	4,620	2,880	2,880
STATOR LAMINATIONS.					
External diam. of stator punchings (cm.)	70.0	103	162	145	332
Internal diam. of stator punchings (cm.)	50.2	88	130	109	300
Gross length between flanges (λg) (cm.)	28	36	40	30.5	75
Number of ventilating ducts	None	2	None	3	None
Width of each duct (cm.)		1.5	—	1.3	—
Net length of laminations between flanges (λn) (cm.)	25.2	29.7	36	23.0	67.5
Polar pitch at air gap (τ) (cm.)	19.7	23	29.2	28.5	31.4
Number of stator slots	72	180	168	108	450
Number of stator slots per pole	9	15	12	9	15
Number of stator slots per pole per phase	3	5	4	3	5
Depth of stator slot (mm.)	15	25	52	39.[illegible]	57
Width of stator slot (mm.)	16	10.5	13	21.6	13
Width of stator slot opening (mm.)	3.0	3.0	2.0	4.0	3.0
Stator tooth pitch, at air gap (mm.)	21.8	15.3	24.3	31.6	2.09
Stator tooth pitch, at ends of the slots (mm.)	23.6	16.2	26.3	34	21.7
Minimum width of stator tooth (mm.)	6.6	4.8	11.3	10.0	7.9
Maximum width of stator tooth (mm.)	7.6	5.7	13.3	12.4	8.7
Weight of stator punchings (kg.)	265	410	1,750	1,220	3,570
ROTOR-LAMINATIONS.					
Radial depth of air gap (△) (mm.)	1.0	1.5	1.25	1.6	1.75
External diam. of rotor punchings (cm.)	50.0	87.7	129.75	108.68	299.65
Internal diam. of rotor punchings (cm.)	35.0	75.7	101.0	86.5	284.0
Gross length between flanges (λg) (cm.)	28	36	40	30.5	75
Number of ventilating ducts	None	2	None	3	None
Width of each duct (mm.)	—	15	—	13	—
Net length of laminations between flanges (λn) (cm.)	25.2	29.7	36	23.9	67.5
Number of rotor slots	96	216	294	144	720
Number of rotor slots per pole	12	18	21	12	24
Number of rotor slots per pole per phase	4	6	7	4	8
Depth of rotor slot (mm.)	35	21.5	23	39.4	22
Width of rotor slot (mm.)	10	8	7.5	11.8	7
Width of rotor slot opening (mm.)	2	3	2	1.6	2
Rotor tooth pitch (at air gap)	21.8	12.8	13.9	23.7	13.1
Rotor tooth pitch (at bottom of the slots)	18.8	12.1	13.4	21.9	12.9
Minimum width of rotor tooth (mm.)	8.8	4.1	5.9	10.1	5.9
Maximum width of rotor tooth (mm.)	11.8	4.8	6.4	11.0	6.1
Weight of rotor punchings (kg.)	145	270	1,340	515	3,400
STATOR WINDING.					
Number of stator conductors per spot	42/4	3 (Each with 2 compounds)	27	33 Each consisting of 2 components	8
Number of stator slots	72	180	168	108	450
Number of stator conductors	756	540	4,536	3,564	3,600
Number of stator turns	378	270	2,268	1,782	1,800
Number of stator turns per phase	126	90	756	594	600
Number of stator turns per pole per phase	15.75	7.5	54	49.5	20
Dimensions of conductors, bare (mm.)	2.9	2×(2.5×6.5)	ø2.5	2+ø=2.34	ø 5.0
Dimensions of conductors, insulated (mm.)	3.5	2×(2.0×7.0)	ø3.0	—	ø 5.6
Cross-section of conductor (sq. cm.)	4 × .066 = .264	.324	.049	2×.0403=.086.	.197
Mean length of one turn	140	150	205	159	288

TABLE I. (*Continued.*)

	A	B	C	D	E
Total length of stator turns per phase (cm.)	17,700	13,500	15,500	94,000	173,000
Resistance per phase at 60° C.	0.134	.084	6.3	2.2	1.75
Weight of stator copper (kg.)	126	117	203	3=72=216	910
ROTOR WINDINGS.					
Number of rotor conductors per slot	2	2	1	2	1
Number of rotor slots	96	216	294	144	720
Number of rotor conductors	192	432	294	288	720
Number of rotor turns	96	216	147	144	360
Number of phases in rotor winding	3	3	3	3	3
Number of rotor turns per phase	32	72	49	48	120
Number of rotor turns per pole per phase	4	6	3.5	4	4
Dimensions of conductor, bare (mm.)	6 × 12	4.5 × 8	16.5 × 5	16×9	16 × 5
Dimensions of conductor, insulated (mm.)	7.5 × 13.5	5 × 8.5	17×5.5	16.5×9.5	16.5×5.5
Cross-section of single conductor (sq. cm)	0.72	.36	.825	1.43	.8
Mean length of one turn	112	144	185	150	240
Length of effective rotor turns per phase (cm.)	3,580	10,400	9,060	7,200	28,800
Resistance per phase at 60° C.	.010	.058	0.210	.01	.072
Weight of rotor copper (kg.)	69	100	200	273	615
POWER FACTOR AND CURRENT.					
Length of laminations / Pole pitch $\left(\frac{\lambda g}{\tau}\right)$					
Type of slot (average of stator and rotor)	1.42	1.57	1.37	1.07	2.30
C in Behrend's formula (from Fig. 1)	Closed Nearly	Closed ⅔	Nearly Closed	Nearly Closed	Nearly Closed
△ × H =	11.0	10.6	12	12.5	10.5
C' in Behrend's formula (from Fig. 2)	1.05	2.5	2.06	1.68	3.4
Dispersion coefficient σ $\left[\sigma\ CC'\frac{\triangle}{\tau}\right]$	1.21	.84	.93	1.0	.71
Maximum power factor $= \left(\frac{1}{1+2\sigma}\right)$	0.068	0.058	0.048	0.070	0.042
Watts output at full load	.88	.895	.912	.876	.922
Full load efficiency	55,200	73,600	136,000	164,000	368,000
Watts input at full load	93.5	90.0	93.0	93.5	91.0
Volt amperes input at full load	59,200	81,900	146,000	175,000	405,000
Volt amperes input per phase	67,000	91,500	160,000	202,000	435,000
Volts per phase	22,400	30,500	53,300	68,000	145,000
Full load amperes per stator winding	500	288	4,620	2,880	2,880
Type of connection	44.8 △	106 Y	11.5 Y	23.5 Y	50.5 Y
Full load line amperes	77.5	106	11.5	23.5	50.5
NO LOAD, AND SHORT CIRCUIT CURRENT.					
Periodicity (in cycles per sec.) (N)	50	50	50	50	25
Number of stator turns per phase (T)	126	90	756	594	600
Approx. Int. voltage per phase (E)	490	280	4,550	2,800	2,800
Megalines flux per pole (M) [from $E=4.2=T\ N\ M\ 10^{-8}$]	1.85	1.48	2.86	2.24	4.50
Per cent. exposed iron at stator surface	85	80	92	87	86
Per cent. exposed iron at rotor surface	89	80	92	.88	90
Mean for stator and rotor (P)	87	80	92	87.5	88
Exposed cross-section of iron at air gap per pole ($=\lambda n \tau P$)	430	544	965	595	1,860
Spreading coefficient	1.15	1.15	1.15	1.15	1.15
Corrected air gap cross-section per pole	495	625	1,110	685	2,140
Average gap density	3,720	2,370	2,580	3,280	2,100
Maximum gap density	6,320	4,030	4,380	5,600	3,570
Ampere turn for gap per pole	505	480	436	720	500
Total ampere turns per pole	565	540	490	810	560
Ampere turns per pole per phase	282	270	245	405	280
Maximum current at no load	17.9	36	4.55	8.2	14
R.m.s. Current at no load	12.6	25.5	3.2	5.8	9.8
R.m.s. at no load in per cent. of full current	28.1	23.5%	27.3%	24.6	19%
$\sigma =$	0.068	.058	.048	.076	.042
Current Corres. to the diam. of the circle $\frac{\text{No-load Cur.}}{\sigma}$	185	440	66.7	76.5	233
Ideal short-circuit current	198	465	70	82.3	243

TABLE I. (*Concluded.*)

DESIGNATION	A	B	C	D	E
Secondary current at full load (from circle diagram for ratio 1:1 of transformation)	42.5	97.5	10.5	21.5	47.5
Number of stator conductors	756	540	4,536	3,564	3,600
Number of rotor conductors	192	432	294	288	720
Ratio of transformation	3.95	1.25	15.4	12.3	5
Actual secondary current	168	121	162	265	237
LOSSES.					
I. C^2R LOSS OF STATOR.					
Current in stator winding	44.8	106	11.5	23.5	50.5
Resistance of stator winding per phase	.134	0.084	6.3	2.2	1.75
C^2R loss of stator per phase	268	950	835	1,210	4,450
Total C^2R loss of stator	800	2,850	2,505	3,630	13,350
II. C^2R LOSS OF ROTOR.					
Current in rotor winding	168	121	162	265	237
Resistance of rotor winding per phase	0.1	.058	.0219	.01	.072
C^2R loss of rotor per phase	282	850	575	700	4,050
Total C^2R loss of rotor	850	2,850	1,625	2,100	12,150
Slip of rotor	1.5%	3.4%	1.2%	1.3%	3.1%
III. IRON LOSS OF STATOR.					
Minimum cross-section of stator teeth per pole	150	214	490	215	800
Average density at these points	12,300	6,900	5,840	10,400	5,620
Maximum density at these points	20,900	11,700	9,900	17,700	9,600
Depth of stator iron above teeth (cm.)	5.35	5.0	10.8	14	5.3
Cross-section of stator turn	272	297	776	670	715
Density of stator turn	6,800	5,000	3,700	3,350	6,300
Periodicity (in cycles per sec.) (*C*)	50	50	50	50	25
Density of stator iron in kilolines (*D*)	6.80	5	3.7	3.35	6.3
$\frac{DC}{100}$	3.4	2.5	1.85	1.67	1.58
Watts stator core loss per kg.	5.4	3.9	2.8	2.5	2.4
Weight of stator punchings (kg.)	265	410	1,750	1,220	3,570
Core loss in stator iron	1,430	1,600	4,900	3,050	8,600
IV. IRON LOSS OF ROTOR.					
Cross-section of rotor teeth at narrowest point	266	219	448	288	960
Average density of rotor teeth at narrowest point	7,000	6,800	6,400	7,800	4,700
Maximum density of rotor teeth	11,800	11,550	10,900	13,200	8,000
Depth of rotor iron below slot	4.0	3.85	12.1	7	5.6
Cross-section of rotor iron	202	228	870	335	755
Density in rotor iron	9,200	6,500	3,300	6,700	5,950
Slip	1.5%	3.4%	1.2%	1.3%	3.1%
Weight of rotor punchings	145	270	1,340	515	3,400
Iron loss in rotor	250	50	35	40	250
V. FRICTION LOSS IN BEARINGS AND THROUGH WINDINGS.	650	1,400	1,500	2,000	2,300
TOTAL OF LOSSES.					
Variable losses (I and II)	1,650	5,400	4,130	5,730	25,500
Constant losses (III, IV and V)	2,330	3,050	6,535	5,090	11,150
Total losses	3,980	8,450	10,665	10,820	36,650
Output in watts	55,200	73,600	136,000	164,000	368,000
Input in watts	59,180	82,050	146,665	174,820	404,650
Full load efficiency	93.5	89.9	92.8	93.8%	91
WEIGHTS.					
Weight of stator copper (kg.)	126	117	203	216	910
Weight of rotor copper (kg.)	69	100	200	273	615
Total weight of copper	195	217	403	489	1,525
Weight of stator laminations	265	410	1,750	1,220	3,570
Weight of rotor laminations	145	270	1,340	515	3,400
Total weight of laminations	410	680	3,090	1,735	6,970
Total weight of active material	605	897	3,493	2,224	8,495
Weight of active material per hp output (kg.)	8.1	9	19	10	17

deep air-gaps, but with few slots and short air-gaps it may rise to a very high figure, and thus it appears that very short air-gaps, besides being mechanically undesirable, lead to far less gain than is generally believed. The range of satisfactory practical designs generally lies between values of 0.8 and 4.0 for $\triangle \times H$, though

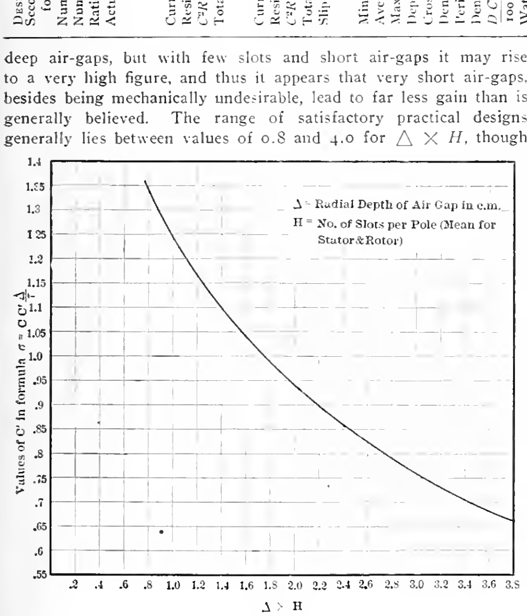


FIG. 2.—CURVE.

for very small motors, values less than 0.8 must occasionally be used, and a precise predetermination of σ is then rendered difficult owing to the inaccuracy in estimating the "zig-zag" component of the total dispersion. With the tendency to employ lower periodicities, the values for both $\triangle$ and H will increase in the near future. This analysis of the phenomena should afford an additional argument against relying on high values of τ and small values of $\triangle$ as means for obtaining high power factors. The curves of Fig. 1 show that high values of τ may lead to such increased inductance of the end connections as to limit improvement in this direction, and the curve of Fig. 2 shows that when $\triangle$ is decreased beyond certain limits, the "zig-zag" dispersion increases so rapidly as to limit any considerable power factor improvement by this means.

The data set forth in Table II (page 808) on 57 induction motors, of eight different manufacturers in four different countries, contain ample proof that the estimation of σ by means of the curves in Figs. 1 and 2 gives results in far closer agreement with the observed results than has heretofore been believed to be possible. In compiling Table II I have employed all the cases I had at hand, where the observed results could be considered as having been carried out with reasonable care and intelligence, omitting only those cases for which $\triangle \times H$ was less than 0.75, since these may be considered to be exceptional, and to be in general, undesirable when they can be avoided. A large number of these examples of observed results were obtained from the data in Dr. Behn-Eschenburg's recent very valuable paper on the dispersion coefficient.* In this paper Dr. Behn-Eschenburg set forth a collection of experimental data of very great value. He also deduced a very interesting formula for estimating σ, which had the great advantage of being in the form of three separate terms relating respectively to the slot dispersion, the flank dispersion and the "zig-zag" dispersion. The results by Dr. Behn-Eschenburg's method do not, however, agree with observations so well as do those obtained by the method employed in this article.

These curves in Figs. 1 and 2 probably permit of a more accurate determination of σ than is in practice generally obtained in factory tests and with the customary rough methods employed in mechanical measurements of $\triangle$, the radial depth of the air-gap.

For squirrel-cage motors, a third constant, C^{11}, may be added and the formula may be written:

$$\sigma = C\,C^{1}\,C^{11}\,\frac{\triangle}{\tau}$$

C^{11} will generally be about 0.75, and where no more precise basis for its determination is available, it should be so taken.

* Institution of Electrical Engrs. of Great Britain, Dec. 10, 1903.

TABLE II.

Reference Number	Manufacturer.	Number of Poles.	Squirrel Cage (S) or Wound Rotor (W).	C'' for Sq. Cage Rotor.	H_1 (No. of Stator Slots).	H_2 (No. of Rotor Slots).	H average of Stator & Rotor Slots per Pole.	X Av. Slot Opening for Stator and Rotor.	l_g Gross Length of Arm. Laminations between Flanges.	τ Polar Pitch or Air Gap.	Δ	$\frac{l_g}{\tau}$	$\Delta \times H$	In Behrend's Formula $\sigma - CC' \frac{\Delta}{\tau}$ C'	C	Estimated Value of σ	Observed Value of σ	Disagreement between Est. & Observed Values in % of Observed values σ	Remarks.
1	Oerlikon	4	W	—	72	96	21.0	0.10	10	22.8	0.065	0.44	1.37	16.0	1.11	0.051	0.06	15	
2	"	6	W	—	72	96	14.0	0.10	10	15.2	0.065	0.66	0.91	14.5	1.26	0.078	0.09	13	
3	"	4	W	—	72	96	21.0	0.10	14.5	22.8	0.065	0.64	1.37	14.7	1.11	0.047	0.045	4	
4	"	6	W	—	72	96	14.0	0.10	14.5	15.2	0.065	0.94	0.91	13.2	1.26	0.071	0.075	5	
5	"	6	W	—	72	120	16.0	0.10	19.0	25.7	0.080	0.74	1.28	14.1	1.13	0.050	0.05	0	
6	"	8	W	—	72	120	12.0	0.10	19.0	19.3	0.080	0.99	0.96	13.1	1.25	0.068	0.063	8	
7	"	6	W	—	72	120	16.0	0.10	28.0	25.7	0.080	1.09	1.28	12.6	1.13	0.044	0.042	5	
8	"	8	W	—	72	120	12.0	0.10	28.0	19.3	0.080	1.45	0.96	11.8	1.25	0.061	0.056	9	
9	"	12	W	—	144	180	13.5	0.10	17.0	23.6	0.100	0.72	1.35	14.1	1.11	0.066	0.067	2	
10	"	12	W	—	144	120	13.5	0.10	40.0	23.6	0.100	1.70	1.35	11.7	1.11	0.055	0.046	20	
11	"	8	W	—	96	144	15.0	0.10	24.0	22.8	0.090	1.05	1.35	12.6	1.11	0.055	0.054	2	
12	"	12	W	—	144	180	13.5	0.0	32.5	23.6	0.110	1.38	1.49	12.5	1.06	0.062	0.070	11	
13	"	12	W	—	144	180	13.5	0.35	32.5	23.6	0.110	1.38	1.49	10.3	1.06	0.051	0.06	15	
14	"	8	W	—	96	144	15.0	0	24.0	22.8	0.090	1.05	1.35	13.3	1.11	0.058	0.054	7	
15	"	8	W	—	96	144	15.0	0.70	24.0	22.8	0.110	1.05	1.65	10.6	1.01	0.052	0.062	16	
16	"	14	W	—	168	210	13.5	0.15	28.0	33.8	0.100	0.85	1.35	13.1	1.11	0.043	0.046	7	
17	"	14	W	—	168	210	13.5	0.15	28.0	33.8	0.140	0.85	1.88	13.1	0.96	0.052	0.055	5	
18	"	12	W	—	108	144	10.5	0	40.0	24.6	0.100	1.63	1.05	12.4	1.20	0.061	0.054	13	
19	"	8	W	—	120	160	17.5	0.10	30.0	22.8	0.070	1.31	1.22	12.0	1.14	0.042	0.042	0	
20	"	4	W	—	120	160	35.0	0.10	30.0	45.6	0.070	0.66	2.44	14.5	0.85	0.0789	0.022	14	
21	"	12	W	—	144	180	13.5	0.15	23.0	23.6	0.100	.098	1.35	12.9	1.09	0.060	0.067	10	
22	"	6	W	—	144	180	27.0	0.15	23.0	47.2	0.100	0.49	2.7	15.3	0.86	0.0260	0.033	21	
23	"	8	W	—	72	120	12.7	0.10	19.0	19.3	0.070	0.99	0.84	12.9	1.30	0.061	0.064	5	
24	"	4	W	—	72	120	24.0	0.10	19.0	38.5	0.070	0.52	1.68	15.0	1.01	0.0276	0.034	19	
25	"	12	W	—	144	180	13.5	0.15	32.0	23.6	0.100	1.36	1.35	11.8	1.09	0.055	0.06	8	
26	"	8	W	—	144	180	20.3	0.15	32.0	35.4	0.100	0.91	2.03	12.9	0.92	0.0335	0.043	22	
27	"	6	W	—	54	72	10.5	0.20	24.0	19.9	0.080	1.21	0.84	11.8	1.29	0.061	0.054	13	
28	"	6	W	—	108	144	21.0	0.10	24.0	19.9	0.080	1.21	1.68	11.4	1.02	0.047	0.039	21	
29	"	16	W	—	144	192	10.5	0	22.0	29.6	0.150	0.75	1.57	14.6	1.05	0.078	0.075	4	
30	"	16	W	—	192	216	12.8	0.25	22.0	29.6	0.150	0.75	1.92	13.2	0.94	0.063	0.065	3	
31	"	8	S	0.75	96	144	15.0	0.10	24.0	22.8	0.090	1.05	1.35	12.6	1.09	0.041	0.037	11	
32	A.E.G.	6	W	—	90	140	19.2	0.25	16.6	23.0	0.100	0.72	1.92	12.9	0.94	0.053	0.042	26	Kapp-Elek-Kon. p. 174
33	"	10	W	—	150	262	20.0	0.35	25.0	26.8	0.150	0.94	3.00	12.0	0.75	0.051	0.065	22	" " p. 161
34	S. & H.	8	W	—	120	72	12.0	0.20	25.0	20.6	0.125	1.22	1.50	12.0	1.06	0.077	0.089	14	" " p. 261
35	Alioth	14	W	—	168	294	16.5	0.20	40.0	29.2	0.125	1.37	2.06	12.0	0.92	0.47	0.050	6	
36	"	30	W	—	450	720	19.5	0.25	76.0	31.4	0.175	2.39	3.40	10.6	0.70	0.41	0.036	14	
37	Allmanna Svenska Elektriska Aktiebolaget.	12	W	—	180	216	16.5	0.30	36.0	23.0	0.150	1.56	2.46	10.7	0.85	0.59	0.052	14	
38		4	S	0.75	72	105	22.1	0.25	20	29.9	0.19	0.67	4.2	14.6	0.65	0.045	0.034	32	
39		6	W	—	72	105	14.8	0.25	20	199	0.10	1.01	1.48	12.5	1.07	0.067	0.066	2	
40		8	W	—	72	105	11.1	0.25	20	15.0	0.11	1.34	1.22	15.5	1.14	0.096	0.088	19	
41		10	W	—	90	105	9.8	0.25	20	11.9	0.11	1.68	1.07	11.2	1.20	0.124	0.099	25	
42		4	W	—	60	84	18.0	0.25	21.5	39.4	0.15	0.55	2.7	14.8	0.80	0.045	0.051	12	
43		6	W	—	108	126	19.5	0.25	21.5	26.3	0.16	0.82	3.13	13.1	0.74	0.059	0.058	2	
44		8	W	—	120	141	16.3	0.25	21.5	19.7	0.13	1.09	2.12	12.2	0.91	0.073	0.065	12	
45		10	W	—	120	141	13.1	0.25	21.5	15.8	0.14	1.37	1.83	11.6	0.97	0.100	0.078	28	
46		16	W	—	192	288	15.0	0.3	42	20.8	0.145	2.03	2.18	11.0	0.91	0.070	0.062	13	
47		28	W	—	420	378	14.3	0.3	22.5	19.2	0.16	1.17	2.28	11.5	0.88	0.084	0.073	15	
48		72	W	—	864	648	10.5	0.4	40.4	13.7	0.23	2.94	2.42	10.7	0.85	0.153	0.129	19	
49	Mavor & Coulson	4	S	0.75	48	67	14.4	0.30	15.2	24	0.08	0.63	1.12	14	1.2	0.042	0.056	25	
50	"	4	S	—	72	119	24	0.35	30.4	36	0.25	0.84	6	12	.63	0.04	0.048	17	
51	Firm A	8	W	—	72	96	10.5	0.40	11.4	14.0	0.082	0.82	0.860	12.0	1.3	0.09	0.143	37	
52	"	8	W	—	72	96	10.5	0.40	15.8	14.0	0.082	1.13	0.860	10.6	1.3	0.080	0.112	20	
53	"	8	W	—	72	120	12.0	0.40	14.6	20.8	0.114	0.70	1.37	13.3	1.1	0.08	0.091	12	
54	"	4	S	0.75	72	67	17.4	0.40	19.7	41.6	0.114	0.475	1.98	14.9	0.94	0.029	0.0297	2	
55	"	6	W	—	108	126	19.5	0.40	22.3	39.6	0.158	0.565	3.12	14.0	.74	0.041	0.0365	12	
56	Brown, Boveri & Co.	6	W	—	54	72	10.5	0.3	20.0	16.8	0.075	1.19	0.79	11.6	1.34	0.069	0.055	26	
57	"	8	W	—	72	96	10.5	0.3	28.0	19.7	0.100	1.42	1.05	11.0	1.21	0.068	0.060	13	

The Elementary Principles of Transformer Design.—II.
(Concluded.)

By Prof. Thomas Gray.

In the discussion just given the links have, as already stated, been considered as rectangular with square corners. and it will be noticed that in the applications given below no account is taken of the variable section at these corners or of the variable flux across the section due to variation of length between the inside and outside of the link. The coefficient of hysteresis is assumed to apply to the sections considered. There is, however, an element involved here which is of considerable importance and which is generally, if not always, neglected. Suppose, for example, that the coefficient and exponent in the equation, $H = h\,B^a$, for heat dissipation in the iron, has been determined from straight samples or from rings in which the internal and external radii do not differ greatly from each other. The question naturally arises, Can the value so obtained be applied to the ordinary forms? As an illustration, assume a circular ring the material section of which is rectangular, internal radius r_1 and external radius r_2. For moderate variations near ordinary values of induction density, B may be taken as inversely as the radius.

Let, therefore, $B = \dfrac{a}{x}$ where a is a constant and x is the radius of any elementary ring. Let the breadth of the ring section be unity and assume the ordinary form of expression for the hysteresis as given above.

Then

$$d\,H = h\,B^a.\ 2\pi\ x\ d\,x = 2\pi\ h\ a^a\ x^{1-a}\ d\,x;$$

$$\therefore \qquad H = 2\pi\,h\,a^a\,\frac{r_2^{\,2-a} - r_1^{\,2-a}}{2 - a}.$$

When $a = 1$,

$$H = 2\pi\ h\ a\ (r_2 - r_1),$$

which is the same as would be given by a uniform induction equal to the mean induction multiplied by the volume. In the actual case, however, a is greater than unity, approximates in fact, as was shown by Steinmetz, to 1.6 for ordinary working ranges of induction. In the general case the value of H calculated from the mean value of B would be:

$$H^1 = \pi\,h\ (r_2^{\,2} - r_1^{\,2})\left(\frac{2a}{r_1 + r_2}\right)^{a-1}$$

$$\therefore \qquad \frac{H}{H^1} = \frac{2^{a-1}\ (r_2^{\,2-a} - r_1^{\,2-a})\ (r_2 + r_1)^{a-1}}{(2 - a)\ (r_2 - r_1)}$$

When $a = 1.6$ this becomes

$$\frac{H}{H^1} = \frac{10\,(r_2^{\,1.1} - r_1^{\,1.1})\ (r_2 + r_1)^{0.6}}{2^{2.6}\ (r_2 - r_1)}$$

Suppose, as a practical case, that $r_1 = 5$ and $r_2 = 15$.

Then $H = 1.035H^1$, which shows an increase due to a difference of radius of 3.5 per cent. If $r_1 = 1$ and $r_2 = 5$, the difference is 9.2 per cent., and when $r_1 = 0$ and $r_2 = 5$, $H = 1.65H_1$. This last is, of course, an extreme case, but it is evident that the data to be used in the design of transformers should be determined from samples of similar shape to that proposed for use.

APPLICATION TO TRANSFORMER DESIGN.

Let the induction per sq. cm. of the core section be represented by $B \sin \omega\ t$, and, therefore, the total induction, $A\,B \sin \omega\ t$; then, since the magnetizing current is very small, the amplitude of the e.m.f. applied will, when the transformer is not loaded, be practically equal to that induced by self-induction. Thus, $E = \dfrac{n\,A\,B\,\omega}{10^8}$, where n is the number of windings on the primary coil. If P be the required full-load activity, C the square root of the mean square of the full-load current in the primary, and the power factor for full load be taken as unity, $P = E\,C/\sqrt{2}$. Taking f as the average current per sq. cm. of coil section, the heat generated in the coils will be approximately $\dfrac{4}{10^6}\,f^2 v$ on the assumption that 50 per cent. of the combined coil section is copper and that the working temperature is 80° C. The coil sections should be so proportioned that the heat dissipations on the load which gives maximum efficiency, assumed in the example given as the full load, are equal. On full load as thus defined the heat generated in the iron due to combined hysteresis and eddy current should be equal to the total heat generated in the coils. This latter can in general be assumed to be entirely due to the ohmic resistance of the coils and the load currents, because in a transformer of good design there is practically no magnetic field in the coil space. In order to obtain definite numerical results for comparison the total iron heat has been assumed to follow the law given by Steinmetz, namely, $H = h\,B^a$, where $a = 1.6$. The value assumed for h, namely, $18/10^{11}$ in watts per cu. cm. per cycle per second, is founded on the writer's own measurements on transformers and agrees fairly well with similar measurements by Kapp and others. Better iron can no doubt be obtained and less insulation may in many cases be found sufficient, both of which would tend towards less weight and higher efficiency.

The value of f is determined from the number of wires per sq. cm., and the current in each and this will in general be different for the primary and secondary coil. No error is introduced by assuming half the coil space to each and a simple change of insulation, the same wires being used.

Hence, $f = 2n_1\ C/A = 2\sqrt{2n_1}\ P/E\,A$. Equating the dissipation of energy in the coils to that in the iron,

$$\frac{4}{10^6}\ .\ f^2 v = \frac{32}{10^6}\ .\ \frac{n_1^{\,2}\,P^2}{E^2 A^2}\,v = \frac{\omega}{2\pi}\ .\ h\,B^a\,v_1.$$

Another equation is obtained from the condition that a certain area of radiating surface must be allowed for each watt of heat dissipated. Let the total exposed surface be S and let s be the surface allowed per watt. The value of s depends on the method of cooling and the allowable rise of temperature above the surrounding air. Since the total heat is twice that generated in the iron,

$$2\,\frac{\omega}{2\pi}\ .\ h\,B^a\,v_1\,s = S.$$

Now, the values of $\dfrac{S\,a}{v_1}$ are shown by means of curves in Figs. 2 and 4 for different ratios of sections or volumes. Let the proper value for any case under consideration be g. Then

$$\frac{\omega}{\pi}\ .\ h\,B^a\,s\,a = \frac{S\,a}{v_1} = g.$$

It thus appears that for the determination of the proper induction, B_1, the proper number of windings, n, in the primary coil and the proper size indicated by a. A or v, etc., the following three equations besides those obtained for the ratios of the linear dimensions, etc., are available:

$$h\,B^a = \frac{\pi}{\omega}\ .\ \frac{g}{s\,a} \qquad (21)$$

$$h\,B^a = \frac{32}{10^6}\ .\ \frac{n_1^{\,2}\,P^2}{E^2 A^2}\ .\ \frac{v}{v_1}\ .\ \frac{2\pi}{\omega} \qquad (22)$$

$$A_1 \text{ or } x\,A_1 \text{ or } x\,x_1\,a^2 = \frac{10^8 E}{n_1\ B\ \omega}. \qquad (23)$$

In equation (23) x_1 is put for b/a, which for any given ratio of sections or volumes can be found from the curves given.

Raising (21) to the fourth power and dividing by (22),

$$(h\,B^a)^3 = \frac{10^6}{64}\ .\left(\frac{\pi}{\omega}\right)^3.\left(\frac{g}{s}\right)^4.\ \frac{v_1}{v}\ .\ \frac{E^2 x_1^{\,2}}{n^2 P^2} \qquad (24)$$

From (21) and (23),

$$\frac{(h\,B^a)^4}{B^2} = \left(\frac{\pi}{\omega}\right)^4 \left(\frac{g}{s}\right)^4 \frac{n_1^2\,\omega^2}{10^{16}\,E^2} \cdot x^2 x_1^2 \qquad (25)$$

(24) × (25) gives

$$\frac{(h\,B^a)^7}{B^2} = \frac{1}{64 \times 10^{19}} \cdot \left(\frac{\pi}{\omega}\right)^7 \left(\frac{g}{s}\right)^8 \cdot \frac{v_1}{v} \cdot \frac{\omega^2\,x_1^4\,x^2}{P^2} \qquad (26)$$

Hence, if $a = 1.6$ and $h = \dfrac{18}{10^{11}}$,

$$B^{9.2} = \frac{10^{67}}{64 \times 18} \cdot \left(\frac{\pi}{\omega}\right)^7 \left(\frac{g}{s}\right)^8 \cdot \frac{v_1}{v} \cdot \frac{\omega^2\,x_1^4\,x^2}{P^2}$$

$$= \frac{10^{67} \times \pi^2}{64 \times 32 \times 18^7} \left(\frac{2\pi}{\omega}\right)^5 \left(\frac{g}{s}\right)^8 \cdot \frac{v_1}{v} \cdot \frac{x_1^4\,x^2}{P^2}$$

$$= 7.866 \times 10^{55} \times \left(\frac{2\pi}{\omega}\right)^5 \left(\frac{g}{s}\right)^8 \cdot \frac{v}{v_1} \cdot \frac{x_1^4\,x^2}{P^2} \qquad (27)$$

which serves to determine B. Then, from (21),

$$a = \frac{2\pi}{\omega} \cdot \frac{g}{s} \cdot \frac{10^{11}}{36\,B^{1.6}} \qquad (28)$$

and from (23),

$$n_1 = \frac{10^8\,E}{x\,x_1\,B\,\omega\,a_1} \qquad (29)$$

$$H = 2 \times 18 B^{1.6}\,v_1\,\omega/2\pi \times 10^{11}.$$

It would be better to determine n first, because in practice the number of terms should be a multiple of the transformation ratio and the change of n to fulfill this condition implies a corresponding change in a and B. The equation for the direct determination of n is not, however, convenient for calculation because of the fractional exponents involved. The number given in the following examples are those given by the above equations without any adjustment. The value of s assumed is 30, which is about the area required for the transformer in ordinary use without oil or artificial cooling. When the case is filled with oil s may be reduced to 20, even on continuous use, and hence a considerable saving in weight and an increase in efficiency is obtained.

Particular Examples.—Example (1): A two-link transformer is to have a capacity $P = 1{,}000$ watts, where $E = 3{,}000$ volts, $\dfrac{\omega}{2\pi} = 100$, $x = 1$, and $s = 30$.

Here $v = v_1$, $x_1 = 3$ and $g = 3.166$, and from equations (27) (29) the following values are found:

$B = 4{,}950$,	$A = A_1 = 38.75$,
$n = 2{,}490$,	$v = v_1 = 1{,}672$,
$a = 3.59$,	$v + v_1 = 5{,}344$.
$b = 10.78$,	

Total heat dissipated per second $= H = 2 \times 18 \times 4{,}950^{1.6} \times 1{,}672 \times 100 = 49.08$ watts.

Efficiency $= 95.1$ per cent.

Example (2): With the same data as for (1) except that $P = 10$ kw, the following results are obtained:

$B = 3{,}000$,	$A = A_1 = 192.3$,
$n = 828$,	$v = v_1 = 18{,}470$,
$a = 8.01$,	$v + v_1 = 36{,}940$,
$b = 24.02$,	$H = 243.5$,
	Efficiency $= 97.6$ per cent.

Example (3): Same data as for (1) and (2) except that $P = 100$ kw.

$B = 1{,}819$,	$A = A_1 = 954$,
$n = 275$,	$v = v_1 = 204{,}100$,
$a = 17.83$,	$v + v_1 = 408{,}200$,
$b = 53.489$,	$H = 1{,}208$,
	Efficiency $= 98.8$ per cent.

Example (4): A three-link core transformer is to have a capacity of one kilowatt when $E = 3{,}000$ and $A = A_1$.

The same formulæ apply in this case, but when $x = 1$, $x_1 = 2$, $b_1/a_1 = 3$, $v_1/v = 1.086$, and $g = 3.462$, the results are:

$B = 4{,}530$,	$v = 1{,}590$,
$n = 2{,}565$,	$v_1 = 1{,}730$,
$a = 4.539$,	$v + v_1 = 3{,}320$,
$b = 9.078$,	$H = 44.04$,
$A = A_1 = 41.17$,	Efficiency $= 95.6$ per cent.
$a_1 = 3.704$,	
$b_1 = 11.112$,	

Example (5): Same as (4), except that $P = 10$ kw.

$B = 2{,}747$,	$A = A_1 = 204.2$,
$n = 853$,	$v = 17{,}600$,
$a = 10.1$,	$v = 19{,}110$,
$b = 20.2$,	$v + v_1 = 36{,}710$,
$a_1 = 8.25$,	$H = 218.3$,
$b_1 = 24.75$,	Efficiency $= 97.8$ per cent.

Example (6): Same as (4), with the exception that the capacity is 100 kw.

$B = 1{,}664$,	$A = A_1 = 1{,}015$,
$n = 283$,	$v = 195{,}100$,
$a = 22.52$,	$v_1 = 212{,}100$,
$b = 45.04$,	$v + v_1 = 407{,}200$,
$a_1 = 18.39$,	$H = 1{,}087$,
$b_1 = 55.17$,	Efficiency $= 99.1$ per cent.

Example (7): Take the same case as (5), with the modification that the iron section is half the coil section, or $x = \frac{1}{2}$. In this case $v_1/v = .796$, $x_1 = 3$, $b_1/a_1 = 2$, and $g = 4.755$.

Example (7):

$B = 3{,}588$,	$A = 245$,
$n = 1{,}086$,	$A_1 = 122.5$,
$a = 9.04$,	$v = 15{,}940$,
$b = 27.12$,	$v_1 = 12{,}700$,
$a_1 = 7.83$,	$v + v_1 = 28{,}640$,
$b_1 = 15.65$,	$H = 222.6$,
	Efficiency $= 97.8$ per cent.

Comparing these results with those obtained in example (5), it appears that there is an advantage in the reduction of weight and in increased induction density, which for most kinds of good iron would mean greater permeability. The dissipation of energy is, of course, slightly greater, but only a little over 4 watts. For transformers of this type considerable economy of first cost will be got by making the iron section considerably smaller than the coil section.

Shell Transformers.—In the case of the shell type the double link is iron and the equations (27)—(29) have to be modified, as follows:

$$B^{9.2} = 7.866 \times 10^{55} \left(\frac{2\pi}{\omega}\right)^5 \left(\frac{g}{s}\right)^8 \left(\frac{v}{v_1}\right)^7 \frac{x_2^4}{x^2\,P^2} \qquad (30)$$

$$a_1 = \frac{2\pi}{\omega} \cdot \frac{g}{s} \cdot \frac{v}{v_1} \cdot \frac{10^{11}}{36\,B^{1.6}} \qquad (31)$$

$$n_1 = \frac{10^8\,E}{x_2\,B\,\omega\,a_1^2} \qquad (32)$$

In these equations, $x_2 = b_1/a_1$ and g is put $= \dfrac{S\,a_1}{v_1}$, instead of $\dfrac{S\,a}{v_1}$, so that the values can be more conveniently taken from the curve, Fig. 4.

Example (8): When the shell type is taken with the same data as in example (4) the only changes to be noted are that $x_2 = b_1/a_1$

$= 2$, being now the ratio of the dimensions of the total section of the double link, and that $\left(\frac{v}{v_1}\right)^7$ appears in the equation (30), instead of $\frac{v_1}{v}$ in equation (27). The results are as follows:

Example (8): Capacity, one kilowatt. $E = 3{,}000$.

$B = 4{,}778$,	$A = A_1 = 40.82$,
$n = 2{,}445$,	$v = 1{,}710$,
$a = 3.69$,	$v_1 = 1{,}570$,
$b = 11.07$,	$v + v_1 = 3{,}280$,
$a_1 = 4.52$,	$H = 43.6$,
$b_1 = 9.03$,	Efficiency $= 95.6$ per cent.

Example (9): Same as (8), with the exception that the capacity is 10 kw.

$B = 2{,}896$,	$A = A_1 = 202.7$,
$n = 813$,	$v = 18{,}890$,
$a = 8.22$,	$v_1 = 17{,}400$,
$b = 24.65$,	$v + v_1 = 36{,}290$,
$a_1 = 10.07$,	$H = 216.2$,
$b_1 = 20.13$,	Efficiency $= 97.84$ per cent.

Example (10): Keeping other things the same as in example (9), let the iron section be made twice the copper section. The results then become:

$B = 3{,}091$,	$A = 124.9$,
$n = 618$,	$A_1 = 249.7$,
$a = 7.90$,	$v = 13{,}060$,
$b = 15.80$,	$v_1 = 16{,}400$,
$a_1 = 9.12$,	$v + v_1 = 28{,}140$,
$b_1 = 27.37$,	$H = 226.6$,
	Efficiency $= 97.7$ per cent.

Example (11): The same as (10), with exception of the ratio of iron to copper section. In this $A_1 = 5A$. The ratio $b_1/a_1 = 6$ and $b/a = 1.4$ in this case.

$B = 3{,}770$,	$A = 59.93$,
$n = 420$,	$A_1 = 299.6$,
$a = 6.54$,	$v = 7{,}362$,
$b = 9.16$,	$v_1 = 13{,}640$,
$a_1 = 7.06$,	$v + v_1 = 21{,}000$,
$b_1 = 42.39$,	$H = 260.2$,
	Efficiency $= 97.4$.

When a transformer is on the circuit continuously, but only loaded for a few hours each day a greater all-day average efficiency may be obtained by choosing a transformer so designed that the iron heat dissipation is considerably less than that of the coil when loaded. The efficiency is, of course, smaller on full load. For such a case equations (29) and (30) should be modified to read:

$$B^{9.2} = 7.866 \times 10^{55} \left(\frac{2\pi}{\omega}\right)^5 \left(\frac{g}{s}\right) \left(\frac{v}{v_1}\right)^7 \frac{x_2^{\,4}}{x^2 P^2} \cdot \frac{m-1}{m^8} \qquad (30)_2$$

$$a_1 = \frac{1}{m} \cdot \frac{2\pi}{\omega} \cdot \frac{g}{s} \cdot \frac{v}{v_1} \cdot \frac{10^{11}}{86\, B^{1.6}} \qquad (31)_2$$

Similar changes have, of course, to be made in equations (27) and (29) for the core types. In forming the modified equations the total heat dissipation is supposed to be m times the hysteresis dissipation.

Example (12): Let $m = 3$ and the other data be the same as in example (9).

$B = 2{,}195$,	$A_1 = 218.6$,
$n = 921$,	$v = 21{,}180$,
$a = 8.53$,	$v_1 = 19{,}510$,
$b = 25.60$,	$v + v_1 = 40{,}690$,
$a_1 = 10.45$,	$Hi = 77.9$,
$b_1 = 20.90$,	$Hc = 155.8$,
$A = 218.6$,	$Hi + Hc = 233.7$,
	Efficiency $= 97.66$.

The efficiency is thus 97.66 instead of 97.84, and the weight is considerably increased, but when the load is only on for six hours out of the twenty-four there is a saving of about 600 watts-hours per day.

The numbers given in the above examples were obtained by the aid of a four-place logarithm table and hence the fourth figure is probably in error in most cases. The results are, however, sufficient to indicate the comparative values of the different types which was the object in view. It will be observed that so far as efficiency is concerned there is little difference. The shell type gives a few watts dissipation than the core type and the core type with three links is a similar amount better than the two-link type. The comparison is better obtained from the values of H than from the percentage efficiency. A noticeable feature is the very considerable saving of weight and increase of induction density obtained by making the links of unequal section. This involves some loss of efficiency, of course, and the question as to how far it can be economically carried has to be determined by considerations of relative cost of material and energy. Curves showing relative weights and efficiencies for different ratios of section can be easily constructd for any particular type and by aid of these the best form for any particular case can be readily estimated. The last example given illustrates how the dimensions may be calculated for a transformer suitable for cases where the primary is continuously on the leads, but the secondary only loaded for a part of the day. The section may, of course, be made unequal in this as in the other cases with advantage as to weight, but possibly with loss of efficiency. It is not, however, essential to economy that a transformer for this purpose should have a smaller iron than coil section. The controlling elements are the induction density and the actual volume of the iron. A transformer of given capacity having the iron section greater than the coil section may have less volume of iron in it than one of the same capacity with equal sections. The sections change shape and the whole volume may become smaller with a sacrifice of efficiency. As indicated above, however, the all-day efficiency may be increased, although the full-load efficiency is diminished.

The capacities of the transformers discussed above have been estimated from the load which gives equal iron and copper losses. In most cases such a transformer will carry a large overload for a short time with safety. The radiating surface will, of course, be too small for continuous use on overload unless artificial cooling is resorted to. When oil cooling, for instance, is used, at least one and a half times the heat can be carried off for the same temperature. A transformer designed for air cooling should not be used with oil and simply loaded higher. A new design should be worked out using the proper value of s in the equations.

The form of link assumed in the above discussion is rectangular with sharp corners. Using the same notation the following modification may be given:

(1) *Two-Link Type.*—(*a*). Links with corners rounded to radius a and a_1:

$$a b = A \qquad a_1 b_1 = A_1$$

$$l = 2\,(a_1 + b_1) + \pi a \qquad l = 2\,(a + b) + \pi a$$

$$\frac{b}{a} = \frac{A_1 + \frac{\pi}{} A}{A_1} = \frac{b_1 + \left(\frac{\pi^2}{4} - 1\right) a_1}{b_1 - a_1}$$

$$\frac{b_1}{a_1} = \frac{A + \frac{\pi}{2} A_1}{A} = \frac{b + \left(\frac{\pi^2}{4} - 1\right) a}{b - a}$$

When $A = A_1$,

$$\frac{b}{a} = \frac{\pi}{2} + 1 = \frac{b_1}{a_1} \qquad a = a_1 \qquad b = b_1$$

(*b*) Links with the edges of the sections and ends of the links both semicircles:

$$A = a\,(b - a) + \frac{\pi}{4} a^2 \qquad A_1 = a_1\,(b_1 - a_1) + \frac{\pi}{4} a_1^{\,2}$$

$$l = 2(b_1 - a_1) + \pi(a + a_1) \qquad l_1 = 2(b - a) + \pi(a + a_1)$$

$$\frac{b}{a} = \frac{A_1(\pi - 3) + \frac{\pi}{2}A}{A_1} = \frac{(\pi-3)\{b_1 - (\pi-3)a_1\} + \frac{\pi}{4}a_1^2}{b_1 - (\pi - 3)a_1}$$

$$= \pi - 3 + \frac{\pi^2 a_1}{4\{b_1 - (\pi - 3)a_1\}}$$

$$\frac{b_1}{a_1} = \frac{A(\pi - 3) + \frac{\pi}{2}A_1}{A} = \pi - 3 + \frac{\pi^2 a}{4\{b - (\pi - 3)a\}}$$

When $A = A_1$,

$$\frac{b}{a} = 3\left(\frac{\pi}{2} - 1\right) = \frac{b_1}{a_1} \qquad a = a_1 \qquad b = b_1$$

(2) *Three-Link Type.* (*a*) The corners rounded, but section of links rectangular. Let a, b, A and l refer to double-link:

$$ab = A \qquad a_1 b_1 = A_1$$

$$l = 2(a_1 + b_1) + \frac{\pi}{2}a \qquad l_1 = 2(a + b) + \pi a_1$$

$$\frac{b}{a} = \frac{A_1 + \frac{\pi}{4}A}{A_1} = \frac{b_1 + \left(\frac{\pi^2}{8} - 1\right)a_1}{b_1 - a}$$

$$\frac{b_1}{a_1} = \frac{A + \frac{\pi}{4}A_1}{A_1} = \frac{b + \left(\frac{\pi^2}{4} - 1\right)a}{b - a}$$

(*b*) In the core type the edges of the section of the iron link may be made semicircles while the sections of the coils are rectangular:

$$A = ab \qquad A_1 = a_1(b_1 - a_1) + \frac{\pi}{4}a_1^2$$

$$l = 2(b_1 - a_1) + \pi\left(a_1 + \frac{a}{2}\right) \qquad l_1 = 2(b - a) + \pi a_1$$

$$\frac{b}{a} = \frac{A_1 + \frac{\pi}{4}A}{A_1} = \frac{b_1 + \frac{\pi}{4}\left(\frac{\pi}{2} - 1\right)a_1}{b_1 - \frac{\pi}{4}a_1}$$

$$\frac{b_1}{a_1} = \frac{\pi}{4} \cdot \frac{A + 2A_1}{A} = \frac{\pi}{4} \cdot \frac{b + \left(\frac{\pi}{2} - 1\right)a}{b - a}$$

When $A = A_1$ the ratios $\frac{b}{a}$ and $\frac{b_1}{a_1}$ become

$$\frac{b}{a} = \frac{\pi}{4} + 1 \qquad \frac{b_1}{a_1} = \frac{3}{4}\pi$$

Other modifications may be readily obtained and the values of these ratios in terms of the corresponding volume or section ratios expressed by means of curves like those given in Figs. 2 and 4, but sufficient has probably been given to illustrate the method of proceeding.

The Braun Tube in the Study of Alternating Currents.

In a paper read before the Russian Physico-Chemical Society, Prof. A. Petrovski described an application of the Braun tube to the study of alternating current. The Braun tube is from 2 to 3 cm. in diameter, carrying at one end an enlarged cylindrical part 10 to 15 cm. in diameter and 10 to 30 cm. long. In this enlarged portion is a plate placed perpendicular to the axis of the tube, the surface of which is coated with a fluorescent substance. At the opposite end of the tube, in the narrow part, is a small aluminum disc which is also perpendicular to the axis. The disc is fixed on a platinum wire soldered into the end of the tube. During operation the wire is connected with the negative pole. In another part of the tube is a second terminal, which connects with the positive pole. After a vacuum has been formed in the tube, the aluminum disc emits the well-known radiation characteristic of the Crookes tube, which is directed along the axis of the tube. Midway in the narrow portion is fixed a diaphragm which allows only the central part of the beam to pass. The latter then crosses the wider portion or bulb, and falls upon the fluorescent screen, producing a small blue spot.

The beam has the well-known property of being deflected in one side under the action of the magnetic field, like a wire carrying a current. If the tube is in the horizontal position and the magnetic field is vertical, the beam will be deflected in the horizontal sense, and the spot of light on the screen will be deflected to the right or left, according to the field's direction. If, however, the field is horizontal, the spot will be displaced up or down. Such displacement may be considered as proportional to the intensity of the field. If the intensity of the field be varied according to the time, the shifting of the spot will follow such variations, and the distance of the spot

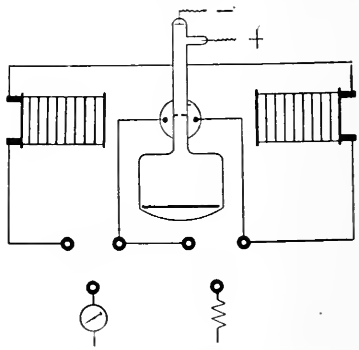


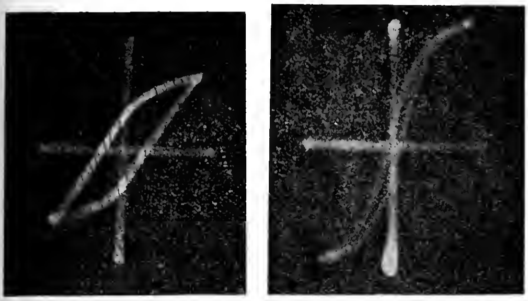
FIG. 1.—ARRANGEMENT OF CIRCUITS.

from the center of the screen is considered as proportioned to the field strength at a given moment. Where a solenoid is used to produce the magnetic field, the deflection of the spot is likewise proportional to the current strength in the coil at any given instant.

Owing to these properties the Braun tube can be used to advantage in the study of variable currents and has a great practised value for observing alternating-current phenomena. In general practice there are three main phenomena of alternating currents which are to be studied, namely, hysteresis, phase difference and rotating field. Each of these cases was examined in turn.

To study the phenomena of hysteresis with the Braun tube, the arrangements of circuits shown in Fig. 1 was used. Around the tube are placed three solenoids. The first of these is placed above or below the tube and perpendicular to its axis. The current in this coil creates a magnetic field which causes the spot of light to take a horizontal movement. The two other coils are placed horizontally on each side of the tube, as shown, and the current flowing in them gives the spot a vertical deflection. The latter coils are connected differentially, so that in the normal case their magnetic action is opposed, and the effect which one of them would exert on the spot is annulled by that of the second. The tube can thus be placed in such a position that the action of the horizontal coils is mutually destroyed. But if in one of the coils is placed a piece of the iron to be experimented with, the action of the latter, by changing the field, gives the spot a vertical direction. The deflection of the spot from its normal position will measure the value of the magnetic induction in the sample at any instant. This corresponds to the ordinate of the hysteresis curve, as usual. As to the third, or upper coil, it produces a horizontal deflection of the spot which at each instant will be proportional to the current flowing through it.

The three solenoids are all connected in series, so that the same



FIGS. 2 AND 3.—HYSTERESIS CURVES.

current which gives the horizontal movement to the spot also produces the magnetization of the sample. The horizontal deflection represents the value of the field strength at any given time or the abscissa of the hysteresis curve. When the current flows through the two sets of coils in series, the spot will take a movement such

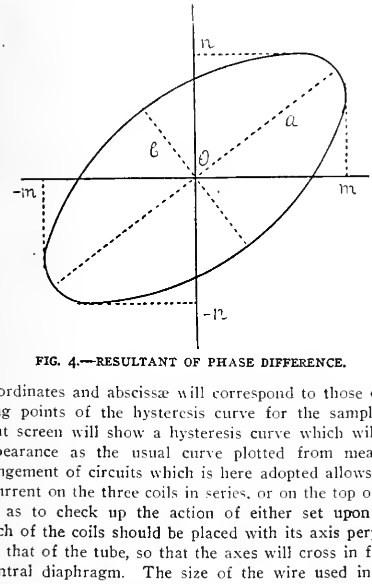
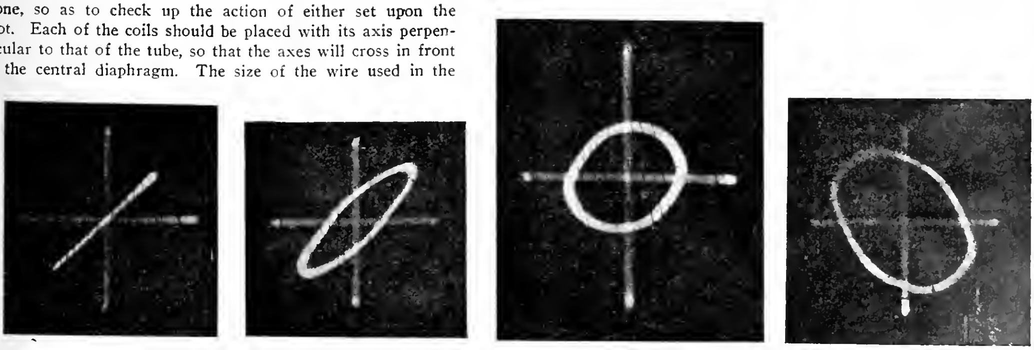


FIG. 4.—RESULTANT OF PHASE DIFFERENCE.

that the ordinates and abscissæ will correspond to those of the corresponding points of the hysteresis curve for the sample, and the fluorescent screen will show a hysteresis curve which will have the same appearance as the usual curve plotted from measurements. The arrangement of circuits which is here adopted allows of throwing the current on the three coils in series, or on the top or side coils alone, so as to check up the action of either set upon the spot. Each of the coils should be placed with its axis perpendicular to that of the tube, so that the axes will cross in front of the central diaphragm. The size of the wire used in the



FIGS. 6, 7, 8 AND 9.—PHASE DIFFERENCES IN ALTERNATING CIRCUITS.

solenoids and also the number of turns are chosen according to the current strength which is used. The light which is emitted by the fluorescent screen is of a high active quality, so that the curve can be photographed without difficulty on a short exposure. The camera should be focused beforehand upon some well-defined object, such as a lighted candle.

In Figs. 2 and 3 are shown photographic reproductions of hysteresis curves which were obtained in this way. The first curve is

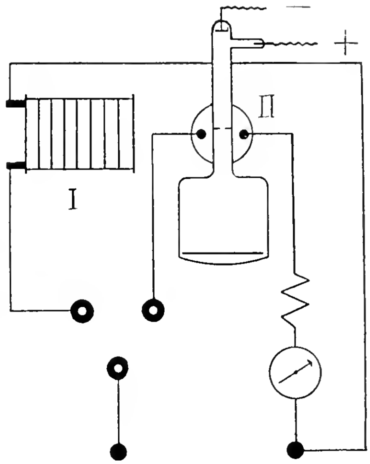


FIG. 5.—MEASUREMENT OF PHASE DIFFERENCES IN ALTERNATING CIRCUITS.

that of a hard file-steel, while the second is the curve of an iron of bad quality. The photographs were taken without enlargement on a plate of average sensitiveness. The tube was supplied from a static machine having two discs of about 60 cm. diameter. The plate was given an exposure of about 1 minute in order to obtain the curve itself. To obtain the lines corresponding to the axes, about 10 seconds is necessary. It should be noted that in tracing the hysteresis curve the axis of abscissæ should not be drawn directly from the curve, but the abscissæ are to be diminished in each case by the value of the so-called "demagnetizing force." As the apparatus does not give this correction automatically, it should be introduced when drawing the curve from the above data.

The use of the Braun tube with the present arrangement gives an easy method of determining the angle of lag between current and electromotive force in an alternating-current circuit, which is in general not easy to measure. In this apparatus the angle of lag, ϕ, is found by the superposition of two oscillatory movements. If we suppose a point which is traveling under the influence of two combined and synchronous impulses, the first in the horizontal and the second in the vertical plane, the resultant of the two movements will be a closed curve. If we use two oscillatory movements, such as a harmonic or sinusoid, it is shown theoretically that the resultant formed by adding their movements will be a sraight line in case there is no difference of phase between the two. Should the phase difference have a certain value, ϕ, the resultant takes the form of an ellipse whose proportions depend mainly upon the value of ϕ. See Fig. 4. It will be remarked that the deflection of the large axis of the ellipse is represented in general by the ratio of the values of the amplitudes, *o m* and *o n*. In the special case where *o m* and *o n* are equal, the inclination of the resulting axis of the ellipse is 45°. The ratio of the length of the smaller axis, *b*, to that of the larger axis, *a*, gives us the tangent of the angle, ϕ:

$$tan\ \frac{\phi}{2} = \frac{b}{a}.$$

These conditions can be applied to the measurement of the angle, ϕ, in the case of alternating currents, in which case we use the system shown in Fig. 5. Near the Braun tube are disposed two coils, *I* and *II*. Coil *I* has many turns of fine wire and takes its current directly from the terminals of the station. Like a voltmeter coil, it does not produce an appreciable effect on the form of the main current. Coil *II* is connected in the main circuit and has a few turns of heavy wire in order to show the current effects. The first coil, owing to its position and the influence of the alternating current which passes in it, gives to the spot an oscillatory movement in a vertical direction. In like manner, coil *II* gives a horizontal movement to the spot. If current is flowing at the same time in *I* and *II*, the spot will take an elliptical movement. If now we displace coil *I* we can easily reach a point where the amplitudes of vibration in the vertical and horizontal sense are equal. Then after measuring the large and small axis of the ellipse thus produced, we find the value for the phase angle according to the above formula. The current flowing in coil *I* equals the number of amperes in the main line. If the ohmic resistance of coil *I* is very high in proportion to its coefficient of self-induction, the current in it will not lag perceptibly behind the e.m.f., so that the relation of the two axes of the ellipse gives the value of the tangent of one-half the angle very closely, representing the lag between the voltage and current waves in the main circuit.

If the resistance of the coil *I* is not very high with relation to the self-induction, the current in the coil will lag behind the voltage wave. The result will not be quite exact, therefore, but it is not difficult to make the proper correction. The curves which are thus obtained can be photographed in the same way as the hysteresis curves. In Figs. 6, 7, 8 and 9 will be observed some of the results which have been obtained by this method. In the first case (Fig. 6) the circuit contains no lag. In the second case (Fig. 7) there is a large self-induction in the circuit. Fig. 8 shows the effect when the self-induction is increased by putting an iron core into the coil. In the last experiment, Fig. 9, the ends of the circuit are open and connected across a condenser of large capacity. As in most cases the alternating-current waves have not an exact sine curve, the resulting form which the spot of light traces is not always a perfect ellipse.

In general the composition of two harmonic oscillatory movements gives an elliptical curve, as above considered, but in the particular case where the amplitudes of oscillation are equal and the difference of phase 90°, a circular form is produced. In like manner, the addition of three harmonic oscillatory movements can give a circle when the amplitudes of all the oscillations are equal and the phase difference is 120°.

The present system allows of investigating the conditions of the rotary field, such as is produced by these circuits spaced 120° apart, in a very satisfactory manner. It is possible to find out whether the rotary field is produced under the best conditions of regularity, which is so important for the good working of three-phase motors and is essential to prevent a loss of energy.

The apparatus for studying the rotary field is disposed on the same lines as the above, using three similar coils ranged around the tube. The axes of the coils are, as before, perpendicular to the axis of the tube, and the coils are spaced at 120° around this axis as a center. The wire of which the coils are wound is heavy enough to allow of introducing each of the coils into one of the phases of the current to be studied. On sending current into the circuit, the spot takes a circular movement: and if there are any irregularities under these conditions, they are shown by the appearance of the circular curve.

The experiments which have been carried on by M. Petrovski have given many interesting curves, and the method recommends itself by its simplicity and the satisfactory results which may be obtained with it in the study of alternating-current phenomena.

Annual Convention of the Iowa Electrical Association.

THE Iowa Electrical Association held its fourth annual convention at Des Moines, April 20 and 21, 1904. President D. F. McGee, of Red Oak, called the first session to order Wednesday morning, and introduced Mayor Mattern, of Des Moines, who welcomed the convention to that city. President McGee then made a brief address, in which he said that members and other central station men over the State were now learning that the Iowa Electrical Association was of great benefit to the central station men of the State. The station managers who never leave their home towns to learn what is being done in other places and to confer with other central station men—as they are able to do in an association of this kind—soon get into a rut, which is a great detriment to their business. The facilities for asking questions about particular points, which are afforded by the Iowa conventions, give the central station man the easiest means of getting out of such a rut.

Secretary W. S. Porter, of Eldora, in his report, said he had received letters from Missouri and Nebraska men, expressing a desire to attend the convention, and he had told them they would be welcome. It might be well for the Association to consider whether such men should be admitted merely as guests or given some rights of membership. He referred also to a movement among the electric railway men of the State to form an organization, a meeting for which purpose was to-day being held. He recommended that a committee be appointed to confer with the electric railway men and to consider whether it would be advisable for the electric railway and electric light men to join together in an association, or whether the two allied interests should be kept apart.

The treasurer's report, by Treasurer Rufus E. Lee, of Clarinda, showed a balance of $68 in the treasury. A ballot taken for the election of a nominating committee resulted in the election of W. J. Greene, of Cedar Rapids; W. S. Carson, of Iowa City; Austin Burt, of Waterloo; M. W. Hovey, of Marshalltown; W. H. Grover, of Cherokee; Prof. George W. Bissell, of Ames, and Robert Ferris, of Eldora.

CENTRAL STATION ACCOUNTING.

Robert Ferris, of Monmouth, Ill., owner of the Eldora electric light plant, gave a talk on station accounting, demonstrated by the various blanks which he employed in his central station business at Monmouth, Ill., and Eldora, Iowa. He requires every man in the employ of the company to make out a daily time sheet, showing the number of hours work on different jobs. The distribution of expense among the different accounts is made at the office. The only bookkeeping responsibility on the men is to make out their time sheets correctly. He requires a record to be written of every trouble report that comes in, even if the man answering the telephone goes himself immediately to remedy the trouble. In such a case the man upon receiving notice of trouble from a customer would make out a trouble slip, file it on the hook, and when the trouble had been fixed return to the office and make memorandum on the slip to that effect. In this way there is no danger when several reports of trouble come in at the same time that one of them will be overlooked or forgotten. These slips form also a record which can be referred to in case customers complain of interruption of the service at the end of the month when paying bills. The system of records devised by Mr. Ferris was founded upon the form of report required by the Massachusetts commission.

He outlined briefly the Massachusetts laws, which provide for the safeguarding of investments in public service corporations. Competition in the electric lighting business in a Massachusetts town cannot be started at random. It must be shown that existing companies are not giving the service that should be given, or that the rates are unreasonably high. If the city undertakes the construction of a municipal plant, it requires a vote of the people and a vote of the council.

Mr. Ferris makes it a practice to invoice a customer's equipment every year, so as to know what is connected with the station. At Monmouth, after taking charge of the plant, it had been found, upon investigation, that under the flat rate system of selling current each company was delivering about half of a kilowatt-hour per day per customer, for which it was receiving 3.7 cents per kilowatt-hour, or less than the cost of production. A change was made to selling current by meter, and a well-worded pamphlet with a few pages was prepared by Mr. Ferris, announcing the change. This was mailed to the customers, followed by a personal visit to each. The rate is 20 cents per kilowatt-hour up to an amount equivalent to 40 hours burning of the maximum number of lights turned on during the month. He explained why he considered a discount based on the maximum demand much fairer than a discount based simply on the amount of current used. For example, a small customer with a low maximum demand and using his lights a great many hours a day, would produce more revenue for the company than a large demand customer, using lights only a short time each day. If the discount were based simply on the total amount of energy consumed, the customer with a large number of lamps running a short time each day might get a better discount than the customer with the small maximum demand, who burned his lights continuously.

Referring again to the trouble slips, he said that men were required to record all of the time put in whether engaged on any specific work or not. Men kept for answering emergency and trouble calls put down the time doing nothing in the office along with the rest. In this way the manager could see when he could take a man off emergency trouble work and put him on other work. All the time put in by the men must be accounted for in some way. The system of bookkeeping was simply a double-entry system, in which everything was balanced.

UNIFORM ACCOUNTING.

Wednesday afternoon the discussion of central station accounting was continued by the reading of a paper by Austin Burt, of Waterloo, on "Uniform Accounting." Mr. Burt, in presenting his paper, said that he realized that 75 per cent. of the central stations in Iowa were in towns of less than 5,000 people. In such stations one man must be superintendent, bookkeeper and electrician. Any elaborate systems of bookkeeping are out of place. He considered it a question how much value the set of blanks he would present would be to the small companies. The question of bookkeeping forms for large stations he considered was taken up in a very complete way before the National Electric Light Association in 1903, by W. M. Anthony, and before the same body by Lieut. J. B. Cahoon, in 1900.

He described his power station log, which was made up by the engineer. The engineer plotted the load curve directly on this log. He considered it better for the engineer to do this than to add it to the bookkeeper's work, and further, a graphic load curve was of more interest to the power station operating man than the mere figures. On this log also are provided spaces, in which, by ruling horizontal lines, corresponding with the load curve, the time of operation of each generator can be seen at a glance. This gives an idea as to whether station machinery is being run as fully loaded as it should be. As to the value of watching this point, Mr. Burt cited the experience in his station, where a few years ago the load factor of the station or the percentage of the average load to the machinery operated, was 13 per cent. for 24 hours. That is, only 13 per cent. of the capacity of the machinery was being used as an average for the 24 hours. The load factor was now about 80 per cent. The coal consumption per kilowatt-hour cost 2.75 cents formerly, and is now 0.9 cent. This change has been brought about mainly by proportioning the generators operated to the load, and ceasing to operate generators for many hours very much underloaded. A small engine was purchased for operation during the hours of very light load. This small unit has proved a very good investment.

As to bookkeeping in connection with the distribution system, that connected with the reading of meters was the most important. He used a small card of a card index system for each meter, each card having space upon it for two years' readings. These cards are arranged in the order which the meter reader will follow on his route, and are given out to each meter reader. He believes in employing responsible men for meter readers, rather than boys. Nothing but the most trustworthy men are employed on this work, so that the company may be sure that each meter has been actually read, and not guessed at, and is furthermore read carefully, so that the customer can have no just cause of complaint or opportunity to say that the company's business was conducted in a slip-shod manner.

He formerly believed in bills showing on their face all the figures in connection with a meter reading, crowding as much onto the bill as possible, giving the last reading, present reading, the kilowatt-hours and the calculation of the discount. In fact, his bills used to contain all the arithmetic of the monthly transaction with the customer. He has come to believe that these figures simply confused the average customer, and he now uses a bill which contains simply the gross bill and the discount which is allowed for prompt payment. He found that there were fewer questions under the present system than under the old system. In adding up the total amount of current sold for the month, he recommended strongly the use of an adding machine. In his case he had been able to make arrangements with a local bank for the use of such a machine. He spoke of two good makes of adding machines, one of which cost $125 and the other $375.

As to time cards, he requires time cards made out on all work and O. K.'d by the foreman in charge of the job. Instead of carrying a ledger account with customers for whom small repair jobs and the like have been done, he uses what is practically a triplicate bill with stub. One bill is sent to the customer, another filed for the use of the collectors, and the third remaining in the book, to take the place of a ledger account. The stub at the bottom of the customer's bill is turned in by the collector with his cash as a memorandum. Mr. Burt also showed the forms he used for stock room and invoice accounts and for general monthly report of the total business.

CO-OPERATION WITH TROLLEY MANAGERS.

At this point L. D. Mathes, of the Union Electric Company, of Dubuque, Iowa, was introduced as a committee representing the electric railway men of Iowa, who were in session at the Kirkwood Hotel at the same time. The street railway men desired a conference with a committee of the Iowa Electrical Association to consider whether it would be advisable for the two branches of work to organize under the same association. Messrs. Burt, Carson and Greene were appointed a committee to visit the railway men's convention. As a result of the conference of this committee with the electric railway men, it was decided by the latter to form a separate organization and to arrange the time of annual convention, so that one day of the electric light convention would overlap that of the electric railway convention of the State. The two associations and those interested in both could, therefore, discuss topics of mutual interest during the one day that the conventions would overlap.

COMBUSTION OF IOWA COAL.

A very practical paper on the "Combustion of Iowa Coal" was read by Prof. George W. Bissell, of Iowa State College, Ames, the data of which should be of much value to those using coal from the Iowa veins.

In response to a question as to the relative heat value of Illinois and Iowa coal, Prof. Bissell said that as far as chemical analysis went, the coals of the two States were about the same. Mr. H. E. Chase said that it required more draft to burn the fine coals, and many steam plants in Iowa did not have sufficient draft, and hence had to burn lump coal. Aside from this, the cheapest coal was the best one to burn as a rule. Mr. Bowers said that in his plant, which burned from 50 to 100 tons of steam coal per day, they found that it took practically as much to do the work with the lump coal as with the slack.

President McGee asked whether an excessive stack was not necessary where a baffle was placed behind a bridge wall as described by Mr. Boyd. The latter said that it was not, and cited an example where the change was made without changing the stack and with a great improvement in the performance of the plant. Prof. Bissell thought that coal should be burned while it was in the furnace and not behind the bridge wall. This discussion ended here and an invitation was read from the Columbia Incandescent Lamp Company, of St. Louis, inviting any of the members who might visit St. Louis the coming summer to go through the Columbia lamp factory and see the processes of manufacture.

SCALE INCRUSTATION IN STEAM BOILERS FROM A CHEMICAL STANDPOINT.

Paul E. Bellemy, of Knoxville, Iowa, presented a paper on the above subject, in which he gave a general résumé of the principles of the several ways to attack boiler scale trouble, of scale formation and iron corrosion. One is to send the water to some of the reliable manufacturers of boiler compounds who will analyze it, furnish a proper neutralizing compound and give the quantity required to neutralize the scale. Another method is to employ some disinterested chemical expert to make an analysis and prescribe the kind and amount of reagents necessary to reduce the scale-forming salts to harmless salts. Some boiler compounds were nothing more than well-known cheap reagents colored in some way. In reply to a question as to how to test feed water after it was in the boilers to see whether the treatment was effecting the proper result, Mr. Bellamy said that the best way was to watch the practical result on the boilers.

Mr. Zahm described a method used by him at Mason City for introducing boiler compound in a closed tank located above the suction of the boiler feed pump. He further said that a galvanized-iron pan in the bottom of the boiler was a good thing. This pan is made just wide enough to go through the hand-hole above the bottom sheet and is suspended three or four inches above the bottom sheet of the boiler. The scale and mud settles upon it. Mr. Emory emphasized the necessity of operating a purifying system systematically and carefully. Too much boiler compound or reagent was worse than not enough.

STORAGE BATTERIES IN CONNECTION WITH A CENTRAL STATION.

Edward Reavy, of Davenport, read a paper on the above subject. A small central station, he said, cannot furnish current twenty-four hours of the day because of the light load during daylight and early morning hours, but stations would be able to give twenty-four hours' service with the aid of a storage battery during the hours of moderate load. He described a battery in his station operated in connection with rotary converters. This sub-station supplies power for lighting and railway purposes from the same transmission line, and it is only by the use of the battery that the fluctuations are kept within feasible limits. This battery is kept floating on the line to take up the fluctuations in load.

In the discussion of this paper the question was raised as to the cost of the storage battery. W. Owen Thomas said that the cost of the battery was about $100 per kilowatt at 1 hour rating. Answering some questions as to efficiency, E. L. Draffen said that the efficiency on this kind of work was 96 to 97 per cent., and that the manufacturers would maintain the battery for 5 per cent. of its initial cost per annum. He called attention to the advantages of using the battery in small direct-current plants, so that the generating machinery could be run for a short time fully loaded, supplying the peak load and afterward charging the battery, leaving the battery to take the light load the rest of the twenty-four hours.

Mr. J. A. White thought the efficiency given for the storage battery by Mr. Draffen was too high. If the battery was floating on the line, taking only the momentary peaks and never being fully discharged, an efficiency of 95 to 96 might be realized. The battery used to aid in carrying the peak load on the station only and discharged fully during the peak each day would probably give about 80 per cent. watt-hour efficiency; 75 per cent. being guaranteed by the manufacturing companies.

ELECTRIC METERS.

George S. Carson, of Iowa City, read a paper which was brief and to the point, on the plan of charging by meter. He condemned the flat rate still in existence in some plants and said that few realized how much the meter has to do with the success of the electric lighting business. The output of the company, which is paid for by the customers, is measured by the meter and, therefore, the earnings of the company are directly dependent upon its accuracy. The early meters were inaccurate, with heavy moving parts, but immense improvement had been made until the modern meter was a fairly satisfactory instrument. Meters should be tested upon receipt from the manufacturer, as their accuracy may have been damaged by their rough usage in transit. After a meter is put in operation it should be tested at regular intervals. The receipts per kilowatt-hour on a flat rate are usually about one-half what they should be. This does not mean that consumers will pay double their former bills when the change is made from a flat rate to a meter basis. Consumers which formerly wasted the current will begin to economize when put on meter, so that the output of the company will be reduced and the receipts on the whole increased.

In a plant which he had tested recently, which operates twenty-four hours per day, and is equipped with new meters throughout, he had found the switchboard output in a given period to be 18,450 kw-hours at the switchboard, and 13,806 kw-hours as measured by the consumers' meters. This represents a loss of 25.2 per cent. between the switchboard and the consumers. He thought the maximum demand system of charging with the aid of a maximum demand meter better than the plan of estimating a customer's maximum demand by the number of lights wired up. The latter system had the effect of restricting a customer in the number of lights he would install, while, if a customer was charged according to the indications of a maximum demand meter he would put in as many lights as he could use in various portions of the house, even though he did not ever expect to use them all at once, and thus his total consumption of energy would be greater than if fewer lights had been wired. This of course was to the company's interest.

Mr. Zahm, of Mason City, cited a case in his experience where 100 meters had been inspected by a company making a specialty of that business. These meters had been running for some time without attention; 97 per cent. of the meters were slow from 7 to 56 per cent. The 3 per cent. which were fast had been struck by lightning, which short-circuited some of the field turns, thus weakening the field and causing the meter to run fast. Now his company had gone over all its meters and established a laboratory for bringing in meters and testing them every six months systematically. Most of the trouble from slow meters is due to charred commutators and injured jewels and tips. He recommended that old jewels removed from meters be saved, as they could be recut after a sufficient quantity had been accumulated, so as to be as good as new, at a considerable price below the new jewels.

In response to a question as to where the 25 per cent. of energy went to in Mr. Carson's case where customers' meters registered 75 per cent. of the energy leaving the station, Mr. Carson replied that he thought 75 per cent. efficiency was considered very good for an alternating-current system, taking into account the line losses and core losses in the transformers.

Mr. Burt said that the results he had obtained in testing a large number of meters at Waterloo also showed that many meters were 55 to 60 per cent. slow. The majority of meters run slow on light loads. He considered the best meter one which could be adjusted accurately for a light load. He brings in his meters for testing. The cost of bringing in meters at regular intervals for testing was at first appalling, but a little calculation of the losses from slow meters showed that it paid.

Mr. Ferris said that at Somerville, Mass., the result of going the rounds of all meters and testing them resulted in 33⅓ per cent. increase in the gross revenue. He figured roughly that the loss of gross revenue would be about 33 per cent. in any station where meters were not tested.

DATA ON STEAM TURBINES.

Mr. J. M. Wilkinson read a paper descriptive of the Westinghouse-Parsons steam turbine and also presented some curves and data on efficiency, much of which has appeared before in these columns. One advantage claimed for this turbine is the large clearance between the moving and stationary vanes, which clearance permits the turbine to be operated without close adjustment. The only wear about such a turbine unit is the bearing wear, and the machine should, therefore, be very durable. Where condensed exhaust is used for boiler feed, the turbine offers pure boiler feed water, free from oil, since there are no valves or pistons which need lubricating. About 38,000 hp of these turbines have been built or are under construction in this country. The list of large turbine units given by him was astounding, even to those who have watched the progress of the steam turbine. He said that in no case had reciprocating engines been installed in plants after Westinghouse-Parsons turbines had been put in.

In response to a request from Mr. Carson to give the performance of a turbine on 120 pounds boiler pressure and 25 in. of vacuum, Mr. Wilkinson cited the nearest case he could find, which was on a 400-kw unit operating on 125 pounds steam pressure and 26 in. of vacuum. With a load of 580 hp the steam consumption was 15.21 pounds per brake-hp-hour. With the load at 457 hp the consumption was 16.36 pounds and at 326 hp the consumption was 17.89 pounds.

In answer to a question as to whether the governor of a turbine could be made to change the speed of the turbine by means of an electric motor controlled from a switchboard as in the case of a Corliss engine where it is desired to operate alternators in parallel, Mr. Wilkinson said that it was possible if thought desirable, but that the change in speed could be easily effected by hand. The cost of the steam turbine unit was given as about the same as that of a reciprocating steam engine unit. When asked for a comparison between the economy of a steam turbine and a gas engine, Mr. Wilkinson assumed that the turbine could be operated with two pounds of coal per hp-hour, while a gas engine would require 11,000 B.T.U. per brake-hp-hour, or about 1¼ pounds of coal. This was giving the gas engine the benefit of the doubt, however. He thought the economy of the gas engine and the steam turbine about the same under the best conditions. It would cost less to install the turbine.

The question was raised whether the reciprocating engine would go out of use. Mr. Wilkinson thought it would in the larger sizes. In the smallest sizes the reciprocating engine would show better economy. Replying to questions as to whether it did not require much greater investment in condenser to give the better vacuum considered desirable with a turbine, Mr. Wilkinson said that the same size of condenser as would be used with a corresponding size of reciprocating engine would give from 1¼ to 2 in. better vacuum with the turbine because of the few chances for air to leak into the turbine. As to spending money on a condenser to secure higher vacuum, that was simply a question as to how much would be gained by the higher vacuum. As more is gained by a higher vacuum on a turbine than on a steam engine, it naturally pays to spend more money in securing this vacuum on the turbine than on the steam engine.

LAMP TESTING.

Thursday morning's session was opened by Prof. L. B. Spinney with his paper on lamp testing. Prof. Spinney referred to the work which had been started at Iowa State College for the benefit of the central station men of the State. For some time the electrical department of this institution, under Prof. Spinney, has been prepared to test incandescent lamps for energy consumption and mean horizontal candle-power for the central stations of the State at the nominal rate of $1 per dozen. Prof. Spinney's paper was in the nature of a report of progress in this work. He said that comparatively few lamp tests by disinterested parties were to be found. Most of the tests heretofore published have been carried on by lamp manufacturers. The best efficiency of lamp to use is likely to be given too little attention. Whether a high or low efficiency lamp should be used will depend very much upon the cost of the current. If a station is operating with water power, so that the cost of supplying a few extra watts per lamp is small, a low-efficiency lamp may be advisable. In general, a high efficiency is desirable. There is an appreciable difference between lamps not only of different manufactures, but of the same make. He advocated lamp testing, at least in the rough, for all moderate-sized stations. He presented, by way of introduction, several curves characteristic of the behavior of incandescent lamps in general, showing how the resistance and watts per candle-power increase with age while the candle-power and efficiency decrease. He brought out the fact, sometimes forgotten, that the efficiency of a lamp depends on the voltage at which it is operated, and it may be made high or low efficiency by simply varying the voltage. He presented a number of shot gun diagrams showing the life and efficiency of 16 makes of lamps sent him for test. A large number of these lamps did not come within the efficiency and candle-power for which they were rated. While many of the results were not bad in themselves, they showed improper rating of lamps by the manufacturers. In response to questions as to whether results shown by Prof. Spinney were usual or simply exceptional cases, Prof. Spinney said that they were usual. Prof. Spinney advised the practice of making a rough photometer and wattmeter test of all lamps by the average central station, these tests to be supplemented and standards checked by laboratories with better testing facilities.

Mr. Carson said there was no trouble in getting lamps which would correspond with the guarantee when such testing was done by a central station company. Mr. Boyd said that he did not know of a single manufacturer sending out lamps of nominal 16-cp which would not vary at least 1 cp either way from this rating. No central station operated with exactly the same voltage at all points of the system. The advisable thing to do was to place lamps at the points best suited for their voltage. He considered that a voltmeter, indicating wattmeter, and a photometer were essential in the operation of any central station. These three instruments would cost about $250, and would prove a good investment.

SERIES ARC STREET LIGHTING.

M. A. Harrison, of Osceola, described a series alternating-current arc lighting system which his company had installed. This system is operated by two-phase, 1,100-volt generators. It has three circuits of 15, 20 and 25 lamps, respectively. He described the Western Electric regulator used to maintain constant current on these circuits. He said that the series enclosed arc lamp required more care in trimming than a series open arc. They had found that when the trimming was done by an inexperienced man there was likely to be trouble from nicking the inner globe so that air would be admitted and the life of the carbon shortened. A careless man would also fail to get carbons in line as they should be. They had found the average life of carbons to be 80 hours, although it was claimed that 120 hours could be run on one trimming. This was not realized in practice. Occasionally lamps would not pick up when the current was turned on to a circuit because of the high resistance of the contact between the carbon tips. This trouble could be overcome by momentarily increasing the current at starting. The cost per carbon on these lamps was 3½ cents per carbon and two 11/12 carbons were consumed per month per lamp. He favored metering current for street lighting in order to settle disputes regarding the number of hours lamps were out, as the city authorities were likely to claim more than the actual time.

MULTIPLE STREET ARC LIGHTING.

Rufus Lee, of Clarinda, read a paper on "Multiple Alternating Current Arc Lamps for Street Lighting." He stated his objections to the series system of arc lighting, namely, the high potential of the lamps, and the consequent danger to trouble men when fixing lamps, and the fact that a broken wire anywhere in the series circuit would put out the entire current. Consequently, he had installed alternating current enclosed arcs for street lighting, operating from constant-potential transformers. He had four circuits devoted to this work and they were operated from a two-phase generator, the arc circuits being provided with throw-over switches, so they can be placed on either phase. He had his arc lamps on a three-wire secondary distributing system, but did not advocate this, and was changing to a two-wire secondary system. In a few cases residences and incandescent lights were operated from the same secondary circuits, where for some reason it might not be feasible to have a regular commercial circuit.

Mr. Burt said that one thing about the multiple system of street arc lighting which he liked was the possibility of running different sizes of arc lamps. That feature he considered undoubtedly an advantage in some places.

EXPERIENCE WITH NERNST LAMPS.

Mr. G. C. Gardner, of Mt. Vernon, Iowa, had prepared a short paper on this subject, which was read by Mr. Greene. The experience of this company with Nernst lamps, which covered one year of operation, has been very satisfactory. These lamps require more attention than incandescent lamps, but his experience had shown that the lamps do all that is claimed for them in the printed matter of the manufacturing company. The quality of the light approached daylight, which made it a good lamp for dry goods stores. His customers liked it both on account of quality and the amount of light obtained for the money.

Mr. Greene said that his company was now supplying current for between 500 and 600 Nernst glowers. The experience had been satisfactory and customers were beginning to ask for the Nernst lamp. With the voltage regulation which they were now maintaining on the system, the maintenance of the Nernst lamps was about 0.6 cent per kilowatt-hour supplied to the lamp. Very close regulation was necessary.

Mr. Burt said that his experience with the Nernst lamp had been exceedingly varied. In a certain Catholic church, where it had been desired to install electric light without the expense of chandeliers, three six-glower lamps had been installed. The church people were very much pleased with the lighting of the church and delegations from other Catholic churches in the State had been inspecting the lighting. In his experience the greatest difficulty with the Nernst lamp is the burning out of the heaters, usually caused by neglect on the part of the customer to turn off the lamp when the glowers are burned out. The Nernst lamp is a good thing with which to compete with the Humphrey gas arc.

Mr. Greene said he was putting in three-glower Nernst lamps to do the same work as a four-burner Humphrey gas arc. The three-glower lamps consumed 270 watts.

Mr. Innes, of Eagle Grove, brought out the fact that a voltage much above normal for a short time would soon ruin the glowers, and that trouble in voltage regulation if the voltage was allowed to get high for a short time was likely to be followed by an unusual number of repairs on Nernst glowers. The Nernst lamp would stand about the same voltage variation as a 3.1-watt incandescent lamp.

Mr. Burt said, for the consolation of the electric light men, that the repairs on Humphrey gas arcs were by no means small, and that his company, which also owned a gas plant, charged $1 per month maintenance on one Humphrey arc installed for a customer and 50 cents each for additional arcs.

RENEWED INCANDESCENT LAMPS.

Mr. J. A. Innes, of Eagle Grove, gave a short paper on his experience with renewed incandescent lamps as compared to new lamps. While not presenting any definite figures, he said that the renewed lamps were similar in performance to many of the new lamps tested by Prof. Spinney, the performance of which was given in Prof. Spinney's paper. The cost of these lamps was about half that of new lamps. In discussing this paper, Mr. Innes said that a good photometer for rough testing could be purchased for about $14.

INCREASING THE OUTPUT OF LIGHTING PLANTS.

"The Best Method of Increasing the Output of Lighting and Power Plants" was the subject of a short paper by Mr. A. W. Zahm, of Mason City. He suggested a number of uses for electric current during hours when the lighting load is small, such as power for city and private pumping, the operation of refrigerating machinery, the use of heating devices and sign lighting. He considered the maximum demand system of charging good, because it tended to increase the consumption by long-hour customers. He made a low rate for opera houses and churches, because their maximum demand did not come at the time of heaviest load on the station, and in the case of opera houses, failure to make such a low rate might mean the installation of an isolated plant. He considered electric elevators an undesirable class of customers, and preferred to sell current to operate a pump for hydraulic elevators. He dwelt at length on the encouragement of sign lighting, mentioning the fact that very attractive signs are now made with low consumption of energy, and that in addition to local merchants, outside corporations sometimes spend considerable money in the illumination of large signs advertising some food product or the like. Thawing water pipes in cold weather was also a source of small revenue. Where a company mailed bills to its customers, it was a good plan to enclose a folder advertising some new electrical device with each bill each month.

On Thursday afternoon the discussion of Mr. Zahm's paper was taken up. The question was asked whether it would pay a central station to add a refrigerating plant. Mr. Zahm said that at Mason City there is a cold storage plant which also manufactures some ice for the use of the company owning the cold storage plant, in supplying its refrigerating cars. He did not advise central stations to go into the refrigerating business with ice as cheap as it is in Iowa, but private refrigerating plants made good customers. The manufacture of ice could only be engaged in profitably in connection with a cold storage plant where the investment in refrigerating machinery had already been made. He arranged with his cold storage plant customers that they should not operate during the winter peak load. These plants afford a continuous load in summer. Mr. McGee said that he had made a cold storage plant a very low rate with the understanding that he could shut them off during the peak load.

Mr. Carson asked how it would be possible to distinguish between store and sign lighting in rates. Mr. Zahm said that low-rate sign lighting should not be on at the peak, whereas store and store window lighting is. Mr. Burt thought that church lighting should only be the very highest rate. For example, a church might have as high as 300 lights, all of which are liable to come on at one time and to provide for which the company must keep a large investment idle except for the few hours the church was lighted. Mr. Carson agreed with Mr. Burt that the lighting bills of a church of this kind would not pay interest on the investment necessary to supply it. Mr. Zahm replied that the peak load is usually off by 7.30 P.M. Churches and opera houses are not fully lighted until about 8 P.M. He had an opera house using 650 lights in Mason City, which had never been turned on during the peak.

Mr. Greene figured that church lighting would come on during the peak of the residence load, but that, on account of the church attendance fewer lights would be used in residences, so that one would partly offset the other. Mr. Burt said that his company had earned about $625 the past winter thawing out frozen water pipes. This was done with the aid of a 10-kw transformer. The charge was $10 for the first hour on the job and $5 per hour after that. This charge was based on the value of the company's "professional services." It would cost several times that amount to do the job any other way. Mr. Smith, of Ackley, told of a man who had purchased a plating dynamo and a gasoline engine, which had been placed on a wagon and used to supply current wherever needed for thawing out water pipes. W. Owen Thomas said that considerable work in thawing out water pipes had been done at Sault Ste. Marie the past winter. They had a rough rule of using ½ volt per ft. of 2-in. pipe, increasing the voltage inversely as the square of the diameter and directly as the length.

OPERATION OF SINGLE-PHASE MOTORS ON LIGHTING CIRCUITS.

A paper on the above subject by Mr. W. A. Layman and Mr. Sparrow, which has previously appeared in the technical press, was read, in the absence of the authors, by Mr. W. Owen Thomas. This paper brought out the advantages of using the Wagner type of single-phase alternating-current motor on single-phase circuits. The curves of starting current and power given, showed the motor to be able to start with normal running current at considerably more than normal torque. These were from tests made by the Chicago Edison Company. Curves of cost prepared by the same company showed the cost of installation of the smaller sizes of single-phase motors to be much less than the cost of the same size polyphase motors.

After the reading and discussion of this paper Mr. Thomas, at the request of the association, gave a talk on the electric power development at Sault Ste. Marie, Mich., of which he is the engineer.

The question box, of which Mr. W. J. Greene, of Cedar Rapids, was editor, was presented to the Association in pamphlet form. A vote of thanks was passed to the Des Moines City Railway Company for the use of its car for a trip Thursday noon and to the supply men for the smoker tendered to the members Wednesday evening. The Association then went into executive session and elected the following officers for the ensuing year: President, W. L. Bowers, Davenport; vice-president, Austin Burt, Waterloo; secretary, W. S. Porter, Eldora; treasurer, Rufus E. Lee, Clarinda. Executive Committee—W. J. Greene, of Cedar Rapids; W. S. Carson, of Iowa City, and A. W. Zahm, of Mason City. The next meeting place will be Dubuque, Iowa, in April, 1905.

President W. L. Bowers.

Telephony In Nova Scotia.

Mr. W. R. Holloway, United States Consul-General, makes an interesting report on telephony in Nova Scotia:

"A new line of long-distance telephone, with 292 miles of copper wire, has been opened between Halifax and Sydney, the offices being equipped with the latest improvements. The reports of the Bell Company show that in the Province of Nova Scotia there is one telephone in use for every 88 inhabitants. In the city of Halifax there is one to every 27 persons, while in other towns the proportion is between 20 and 30. The report of the general manager of the Nova Scotia Telephone Company shows 790 miles of poles for their long-distance lines and 2,246 miles of copper wire. The total mileage of telephone wires in the Province is 7,136, and of posts is 791.

"The number of telephones in the Province is 3,260, of which 1,801 are in the city of Halifax. Last year the company transmitted 14,000,000 messages. The long-distance lines unite Truro, Amherst, Bridgewater, New Glasgow and Windsor-Sydney.

"The average number of calls per day, per telephone, in Halifax, is 11, compared with 7½ under the old system. Halifax answers daily 18,000 calls; the average per telephone is only 10, although some instruments go as high as 150 calls a day. The rates for conversations of three minutes between Halifax and points in Cape Breton country are each $1.25 in the daytime and 65 cents at night, between 6 P. M. and 8 A. M."

April Meeting of American Institute of Electrical Engineers.

At the regular monthly meeting of the American Institute of Electrical Engineers held on Friday evening, April 22, two papers were presented, one by Mr. David B. Rushmore on the "Mechanical Construction of Revolving-field Alternators," and another by Messrs. H. M. Hobart and Franklin Punga, entitled "A Contribution to the Theory of the Regulation of Alternators."

Mr. Rushmore, in his paper, gave information in detail concerning the construction of revolving-field armatures, under the head of yokes, laminations, clamps for laminations, slots, armature winding, ventilating space blocks, shields, rims, arms, hubs, field coils, pole shoes and collector rings. The paper, which is profusely illustrated, does not admit of abstract, but in its original form will be found of much value as presenting the present status of the construction of revolving-field alternators, with a discussion of the various differences in design.

The paper by Messrs. Hobart and Punga described a new method for the predetermination of the characteristic curves of alternators with special reference to regulation. The paper is accompanied by numerous curves, and abundant data are given for use in applying the method. The authors start with the assertion that the change in the voltage of a constantly-excited generator when its load is varied in nature or amount, is chiefly occasioned by the magnetic flux set up by the current in the armature winding and linked with the turns constituting the winding. This flux is classified according as the flow in one or the other of three paths as follows: In the first path the lines never emerge from the armature and consist of those which cross the armature slot from side to side, and those which are linked with the end connections. In the second path the lines emerge from the armature and cross the air-gap toward one end of the pole shoe, and after passing along the pole shoe return across the air-gap to the armature from the other end of the pole shoe. In the third path the lines, after emerging from the armature, traverse successively the air-gap, pole shoe, magnet core, yoke, adjacent magnet core and pole shoe; and after again traversing the air-gap re-enter the armature.

On the basis of this analysis the authors proceed to develop a theory, and a table is given which shows a close agreement between calculation and experiment in the case of seven single-phase and eleven three-phase machines.

The paper in referring to the specification of regulation, says it is exceedingly difficult, even with the best wattmeters and other measuring instruments, to demonstrate the presence or absence of a slight difference of phase or to measure it, although such a slight phase difference has a great influence on the regulation. Furthermore, for tests with unity power factor a certain fall in speed is difficult to avoid in throwing on the load. It is stated that a very desirable step would, therefore, be the introduction of the percentage inherent regulation at zero power factor as an important criterion of design, and the paper discusses a number of factors which in this case it would be necessary to specially consider since they may affect the inherent regulation at unity power factor without impairing the inherent regulation at zero power factor.

The discussion of papers was participated in by Prof. C. A. Adams and Messrs. B. A. Behrend, W. L. Waters, Gano S. Dunn and Dr. F. A. C. Perrine. Prof. Adams criticised the use in the paper of Messrs. Hobart and Punga of the average in connection with leakage reactance. He took exception also to the statement that similar methods previously suggested did not yield good results, and referred to a method which he had devised which gives quite as good accuracy as that of the authors'. In this method the whole magnetomotive force is considered as one, and its space direction, not the phase, is employed in such a manner that it takes account of the shift from the central full-phase position. The chief approximation is the position of the field magnetomotive force and the armature magnetomotive force. Recently the method was applied to a closed-coil ring armature in which the three-phase connection gave a three-belted winding, a single belt occupying 120° instead of 60°, as in the ordinary three-phase machine. This makes the application of the armature magnetomotive force more complicated, but the results came out closely.

Mr. B. A. Behrend said that the problem considered is so complex and intricate and there are so many factors to be taken in account, that it does not admit of general solution. He criticised severely the specification of regulation on a power factor of unity. In large machines a unity power factor can never be obtained. If tested with a water rheostat, a leading current is introduced owing to the electrostatic capacity of water resistance. He considered that the regulation should be determined at zero power factor. By using two machines, one as a synchronous motor and one as a generator, this can be done, and it can also be done by splitting the field with perhaps less accuracy. Mr. W. L. Waters, in a communication, criticised some of the assumptions of the authors, particularly with respect to the factor of cost magnetization. He believed that Mr. Hobart's method, if considered an empirical method, will probably be able to give good results in practice. As to the calculation of the short-circuit current of an alternator, he considered this cannot be accepted as a test of any theory, the real test being to calculate the regulation on inductive loads. He thought, however, that the authors are doing good service in again emphasizing the advisability of guaranteeing regulation upon zero power factor rather than on non-inductive load. The most important point in the theory is the way in which account is taken of increased leakage caused by the back ampere-turns on the armature, the paper presenting for the first time any method of calculating the effect.

Prof. Adams took exception to the last statement, saying that the method used by Messrs. Hobart and Punga was described in detail by himself two years ago in almost exactly the same form. Mr. Behrend called attention to the fact that Prof. Blondel, some four years ago, published a theory based on tests made by Mr. Behrend on alternators, which was essentially the same as that just referred to. Mr. Gano S. Dunn pointed out that some of the criticisms were due to the evident misreading of the paper of Messrs. Hobart and Punga, and agreed with Mr. Behrend that engineering and designing of the kind to which the papers of the evening referred are not a science but an art. A consideration of innumerable factors is required, many of which are human rather than mathematical. Mr. Dunn mentioned the desirability of a construction whereby the bursting strain would be taken by the armature or revolving ring as an annulus and not by the spokes. Mr. Rushmore, referring to the remarks made concerning the difficulty of predetermined alternator regulation, said that when we get down to actual figures the regulation of alternators can now be estimated as closely as is desired. Referring to the matter of the strains and revolving armature, Dr. Perrine cited the case of a revolving field which is constructed with a smooth uniform rim bolted to spokes that had extended ends and with a spider construction that was not continuous. The rims are fastened to a spoke that is capable of extension and the former are so arranged as to produce the elastic spoke referred to by Mr. Dunn.

British Telegraphs and Telephones.

The Postmaster-General recently asked Parliament for $15,000,000 for the extension of the government's telephone system. The Postmaster-General also admitted in debate that the government was negotiating with the National Telephone Company for the purchase of their business.

The charge for telephones in London is £5 per year, plus 1d. per call for inner London, and 2d. per call for outer London, or an average of about £8 per year. The London system netted last year only £6,155, allowing nothing for an interest and depreciation charge of £60,780.

The government's telephone and telegraph systems in Great Britain last year cost £267,000 more than it earned, allowing for £167,000 received from the National Company as a bonus for doing business. The government has about £30,000,000 invested in telephones and telegraphs, the annual interest upon which is about £1,200,000. In other words, government control in this case costs some $6,000,000 per year.

A correspondent of the London *Times* says: "If we had a telephone service in London such as they have in New York or in any of the other cities of America, I venture to say there would, without question, be an enormous saving of time, temper and money; but so long as people are willing to tolerate the execrable service with which we in London are at present afflicted, so long will the authorities take no steps to improve the service."

Spring Meeting of the Magnetic Club.

The spring meeting of the Magnetic Club was held at Hotel Spalding, New York, on the evening of April 21, and in point of attendance and the prominence of the guests it was probably the record meeting of the club. The affair was planned on a liberal scale and successfully carried out, everyone present evincing that spirit of good fellowship for which the club is justly famous.

The Magnetic Club is essentially an organization of New York telegraphers, but a happy thought occurred to President Francis W. Jones in laying his plans for this meeting, and that was to get the telephone men interested in the club so that those connected with the two great organizations might meet together occasionally on a social plane and become better acquainted with one another. The result was that the meeting had a distinctively telephonic character, and the hospitality of the club was generously bestowed upon the many telephone officials present. The officials of the two great telegraph companies were also present to do honor to the telephone guests.

The guests of honor included Messrs. F. P. Fish, president of the American Telephone & Telegraph Company; E. J. Hall, vice-president, and Thomas D. Lockwood, electrician; W. D. Sargent, J. C. Reilly and B. Gherardi, Jr., vice-president, general manager and electrical engineer, respectively, of the New York & New Jersey Telephone Company; U. N. Bethell, vice-president of the New York Telephone Company, and C. H. Wilson, general superintendent of the same company. Other well-known gentlemen present were Col. R. C. Clowry, president and general manager of the Western Union Telegraph Company, and J. C. Barclay, assistant general manager; Clarence W. Mackay, president of the Postal Telegraph and Commercial Cable Companies, and G. G. Ward, vice-president and general manager Commercial Cable Company; Col. A. B. Chandler, W. H. Baker and C. P. Bruch, of the Postal Telegraph Company; Melville E. Stone, general manager of the Associated Press, and H. L. Shippy, treasurer of the John A. Roebling's Sons' Company. Many other persons well known in the telegraph and telephone fields were present, there being about 250 in all.

After the dinner President Jones, in a few well-chosen remarks, introduced President Fish, of the Bell Telephone Company, who responded to the toast, "The Telephone." Mr. Fish evidently kept it in mind that the gathering was more in the nature of a social function than one assembled to listen to and discuss statistics and business problems, so he refrained from touching upon such matters. His remarks were confined to pleasantries regarding the telephone and the telegraph, and his sallies kept the company in good humor.

Mr. U. N. Bethell was next called upon to respond to the toast, "Professor A. G. Bell." The speaker paid an eloquent tribute to the character and work of the great inventor. He referred to Prof. Bell's steadfast faith in the future of the telephone, while capitalists, in the early days, looked upon it as a mere scientific toy. These capitalists, for whom Prof. Bell was developing some other inventions, actually placed a guard over the inventor to prevent him from wasting time on the telephone. By patient persistence, however, Prof. Bell demonstrated that he was right.

Persistent workers, said the speaker, are of more worth to the world than brilliant minds, and, combined, their efforts are irresistible. Mr. Bethell then reviewed the development of the telephone from its conception in the mind of Prof. Bell, in 1874, through the trying period of its growth up to the time when it became a practical every-day thing. He read extracts from a letter written by Prof. Bell in 1878 to show that at the very outset the inventor had a clear conception of the possibilities of the invention. The letter outlined a proposed method of running individual lines to a central point for interconnection, thus laying the foundation for what is now known as the telephone exchange. He even suggested the advisability of laying the wires underground and running them in cables.

"The telephone art," the speaker continued, "is changing so rapidly that no one dare take an extended vacation for fear that when he came back he would not understand things." Mr. Bethell treated his subject in a masterly manner and his address was listened to with the keenest attention and interest.

Other toasts responded to were: "The Telegraph," by Mr. C. P. Bruch, who was the first president of the Magnetic Club; "Old-Time Telegraphers," by Col. A. B. Chandler; "Cables," by George G. Ward; "The Press," by Melville E. Stone, and "The Magnetic Club," by John R. Van Wormer.

President Jones read a letter from Prof. Bell, in which the writer expressed regrets at his inability to be present at the meeting, owing to a prior engagement, which he had hoped to postpone, but found, at the last moment, that he could not break.

The speaking was interspersed by excellent vocal and instrumental music, an exhibition of ventriloquism being an interesting feature of the programme. Over the doorway of the banquet hall were placed two electric signs, one bearing the word "Hello" and the other the well-known telegraph signal, "O. K." These were used effectively during the addresses in flashing out their expressions by way of appreciation and approval at striking points in the remarks of the different speakers.

The menus contained a very fine three-quarter figure etching of Prof. Bell, made from one of his most recent photographs. It was an artistic piece of work and was carefully preserved by all as a souvenir of the occasion.

Electric High Pressure Fire Service in New York.

Mr. N. Hill, chief engineer of the Bureau of Water Supply, New York City, has made a report on the use of high-pressure fire service for the Borough of Manhattan, and Mr. I. M. de Varona has reported as to Brooklyn. The reports have been approved by the Board of Estimate and Apportionment, and call for an appropriation of $5,425,400, which the Board of Aldermen have voted for the purpose. The idea is to provide both fresh and salt water for fire and street flushing purposes. As between the three powers—steam, gas and electricity—the last is decidedly favored. Three pumping stations are proposed in the area of one-tenth of Manhattan, comprising the dry goods section and the East Side lower tenement district. Mr. Hill presents the following data as to electric plants compared with gas:

The mechanical efficiency of the gas and electric plants is approximately the same. In comparing the use of gas and electricity as the probable source of energy it may be well to present the following points in favor of electricity: 1. Economy in first cost of machinery and buildings. 2. Economy in space necessary for installation, thereby reducing cost of land required. 3. Economy in cost of wages, maintenance, repairs and renewals. 4. Simplicity.

The relative cost of power cannot be stated with accuracy until the price for which gas can be had is determined. Following is a statement of the comparative cost of one pumping station operated either by gas or electricity, an estimate of the probable operating expenses and fixed charges per annum, a similar summary for the three stations and an estimate of the total cost of high-pressure fire service complete:

COST OF ONE PUMPING STATION.

	Electric.	Gas.
Number of units in station	4	6
Capacity in million gallons per hour	1	1
Estimated number of hours plant will be in operation per year	80	80
Cost of motors and turbines, including piping, foundations, switchboard and wiring and cables	$255,000	......
Cost of gas engines and pumps, including piping, foundations and auxiliaries, complete	......	$448,000
Cost of buildings, foundations and land	90,000	270,000
Total cost	$345,000	$718,000
Cost of wages per annum	7,650	18,150
Cost of gas per year	......	17,000
Cost of electricity per year at 4½ cents per kw-hour	13,200	......
Cost of oil, waste and supplies per year	300	300
Cost of repairs per year	2,400	3,600
Total cost of operation	$23,550	$39,050
Interest and depreciation	26,710	55,000
Refunding sinking fund	11,500	27,000
Total cost per annum	$61,760	$121,050

Cost of Three Pumping Stations.

	Electricity.	Gas.
Cost of three stations	$1,035,000	$2,154,000
Operating expenses and fixed charges per annum for three stations	185,280	363,150

Summary of Total Cost.

	Electricity.	Gas.
Pumping stations	$1,035,000	$2,154,000
Mains for distribution system, complete, with gate valves and hydrants	2,107,000	2,107,000
Telephone system	150,000	150,000
Total cost	$3,292,000	$4,411,000
Add 10 per cent. contingencies	329,200	441,100
Add 10 per cent. superintendence	329,200	441,100
Totals	$3,950,400	$5,293,200

The pressure at the station is proposed to be 300 pounds and the minimum pressure at the hydrant 200 pounds. Mr. Hill counts apparently on drawing current supply from the mains of the Manhattan central stations and says that the three pumping plants would require 15,000 hp working at their full capacity. The data for Brooklyn follow the same general lines.

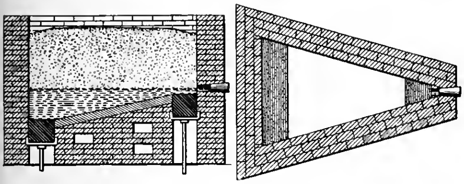
Recent Electrochemical Developments.

CALCIUM CARBIDE FURNACE.

Formerly the object of electric furnaces was to produce as high a temperature as possible; now the tendency is manifest to design furnaces in such a way as to always have the temperature under exact control. In some cases (in those in which the charge may give different products at different temperatures) it is evidently important to provide as uniform as possible a temperature throughout the furnace. Some of Mr. Acheson's recent furnace designs belong to this class.

In the manufacture of calcium carbide, the problem is a different and simpler one, and the main object of a large number of furnace constructions disclosed in seven patents granted on April 19th to Messrs. W. S. Horry and E. F. Price, of the Union Carbide Company, of Niagara Falls, is to design a furnace with a non-uniform distribution of the generated heat. While in general the temperature in the furnace must be sufficient for the formation of carbide, yet it is only near the tapping hole, where an extremely high temperature should be produced, sufficient to render the calcium carbide fluid at that particular place.

Several principles are made use of for this purpose. In several designs, the cross-section of the charge is diminished gradually towards the tapping hole, so that the current density is highest at that point. This is shown in Figs. 1 and 2, which represent a vertical and horizontal cross-section, the tapping hole being at the right.



FIGS. 1 AND 2.—HORRY AND PRICE ELECTRIC FURNACE.

In other designs a superposition of currents is made use of, for instance in the following manner: In a stack furnace a single negative electrode is provided at the bottom, and here is also the tapping hole. Several positive electrodes are provided at different heights of the furnace. If, through each of them direct current is sent into the furnace, which leaves it through the negative electrode at the bottom, it is clearly seen that the current passing through the charge becomes gradually greater as the bottom is approached.

Two of the patents refer to the use of polyphase currents for a furnace of circular cross-section. It is proposed to use a great many phases and to distribute electrodes at equal intervals around the circumference, each electrode corresponding to one phase. If a central electrode is provided which is connected to the neutral point of the polyphase system, then the temperature becomes highest near the center of the furnace, and the tapping hole is, therefore, provided at that place.

COPPER EXTRACTION BY ELECTROLYSIS.

A patent granted on April 19th to Mr. S. Laszynski, of Kielce, Russia, refers to the use of a tight envelope of fabric around an insoluble anode for the purpose of preventing anodic oxidation of the cations. For instance, in a solution containing ferrous sulphate the anodic reaction at the anode would be the oxidation of ferrous salt to ferric salt. In an electrolytic process of extraction of copper ores containing iron, this reaction would have the disadvantage that the ferric sulphate, while formed at the anode, might come in contact with the cathode and redissolve the deposited copper by local action. If a porous fabric envelope around the anode is used, the anodic reaction is essentially the formation of sulphuric acid and no ferric salt is formed since the ferrous sulphate does not come into contact with the anode. This envelope, therefore, acts like a diaphragm. The author states that in this way the direct electrolysis of copper baths containing iron is possible with a nearly theoretical efficiency, even if they contain twice as much iron as copper, since the iron remains in the state of the wholly unoffensive proto-sulphate of iron and with no corroding action of any kind.

MISCELLANEOUS.

A patent granted to Messrs. W. J. Joly and J. H. Joly, of San Francisco, Cal., refers to details of mechanical construction of apparatus for the electrolytic extraction of metals from slimes, sands and solution. The apparatus comprises essentially a sluice box and electrodes swinging on horizontal axes and adapted to float on the surface of a stream passing through the box.

A patent was granted to Mr. J. Bijur, relating to the manufacture of open-work structures for storage battery plates. The primary object is to enable strong and efficient plates to be made by embracing a number of individual elements having interstices—as, for instance, grilles or pastilles—with molten metal, to form the completed structure, although the elements may have any desired form. The interstices of the individual elements are first filled with a soluble material, like soda-ash, to prevent them from becoming filled with molten metal. The elements are then assembled in the desired arrangement with channels or spaces between them, and the channels filled with molten metal to embrace the elements to form the completed structure. The soda-ash is then removed to leave the finished open-work plate.

A patent granted to Mr. A. V. Meserole, of New York City, refers to the construction of a light and durable storage battery plate in which the mechanical strain is distributed by a new arrangement of the electrodes and their supporting devices. A supporting bar is provided with depending tubular members through which bolts are threaded. A stirrup plate is mounted on the bolts and tablets of active material encircle the tubular members and rest upon the stirrup plate.

A patent granted to Mr. J. H. Reid, of Newark, N. J., relates to his "gas battery," which has been noticed before in these columns. The object of the present patent is to obtain a circulation of the electrolyte so that "the bubbles in the electrolyte formed by the action of the gas or gases in the development of the electric current may be broken up and the inert gases allowed to escape."

New Telephone Patents.

A WELL-DESIGNED DESK STAND.

While the tendency on all sides has always been toward the simplification of the telephone subscriber's set, it is apparently but recently that any great effort has been made to make the internal workings readily accessible. In receivers this effort has resulted in some designs which when considered from this standpoint approach perfection, and now that similar good work is being done on the desk stand set is evidenced by a patent just issued to Mr. H. P. Claussen, of Chicago. In this stand the removal of a single screw from the base plate allows of the whole stand being knocked down. The base comes off and then the tubular upright may be slipped down over the cord, entirely exposing the working parts. These latter are all mounted upon a strip of insulating fibre which is secured to the transmitter bracket piece. A good idea of the arrangement of the parts may be obtained from Fig. 1, which shows a partial sectional view, and a side view of the transmitter with those parts integrally connected thereto. Mr. Claussen has assigned his patent to the American Electric Telephone Company.

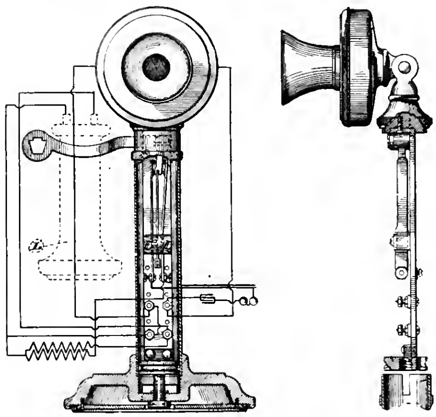


FIG. 1.—CLAUSEN DESK TELEPHONE.

POCKET MICROBE CATCHER.

Of all the numerous antiseptic devices for telephone transmitters thus far brought out, that which has recently been patented by H. S. Thompson, of Waterbury, Conn., seems to have most points in its favor. This is a device put up to be carried in the pocket and differing little in size and shape from a watch. The case is of a diameter to just fit over the transmitter mouthpiece, a screen of gauze being stretched across it. Each cover carries a pad which contacts with the gauze whenever the case is closed. These pads are wet with

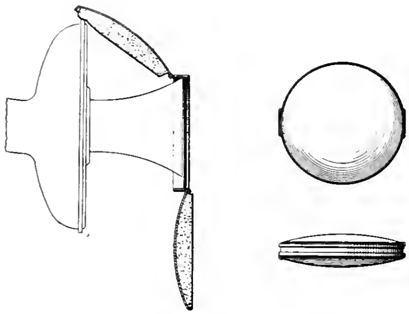


FIG. 2.—THOMPSON ANTISEPTIC ATTACHMENT.

antiseptic solution. Fig. 2 shows the case closed and in position for use.

TRANSMITTER.

W. L. Wilhelm, of Buffalo, has had issued a patent for a special type of casing for a double-diaphragm transmitter. The casing is of ellipsoidal shape, the mouthpiece surmounting one of the smaller ends. The diaphragms are in a plane parallel to the long axis and the sound waves are conducted to them through two curved tubes, which combine into a threaded ring as they approach the mouthpiece. This ring screws into the casing.

SELECTIVE SYSTEMS.

Two selective systems for party line signalling complete the list of patents. Both these are step-by-step systems, the one most simple and the other of a complexity apparently fatal to its success. The former is the work of Albert Meinema, of Chicago, while P. H. Fisk, of Clay, Iowa, is the inventor of the latter.

In Mr. Meinema's system a rotating ratchet wheel is interposed between the hook switch lever and its springs. When the wheel is in the proper position the bell of that station is connected to the line. The further actuation of the hook switch springs into the talking connection also depends on the position of this same wheel, and thus a lock-out for non-wanted stations is provided.

National Electric Light Association.

Mr. Charles H. Hodskinson, chairman of the committee on hotel accommodations for the twenty-seventh convention of this association, to be held in Boston May 24, 25, 26 and 27, reports that an unusually large number of rooms have already been assigned to members. The placing of this matter in the hands of a committee to whom all applications for rooms are referred, will undoubtedly result in better satisfaction for members of the association, as they will be cared for first and will not be obliged, should they be a little late in deciding to attend, to make the best of such accommodations as were left after non-members have been provided for, as has often happened in former years.

In addition to the New England Passenger Association and the Trunk Line Association, the secretary reports that the Central Passenger Association and the Southeastern Passenger Association have made a rate of a fare and a third for the round trip, from all points throughout their territory for delegates and friends attending the twenty-seventh convention at Boston. Mr. Frank L. Perry, of the *Western Electrician*, has consented to take charge of transportation matters for Chicago and vicinity, and proposes to arrange for a special train to bring delegates to the convention. Mr. Perry's well-known energy ought to insure the success of this effort.

The following are among the recent additions to the membership of the National Electric Light Association: Active—Connecticut, South Manchester, South Manchester Light, Power & Tramway Company. Indiana, Marion Light & Heating Company. Massachusetts, Leicester, Rawson Light & Power Company. Mexico, Monterey, Monterey Light & Power Company. New York, Little Falls, Herkimer County Light & Power Company; Lockport, Lockport Gas & Electric Light Company. Washington, Olympia, Olympia Light & Power Company. West Virginia, Bluefields, East River Electric Company. Associate—Indiana, Jonesboro, India Rubber & Insulated Wire Company. Iowa, Keokuk, Garton-Daniels Company. Missouri, St. Louis, Wagner Electric Manufacturing Company; St. Louis, The Emerson Electric Manufacturing Company. New York City, Sanderson & Porter, 52 William Street; Holophane Glass Company, 15 East Thirty-second Street; The Electric Carriage Call Company, Incorporated, 328 West Forty-first Street; New Brighton, C. W. Hunt Company.

The Cumberland Telephone Company in Evansville, Ind.

The Cumberland Telephone Company, of Evansville, Ind., has made the city council a proposition with a view to settling the controversy between the city and company and end further litigation.

The terms proposed by the Cumberland Company are: First, to submit the question of telephone rates to a committee of arbitration. The Cumberland agreed to Major Gilchrist, one of the attorneys for the so-called municipal telephone; Col. R. K. Dunkerson, a director of the municipal company, and A. C. Rosencranz as the committee. In case this committee was not satisfactory to the council it is proposed that the city make one nomination, the company another and the two to select a third. This committee may hire an expert accountant, who can examine the books of the Cumberland Company, both in Evansville and Nashville. The only stipulation is that the committee be of such a character as to command the confidence of the people of the city.

Second, growing out of the first proposition, the committee is to determine whether the city should be given a bonus by the company or pay an annual stipend. The entire matter of rates and compensation is to be left to the arbitration committee.

Third, the agreement shall be entered upon the journal of the United States District Court of Indiana and have the effect of decree of court. In effect it would be a permanent injunction against the city from removing the poles and wires of the Cumberland Company.

Subsidiary considerations discussed at the meeting between the Mayor and representatives of the company were:

First, a suggestion that the Cumberland Company pay the cost of the city in defending the injunction suit brought by the Cumberland against the city; that the Cumberland pay the attorney fees and cost of preparing the case, though the amount was not discussed. The cost of defending the Richardson suit was not mentioned.

Second, while it was not requested by the Mayor or offered by the company, there was an informal suggestion that the Cumberland assume the losses of the defunct Municipal Telephone Company. It is understood this amounts to nearly $7,000.

Briefly stated, the Cumberland offers to leave to arbitration of a committee of Evansville business men the rates to be charged and the compensation to be given the city. Their finding is to be made a record of court and in return the Cumberland is to have practically a perpetual franchise. The company also offers, aside from any award ofthe arbitration committee to pay the cost of the recent suit and perhaps to recompense the losses of the municipal telephone fiasco. No exclusive franchise is or could be asked for. Other companies may be admitted to the field. Action upon the proposition of the Cumberland Company rests with the Mayor and council.

Volunteer Russian Telegraphers.

The Czar of Russia has accepted the offer of the senior class of the Electro-Technical School at Odessa to serve as volunteer telegraphers in Manchuria. These volunteers will have charge of the wires along the Manchurian line.

Prices of Radium in France.

It is stated that the makers of Curie's radium can furnish it in several different degrees of purity, and therefore in varying intensities. A price list is given for radium and barium chloride, except the lowest activity, which is a compound of radium and carbonate. The minimum quantities sold as well as the current prices for radium are stated. The prices vary from $1.50 per gram for 40 activity to $1,250 per gram for 20,000 activity. The prices, it is stated, are advancing from week to week, owing to the enormous demand.

CURRENT NEWS AND NOTES.

SEOUL ELECTRIC PLANT BURNED.—Fire destroyed the imperial palace at Seoul, Corea, April 15. The new electric lighting plant was also destroyed.

VERMONT ELECTRICAL ASSOCIATION.—This association will hold its next meeting in Montpelier, September 21 and 22 next. Mr. C. C. Wells, Middlebury, Vt., is secretary.

WIRELESS IN SOUTHWEST AFRICA.—Germany, which is having serious trouble with the natives there, is sending men to German Southwest Africa equipped with wireless telegraphy apparatus and balloons to be used in the campaign against the Herreros.

CANADIAN ELECTRICAL ASSOCIATION.—The next annual meeting of the Canadian Electrical Association will be held in Hamilton, Ont., June 15, 16 and 17 next. A series of interesting papers has been arranged for. Mr. C. H. Mortimer, Toronto, Ont., is secretary.

STATE ELECTRICAL ENGINEERS.—The New York State Civil Service Commission among examinations to be held May 21, 1904, will include positions for electrical engineers in State hospitals and institutions. Application must be made to the chief examiner, C. S. Fowler, Albany, before May 16.

ELECTRIC AUTOMOBILES.—A cable dispatch from Paris of April 23 says: "Electric automobiles bid fair to eclipse petroleum vehicles for town locomotion. Manufacturers are selling them as rapidly as they can produce them. At the Société Française des Electromobiles it is almost impossible to hire a machine." France usually leads the way in these things.

BUFFALO TO CLEVELAND.—The De Forest wireless system is now in successful commercial operation between Buffalo and Cleveland, an air distance of 170 miles, most of which is overland and part across Lake Erie. The poles are 195 ft. high, with 11 wires for sending and 3 for receiving. Dr. Lee De Forest has had personal charge of the equipment.

WAR PENSIONERS.—An article on "Our Enormous Pension Roll," by Mr. R. L. O'Brien, in the *World's Work* for May, contains some very interesting and curious data. It tells of one man who drew a pension for total deafness, on the certificate of an examining committee, and was found in active charge of a telephone switchboard. The State of Georgia at one time had so poor an opinion of lightning rods that it did not grant its Confederate veterans the usual exemption from license in connection with their sale.

REUNION OF POSTAL TELEGRAPH OFFICIALS.—A reunion of officials and heads of departments of the Postal Telegraph-Cable Company from all over the country will be held in New York May 24 next. The gathering is for the purpose of exchange of ideas and experiences for the general good of the service. This meeting will also celebrate the sixty-fourth anniversary of the invention of the telegraph. It is proposed to hold these meetings annually hereafter. The last general convention of officials was held ten years ago.

ELECTRICITY IN PARAGUAY, S. A.—Mr. J. N. Ruffin, United States Consul at Asuncion, Paraguay, says: "An electric lighting plant has been established here, though the lamps have not yet been put up. If the enterprise is successful it will be extended so as to supply electric motor power, the introduction of fans, etc. It seems as if the electric light will be a success, and in view of this some persons have applied at this consulate for catalogues of electric lamps, fans, etc., accompanied with export prices, if possible written in Spanish."

PAIN-KILLING RADIUM.—Doctor Darier, of Paris, describes a case of cancer of the face which, through application of radium, had been rendered painless. Similar results have been obtained by other noted experts. He has also found quick and pain-killing effects of radium in certain diseases of the eye. The influence of radium upon the motor-nerve centers he considers of still greater importance. In two cases of nervous spasms—which occurred three to four times a week—weak radium preparations were applied to the temples for two or three days, when the spasms ceased. In a case also of presumptive inability of motion, caused by nervous debility, radium effected a complete cure within three days—probably, however, through suggestion. In acute facial paralysis of entirely new origin, radium effected a cure in one day.

WAR RULES FOR WIRELESS.—A cable dispatch to the New York *Times* of April 21 says: "The British Government is giving careful consideration to the Russian edict in reference to the use of wireless telegraphy by war correspondents in the Far East. Whether it has made any representations to Russia in the nature of a protest against her line of action, it is impossible to state at this moment; but if such representations have not yet been made, it is quite likely that they will be made. At any rate, Lord Lansdowne is fully impressed with the view that the attitude Russia has assumed as to wireless telegraphy is unjustifiable and altogether absurd. The only correspondent directly affected by the Russian note is the correspondent of the London *Times* and the New York *Times*. Lord Lansdowne, who fully understands the methods and status of this correspondent, unqualifiedly repudiates the Russian contention that he is in the same category as a spy, and condemns the purposes Russia entertains in respect to the correspondent, his chartered vessel, and his wireless telegraphy apparatus."

ELECTRICITY IN JAVA.—Mr. B. S. Rairden, United States Consul at Batavia, Java, informs us that the only city in Java with electric lighting is Batavia. The harbor of that city, Tandjong Priok, also has its own lighting station, owned and operated by the government. There are three telephone exchanges in Batavia and a system for long-distance work connecting the city with Samarang and Soerabaya (Intercommunale Telefoon Maatschappij). There is also another telephone exchange—Batavia-Soekaboemi Telephone Company—which connects Batavia with Buitenzoig and Soekaboemi. The telephone systems have a number of American instruments in use, and are using more American material lately, the appliances and material being found superior by the Netherlands-India Telephone Company. The eight miles of trolley in Batavia were equipped by Siemens & Halske, of Berlin, who also put in the electric power plant, which operates the government opium factory. The street railway company is known as the Electric Tram Company, or Electrische Tram Maatschappij. There are two electrical supply houses —Maintz & Co. and Carl Schlieper.

A NEW COLOR QUESTION.—According to veracious advices from Philadelphia, "Dr. Thomas R. Eldridge, of 1639 North Broad Street, for several months has been making a series of experiments, the aim of which has been the transforming of negroes into whites. There was a fire at the surgeon's establishment last Sunday and the apparatus with which the experiments were being carried on were destroyed. As a consequence there are half a dozen negroes who are guessing hard. Dr. Eldridge was doing the bleaching by throwing an X-ray light through radium, thus destroying the coloring pigment of the skin. Several negroes who had undergone treatment are now partly white. With the destruction of the electrical appliances the work of completing the transformation is halted. The patients are, therefore, left in a state of what might be termed dermatological suspense. It will be several months before duplicate apparatus can be built. Meantime, Dr. Eldridge does not know what will become of the blacks. He does not think that the whitened parts of the skin will become black. All he knows just now is that there are a half dozen unhappy negroes in Philadelphia."

EXTRACTING NAIL FROM BODY.—According to a statement from Salt Lake City, a nail has been drawn from a point close to the heart of Louis E. Cherry, aged 16 months, by an electric magnet. The child swallowed a nail two weeks ago. Experiments on a dog showed it to be impossible to extract a nail with the usual instruments. A long curved piece of steel, attached to a powerful electromagnet, was pushed down the windpipe, and as soon as the current was turned on the nail became attached to the steel and was withdrawn.

WIRELESS IN WAR.—At a meeting of President Roosevelt's Cabinet last week a discussion was had, it is credibly reported, looking to the control by the government of wireless telegraphy. The opinion was expressed that it would be desirable, if not, indeed, absolutely necessary, for this government to control, at least in a supervisory way, the operation of wireless telegraphy, particularly along the coast. It was pointed out that, in the event of a war with a foreign nation it might be necessary in defence of the nation for officers of the United States to have charge of these stations, as a means of assurance to the government that no communication was established with vessels of the enemy's fleet, and that the system was not employed to the detriment of United States interests.

SIBLEY JOURNAL OF MECHANICAL ENGINEERING.—The contents of the current issue of the *Sibley Journal of Mechanical Engineering* belie its title, two of the three papers contained treating of electrical subjects. Prof. H. J. Ryan contributes an interesting paper entitled "Some Problems in Electrical Engineering Due to Conductivity of the Atmosphere," in which, after pointing out the gravity of the problem of atmospheric conductivity in connection with high-voltage transmission work, he gives the results of experiments to determine the variation of such conductivity in the case of conductors in an undue pressure. It is shown that air under a compression of 150 pounds per square inch has an insulating strength at least ten times its normal strength. The second paper referred to is by Mr. Bion J. Arnold, and describes the Arnold electro-pneumatic railway system in detail.

ELECTRIC ROAD UP VESUVIUS.—Visitors to Naples familiar with the old Funicular Railway that for twenty-three years has been in operation on Mount Vesuvius will welcome the news that the long and dusty drive from Naples to the old station has at last been obviated by the opening of a new electric railway. The starting point of the new line, which has been constructed for Thomas Cook & Son, the tourist agents, is at Pugliano, where connection with Naples by electric cars is made. The length of the railway, exclusive of the old line up the cone, is 4.7 miles, and it is divided into three sections. The first and third sections are ordinary lines; the second section is a rack railway, with an incline as great as that of the famous Rigi Railway, in Switzerland. The cars of this section are pushed up by a powerful four-wheeled electric locomotive, fitted with an elaborate system of ordinary and emergency brakes. The current throughout is picked up by overhead trolleys. At the Hermitage Cook's have built a hotel, near the famous Royal Observatory. The new line makes the trip from Naples to Vesuvius a much more speedy and comfortable journey than it has hitherto been.

AUSTRIAN TRANSMISSION SCHEME.—Mr. S. C. McFarland, United States Consul at Reichenberg, Austria, says: "A project for the establishment of a central distributing electric power and light plant in the Reichenberg land district has taken definite form. The territory included is about 10 miles square, and 24 towns and villages have joined in the movement and subscribed to the capital stock. Some 10 more are expected to join. The population of the district, exclusive of Reichenberg, is about 60,000. Stock is subscribed at present to the amount of $200,000, and this it is proposed to increase to $400,000. The principal purpose of the corporation will be the distribution of electric light and power, with the possibility of installing and operating a system of suburban electric tramways. Tramway and light franchises for the city of Reichenberg are at present owned by private corporations, and at their expiration it has been generally supposed that the city would take over and conduct the enterprises. Negotiations are pending, however, which may change the situation in this respect. Communications regarding equipment, etc., may be addressed to Directors Alfred Ginskey, Maffersdorf and Dr. Richard Pirkl, Reichenberg."

LETTERS TO THE EDITORS.

Maximum Efficiencies of Transformers and Constant Potential Shunt Motors.

To the Editors of Electrical World and Engineer:

SIRS:—Dr. Kennelly's article on "The Efficiency Curves of Constant-Potential Transformers," in your issue of April 16, I have read with much interest. Dr. Kennelly has given to an old proposition a new and elegant graphical solution. He has also drawn attention to the fact, which I do not remember to have seen mentioned before, that the efficiency curve of a constant-potential transformer is an acute hyperbola.

Permit me, however, to call attention to the fact that the chief conclusion of Dr. Kennelly's paper was published in two articles of mine in the ELECTRICAL WORLD AND ENGINEER for September 18 and November 6, 1897. In these papers will be found the analytical proof that at maximum efficiency the copper and iron losses of a transformer are equal to each other. This is the main point in Dr. Kennelly's summary.

Further, for the past three years I have given to my class in electrical design a similar demonstration to show that in a constant-potential shunt motor, at maximum efficiency, the approximately fixed losses are equal to the variable copper loss in the armature. This conclusion is not so exact for the shunt motor as for the stationary transformer, but I have applied it in tests made on a number of motors and have found it to hold near enough for many practical purposes.

The demonstration is as follows: Let b be the fixed losses in watts in the motor, including iron loss, field current, windage, etc. The armature copper loss is I^2R, in which R is the resistance of the armature. Then at any load the losses are $I^2R + b$, while the input is $I E$, where E is the constant-potential difference at the terminals of the motor. Then for maximum efficiency the fraction $\frac{I^2R + b}{I E} = c$ should be a *minimum*. Differentiating, $\frac{dc}{dI} = \frac{R}{E} - \frac{b}{E I^2} = 0$ for a minimum. Whence we have

$I^2R - b = 0$, or $I^2R = b$. Hence, at a load giving maximum efficiency, the copper loss in the armature is equal to the fixed losses, or the stray power losses plus the loss in the shunt field.

UNIVERSITY OF MICHIGAN. HENRY S. CARHART.

Steam Turbine Economy.

To the Editors of Electrical World and Engineer:

SIRS:—The writer was interested in the letter in your issue of March 5 from Mr. Cyrus Robinson regarding the steam consumption of an air pump used in testing a 1,250-kw turbine unit. On several different occasions I have put a steam indicator on our air pump (which has an 8-in. steam cylinder, and two 20-in. air cylinders, with the vacuum being from 28 to 29 in.), and found the steam consumption to be 9 indicated hp. We are aided a good deal by running the exhaust steam from the air pump and some of the other auxiliary machinery into the condenser, so that the engines are run condensing. This statement may be of some interest to those who are anxiously inquiring about turbine efficiency.

PORT HURON, MICH. J. E. DAVIDSON.

Silicon and Silica.

To the Editors of Electrical World and Engineer:

SIRS:—On page 733 in your issue of April 16, in a report of the Washington meeting of the American Electrochemical Society, I am quoted as suggesting the use of silicon as a possible substitute for glass as a container for standard cells. Some erratic genius inserted the remark that pure silicon is now made cheaply by a certain patentee.

My suggestion made no reference whatever to silicon, but to silica, sometimes called "quartz glass." In view of the solubility of various forms of glass, and the great liability of glass varying in composition in different countries and at different times, it is advisable to investigate the effect of glass containing vessels for standard cells, and possibly to substitute therefor vessels of silica, which does not vary in composition and is much less soluble than any of the ordinary glasses.

New York City. Henry Noel Potter.

Reciprocating vs. Turbine Engines.

To the Editors of Electrical World and Engineer:

Sirs:—In the communication of Mr. Hodgkinson, criticising the writer's article in your issue of April 2, he first states that the data published in the article appeared to be reliable, and then proceeds to intimate that there are discrepancies in the results given as compared with those in the paper of Messrs. Moultrop and Curtiss, read before the A. S. M. E., which was referred to in the article. This paper specifically gave only the results of four single tests at full load made with and without the reheater for engine No. 8, and with and without the reheater for engine No. 9, respectively. The writer's article stated definitely that the average results given were made up from all the acceptance tests, which were made with reheaters in use, of engines No. 9, No. 10 and No. 11, and that the results of tests on engine No. 8 were not included for the reasons given. The least that can be said is that there are no grounds for the comparison made by Mr. Hodgkinson. Necessarily, from the above, only one of the tests mentioned in the paper by Messrs. Moultrop and Curtiss was used in making up the average results given in the article. The individual tests given in the latter were not mentioned in the paper, nor were the tests on engines No. 10 and No. 11, which in fact were made at a date subsequent to its reading.

It would doubtless have been somewhat more satisfactory, for purposes of comparison, if these engines had been tested at less than half load. On the other hand, it is not often possible to obtain such an accurate measure of the actual performance of an engine as is afforded by carefully conducted tests of several identical engines under substantially identical conditions. Furthermore, it is unfortunate that no reliable electrical instruments were available in the series of tests conducted by Prof. Hollis and Prof. Marks. At the same time the rates of B.T.U. per minute and the corresponding efficiency ratios given, respectively, on an indicated horse-power basis for full, quarter and half loads for these tests, and for the corresponding points on the curve *C*, form just as reliable and satisfactory a check upon the form of curve *C* for steam consumption at light loads as though direct electrical readings had been obtained.

Mr. Hodgkinson objects to the method of indicating the relation of total losses at different loads, shown in Fig. 2. In the original article by Mr. Mattice, the comparative percentage of the total losses at different loads was discussed. In laying out Fig. 2, the basis of comparison indicated by Mr. Mattice was followed. Moreover, the observations indicated include those obtained from a number of engines in other locations differing both in combined efficiency and in steam consumption, and this affords a comprehensive method of determining the law of variation of the total losses. In this connection a typographical error in the second sentence on page 652 should be noted. It should read: "The efficiency ratio given in the table, etc."

The objection of Mr. Hodgkinson that the article does not state whether allowance had been made for variation from contract conditions in determining the basis of full load rating in laying out curve *C*, is well taken. In laying out this curve it was considered proper to determine full load on the basis of rated cut-off, as indicated by Mr. Hodgkinson, which, under the actual conditions, gives a full-load rating of 2,040 electrical horse-power.

The point of Mr. Hodgkinson's comments on the necessity of expansion to back pressure for maximum economy with an ideal engine is not apparent. No one would attempt to run an actual reciprocating engine of the condensing type and expand to back pressure with the idea of securing good economy, or to maintain that there was any similarity between a reciprocating engine and the steam turbine in this respect. What the writer intended to show in this connection was that when the economy of any type of engine is improved by a reduction of the clearance due to the use of a longer stroke or better design, or by a reduction of cylinder condensation from the use of reheater or superheated steam, or in any way which improves the ratio of its thermal efficiency to that of the ideal engine, the resulting saving in steam consumption will be proportionately greater at light than at heavy loads, and the curve of water consumption for light loads will be flattened, as shown in curve *C*. This is equally true of any make of reciprocating engine which is so constructed that high economy is secured.

Mr. Hodgkinson asserts that the curves of steam consumption given show "an important feature of the turbine—that it may be run at full load with its best economy—whereas an engine must be run at about 25 per cent. underload to secure its best economy." This last clause seems like hair-splitting, since results indicated by curve *C* show a rate of steam consumption from half to full load, which is practically constant; that is, it varies less than 2 per cent. from the full-load economy. These engines also have an overload capacity of over 80 per cent. above rated load if the steam pressure and vacuum be maintained.

Mr. Hodgkinson's argument that this reciprocating engine with its practically constant rate of steam consumption from half to full load, and with its large overload capacity is over-rated, and that the general form of its curve of steam consumption for different loads is inferior as compared with the corresponding curves given for the turbine in question, appears like an attempt to befog the situation, in view of the fact that since the turbine curve falls away materially with any reduction of load below full load, on the one hand, it must be run at full load to secure economy; and on the other hand, it can carry no overload unless an attendant is on the spot to open a hand-operated by-pass arrangement for letting steam pass directly from the boiler around the high-pressure end of the turbine, with consequent increased drag upon both boiler and condenser. In fact, the by-pass arrangement hardly seems for overloads "one that is suitable for the most exacting demands of fluctuating loads."

According to his figures, if the vacuum should fall to, say, 21 in. instead of 25 in., which, however, does not seem unreasonable, the capacity of the turbine would be cut down 30 per cent., with a corresponding increase in steam consumption, and under such conditions with a drop in steam pressure of 10 per cent., the turbine would not pull its rated load, with by-pass full open.

Mr. Hodgkinson asks in several places in his letter for more tests —more data. This is an invitation to a controversy which the writer must decline, and it does not seem that this would interest your readers. The article was intended solely to correct a prevailing wrong impression that a reciprocating engine, even when of the highest economy at full load, must necessarily be wasteful of steam at light loads, an impression which turbine advocates have made use of a great deal in making comparisons. It was in no sense meant to cover the general subject of the comparative economy of turbine and reciprocating engines, in which case an allowance for the material difference in vacuum, etc., would have been proper. For such a comparison the present time seems inopportune to the writer. The results of tests by disinterested parties of steam turbines which have been in actual service for a sufficient number of years to judge properly of their lasting qualities are too poor to be worth comparing with an up-to-date reciprocating engine. Only a trying-out process will determine, not only how far the expectations of greatly increased economy will be realized from the many improvements in steam turbines which are being actively exploited at the present time, but, *more especially*, how these improvements will affect the durability and lasting qualities of the turbine. There would seem to be no difficulty in making a turbine which will give, after careful adjustment, good results for a short time, provided sufficiently close clearance or sufficiently high steam velocities are used. The question is how far can one go in this direction in a machine which will at the same time prove sufficiently robust for commercial handling, and will also prove to be durable and without deterioration in economy. It would seem that time is needed to solve this problem.

Auburn, N. Y. J. A. Seymour.

Variable-Speed Motors.

To the Editors of Electrical World and Engineer:

Sirs:—The writer has been using electric-driven machine tools for some time. He has used variable-speed motors, obtaining his speed changes by varying the field strength. He has, however, had some trouble with the motor starters and field rheostats. So much has been written lately regarding systems of control for variable-speed motors that the writer thinks some attention should be paid to special types of controllers for use with variable-speed motors. From an operator's standpoint, I have the following complaints to make against apparatus which I have received from motor manufacturers who have sold me variable-speed motors with their controlling outfits for my machine tools:

1. Upon weakening the field to get higher speed, the underload release magnet has released the arm and stopped the motor.

2. Upon starting up under load my fuses have blown, the underload magnet not being operative during the starting period.

3. Upon starting the motor under weakened field conditions while under the lightest load, my fuses have blown.

4. I have had some trouble due to metallic chips falling upon the exposed resistance coils in the box, causing short-circuits, thus destroying the box.

I believe, therefore, that some better apparatus could be constructed and that some attention should be given this question as it is the only complaint which the writer has found against the driving of milling machines and such class of goods by use of variable-speed motors. I would thank any of your readers who wauld take this matter up and co-operate with me.

Bronxville, N. Y. Chester Burkhardt.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Converters.—Loewy.—In a continuation of his serial on electric machine construction in 1903 he discusses converter designs by Davis, Lamme, General Electric Company, Auvert and the following machine of Bragstad and La Cour. The latter, shown in Fig. 1, consists of an induction motor coupled with a rotary converter, *U*, the secondary winding, *R*, of the induction motor being connected to the armature winding of the converter. *S* is the stator winding of the motor, *W* the starting resistance, *K* the commutator, and *F* the direct-current field of the converter, which is in shunt with the direct-current circuit. If motor and converter have the same number of poles, the two machines coupled together run with a speed which corresponds to half the frequency of the primary current. An e.m.f. of half the frequency of the primary current is thereby induced in the rotor winding of the induction motor. On account of the connection of the rotor winding with the armature winding of the converter, a rotary field is produced in the latter which revolves (with regard to the armature) with a speed equal to that of the armature. If the connections are so made that the rotary field revolves in the opposite direction as the armature, then the rotary field is stationary in space and the machine acts at this speed like a synchronous motor. The induction motor acts to one half as motor and to the other half as transformer, while the converter acts to one half as direct-current generator and to the other half as converter. The relative position of both stationary converter fields depends upon the load of the machine, and the relative position of both fields can be changed only by an external force. In the case of an external disturbance there exists a strong synchronizing force, because there is only a relative displacement of the converter fields, but also one of the fields of the induction motor. For starting the converter, the resistance, *W*, is used which is gradually disconnected so that the speed gradually increases. With correct excitation, the condition of synchronism is reached by itself and the resistance may be short-circuited. The arrangement is shown of using the machine for converting single-phase into direct current and also for using it as an alternating-

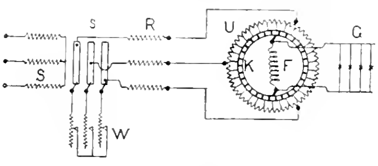


Fig. 1.—Converters.

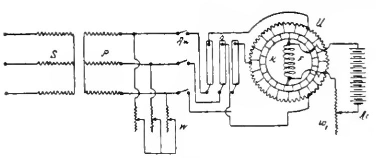


Fig. 2.—Converters.

current motor. Fig. 2 shows the application of such a motor for three-phase traction. The stator winding, *S*, is placed between the rails on the road, while the rotor winding, *P*, is mounted on the car. The converter, *U*, is connected to the driving axle of the car. When starting, the switch, *Au*, is open, and the car is started partially by means of direct current from the battery, *Ac*, and by means of three-phase current. When the speed is reached at which the frequency of the three-phase current induced in the rotor is equal with that of the armature current of the converter, the switch, *Au*, is closed and the resistance, *W*, is opened so that the car continues to run at this speed, which corresponds to synchronism. When the resistance, *W*, is decreased the speed of the car increases and the converter, *W*, sends current into the battery, *Ac*. Fig. 3 shows the application of the machine as alternating-current generator with the non-synchronous machine, *G*, as main generator and the converter, *Er*, as exciter. The exciter and the generator are self-exciting if the field of the exciter has body poles. The alternating currents generated in the exciter produce a rotary field in the rotor of the non-synchronous machine. The currents induced in the stator of the non-synchronous machine have a frequency which is equal to the sum or difference of the speed of the rotor and the speed of the rotary field in it. Such a generator is, therefore, suitable when connected with high-speed prime-movers, like steam turbines, for furnishing alternating current of a lower frequency than would correspond to the speed of the prime-mover.—*Zeit. f. Elek.* (Vienna), April 10.

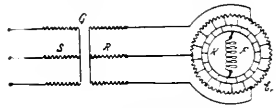


Fig. 3.—Converters.

Alternators Connected in Parallel.—Sommerfield.—The first part of a long theoretical article. The author first sums up the former papers by Kapp, Benischke, Goerges and Rosenberg on this subject. The common feature of the various explanations given by these authors is the consideration that by the driving machine a forced oscillation is impressed on the machine set and that on the other hand, the system is capable of a free oscillation, the period of which depends upon the mechanical and electrical constants of the two machines. The special phenomena of surging make themselves manifest when both oscillations are in resonance. Benischke also emphasizes the possibility of interference between the free and forced oscillations. The influence of the regulator may be considered as a separate problem. The present author starts from the mechanical and electrical differential equations of the generation of current as the simplest foundations of the phenomena. He does not discuss the process of connecting in parallel, but speaks only of the conditions which are obtained when the connection in parallel is made in the proper way at equal instantaneous values of voltage and when the main power of both machines is equal. His mathematical equations lead him to a mechanical analogy with the pendulum and he has devised an apparatus which he calls the "sympathetic pendulum" for demonstrating the phenomena of surging. The article is to be concluded.—*Elek. Zeit.*, April 7.

Distorted Magnetic Fields.—Goldschmidt.—The first part of an article, illustrated by diagrams, on distorted alternating and rotating magnetic fields. It is pointed out that an induction motor shows great sensitiveness to distortion of the voltage curve, especially to the higher harmonics of the lower orders, such as the third, fifth and seventh harmonics. The following experiment is described. A no-load test on a 400-volt, 50-period, 1,000-revolution, 70-hp, three-phase motor was first carried out, using a small generator which had been designed for about 350 volts and 50 amp. This was over-excited to give 400 volts and the test showed a no-load current of 42 amp. The test was then repeated using a three-to-one ratio transformer to raise the voltage so that the generator should be working with a much higher current at a lower voltage, the percentage voltage drop being increased approximately nine volts. The transformer also had a considerable drop at the load employed. With the same voltage (400 volts) at the motor terminals, the no-load current now measured only 30 amp., against 42 amp. when supplied directly from the generator. The chief cause of the difference was curve distortion. In the first test this distortion had full play, while in the second the high reactance of the circuit prevented the occurrence of currents of high frequency.—Lond. *Elec. Rev.*, April 8.

Lights and Lighting.

Train Lighting.—An account of the results obtained with various systems of electric train lighting on the State Railways of Prussia. On the D-trains, between Berlin and Stassnitz, and between Berlin and Altona, the following system has been in use for over a year and has proven very satisfactory. The lamps in all cars are supplied with current from one steam dynamo consisting of a 20-hp Laval turbine geared to a shunt dynamo and placed on the locomotive. The cars are provided with batteries which supply the lighting current only when the locomotive is disconnected from the train. In case of an accident to the machine, the batteries are capable of furnishing current for all lamps for three hours. Since the machine and the battery are continually at the lighting circuit, while the voltage must be changed from 64 to 86 for charging the battery, the lamps are in series with iron wire resistances. As has already been noticed in the Digest, these consist of fine iron wires in glass tubes, filled with hydrogen. If the current increases, the resistance increases in such a way that the voltage at the lamps remains approximately 48, while the voltage of the network is increased from 64 to 86. The same system is used on the new passenger cars for D-trains between Berlin and Cologne and between Berlin and Basel, only the generating plant is constructed in a different way. It consists of a dynamo driven by a car axle. The 17-kw generator has two shunt windings and one main winding. One of the shunt windings is connected to the battery, the other to the machine terminals. In both shunt windings the current is kept approximately constant by means of iron wire resistances, so that the machine voltage remains between 64 and 86 volts for speeds beginning with 40 km. Aluminum cells are inserted between battery and machine to prevent current from flowing back from the battery to the machine when the voltage of the machine decreases. The well-known property of aluminum electrodes to allow the current to pass in one direction only, is here made use of. The system has been used for three months and has been found satisfactory. On other trains experiments have been made with lighting each car separately, a dynamo driven by the axle and one or two auxiliary batteries being provided. The total cost of first installation for the latter system has been $3.63 per candle, for the system used between Berlin and Stassnitz $5.12, for the system used between Berlin and Altona $4.62, for the system between Berlin and Cologne $3.50, and for the system between Berlin and Basel $3.75. The cost for installing gas lights in some new D-train cars amount to about $1.81 per candle. The cost of operation which can only be given after a long time of use will be smaller for electric light than for gas light and will be smaller for lighting a whole train from one source than for lighting each car separately. If interest, amortization and cost of operation are taken into account, it will be seen that the cost of electric lighting a train is considerably higher than gas lighting, if the lamps are lighted only for a few hours. The longer the time the lamps are lighted each day, the smaller will be the cost of electric lighting, and it may even become smaller than that of gas lighting. A table is given on the power consumption in the Stone system for car lighting.—*Zeit. f. Elek.* (Vienna), April 10.

Power.

Electricity in Mines.—Schulte.—An illustrated description of the electric power transmission plant of the Courl mine near Dortmund, in Germany. In 1897 a small underground primary station was erected in the mine, consisting of a 90-hp steam engine coupled to a 2,000-volt, three-phase generator, which supplied several induction motors. On account of the large extension of the mine the high voltage of 2,000 was chosen. This installation was found to be very satisfactory, so that in 1900 it was decided to erect a larger primary station above ground, consisting of a 630-hp steam engine coupled to a 2,000-volt, 550-kv-amp., three-phase generator, the frequency being 50. Afterwards a second steam dynamo of 550 kv-amp. was installed and both dynamos are operated in parallel. In the mine there is water falling from one level to another, 240 meters deeper, and this has been utilized for driving a Pelton wheel coupled to a 100-kv-amp., three-phase generator. There are installed in the whole 16 motors with an aggregate capacity of 510 hp over ground and 30 motors with an aggregate capacity of 747 hp in the mine. For the underground motors the voltage is transformed from 2,000 to 215 by transformers, placed near the motors. The motors are used for driving ventilators, for hauling and various power purposes. By this means a centralization of the total power generation has been accomplished which has produced a saving of $21,000 in the year 1903, against the year 1901, which can be traced accurately, while the actual saving is larger.—*Glückauf*, April 9.

Water Power Stations.—Adams.—An illustrated article giving various examples from American practice. Cost of water power development depends in a large measure on the location of the electric station which is to be operated. In Burlington, Vt., the upstream wall of the station serves at the same time as a dam, there being neither canal nor long penstocks and only one wall of the power house apart from the dam. The peculiar natural conditions favorable to such a construction are seldom found. In many cases in comparatively level country a water power can be only fully developed by means of canals or pipe lines, and the generating stations cannot be located at the points where the water is diverted. In mountain districts it is generally necessary to employ rather long canals, flumes or pipe lines and an important question is whether to erect one or several stations. Whether the expense of extending conduits and pipe lines to a single generating station will more than offset the advantages to be gained thereby depends on a number of factors, but in general the smaller the volume of water to be handled and the greater its head, the more advantageous is it to concentrate the generating machinery in the smallest practicable number of stations.—*Cassier's Mag.*, April.

References.

Electric Power in Ship Yards.—Brown.—The conclusion of his fully-illustrated article on the application of electric power in British ship yards with special reference to the North East coast. A great many different applications are shown and described, and it is pointed out that in a comparatively short time the introduction of electric power has brought about in that district not only a complete change in the manufacturing methods of the shipbuilder, but in the characteristics of his business. "It may safely be predicted that at the end of the next decade there will not be a steam engine at work in the district driving a ship yard machine tool, and that electric power will be exclusively employed."—*Cassier's Mag.*, April.

Electricity in Mines.—Guarini.—Two illustrated articles on electric installations in mines. The first deals with electric signalling and electric ventilators, the second with electric ore cutters, electric locomotives and hauling machines. Finally, several electric installations in mines are described.—*L'Eclairage Elec.*, April 2 and 9.

Traction.

Field Coils.—An illustrated account of some changes which were made with General Electric 57 field coils by the St. Louis Transit Company. They are made of flat bare copper strips wound with a strip of asbestos between the turns. Two such coils make up one field coil. They are wound side by side on a brass shell. The brass shell carrying the coil is slipped over the pole piece. It was found that frequently one or two turns would be short-circuited by contact at the edges of the copper strap and that the vibration of the coils in the brass shell often ruined the insulation. The new plan is to wind up the two sections of the field coil separately on a wooden form using the copper strap and asbestos as before; it is then taped and the coil is dipped in insulating paint and covered with a special cloth and another layer of tape. The two coils are then laid side by side, connected together and covered with canvas, micanite and red board. The whole is then dipped again in insulating paint. Instead of using the brass shell for mounting on the field poles, two pressed-steel forms are used. As the pole piece is drawn in place the insulating covering of the coils is pressed so as to hold the field coil firmly and prevent vibration.—*St. R'y Jour.*, April 16.

Liverpool-Southport Electric Railway.—Rinkel.—A brief communication in which the author thinks that the use of a fourth rail (between the two running rails) for the return current is not suitable, since the maintenance of the track is not as good as when the running rails themselves are used for the return current, and, therefore, provided with rail joints. The author refers to the fact that in such extended railways in the United States and England a tension of 600 volts is still used, while the experience of the Wannsee road and on the Berlin elevated road have shown that an average voltage of 800 is thoroughly feasible. He asks whether the construction of motors in Germany is further developed in this respect than in England or the United States.—*Elek. Zeit.*, April 7.

REFERENCES.

Electric Railways of New Jersey.—A description and map are given of the electric railways in the State of New Jersey, particularly with reference to the lines between New York and Philadelphia. While it is now possible to travel from one city to the other by electric railway exclusively, through car trips are not yet possible owing to differences in track gauge. Most of the lines are of interurban character, but do not use such heavy equipment and attain such high speeds as is common on the interurban lines in Ohio and Indiana. The only large system is that of the Public Service Corporation, which owns the lines connecting the most important cities of northern New Jersey.—*St. R'y Jour.*, April 16.

Electric Traction in Italy.—Koromzay.—An article giving some critical notes on a former paper on this subject by Vaudeville. The present author appears to be somewhat more in favor of three-phase traction, compared with direct-current traction, than the former author was.—*L'Eclairage Elec.*, April 19.

Berlin and Paris.—Jacquin.—The first part of an illustrated article on the various traction systems of Berlin and Paris.—*La Revue Elec.*, March 30.

Single-Phase Traction.—An editorial note on some American papers on this subject. Concerning Steinmetz's recent Institute paper it is said that "Reading between the lines, it would seem that Steinmetz believes the repulsion motor to be superior to the series motor for traction purposes, and in this he echoes the opinion of many electrical engineers on this side of the Atlantic."—Lond. *Elec.*, April 8.

Single-Phase Traction.—Renshaw.—An article, illustrated with many diagrams, giving a summary of the various features of the Westinghouse single-phase railway system.—*Elec. Club Jour.*, April.

Train Lighting.—See the abstract under "Lights and Lighting."

Installations, Systems and Appliances

Paris Central Station.—Dupuy.—An illustrated description of the plant of the Est-Lumière Company, which supplies a great many towns east of Paris with electric current. The station is located at Alfortville and contains six 700-hp steam engines coupled to alternators. The capacity of each alternator is 540 kw, the voltage 5,240, the power factor 0.75, the frequency 50. The current is transmitted to the various sub-stations by six underground feeders. The transmission voltage is 5,000. In the sub-stations transformers reduce the voltage to either 250 or 110, which is the tension of the distributing system. Data are given which show that this station has been a financial success.—*L'Eclairage Elec.*, April 9.

Protection of High-Tension Lines Against Atmospheric Discharges.—Benischke.—A report of a committee of the Berlin Electrical Society, giving a summary of answers received from various stations on an inquiry with regard to accidents due to atmospheric discharges during 1903. In 41 cases accidents had occurred and since in these cases all known systems of lightning arresters were used, it seems that an absolutely sure safety device does not yet exist. In a certain plant in Bohemia where accidents due to atmospheric discharges appear to occur very often, four different systems of lightning arresters were used simultaneously; nevertheless, three transformers were disabled last year. Experience seems to show that it is useful to insulate the iron frames of the machines and apparatus from earth. In various cases atmospheric discharges were observed while there was no thunderstorm and in other cases lightning arresters, insulators and line poles were destroyed by direct lightning flashes.—*Elek. Zeit.*, April 7.

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Circuit-Breaker.—Bruell.—An article, illustrated by diagrams, on a circuit-breaker for protecting electric lines against currents, dangerous by their duration and intensity, while the circuit is not broken for harmless short increases of the current. The principle is that the flux of the electromagnet which operates the circuit-breaker does not only depend upon the intensity of the current in the line, but upon the thermic conditions of the circuit. For this purpose a resistance is added to the coil of the circuit-breaker and this resistance is a function of the thermic conditions of the line to be protected. The variation of this resistance produces in the coil a variation of current which also is a function of the conditions of the circuit. The variable resistance consists of a metal with a high temperature coefficient, like iron or nickel, subjected to the heat effected by the current and placed under convenient conditions of temperature, caloric capacity and radiation. Several applications of this principle are described and exact data are given for an apparatus based on this principle.—*L'Eclairage Elec.*, April 2.

Insulation Material for Wires.—An article on the insulating material, devised by Hackethal, which has been repeatedly noticed in the Digest. It is formed of a vegetable tissue impregnated with linseed oil and minium and used to good advantage in Germany for telephone wires, especially in the neighborhood of tramway lines. It has also given good results in chemical plants on account of its resistivity against the corrosive action of an atmosphere saturated with acids. Boehm-Raffay recommends the same insulating material for transmission lines and remarks that when too high a current flows through the wire the insulation may be dried out and may even carbonize, but will not burn. Wires of 6 mm. diameter were supplied for several hours with a current density of 50 to 60 amp. per sq. mm., but did not show the slightest dangerous phenomena.—*L'Elec.*, April 2.

REFERENCE.

Telephone Cables.—Schmidt.—An illustrated description of the methods used by various manufacturers for making telephone cables with a plurality of wires with air insulation.—*Zeit. f. Elek.* (Vienna), April 10.

Electro-Physics and Magnetism.

Emanation from Radium.—McClelland.—A paper in which the author remarks that the emanation produced by radium has been much studied and many of its properties are known, but it had so far not yet been definitely settled whether or not the emanation particles are charged. The author has tested this point and has found that the emanation is not charged. This result has a bearing on our conception of the manner in which the radium atom breaks up. The radium atom certainly gives off positively charged particles—the α rays. The emanation particles cannot be what remains of the atom after the emission of one or more α rays, because in that case it would be negatively charged. The atom must have parted with an equal negative charge either by the emission of negative particles or in some other way.—*Phil. Mag.*, April.

REFERENCES.

Radioactivity.—Becquerel.—The first part of an article on the radioactivity of matter. In the present installment he discusses the discovery of the radioactivity of uranium, and the radiation from uranium.—*L'Eclairage Elec.*, April 2.

Alternating-Current Diagrams.—Karapetoff.—The first part of an illustrated serial on applications of alternating-current diagrams. The present installment gives elementary examples.—*Elec. Club Journal*, April.

Alternating-Current Working.—Gump.—The first part of what will probably become a long serial illustrated by diagrams in which the author intends to treat in a simple manner with the fundamental principles of alternating-current engineering.—*West. Elec.*, April 9.

Radiation from a Circular Circuit.—Orr.—A mathematical note on the radiation from a perfect conductor in the form of a very thin circular ring, which carries an alternating current.—*Phil. Mag.*, April.

Electro-Chemistry and Batteries.

Calcium Carbide.—Moissan.—A French Academy note on a new experimental process for making calcium carbide. Metallic calcium combines with lamp black at any temperature above red heat. In any electrolytic process, therefore, where calcium is produced in contact with carbon at red heat, calcium carbide is formed. The author bases a new carbide process on this consideration, which, however, appears to have no commercial value, since the carbide obtained is firmly embedded in a fused mass of calcium chloride and fluoride. A carbide crucible which serves as the positive pole is filled with calcium chloride fused by means of a small electric arc. A vertical rod of graphite serves as a negative electrode. The chloride is put in gradually and after the first fusion electrolysis is carried out by means of a current of 10 to 15 amp. at 120 volts. Chlorine is given off freely and after an hour the process is stopped and the crucible broken. Under the crust is found a mass with a crystalline fracture. The central portion dissolves in water and evolves a mixture of gases containing some 14 per cent. of acetylene, the rest being hydrogen. The process is greatly improved by mixing the chloride with a quarter of its weight of fluoride, which makes the mixed mass more fluid and the conduction of the current more regular. The amount of graphite obtained is small, but it may be increased by adding to the liquid a coarsely-powdered mass of petroleum coke.—*Comptes Rendus*, March 14; Lond. *Elec.*, April 8.

REFERENCE.

Ferro-Silicon.—Amberg.—Ascherman has claimed that by treating a mixture of iron sulphides with quartz in an electric furnace under proper conditions, a reaction may be obtained, yielding ferro-silicon and sulphur dioxide. This would represent an important progress, since the use of carbon as reducing agent would be eliminated. The present author has made an experimental study of this problem, but has found that there is very little hope for the conduction of a process like that of Ascherman on a commercial scale.—*Stahl und Eisen.*, April 1.

Units, Measurements and Instruments.

Comparison of Capacities.—McClelland.—An application of radioactive substances for a simple and accurate method for comparing capabilities. The method is suitable for the determination of capacities of any magnitude down to a few micro-microfarads or even less. The method is based on the fact that the ionization current that can be obtained by the use of a radioactive substance like uranium is extremely constant and can be made so small that the time taken to charge a condenser by it can be accurately measured. This small constant current is used first to charge one condenser to a given potential; and then a second condenser is charged to the same potential, and the time taken in the two cases observed, so that we get the ratio of two capacities by simply observing two intervals of time. It is not necessary to have a supply of radium; uranium is even better in some respects and uranium is to be found in every laboratory. In Fig. 4 *A* and *B* are two insulated plates, one of which, *B*,

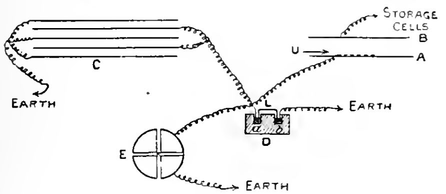


FIG. 4.—COMPARISON OF CAPACITIES.

can be joined to one terminal of a battery of small storage cells, the other terminal of which is to earth. The battery may consist of 100 or more small test-tube cells, so that *B* can be kept at 200 volts or higher. A few grams of uranium nitrate are spread on a sheet of paper and placed on the plate *A*. The radiation from the uranium ionizes the air between *A* and *B*; and so *A* gradually rises in potential if insulated, supposing *B* to be positive. The ionization current thus obtained between two plates increases at first as the potential differences between the plates increases. But when this potential difference is made sufficiently great, the current attains a maximum and does not further increase, for further increase of potential difference between the plates. If, then, *B* is kept at a sufficiently high potential, small changes in this potential, due to the potential of the battery falling, will produce no effect: and again, in making an observation, the potential of *A* need never change by more than one volt, so that there is no trouble in keeping a constant current to the plate *A*. *C* is one of the condensers being compared and *E* is a quadrant-electrometer. *D* is an insulating block of paraffin, containing two mercury cups, *a* and *b*, one of which is connected to earth. A connecting piece, *L*, joins the mercury cups and can be lifted out and lowered again from a distance. As soon as *L* is lifted out, *A* and *C* and *E* begin to charge up; and the time is observed during which the spot of light moves, say, over 100 scale divisions. An exactly similar experiment is made with a second condenser, C^1, instead of *C*. If the intervals of time are t and t^1, respectively, then $C + c$ to $C^1 + c = t$ to t^1, where c is the capacity of the electrometer, the condenser, *A B*, and the connecting wires, and can be determined in terms of *C* by taking an observation with *C* joined of as shown in Fig. 5, and then an observation with *C* disconnected so that only *c* is charged.—*Phys. Mag.*, April.

Optical Ammeter.—Orlich.—A description of a method for measuring currents which is employed at the Reichsanstalt for testing alternating-current ammeters. It consists in heating to incandescence a sheet of platinum foil by a continuous current and an alternating current in succession. If the effective value of the alternating current equals that of the continuous current, the amount of heat developed in the platinum foil is the same in both cases, and if the emission is also the same, the sheet must attain the same temperature in both cases. The equality of temperature may very conveniently be tested by Holborn and Kurlbaum's optical pyrometer. An image of the glowing platinum is projected by means of a lens upon the filament of a small incandescent lamp, which is observed through a second lens. The current feeding the lamp is so regulated that the filament apparently disappears in the bright background. Special provision has to be made for constancy of temperature. As regards radiation, it is kept constant by allowing the platinum to radiate into the open air, and the conduction of heat is kept constant by perforating the electrodes and supplying them with a stream of cold water. The temperature imparted to the platinum sheets varied from 400 to 1,400°. At higher temperatures the method loses in sensitiveness, and the platinum begins to evaporate. The author quotes a number of tests of commercial ammeters. A Kelvin hectoampere balance with subdivided copper leads gave correct readings, but a kiloampere balance containing massive leads required an alternating-current 5 per cent. stronger than the corresponding direct current to produce the same temperature.—*Zeit. f. Instrumentenk.*, March; Lond. *Elec.*, April 8.

Testing Induction Motor Windings.—Garcelon.—An illustrated article in which the author describes tests of induction motor windings. The test is based upon the fact that any error in the winding will destroy symmetry of the magnetic field produced by the winding when single-phase alternating current is passed through it. This, in turn, will affect the impedance of the winding. The first test to be made is always to determine whether or not the winding is correct. This is done by observing the impedance drop across each phase. If these readings indicate an error, then a second test—or location of the error—must be made. The point where the fault exists is indicated by an irregularity of the field-form, which may be investigated by moving an exploring coil around the core. A simpler way is to measure the drop from stub to stub, the stubs being easily exposed by removing the tape. These drops should be alike for each coil symmetrically located with respect to the poles. The author shows how such mistakes as a reversed phase or a reversed group affect the first part of the test and locate themselves at once without an application of a second or locating test. A suitable switchboard for making such tests is described and illustrated.—*Elec. Club Jour.*, April.

Hot-Wire Voltmeter.—Threlfall.—An illustrated description of a new form of sensitive hot-wire voltmeter. The chief peculiarity of the instrument is in regard to the means adopted for securing uniformity of tension of the fine silver wire. The active wire is carried between two adjustable supports, one of which is insulated from the rest of the apparatus. The other support can be moved to and fro in the direction of the wire by means of a micrometer screw. The wire is pulled down at the center by a microscopic hook and spiral spring insulated from the base. A small mirror hinged on a wire stretched alongside rests on the head of the hook. As the active wire heats up, the hook descends and the mirror is tilted downward. There is a small incandescent lamp in the lid of the box enclosing the instrument, and a scale opposite a slot in the front of the case. By means of a prism and lens an image of the filament is thrown on the screen by the mirror, and by turning the micrometer screw this image can be brought to any desired point. Small voltages can be read off at once on the scale, but larger ones are compensated by working the screw.—*Phil. Mag.*, April.

New Books.

DIZIONARIO TECNICO IN QUATTRO LINGUE. II. Tedesco, Italiano, Francese, Inglese. 2 Edizione. Ing. Edoardo Webber. Milan: Ulrico Hoepli. 611 pages. Price, 6 lire.

This is a handy little volume of technical expressions in four languages—English, French, Italian and German—for it is more than simply a dictionary. It is arranged alphabetically, each two pages being printed in four parallel columns, thus: Deutsch, Italienisch, Französich, English. The volume for each language has the phrases alphabetically arranged in the first left-hand column, while the corresponding translations in the other three languages are opposite in the corresponding headed columns; for example, the German volume has the German phrases arranged alphabetically on the left hand of the page, and thus to complete the set one must procure all four volumes.

The arrangement is exemplified by the following quotation:

"Ammoniakgasmotor: Motore ad ammoniaca: Moteur à gaz ammoniac: Ammoniacal Gas Motor."

The book is of convenient size, substantially bound and of excellent typography. It will be found an exceedingly handy volume for those who employ scientific technical phrases.

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY. Vol. IV. Philadelphia: American Electrochemical Society. 192 pages.

Of all the applications of electricity, that of electrochemistry is the youngest and yet has perhaps made the most marvelous development. This is evidenced by the fact that the bulk of the output of the Niagara power plant is employed in electrochemical operations. Had it not been for electrochemistry aluminum would still be a precious metal, nor would carborundum or acetylene have become commercial possibilities. While electricity is the agent which makes these new commercial fields possibilities, it is only by means of the patient investigation of both electricians and chemists that the ability to so employ it has become feasible. No wonder, therefore, that the Electrochemical Society is now one of the most important scientific bodies, or that their proceedings should arouse the liveliest interest.

The present volume reports the transactions of the meeting which took place at Niagara Falls during the latter part of September, 1903. In many respects the papers presented are a marked contrast to those of other professional societies, for they are so brief as in many cases to hypothecate for comprehension an amount of special knowledge much beyond that of the average reader. The volume contains sixteen papers, among which the following appear to be of special interest: "Note on Some Theoretical Considerations in the Construction of Resistance Furnaces," by H. A. Fitzgerald. This paper briefly describes some of the conditions governing resistance furnaces and presents data valuable in designing and proportioning. "Electrolytic Copper Refining," by W. D. Bancroft, contains a quantity of data bearing directly upon the cost of the refinement of copper by electrolysis. A "Note on Berthelot's Law Relative to the Electromotive Forces of Cells," by C. J. Reed, together with Mr. Roberts' contribution on the "Electrical Properties of Free Ions in Solution," is notable as bearing upon the theory of the electrolytic cell.

To even mention all of the contents of the volume would transcend our space limit, but the reader who is interested in and desires to be fully posted in electrochemical affairs should by no means fail to secure this set of papers.

A TREATISE ON FRICTION AND LOST WORK IN MACHINERY AND MILLWORK. By Robert H. Thurston. New York: John Wiley & Sons. 430 pages, 77 illustrations. Price, $3.00.

No engineer can take up this volume without mingled feelings of affection and sorrow. Of affection because Dr. Thurston of all scientific writers most endeared himself both to the student and professional man, and of sorrow because the hand which has produced so many works has now forever laid the pen aside. The "Treatise upon Friction and Lost Work" is so well known to the entire engineering profession that to describe even this latest edition is almost superfluous. The first edition, which appeared nearly 20 years ago, was the earliest attempt to give a systematic and scientific explanation of the doctrine of lubrication, and to so guide the man in the engine room that he might select and apply lubricants with such discrimination as to produce the most successful results. From time to time succeeding editions have built upon the foundation laid by the first one, rearing a structure which has endeavored to keep pace with the art of lubrication, to embody the changes in practice which have occurred and to recommend both methods of applying lubrication and new lubricants. It is perhaps hardly exaggeration to say that Dr. Thurston's treatise laid the foundation of the modern method of lubrication now almost universally adopted in large plants, viz.: that of providing a complete system of flowing lubricant which is pumped through the bearings of every machine, returned to a filtering apparatus and again circulated after being clarified.

The present volume elaborates somewhat upon previous editions by containing a complete résumé of the improvements and changes in the practice of lubrication which have occurred during the last five years. The chapters on the method of applying lubricants, the testing and inspection of them, and the machines which have been developed for this purpose have particularly undergone modification and modernization, and as a result thereof the data relating to the action of lubricated surfaces have been correspondingly expanded and increased both in quantity and in quality.

The chapter upon the "Finance of Lubrication" will be found by the power station and mill owner to be of the greatest value and is unique in the literature of lubricants. Finally, a chapter upon "Recent Investigations and Conclusions" embodies some novel methods of plotting the results of experiments and brings the volume thoroughly into touch with modern practice.

TECHNICAL MECHANICS. By Edward R. Maurer. New York: John Wiley & Sons. 382 pages, 250 illustrations. Price, $4.00.

This volume is the latest addition to a somewhat extensive library of college text-books, of which Weisbach and Rankine were the illustrious and revered progenitors. In his preface Prof. Maurer has defined his object in stating that the work is not a treatise upon pure or applied mechanics, but a "Theoretical Mechanics" for students of engineering. A perusal of this volume fully sustains this assertion, for in many cases the mixture of pure theory with attempted applications to practice appears abrupt and harsh. Some of the definitions strike one peculiarly, for example: "An action of one body upon another which changes or which exerted alone would change the state of the motion of the other body is called a force." One ordinarily would hardly include the operations of heat and electricity, which are customarily spoken of as forces, within such a definition, but the author proceeds to explain that inasmuch as it is necessary to postulate an intervening medium for the operation of a force, this medium may be termed a body.

Throughout the entire work there is a distinctly German flavor and one constantly encounters German methods of analysis and German ways of reasoning, which, while unquestionably of value, are likely to jar a little upon the American reader. In his analysis of the subject of mechanics the author classifies as follows:

$$\text{1. Mechanics: }\begin{cases}\text{Kinematics.}\\ \text{Dynamics}\begin{cases}\text{Kinetics}\\ \text{Statics}\end{cases}\end{cases}$$

and further proceeds to state that statics is that portion which deals with uniform motion. To the bridge builder such a definition will appear somewhat forced, because while theoretically we are all aware that the ultimate particles of even the mosit rigid solids are probably in motion, yet the constructor usually regards his tension and compression members as something as solid and immovable as he can make them, and certainly hopes that they will never escape from their preassigned positions and go gyrating off into space while a limited express train is traveling across the track which they sustain.

There are three sections—Statics, Kinematics and Kinetics—and these are further subdivided into 15 chapters, which, under the heading of Statics treat of Force, Equivalence of Force System, Center of Gravity and Centroid, Attraction and Stress, General Principles of Equilibrium, and the Application of the Principles of Equilibrium.

Under kinematics, the rectilinear motion of a particle is first considered, then curvilinear motion and motion of a rigid body.

Kinetics is sub-divided into motion of a particle and of a system of particles, translation of a rigid body, rotation, work and energy, and finally impulse and momentum.

A quartette of appendices, of which the first is a brief explanation of the principles of vectors followed by a dissertation on rates of motion, the dimensions of units and moment of inertia, complete the book.

The volume is clearly and tersely written. For each problem, as far as possible, both a graphical and analytic analysis is given. The illustrations are well selected and present the various subjects clearly. From a theoretical standpoint it is attractive, but when one lays it down the academic flavor is so strong that one is inclined to wonder whether a student thereof will not be so afflicted with theoretical hydrocephalus as to be unfitted for the every-day experience of the shop or of the railway.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Twenty-sixth Convention. Published by order of Executive Committee. New York: James Kempster Printing Company. 221 pages, illustrated.

It is the fashion for those who are interested in commercial developments which lie along technical lines, to hold occasional conventions at which those interested in the particular branch represented can meet and interchange ideas. One of the earliest organizations of this kind is the National Electric Light Association, and indeed this body has almost set the pace for other similar associations to follow.

The volume in hand is the report of the *Proceedings* at the last convention, an examination of which shows a series of papers partly scientific and partly commercial, but all apropos to the best development of the particular industry. The matter presented is so carefully considered, so well arranged, so thoroughly pertinent to the questions of the day, so generally helpful, and, withal, so dignified in tone as to make one wonder at the contrast presented between the National Electric Light Association and some of the younger associations. Naturally, the present volume commences with the president's address, which is chiefly a perusal of the work accomplished by the organization during the past year.

This is followed by Mr. T. C. Martin's report upon the "Electrical Progress of the Year," a document that is replete with statistics and will put the reader perfectly *au courant* with electrical development in 1903. The next paper is a report upon office methods and accounting by Mr. W. M. Anthony, which is strictly a commercial contribution. Some one has tritely remarked that "any business can be made to pay if you know what it costs, while no business can be made to pay if you don't." This is the keynote of Mr. Anthony's report. He deals with the methods of accounting, particularly with the employment of various mechanical aids, such as the addressograph, comptometer and a number of other mechanical devices, which are aids to the bookkeeper and statistician. The author shows a number of forms applicable to electric light and street railway stations which may be studied with much profit, and, indeed, though the report is addressed particularly to the electrical fraternity it is well worth the study of any business man.

The paper on "Boiler Efficiencies," by A. Bement, and the one on the "Application of the Four-Ampere Series Alternating Arc Lamps" are particularly worthy of study to those who are interested in these subjects. "The Young Engineer in the Electric Light Plant," by Charles F. Scott; "Tactful Relations with Customers," by John W. Ferguson; "Relations with Employees," by Arthur Williams, and "First Aids and Appliances," by Dr. J. D. McGowan are not technical papers in any sense of the word, but are addressed to the business side of electric lighting and thus give to the proceedings of this Association a breadth which the transactions of purely technical societies usually lack. The paper by Dr. McGowan would have had much more value if, previous to its preparation, he had consulted the very considerable literature on the subject. His presentation is decidedly amateurish in view of the audience addressed.

In a report upon "District Steam Heating," by John W. Glidden, and in a paper on "Salt as a By-Product," by Alex. Dow, some methods whereby central stations may increase their income by the utilization of the so-called by-products are interestingly discussed.

Of all the papers the report in appendix A upon "Decorative and Sign Lighting," by Arthur Williams, is the most elaborate, for it is profusely illustrated by a series of some of the finest half-tones that one could imagine. Undoubtedly, however, the most valuable feature of the volume is the "Question Box," which department should be of immense benefit to the members of the Association, whether as querists or for the general mass of practical information conveyed.

BOOKS RECEIVED.

MANUALE PRACTICO PER L'OPERAIO ELETTROTECNICO. By G. Marchi. Milan: Ulrico Hoepli. 337 pages. 189 illustrations. Price, 2.50 lire.

DIE ELEKTROLYTISCHE RAFFINATION DES KUPFERS. By Titus Ulke. Halle: Wilhelm Knapp. 152 pages, 86 illustrations. Price, 8 marks.

Carcano Power Factor Indicator.

BY GUIDO SEMENZA.

What may be termed a novel feature in the instrument to be described below is that it is rather a power factor meter than a power factor indicator, since it affords a means for taking accurate data; whereas, the ordinary power factor at the present time does not give indications of any great accuracy.

The new instrument is based on a reduction to zero method, which, while not permitting the following of sharp variation, facilitates, on the other hand, the realization of a relay recording apparatus. The instrument comprises a disc which can freely rotate under the action of a shunt and of a series set of coils, in connection with which a special rheostat box is used. The way to proceed in taking measures is as follows:

The rheostatic resistance is varied until the rotating disc is brought to rest, when the values of the resistances give the corresponding value of the power factor; and since to each position of the rheostat there corresponds one value of the power factor, the rheostat is directly graduated in power factor values. The principles on which Mr. Carcano, electrical engineer in charge of the Milan Edison Company's testing department, has designed his method, are as follows:

In an apparatus like the one shown in Fig. 1, consisting of a disc which can rotate under the influence of a revolving field due to a system of coils, the motion will cease the moment all the currents flowing through the different coils have the same phase; therefore, if a number of coils are connected in series in the circuit, and another number of them in shunt, the motion will cease when the current, i, which flows through the coils connected in shunt, are in phase with the current, I, of the principal circuit. Now, for a given shunt coil having such a ratio between reactance and resistance as to cause the current, i, to lag by an angle Θ behind the e.m.f. applied to its ends, such condition will be realized when the principal current, I, lags behind the e.m.f. acting in the circuit, by an angle $\phi = \Theta$. (See Fig. 2.)

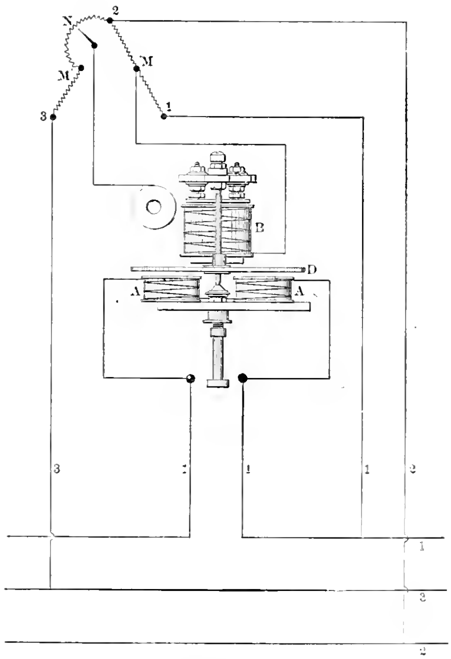


FIG. 1.—DIAGRAM OF APPARATUS.

It follows that if we have at our disposition a coil or a number of coils in shunt, in which the ratio between reactance and resistance, or the angle Θ, can be varied, it is quite possible to balance any value of ϕ. We can, therefore, for any value of the power factor, obtain a zero position of the disc by altering the value of Θ. If the method of altering the angle Θ enables us to know at any moment its value, we can at once read the angle Θ, corresponding to the angle ϕ. It is possible to obtain for any value of ρ the current I in phase with i, without making an alteration in the shunt coils by applying to them, for every value of ϕ, a voltage taken from the opposite points of the circuit, in such a manner that the displacement between such voltage and the principal current is exactly equal to the angle $(\phi - \Theta)$, but of opposite sign. (See Fig. 2.)

In the case of polyphase currents the method is particularly easy and simple. For instance, with three-phase currents, the following arrangement can be applied (Figs. 1 and 3): The ampere coils, A, of the system are put in circuit with the wire, i; B are the coils in shunt; A and B are arranged in such a manner as to produce the rotation of a disc D, so long as a difference of phase exists between

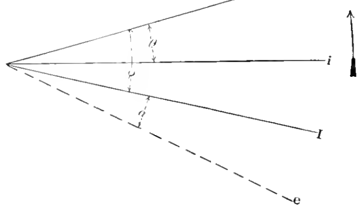


FIG. 2.—ANGLES OF LAG.

i and I, the rotation ceasing when i is in phase with I. Between the wire 1 and 2 of the system a resistance is inserted of which M is the middle point, and between 2 and 3 another resistance is inserted of equal value, but divided in two portions, one being a fixed resistance and the other a rheostat having a certain number of contact points. The shunt coils are connected to M and the sliding handle of the rheostat.

By changing the position of the rheostat we change the phase angle between the e.m.f. acting on the shunt coils and the current I, and the limits of this change are a lag or a lead of 30°. Then the current i, which flows through such coils will vary from a leading value of $30° - \Theta$ to a lagging value of $30° + \Theta$ with respect to I; and through the rheostat N we are able to obtain i in phase with I; or in other words the stoppage of the movable disc for any value of ϕ, comprised between $30° - \Theta$ and $30° + \Theta$, leading or lagging.

As long as i is slightly lagging or leading with respect to I, we will have motion on one or the other direction. In practice the sensibility is very high, since a slight variation in the load of an induction motor arising from its power factor is sufficient to impart a decided motion to the disc, once the position of equilibrium is reached. To every contact point of the rheostat N—that is to say,

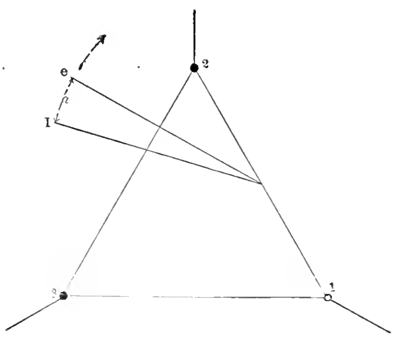


FIG. 3.—DIAGRAM FOR THREE-PHASE CIRCUITS.

to every ratio of the resistance inserted between N and 2 and the one inserted between N and 3—the equilibrium will correspond to a given value of ϕ. In this way a proper graduation or scale of power factor can be established for every value of the resistance, and in practice it will be sufficient to move the contact lever on the contact points forward or backward to obtain the stoppage of the movable disc, and the power factor will be the one shown at the resistance point in contact with the lever.

We thus have an indicating apparatus which can easily also be made a recording apparatus. In fact, if the disc instead of being free is kept to a zero position by a system of springs, and when forced out of such a position, can close the circuit of a relay recording instrument, it is easy to arrange that the motion of the recording pointer will change the position of the rheostat until the disc has taken its zero position. This principle is successfully applied in the Olivetti recording wattmeter.

Mr. Carcano's method and instrument are quite a novelty in the field of alternating-current measurement, and no doubt they will be of great service in testing induction motors and in the control of synchronous motors and converters.

Equipment for New Wanamaker Store.

The huge new Wanamaker department store to be built between Eighth and Ninth Streets on Broadway, New York, will be equipped with one of the largest and most elaborate isolated electric lighting plants in the country. The plant will be a three-wire one and will have many new features. Its capacity will be 1,800 kw. There will be 1,700 arc lights and 6,000 incandescents of 16-cp capacity.

The generators will be six in number, Westinghouse engine type, direct-connected, of 300-kw capacity each. The engines will have a capacity of 450 hp each and are to be horizontal cross compound, automatic cut-off, built by the Buckeye Engine Company, of Salem, Ohio. All couplings are to be made with galvanized iron. The boilers are to be Babcock & Wilcox. The motors will aggregate about 350 hp in capacity. They will be of Westinghouse make and are to range in size from 10 hp to 60 hp. A 10-hp motor and a 25-hp one will be used to drive disc fans, while a 40-hp machine will operate an exhauster. A 20-hp motor will drive a house pump and a 10-hp will work a brine pump. The feeder to the ejecter compressors will be driven by a 20-hp motor. The bilge and drinking water pumps will be 10-hp and 7½-hp motors. A 10-hp machine will drive the temperature regulator, while 25-hp, 45-hp and 60-hp motors will operate fans. The lamps will be operated at 125 volts. The motors will be driven at 250 volts.

An extra heavy conduit will be used in the plant. It will weigh 86 pounds to the 100 ft. The wires will be enclosed in ½-in. pipe, of which there will be several miles. The conduit contract will be undertaken by the Safety Armorite Conduit Company, of Pittsburg, Pa. The panel boards will be of special design.

The Thompson-Starrett Company, 51 Wall Street, New York, have secured the contract for the construction of the building, including the plant. D. H. Burnham & Co., Chicago, are the architects. Mr. Charles Wilks, the Burnham Company's chief engineer, designed the electric plant. The contracts for equipment, etc., are being awarded through H. D. Babbit, the electrical engineer of the Thompson-Starrett Company, who was formerly associated with the Chicago Edison Company. The plant will entail an expenditure not far short of $200,000.

Automobile Parade.

An automobile parade will be made in New York City, April 30, under the auspices of the Automobile Club of America. The head of the parade will start in front of the club house on Fifth Avenue, the officers of the club with their invited guests being in the van. Mayor McClellan will ride at the head of the procession, and at the end of the run he, with other officials, will review the parade from the windows of the club house, after which the parade will disband. The time occupied by the parade will be from one and one-half to two hours. It will start at 2 o'clock promptly, and by 4 o'clock the last car will probably have passed the club house. The parade will be divided into sections, according to the variety of the machines. In the first section will be the guests and club officers, after which will come American gasoline runabouts, American gasoline touring cars, racing cars, foreign gasoline cars, electric runabouts, electric pleasure vehicles, steam pleasure vehicles, electric cabs and hansoms, and commercial vehicles. No notices of any kind will be allowed on the vehicles.

Milne Water-Tube Boiler and Superheater.

The accompanying illustrations show elevations and sections of the Milne water tube boiler, and also in figure to the right, an elevation of the Milne superheater connected to the boiler. The boiler is a simple combination of four parts, namely, an upper and lower drum, connected by a number of sections of 4-in. seamless drawn-steel tubes, arranged in staggered effect, to which is coupled an independent feed water section composed of a single staggered row of tubes. The design, it will be seen, avoids the numerous parts and complications so prevalent in steam boiler practice and reduces the weight of material to a minimum. Materials only necessary to generate steam efficiently are used, and with the best fuel economy.

The tubes are all curved to a five-foot radius. There are five different bends in a complete set of tubes and the front and back rows are interchangeable. The tubes are spaced and arranged so that any of them can be removed and replaced without disturbing the brick work or the tubes adjoining.

The feed water section is composed of a single staggered row of 4-in. tubes, extending completely across the back of the boiler, their upper ends expanded into an independent header, not connected with the upper drum, which receives the feed water. Feed water is not admitted to the upper steam and water drum. This feed water section takes up considerable heat that otherwise would be wasted, as it presents a cool surface to the escaping gases. It also adds another element of safety in protecting the drum plates from the influence of the feed water, particularly in case of low water, and much drier steam is produced, as fluctuations in temperature due to variable feed supply do not occur.

The furnace design and disposition of heating surface will, with intelligent firing, produce the most efficient combustion. The fire brick arch covering the furnace maintains the high temperature required to ignite and burn the fuel gases, and as the heating surface is situated at the back of the furnace and bridge wall, the highest furnace temperature is maintained, and the temperature of the fuel gases not reduced until combustion is completed.

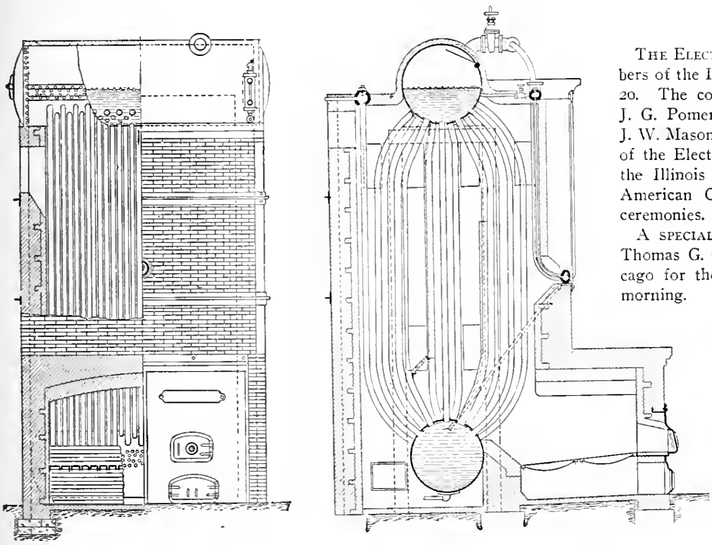
The boiler is constructed of wrought steel material throughout, and does not contain flat, stayed or inaccessible surfaces, all surfaces being cylindrical, of moderate diameters, and accessible in the most direct manner for every purpose. The vertical position of the tubes prevents the collection of dust and ashes, thereby insuring a rapid and uniform transmission of heat; and as the gases of combustion travel about 70 ft. over the heating surface, and finally over the feed water section before escaping, the highest fuel economy is insured.

The tubes can be cleaned with greater ease, and with less expense than straight tubes. Scaffolding or other structures are not needed, and there are no hand-hole plates to remove and replace. One man-hole gives access to every tube in the boiler, and any of the mechanical rotary cleaners, now so extensively used, will clean them in the most direct manner.

The Milne superheater, shown in the figure to the right, is of the most simple form, being composed merely of an upper and lower steel header, into which the superheating tubes are expanded, the flexibility of the system amply providing for expansion and contraction. Being situated in the front of the boiler, it is directly accessible for any purpose, and in case of serious derangement can be removed entirely while the boiler is under pressure. Equally important is the fact that the degree of superheat can be varied to suit all practical working conditions.

The makers claim that the simplicity of the complete boiler and superheater guarantees the greatest ease and efficiency in operation and the lowest cost for maintenance; and that the large water holding capacity and ample steam liberating surface insure steady water level and perfectly dry steam.

These boilers and superheaters are constructed in all sizes up to 1,000 hp and for any steam pressure, the design permitting ample grate area for capacities far in excess of the rating. They are made by the Milne Boiler Company, 95 Liberty Street, New York.



FRONT AND SIDE SECTIONAL ELEVATION OF WATER TUBE BOILER.

Iowa Convention Notes.

THE ELECTRICAL SUPPLY MEN gave a smoker to the members of the Iowa Electrical Association the evening of April 20. The committee in charge of the arrangements were J. G. Pomeroy, of the Adams-Bagnall Electric Company; J. W. Mason, of the Central Electric Company; P. R. Boole, of the Electric Appliance Company, and N. G. Harvey, of the Illinois Electric Company. Thomas G. Grier, of the American Circular Loom Company, acted as master of ceremonies.

A SPECIAL CAR of Chicago supply men arranged for by Thomas G. Grier, W. S. Goll and W. H. Colman left Chicago for the convention Tuesday night, returning Friday morning.

THE NATIONAL ELECTRIC COMPANY, Fort Wayne Electric Works, and Illinois Electric Company made parlor exhibits of light apparatus and specialties.

The following supply and manufacturing concerns were represented: American Steel & Wire Company, American Circular Loom Company, Thomas G. Grier; Allis-Chalmers Company, E. Dryer; American Electric Works, American Transformer Company, P. T. Ackerson; Adams-Bagnall Electric Company, J. G. Pomeroy; Bullock Electric Manufacturing Company, Bryan-Marsh Electric Company, J. S. Corby, J. L. Barnard; Central Electric Company, J. W. Mason, J. G. Ball, C. A. Filker; Crescent Company, Albert Meyer; Crouse-Hinds Company, F. F. Skeel; Columbia Incandescent Lamp Company, J. G. Boyd; Dearborn Drug & Chemical Company, Diamond Meter Company, Electric Appliance Company, P. R. Boole, Leon Bly; Ewing-Merkle Electric Company, Electric Storage Battery Company, J. A. White; Ft. Wayne Electric Works, Garton-Daniels Company, W. P. Cosper; General Electric Company, W. H. Colman, G. A. Seabury; General Incandescent Arc Light Company, Francis Raymond; Gould Storage Battery Company, E. L. Draffen; Guarantee Electric Company, Hazard Manufacturing Company, Heine Safety Boiler Company, James H. Harris; Illinois Electric Company, A. H. C. Dalley, N. G. Harvey, H. W. Johns-Manville Company, F. E. Johnson; Macomber & Whyte Rope Company, Manhattan Electrical Supply Company, W. N. Matthews Brothers, Monarch Electric & Wire Company, New York Insulated Wire Company, Nungesser Electric Battery Company, A. D. Trempe; National Electric Company, A. P. Peck; National Conduit & Cable Company, F. B. Switzer; Nebraska Electric & Fixture Company, A. G. Munro; Nernst Lamp Company, Robert P. Payne; Osborne Flexible Conduit Company, C. B. Roulet, I. A. Bennett; Pass & Seymour, J. S. Jackson; Phelps Company, I. A. Bennett; John A. Roebling's Sons' Company, W. H. Schott, J. C. Hormung; Sawyer-Man Electric Company, A. Sorge, Jr., & Co., E. Emery, George Searing, C. A. Ross; Standard Underground Cable Company, Stanley Instrument Company, F. J. Alderson; Standard Electrical Manufacturing Company, R. W. Loose; Tri-City Electric Company, I. N. Butterworth; Wesco Supply Company; Waterloo Electric Supply Company, L. G. Hopkins; Westinghouse Machine Company, J. B. Wilkinson; Westinghouse Electric & Manufacturing Company, W. R. Pinckard, H. G. Peticolas, Arthur Huntington, A. M. Miller; Western Electric Company, M. R. Lash.

Regulating and Reversing Controllers for Machine Tool Service.

The use of individual motors for driving machinery has grown in general favor as the advantages derived from an independent source of power for each appliance have become recognized. Shunt and compound variable-speed, direct-current motors especially adapted for such service have been designed and suitable controllers for applying the power to the work in hand and properly regulating the speed of the machinery are thus a prime requisite.

A line of controllers, particularly adapted for use with independently-driven machine tools is manufactured by the Westinghouse Electric & Manufacturing Company and known as types V and W, the assortment being comprised of over 600 different sizes and capacities, to cover all the requirements of service. The type V controllers are used upon two-wire, single-voltage circuits, eight forward speeds and four reverse speeds being obtained by resistance in the shunt field circuit. In the type W, used upon three-wire, two-voltage circuits, the speed variations are obtained by means of the two voltages as well as the shunt resistance, provision being made for six forward speeds on the lower and nine on the higher voltage, and six reverse speeds on the lower voltage. Experience has proven that this number of speed variations is the best possible for general use, and affords all the differences in speed required in service.

The type V controllers are ordinarily adopted when a speed variation of 2 to 1 is required, and the type W for variations of 4 to 1, although other variations may be obtained as desired, each installation being separately considered and the controller used which is best adapted to the motor with which it is to be used. The successive intermediate speeds are arranged in practically geometrical progression, but extra leads are provided by the use of which the owner may make such changes as he desires.

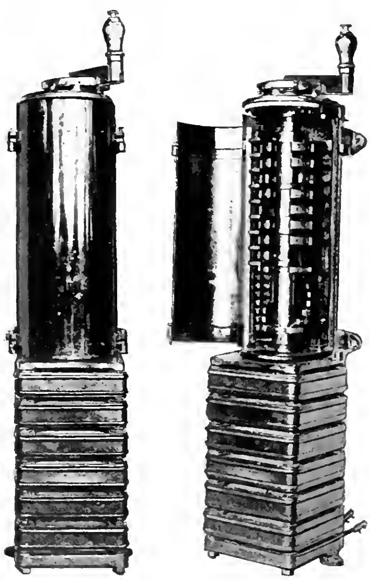


FIG. 1.—CONTROLLER FOR TWO-WIRE, SINGLE-VOLTAGE CIRCUITS.

In general structure, these controllers are based upon the most modern and improved types of Westinghouse design, insuring reliability and long life regardless of hard usage. They are thus practically independent of their surroundings, and give satisfactory service under all conditions. The drum is made of metal and secured to an insulated shaft. The contact strips are of hard rolled copper. The fingers are also made of hard rolled copper and provided with lock nuts and adjusting screws. All parts are liberally proportioned and are made easy of access. The cover can be removed by withdrawing with the fingers the pins which hold it in place, and access to the leads is quickly obtained by removing the strips screwed to the back of the controller. The contacts, the arcing tips on the main contacts and the fingers are easily removed and renewed.

Another important particular which assures the adaptability of these controllers to various conditions is the fact that the handle and ratchet are so designed that they may be removed from the controller and placed at any point which is convenient, and which permits connection to the controller by means of bevel gears and shafting. This not only adapts the apparatus for distant control, but it enables the operator to use the identical handle, ratchet and indicator dial which are furnished with the controller. This not only saves the expense of making a new handle and ratchet, as is necessary with other appliances, but retains the advantages of the peculiarities of the Westinghouse operating mechanism.

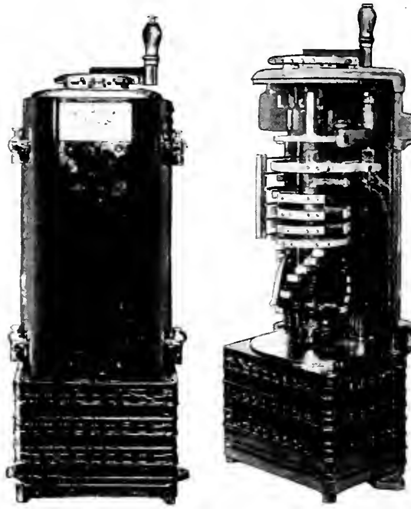


FIG. 2.—CONTROLLER FOR THREE-WIRE, TWO-VOLTAGE CIRCUITS.

The notches in the ratchet are positive, and the design is such that as each step is reached a key drops into a notch and stops the handle, holding it firmly in place until released by a pressure upon the thumb stop in the end of the handle. The operator is thus able to watch his work uninterruptedly while applying power or changing the speed, a fact of distinct advantage.

In the type V controller the starting resistance is inserted when the first contact is made, being cut out when the handle is moved to the second position.

In the type W, a cam lifts from the contact the finger, whose function is to cut out the starting resistance, and thus leaves the resistance in circuit when starting or when changing to a higher or a lower voltage. By means of a dash-pot, the return of the finger is delayed for a predetermined interval of time, the speed of the return being regulated by means of a screw. The checking medium is a non-freezing liquid, greatly superior to air as a means of even and close regulation and not affected by atmospheric conditions. If desired, the dash-pot can be removed without disturbing any other portions of the controller.

Arc shields are placed between all contacts which carry the main current, and in addition all sizes above 10 hp have a powerful magnetic blow-out coil. In capacities to and including 10 hp, the resistance, which is of the imbedded type, is regularly mounted directly beneath the controller. In large sizes it is mounted separately. The leads are conveniently located and have screw connectors.

In every particular these controllers have been designed to give superior service under even the least favorable conditions. They have an unusual amount of strength and durability, and the large assortment insures the adoption of the proper controller to give the best results in every instance.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and narrow, trading being entirely professional. The uncertainty as regards the Northern Securities complications is still a factor in the market. The reports of slackness in the iron trade caused weakness in United States Steel preferred. Easy conditions prevailed in the money market, and the demand for time loans was light, plenty of money being obtainable at 4 per cent. Commercial paper was in demand at 4½ per cent., but the supply was only moderate. Toward the end of the week there was a better tone in the stock market. Some strength was exhibited in traction, gas and other specialties. Metropolitan Street Railway was favorably influenced by the prospect of its bidding on some of the new subway work proposed by the New York Rapid Transit Commission. The prices ranged from 110½ to 114⅝, closing at 114⅛—a net gain of ⅜. Fifty-one thousand, nine hundred and eighty shares of this stock were traded in. Brooklyn Rapid Transit was quiet in respect to trading, but it was firmer and closed with a net gain of 1¼ points, the last price being 47½, which was also the highest of the week. General Electric closed at the highest quotation, 164½, and Westinghouse at 158, which represents a net decline of 3 points. Allis-Chalmers common closed at 6½ which was also the lowest point for the week and a net loss of 1⅜, while the preferred closed at 43, the highest figure. The closing quotations and net changes in other stocks in the electric class were: American Telegraph and Cable, 86, a loss of ¾; American Telephone and Telegraph, 126¾, gain ¾; Commercial Cable, 187, loss 2, and Western Union, 88⅞. The curb market showed some activity and firmness, but was irregular. The main interest centred in the newer stocks, Mackey Company shares being freely dealt in. The common showed noteworthy strength, while the preferred reacted several points on what looked like profit-taking sales. Mackey common closed at 24, being a net gain of 4 points, but the preferred lost 3⅞, closing at 134½. The closing prices of the main market, of April 26, are as follows:

NEW YORK.

	Apl.19	Apl 26		Apl.19	Apl.26
Allis-Chalmers Co.	6¾	6½	Electric Vehicle	5¾	8
Allis-Chalmers Co. pfd.	40	39	Electric Vehicle pfd.	9	8
American Tel. & Cable	85	86	General Electric	163½	161
American Tel. & Tel.	126	126	Hudson River Tel.	..	..
American Dist. Tel	23	23	Metropolitan St. Ry.	111¼	113
Brooklyn Rapid Transit	44¾	46½	N. Y. & N. J. Tel.	..	..
Commercial Cable	170	185	Marconi Tel.	..	..
Electric Boat	24	25	Western Union Tel.	88¾	88⅝
Electric Boat pfd.	57	61	Westinghouse com.	159	158
Electric Lead Reduction	½	½	Westinghouse pfd.	175	175

BOSTON.

	Apl.19	Apl.26		Apl.19	Apl.26
American Tel. & Tel	..	126	Western Tel. & Tel. pfd.	..	*80
Cumberland Telephone	..	113	Mexican Telephone	.	1¼
Edison Elec. Illum.	..	238	New England Telephone	..	*123
General Electric	..	160¼	Mass. Elec. Ry.	..	20
Western Tel. & Tel.	..	..	Mass. Elec. Ry. pfd.	..	73

PHILADELPHIA.

	Apl.19	Apl.26		Apl.19	Apl.26
American Railways	44	44	Phila. Traction	95⅞	..
Elec. Storage Battery	57	57	Phila. Electric	5⅝	5⅝
Elec. Storage Battery pfd.	57	57	Phila. Rapid Trans.	13¾	13½
Elec. Co. of America	8	7⅞			

CHICAGO

	Apl.19	Apl. 26		Apl 19	Apl.26
Central Union Tel.	..	..	National Carbon pfd.	100	102½
Chicago Edison	..	..	Metropolitan Elev. com.	15	15
Chicago City Ry.	155	155	Union Traction	5¾	5½
Chicago Tel. Co.	115	..	Union Traction pfd.	30¼	30¼
National Carbon	28	28			

*Asked

TROLLEY AND STEAM.—The statistics of street railways are compared by the *Wall Street Journal*, with the statistics of the steam roads in the United States for the same year. Already the mileage of the electric street railways amounts to 11 per cent. of the steam mileage. The capital stock amounts to 21 per cent.; the funded debt to 13 per cent.; the dividends to 18; and the interest on bonds to 14 per cent. When one remembers that electric street railways are a development of a very few years, and the steam railroads of the United States are a development of three-quarters of a century, this showing seems little less than marvellous. It appears, however, that the total capitalization of stocks and bonds of the street railways amounts to $96,287 per mile, while the total stock, bonds and unfunded debt of the steam railroads amounts to $64,371 per mile. The dividends paid by the electric street railways amounted to 2.5 per cent. of the total outstanding stock, while the dividends paid by the steam railroads amounted to 2.9 per cent., the comparison being for 1902. From this it would appear that the steam railroads are on a better basis, as regards earning power, than the street railways. The latter, however, are essentially passenger traffic lines. In 1902 they carried nine times as many passengers as all the steam railroads of the United States. These, while carrying over 655,000,000 of passengers, nevertheless obtained the bulk of their revenue from the carriage of freight.

CHICAGO EDISON REPORT for the year ended March 31, 1904, is as follows:

	1904.	1903.	1902.	1901.
Gross	$3,837,659	$3,409,576	$2,806,609	$2,517,219
Expenses	2,515,050	2,195,647	1,720,820	1,614,260
Net	$1,322,619	$1,213,929	$1,085,789	$902,959
Charges	307,088	300,900	300,983	279,791
Surplus	$1,015,531	$912,939	$784,806	$623,168
Dividends	720,526	593,346	515,982	477,688
Surplus	$295,005	$319,593	$268,824	$145,480

The general balance sheet as of March 31, 1904, compares as follows:

Assets:	1904.	1903.	1902.
Plants, etc.	$16,940,220	$14,230,840	$12,766,540
Material	326,498	388,025	405,494
Accounts receivable	656,998	784,465	358,997
Cash	262,933	136,035	121,033
Total	$18,186,650	$15,539,365	$13,652,064
Liabilities:			
Capital stock	$9,865,880	$7,589,500	$6,899,900
Advance payment for stock	....	997,357	....
Bonds and debts	6,483,000	5,508,000	5,508,000
Accounts payable	250,130	123,859	140,336
Depreciation reserve	690,000	590,000	500,000
Insurance fund	76,000	68,000	6,000
Surplus account	797,088	610,084	431,077
Open accounts	24,551	52,565	112,751
Total	$18,186,650	$15,539,365	$13,652,064

The allied Commonwealth Electric Company makes the following report:

	1904.	1903	1902.	1901.
Gross	$1,350,999	$1,002,085	$769,666	$629,047
Expenses	834,734	623,264	497,903	410,176
Net	$516,265	$378,821	$271,763	$218,871
Charges	275,737	220,704	167,261	137,770
Surplus	$240,528	$158,117	$104,502	$81,101

The Chicago Edison Company earned 10.2 per cent. on the present outstanding capital, and has declared the regular 2 per cent quarterly dividend payable May 1st. Its gross business increased 12.5 per cent. for the year. The Commonwealth Electric Co. is at present a subsidiary corporation, owning the outlying plants, but in 1911 it will become the successor of the Edison Co. It is now building what will be the largest central station plant in the country, and its business increased 34.8 per cent. last year. The earnings amounted to 3.84 per cent. on the present outstanding capital. In the balance sheet of the Commonwealth Electric appears an item of $32,033 credited to "municipal compensation reserve." The company's ordinance provides that the company shall begin the payment of compensation to the city at the rate of 3 per cent. per annum of the gross receipts after the first five years of the life of the franchise. Compensation began to accrue on June 30 of last year.

DIVIDENDS.—Directors of American Light and Traction Company have declared the regular quarterly 1½ per cent. dividend on the preferred stock, payable May 2. A dividend of 40c. per share has been declared upon certificates of deposit of the Edison Electric Illuminating Company, of Brooklyn, payable May 5. Automatic Electric Company's directors have declared the regular quarterly dividend of 2 per cent. payable May 2. This is the old Strowger Automatic Telephone, which has grown into a big business. American Graphophone directors have declared a dividend of 1 per cent. on the common stock, payable June 15. The Cincinnati Gas & Electric Company has increased the dividend ½ per cent. to 4½ per cent. per annum.

FINANCING LONDON UNDERGROUND.—Speyer & Co. and Blair & Co. offer $10,000,000 5 per cent. profit-sharing secured notes, due June 1, 1908, of the Underground Electric Railways Company, of London, England. The notes are offered at 96½ and interest. This is part of an issue of £7,000,000 sterling, of which $16,650,000 are payable in United States gold. The proceeds of this issue of notes are being used for the construction and equipment of the railways of the Tube Companies, and for electrically equipping the existing lines of the Metropolitan District. The Underground Co. has a capital of £5,000,000 fully subscribed (£2,500,000 paid up). The articles of association provide that Messrs. Speyer & Co., of New York; the Old

Colony Trust Company, of Boston, and Speyer Brothers, of London, shall, during a period of ten years, have the right to nominate a majority of the directors for the time being of the company, thus insuring a continuity of management. Mr. Yerkes says: "There is every probability that all the tube lines will be finished in about two and a half years from the present time. The fact that the power station will be entirely completed leaves us with only the construction of the two lines, and the building of the stations, which can always be pushed along with rapidity. I am happy to say that our expenditures are well within our estimates, which is a condition not often realized."

WASHINGTON, D. C., REPORTS.—The Washington (D. C.) Railway and Electric Company reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.
Gross	$1,400,441	$2,325,755	$2,162,559
Expenses	561,271	1,251,814	1,187,449
Net	$839,170	$1,073,961	$975,110
Other income	....	19,644	16,016
Total income	$839,170	$1,093,605	$991,126
Charges	617,291	892,477	892,477
Surplus	$221,879	$201,128	$98,649

GENERAL ELECTRIC ANNUAL MEETING.—The annual meeting of the stockholders of the General Electric Company will be held at the company's office in Schenectady, N. Y., on May 10, 1904, for the election of directors for the ensuing year.

Commercial Intelligence.

THE WEEK IN TRADE.—The cold weather complaint is still with us. It is interfering with planting preparations and growth, and interrupts outdoor activity in many lines, notably building. Spring trade on the whole is very quiet and collections are slow, although a slight improvement is noted in the latter as compared with previous weeks. All weather and crop reports show the influence of the cold upon plant preparation and growth. In the iron and steel industry the quiet of the previous week has been more pronounced. The demand for deliveries during the second quarter of the year is insistent, but there is an evident hesitation in placing orders for finished products for the remainder of the year. Manufacturers of agricultural implements are the freest buyers. The Pacific Coast lumber trade is still unsatisfactory, but there is report of improvement in general trade. In the eastern markets retail and jobbing trade is rather quiet. There was an increase in business failures during the week ending April 21, as compared with those of the corresponding week last year, the figures for the two periods being 199 and 152 respectively. Copper was dull and featureless, the closing quotations being 13 at 13¼c. for Lake; 12⅞ at 13c. for electrolytic, and 12½ at 12¾c. for casting stock. Activity is noted in the rubber trade.

BIG AUSTRALIAN LIGHTING AND POWER SCHEME.—Australian advices state that an electric light and traction offer has been made to the Victorian Government through the representative of a local company now in London. The gentleman in question, T. Holroyd, manager of the Victorian Light and Power Distributing Corporation, has, according to cabled reports, associated with his company five leading electrical engineering firms in Great Britain, one of which concerns is understood to be the British Westinghouse Electric and Manufacturing Company, Limited. This syndicate has cabled an offer to the Victorian Government to supply the Government and City Councils with electric current at 1d.—two cents—per unit provided not less than 10,000,000 units are consumed annually for at least 10 years. The syndicate intends to generate current from the large coal deposits known to exist between Laverton and Werribee, some seven miles distant from Melbourne. These deposits were tested by Mr. Holroyd's company, who hold options on over 10,000 acres of land. Their proposal is to erect in the vicinity of Laverton, a plant whence the power could be distributed and the consent of a number of municipalities was obtained by the company some time ago. Half their capital being expended in the erection of boring plant, etc., and a large sum being required to carry out the proposals in their entirety, Mr. Holroyd went to London to float a larger company, and the outcome of his visit is the offer before stated. Under their programme, as put forward some time ago, the Victorian members of the syndicate undertook to supply power to private consumers at not more than 8 cents per unit for lighting and not more than 4 cents per unit for power purposes.

THE HENRY R. WORTHINGTON HYDRAULIC WORKS, at the corner of Rapelyea and Van Brunt Streets, Brooklyn, are shortly to be removed to Harrison, N. J., to occupy the new $2,000,000 plant of the International Steam Pump Company, now nearly completed. The Brooklyn site consists of two city blocks, or about four and one-half acres, while the Harrison plant is located on a 35-acre tract and contains 18 acres of floor space. The Worthington Company is one of the oldest and largest manufacturing concerns of Brooklyn, having been founded in 1843 by Henry R. Worthington, the inventor of the duplex steam pump and other hydraulic devices. About 2,000 men are employed in the South Brooklyn works and the new plant at Harrison will accommodate from 5,000 to 6,000 men. The Brooklyn works will probably be sold, the company having already disposed of its large foundries at Elizabethport, N. J. The new plant will employ electric power on a large scale.

NEW ORLEANS LIGHTING FRANCHISE.—A 10-year franchise to date from September 30, 1905, for lighting the public highways, street, squares and parts of the city of New Orleans with electricity and for furnishing electric energy for public buildings for the operation of arc and incandescent lights, motors, pumps, fans, elevators and other public purposes, has been granted by the municipal authorities of the Crescent City to the New Orleans Railway Company, for which concern Sanderson & Porter, Kuhn-Loeb Building, William Street, New York, act as consulting engineers. The franchise calls for the lighting of 476 underground district circuits at $83, and for 2,151 overhead district circuits at $69. It also includes 200,000 kw of power at six cents per kilowatt hour. The company will receive $200,879 per annum for the service.

TELEPHONE EQUIPMENT WANTED.—Mr. M. A. Joy, cotton compress owner, etc., at Camden, Ark., is the proprietor of the Ouachita Telephone Company. It is to be entirely reconstructed, with a central energy equipment of from 300 to 500 central energy visual signal lines, 20 magneto jacks and drops for toll lines, and 300 telephone sets. The construction will include complete new material inside and out, with some 10,000 ft. of cable 25 to 200 pair. The exchange has been in operation for some years and will now be brought up to date. Mr. Joy is in the market to make immediate purchase of this equipment.

MERGER OF SIGNAL COMPANIES.—A negotiation whereby the Taylor Signal Company, of Buffalo, N. Y., and the Pneumatic Signal Company, of Rochester, are to to be merged into one firm, to be known as the General Railway Signal Company, has just been completed. It is capitalized at $5,000,000. Although the officers of the General Railway Signal Company have not been selected, it is said to be settled that W. W. Salmon, of the Taylor Signal Company, will be the executive head of the firm.

MAGNET WIRE COMPANY'S ORDERS.—The Magnet Wire Company, 42 Broadway, has secured a substantial contract from the Massachusetts Electric Companies for magnet, trolley and weather-proof wire. The Pittsburg (Pa.) Coal Company has sent in a fair-sized order for trolley wire. The Cleveland Electric Railway Company has also requisitioned for a fair-sized lot of trolley wire and for magnet and weather-proof. The Interborough Rapid Transit Company has also sent in a good-sized order for specialties.

EQUIPMENT FOR TROY, N. Y., HOTEL.—MacKenzie, Quarrier & Ferguson, New York, have been awarded the contract for the electrical equipment of a large new hotel to be built at Troy, N. Y. and to be known as the Rensselaer. There will be two 75-hp Harrisburg standard engines direct connected to 50 kw generators of General Electric build. The switchboard will be made by the Walker Electric Company, of Philadelphia. The equipment will be used for both lighting and power purposes.

EQUIPMENT FOR CANADIAN SINGER PLANT.—Considerable electrical equipment will be installed in the Canadian plant which is to be built by the Singer Manufacturing Company, of Elizabethport, N. J. The machinery will include a 600-kw generating set and some 200 hp of motors ranging from 1 hp to 5 hp each.

HEINE BOILER ORDER.—The Electric Company of America, Philadelphia, which controls the Auburn, N. Y., Light, Heat and Power Company, has awarded an order to the Heine Safety Boiler Company, New York, offices, Bowling Green Building, for additional boiler equipment for the Auburn plant.

NUEVO LEON WATER POWER SCHEME.—Francisco Garza Trevino, of Monterey, Mexico, has been granted a concession by the government authorities with a view to the construction of a large water power plant on the Rio Ramos, Cadereita district, State of Nuevo Leon. The current will be used for general power purposes.

LIGHTING EQUIPMENT FOR CUBAN PLANTATION.—The Robb Engineering Company, of Amherst, Nova Scotia, represented by G. F. Tremain, 136 Liberty Street, has taken a contract for a 300-hp automatic Robb-Armstrong engine for direct connection to a Stanley generator for lighting a large Cuban sugar plantation.

EQUIPMENT FOR $1,000,000 APARTMENT HOTEL.—Percival Robert Moses, the consulting engineer, 35 Nassau Street, is drawing up plans for the electrical equipment to be installed in a $1,000,000 apartment hotel at 10-14 East Twenty-eighth Street, for C. F. Rogers.

BELL TELEPHONE OUTPUT.—The American Telephone and Telegraph Company instrument statement for the month ended March 31, is as follows:

	1904.	1903.	1902.	1901.
Gross output	126,522	84,286	96,557	76,751
Returned	35,043	38,172	42,847	37,517
Net output	91,479	46,108	53,710	39,234
Total outstanding	3,972,095	3,339,635	2,691,065	2,079,498

The statement for January, 1903, showed a gross output of 129,837, and a net output of 86,551; but this statement covered 42 days, from December 20, 1902, to January 31, 1903. It was in this month that the company changed its system of reporting instrument output so as to cover the calendar months. The net output since the close of the fiscal year December 31, 1903, was 192,578, making total instruments outstanding March 31, 1904, 3,972,095. The indicated gain in the number of subscribers is about 75,000, making the total number of subscribers March 31 in excess of 1,600,000. The indicated gain in the gross earning capacity of the Bell system, at $50 per subscriber, is $3,750,000 per annum; and the indicated gain in net earning capacity is over $1,000,000 per annum. With the number of subscribers now at 1,600,000, the annual gross earnings of the Bell Telephone system will amount to $80,000,000, of which about $23,000,000 is estimated as net earnings.

DE LAVAL TURBINES, ETC., FOR WESTERN PLANTS.—The Turbine Engineering Company, Whitehall Building, Battery Place, New York, recently organized for the purpose of assuming contracts covering the installation of power units and carrying on a general engineering business in addition to acting as exclusive selling agents for the De Laval turbines in Illinois, Missouri, Michigan, Iowa and Indiana, has secured a contract for two De Laval turbine dynamo sets of 200 kw capacity each, direct current, 240 volts, to run condensing, for lighting purposes in the plant of the Anheuser-Busch Brewing Association, at St. Louis. The order has also been taken from the Pfister & Vogel Leather Company, of Milwaukee, for a De Laval turbine dynamo set—the second order—direct current, 250 volts, to run condensing. A 35-kw direct-current turbine dynamo set is also to be put in the Gund Brewing Company's plant at Cleveland, Ohio. A De Laval steam turbine centrifugal pump of 300-hp capacity 4,750,000 gallons per day, to operate against a head of 230 feet, is to be installed at the Ottumwa, Iowa, water works.

MACKAY ENGINEERING COMPANY ORDERS.—The MacKay Engineering Company, Singer Building, New York, has secured a contract for a 40-hp two-cylinder Walrath gas engine to be manufactured by the Marinette Gas Engine Company, of Chicago Heights, Ill., for direct connection to a General Electric generator. This outfit will be used for lighting Calumet Island, St. Lawrence River, Clayton, N. Y. The M. F. Thompson Dry Good Store, at Binghamton, N. Y., is also to be equipped for lighting purposes with a 30-hp, two-cylinder Walrath gas engine. The new Rogers Building, at Fourteenth Street and Sixth Avenue, is to have a number of motors built by the Richmond. Va., Electric Company, for driving centrifugal pumps, MacKay blowers, etc. The Fraser Tablet Company, Eighteenth Street and Eighth Avenue, Brooklyn, has requisitioned for several Richmond motors of 10 hp, 3 hp and 2 hp capacity, and the Wheeler & Wilson Manufacturing Company, 833 Broadway, New York, has ordered some small ones for operating sewing machines.

MILK BY TROLLEY.—Besides handling ashes and building material, and the contract entered into with the Bush Terminal Company for the handling of package freight as already described and illustrated in these pages, Brooklyn Rapid Transit Company has recently entered into arrangements with Borden's Milk Company whereby it will haul this company's milk supply to the distributing stations. It is now hauling beer in the Coney Island section. The Borden Company has taken its milk from the cars in Jersey City by its own teams to its depots in Brooklyn, but hereafter the railroad cars will be floated over to South Seventh Street, and the cans there transferred to the trolleys of the Brooklyn Rapid Transit. Not only will this mean a saving for the milk company and increased earnings for the trolley company, but the milk itself will reach the consumer in better condition. The delivery of beer by trolley in the Coney Island section is giving satisfaction.

WATERTOWN ENGINE ORDERS.—Recent orders for Watertown engines include the following: One 12 & 20 x 14 tandem compound engine for Jacob Ruppert, New York City; two 15½ x 14 high speed engines arranged for direct connection to Sprague generators, for Christian Feiganspan, Newark, N. J.; two 13 x 12 high-speed engines arranged for direct connection to Crocker-Wheeler generators, for Ballantine & Co., Newark, N. J.; two 17 x 16 four-valve engines for F. Wesel Manufacturing Company, Brooklyn, N. Y.; one 17 x 16 four-valve engine, Bloomingdale Bros., Fifty-ninth Street, New York; one 17 x 18 four-valve engine, Railway Steel Spring Company, Oswego, N. Y., this being the fourth order from this concern; one 17 x 18 four-valve engine, Bernardsville Electric Light Plant, Bernardsville, N. J.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., reports an unusual activity in switchboard work, having contracted for switchboards and additional equipment during the past month for Kansas, Ill.; Newton, Ill.; Hudson, N. Y.; Racine, Wis.; Sheboygan, Wis.; Peru, Ind.; Auburn, Ind.; Russiaville, Ind.; Goldsmith, Ind.; Zionsville, Ind.; Seymour, Ind.; Cairo, Ill.; Clinton, Ill.; Decatur, Ill.; Abilene, Tex.; Albany, N. Y.; Canton, Ill.; Tremont, Ill.; Hoopeston, Ill.; McArthur, Ohio; Chardon, Neb.; Avery, Ind.; Brookville, Pa.; Austinburg, Ohio; Stackbridge, Mich.; Stranghn, Ind.; Sully, Iowa; Webster City, Iowa. The list includes equipments of its well-known boards of common battery multiple, lamp signal magneto, standard Bell type.

THE REEVES ENGINE COMPANY, Trenton, N. J., has just closed with the Drew-Selby Company, of Portsmouth, Ohio, for one of its 400-hp vertical cross compound engines for direct connection to an electric generator. Messrs. Plotner & Stoddard, of Dayton, Ohio, have also purchased a direct-connected 400-hp vertical cross compound. It has sold to the International Steam Pump Company four direct-connected vertical cross compounds. The Trenton Mills and Elevator Company has purchased one of its large vertical cross compounds and it has contracted with the Construction Realty Company to install three simple horizontal engines for direct connection to 65-kw generators, for its new hotel at Broadway and Sixty-ninth Street, New York.

LIGHTING EQUIPMENT FOR TIENTSIN.—Contracts are expected to be let in this market shortly for various equipment to be installed at Tientsin, for the purpose of lighting the British settlement in that Chinese city. The plant will have a capacity of 300 hp. There will be two 100-kw generators direct connected to 13-in. x 14-in. engines. The boilers will be of water-tube type—two units. The street lighting will be done by 250 arc lamps. The export commission house of Muller, Maclean & Co., Centennial Building, 116 Broad Street, whose treasurer, L. E. Phipps, has just returned from the Far East, holds a copy of the specifications, etc.

PHONOGRAPH WORKS BURNED.—The interior of the large four-story building of the Victor Talking Machine Company, at Camden, N. J., was totally destroyed by fire on April 24, causing a loss estimated by an official of the company at nearly $500,000. The concern carried an insurance of $250,000. Upward of 50,000 phonographic disk records and 25,000 talking machines in various stages of completion were destroyed. Thousands of original records, which cannot be replaced, were also ruined. A fireboat and four fire companies from Philadelphia assisted the Camden Fire Department in preventing the flames from spreading.

JALISCO WATER POWER PROJECT.—A fair-sized hydraulic plant is to be built on the Rio Grande de Santiago, municipality of Hostotitaquillo, State of Jalisco, Mexico. Francisco Brenna, of Mexico City, has secured the necessary concession from the Secretary of Fomento. The franchise permits of the utilization of 15,000 liters of water per second. The power is to be generated principally for lighting towns in the vicinity.

EQUIPMENT FOR APARTMENT HOTEL.—The apartment hotel which is being constructed at Sixty-ninth Street and Broadway, is to be equipped for lighting purposes with three 13-in x 12-in. simple engines of Reeves build direct connected to 65-kw C. & C. generators. Percival Robert Moses, 35 Nassau Street, is the consulting engineer.

WESTINGHOUSE EQUIPMENT FOR CANTON PLOW PLANT.—The contract for the additional equipment—500 hp—to be installed in the big agricultural implement manufacturing plant of the Parlin & Orendorff, at Canton, Ohio, has been allotted to the Westinghouse Company.

MONTAUK FIRE DETECTING SYSTEM FOR AUSTRALIA.—The Montauk Fire Detecting Wire Company, American Surety Building, New York, has just received a large Australian contract by cable for its specialties to be installed in one of the principal Melbourne theatres.

EQUIPMENT FOR MEXICAN MINES.—An American syndicate in which William M. McCord and Lucien M. Fairbanks, of Chicago, Ill., are largely concerned, is about to erect a large electrically operated mill at the Peregrino mines in the Guanajuato district, Mexico.

GENERAL ELECTRIC DESK FANS FOR EGYPT.—The General Electric Company has secured a substantial contract for desk fans for export to Alexandria, Egypt. The order was secured through the export commission house of Muller, Maclean & Co.

General News.

THE TELEPHONE.

TRINIDAD, COL.—The Colorado Telephone Company has moved into its recently completed new building, and the overhead wires have been placed under ground. The equipment of the new building is of the most modern design. About $100,000 was expended by the company in these improvements.

PEARL CITY, ILL.—The Farmers' Mutual Telephone Company has been organized here with L. C. Hollister as president.

CAMPUS, ILL.—The Campus Telephone Company has been incorporated with a capital stock of $2500. A. J. Harrington is one of the directors.

ASSUMPTION, ILL.—A new telephone company has been formed here. Among those interested are Ray Johnson, Dennis Keating and others.

DUVAL, ILL.—The Okawa Township Telephone Company has been incorporated with a capital stock of $2500 by William Hendricks, G. L. McCullough and Alex Roberts.

NEW HOLLAND, ILL.—The New Holland Telephone Company has been incorporated with a capital stock of $2,500. The directors are J. W. Collins, P. E. Kuhl and L. C. Schwerdtfeger.

SUMMITVILLE, IND.—The Farmers' Rural Telephone Company has been incorporated with a capital stock of $5000. F. P. Thurston, G. W. Webster and others are the incorporators.

RANDALL, IA.—The Martin Telephone Company will install a new switchboard here.

STORY CITY, IA.—The Gilbert and Story City Telephone Company has been formed to build a rural line.

PLYMOUTH, IA.—The Plymouth Telephone Company has been incorporated with a capital stock of $10,000.

OXFORD, IA.—The Eastern Iowa Telephone Company has been incorporated with a capital stock of $100,000.

FOREST CITY, IA.—The Farmers' Co-operative Telephone Company has been organized with G. A. Faber as president.

CHASE, KAN.—The Chase Telephone Company has been incorporated with a capital stock of $5000.

ENGLEVALE, KAN.—The Englevale Telephone Company has been incorporated with a capital stock of $5000.

FRANKFORT, KY.—The Allen County Home Telephone Company has been incorporated with a capital stock of $2500. A. M. Haines and S. F. Cornwell, of Hainesville, are the incorporators.

NORTH ATTLEBORO, MASS.—A new telephone building is to be erected here for the Providence Telephone Company.

COLDWATER, MICH.—The Wolverine Telephone Company has been organized here.

SOUTH HAVEN, MICH.—The Kibbie Telephone Company will build a line from South Haven to Covert.

EAST AMBOY, MICH.—The Dutch Street Telephone Company has been incorporated. J. B. Dick is president.

HINKLEY, MINN.—The Hinkley & Rural Telephone Company has been formed to build lines in this vicinity.

AUSTIN, MINN.—The Tri-State Telephone Company will build a long-distance line from this place to Lacrosse, Wis.

ANOKA, MINN.—The Potato Belt Telephone Company has been incorporated with a capital stock of $20,000. R. J. Dyer is president.

HATTIESBURG, MISS.—The Cumberland Telephone Company has petitioned for a franchise in this place, but there is considerable opposition to granting the same. There is a local system in operation which is controlled by local capitalists. The latter are willing, however, that the council grant the Cumberland company the privilege of establishing a long distance station here.

BIG TIMBER, MONT.—A co-operative telephone company has been organized here to construct a telephone line between Big Timber and Melville, a distance of 45 miles. B. O. Felland is president; E. H. Ellingson, secretary, and D. O. Clack, treasurer.

CHARLESTON, MO.—The Southeast Missouri Telephone Company has been incorporated with a capital stock of $150,000. The directors are M. Moore, J. E. Armstrong and others.

MOBERLY, MO.—The Cairo Telephone Company has elected officers as follows: President, Harry McKinney; vice-president, F. Haines; secretary, John Boucher; treasurer, J. W. Stigall.

ST. LOUIS, MO.—The Kinloch Telephone Company will install in the Palace of Electricity at the Exposition a "model" telephone exchange. The switchboard is for 1000 lines, and instruments will be placed in all of the World's Fair buildings and in all parts of the grounds.

CHARLESTON, MO.—The Southeast Missouri Telephone Company has been incorporated to establish and operate telephone exchanges at Charleston, Sikeston, Dexter, Melden, Campbell and Bloomfield. The capital stock is $150,000. The incorporators are J. Handy Moore, Paul B. Moore, Mary Moore, J. E. Armstrong and R. B. Boyce.

LINCOLN, NEB.—The Dewitt Telephone Company has increased its capital stock to $20,000.

EGG HARBOR CITY, N. J.—The Egg Harbor Telephone Company has been organized with a capital stock of $3000 by L. Krevin, W. G. Shottman, G. W. Otto and Charles Oberuder.

PENNINGTON, N. J.—The Pennington Telephone Company has been incorporated with a capital stock of $5000. The incorporators are: William H. Bogart, Jerry F. Crowerly and Joseph F. Harris.

NEWARK, N. J.—The Newark Telephone Exchange has been incorporated with a capital stock of $25,000. The new company has purchased the local telephone system established and operated by Mr. William H. Kelley. The exchange has 220 telephones. The directors of the new company are: William H. Kelley, John E. Pulver, Ernest A. Smith, Edward P. Thatcher, J. P. Ballou, F. D. Burgess and Albert Proseus.

WOLCOTT, N. Y.—A new telephone company is being organized here with E. T. Phillips as president.

COOPERSTOWN, N. Y.—The Cooperstown Telephone Company has increased its capital-stock from $7,000 to $10,000.

CORTLAND, N. Y.—The Empire State Telephone Company has asked permission of the council of this place to place its wires in underground conduits.

DUNDEE, N. Y.—The Dundee, Himrod & Dresden Telephone Company is being organized here to build a line from this place to Himrod and Dresden. Mr. Henry C. Harbending, of Dundee, is interested.

SARATOGA, N. Y.—The Commercial Union Telephone Company has arranged to purchase the property and rights of the Saratoga Telephone and Telegraph Company, the Rensselaer Telephone and Telegraph Company, of Troy, and the Union Telephone Company, of Glens Falls. Each of the individual companies has voted in favor of the consolidation.

FAIRMOUNT, N. D.—The Farmers' Telephone Company will be incorporated with a capital stock of $6000.

STRUBLE, OHIO.—The LaMars Telephone Company has been granted a franchise.

SPRINGFIELD, OHIO.—Prominent citizens are organizing an association favoring the use of one telephone system. They think that two are a nuisance.

CENTERBURG, OHIO.—The Central Ohio Telephone Company has been incorporated with a capital stock of $10,000. The directors are: T. P. Sylvan, E. E. McGuire and others.

COLUMBUS, OHIO.—The Preble County Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are: John C. Stover, J. E. Flora, A. M. Fudge and J. S. Steward.

EAST LIVERPOOL, OHIO.—The Winona Central Telephone Company has commenced the construction of an exchange in Dungannon. It will take care of 40 or 50 telephones to begin with. The company will build another trunk toll line to Lisbon.

CLEVELAND, OHIO.—President Dickson, of the United States Telephone Company states that he has secured $150,000 of new money for use in the development and extension of the long distance lines of the company. The money will be used in connecting the United States system with those of the Indianapolis, St. Louis and Pittsburg independent systems.

CLEVELAND, OHIO.—President F. S. Dickson, of the Cuyahoga Telephone Company, states that since the new switchboard was installed two months ago the company has been gaining new subscribers at the rate of 15 per day. The company is now earning the dividend on its preferred stock and piling up a surplus that will be used for future improvements. President Dickson denies that the company will pay a dividend on common stock as reported in the daily press recently.

LINTLEYVILLE, PA.—A new telephone company has been organized here with A. N. Both as president.

PHOENIXVILLE, PA.—The Phoenixville Telephone Company has been organized here by E. C. Meier, William Ellis and others.

PHILADELPHIA, PA.—The Keystone Telephone Company's April directory is said to contain the names of some 14,500 subscribers, an increase of 1,500, more than 10% over the January directory. The number of nearby outside connections has also increased about 10%. The Atlantic City line of the company will open about May 15, making connection with the Atlantic Coast Telephone Company, a subsidiary of the Interstate Telephone Company, which has 1,600 subscribers in Atlantic City.

GRANITEVILLE, S. C.—A local telephone company has been organized here and will install the Clark automatic system. Arrangements have been made with the Southern Bell Telephone Company for long-distance connection. The new company has been incorporated with a capital stock of $3000, the officers being W. A. Giles, president and treasurer; Rev. Graves L. Knight, T. H. Rennie and W. A. Giles, board of directors.

NASHVILLE, TENN.—The Western Dixie Telephone Company, of Henry County, has been incorporated with a capital stock of $1,000. The directors are H. A. Liles, A. Turner and others.

SALT LAKE CITY, UTAH.—The management of the Rocky Mountain Bell Telephone Company announces that it will expend about $150,000 in the next few weeks in improvements to its system in Salt Lake.

OSHKOSH, WIS.—A. B. Ferdinand again seeks a franchise for an independent local telephone exchange.

EAU GALLE, WIS.—The Eau Galle Telephone Company has been incorporated with a capital stock of $5000. The directors are: C. G. Billings, Wm. Stoops and others.

MINERAL, WIS.—The Willow Springs Telephone Company has been incorporated with a capital stock of $4000. The directors are: J. P. Sheldon, R. M. Phillips and others.

ROBERTS, WIS.—The Roberts Telephone Company has been incorporated with a capital stock of $5000 by A. Turner, R. C. Andrus, George A. Turner, David Imrie and A. J. Walker.

SOUTH WAYNE, WIS.—The Crosby & Blaisdel Telephone Company, of South Wayne, Lafayette County, has been incorporated with a capital of $25,000. The incorporators are: A. N. Crosby, W. C. Blaisdel and W. R. Bixby.

Electric Light and Power.

DEMOPOLIS, ALA.—The Demopolis Electric Light & Power Company contemplates an extension to its plant. A new brick engine room will be built. Mr. A. R. Smith, of Demopolis, is manager.

MALVERN, ARK.—The Malvern Light & Power Company contemplates the installation of a new dynamo and boiler. Mr. C. W. Turner, of Malvern, is president and manager.

PINE BLUFF, ARK.—The Pine Bluff Light & Water Company will install a new alternating current generator and direct-connected engine. Mr. Robert York, Pine Bluff, is manager.

VASALIA, CAL.—The Mt. Whitney Power Company is installing a second power plant containing three 500-kw units which are driven by Stilwell-Bierce and Smith-Vaile turbines. Mr. B. M. Maddox is manager.

WATSONVILLE, CAL.—The Big Creek Power Co. of Santa Cruz will purchase property in this city as a site for a plant to furnish the local circuit with electric power. About $100,000 will be spent in improving the service here.

LODI, CAL.—The Northern San Joaquin Electric Company has absorbed the Lodi Electric Works. The new company will give its patrons a continuous service. At the present time the lights are turned on at dusk and shut off at twelve o'clock.

LOS ANGELES, CAL.—The Los Angeles Gas Company and the Los Angeles Electric Company have been merged into a single corporation with a capital stock of $4,000,000. A meeting of the stockholders of the concerns is announced for April 27 to perfect the plans of consolidation.

MONTROSE, COL.—The Montrose Electric Light & Power Co. has secured a new site for an electric power, cold storage and ice plant to be constructed here this summer.

GLASTONBURY, CONN.—The Glastonbury Power Company has been incorporated in this State with an authorized capital stock of $350,000. The company proposes to develop the water power of Roaring Brook for electrical purposes. The project calls for an immediate development of 1,600-hp. The incorporators of the company are Lewis W. Ripley, Henry S. Goslee, D. W. Williams, James S. Williams, J. H. Hale and Frank D. Glazier.

WASHINGTON, D. C.—The Potomac Electric Power Company will, during the coming summer, put underground its 73,820 feet of overhead electric wires. The cost for this improvement is estimated at $16,000.

WASHINGTON, D. C.—Bids will be received May 3, at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards, Portsmouth, N. H., Boston, Mass., and Newport, R. I., a quantity of arc lamps, switch boxes, conduit and fittings, copper wire, electrical supplies, crucible steel wire and other material. H. T. B. Harris, Paymaster Gen., U. S. N.

JACKSONVILLE, FLA.—Bids are wanted May 4 for furnishing f.o.b. cars at Jacksonville a 500-kw generator, together with exciter and switch panels; turbine to be worked condensing at 150 lbs. steam pressure; 27-in. vacuum; generator to be three phase, 60 cycle, 2,300 volts; makers must guarantee efficiency to be equal to first-class Corliss engine; also for surface condenser complete for above turbine, with separate water and dry vacuum pumps. For further information apply to R. N. Ellis, superintendent of water works and electric light plant.

ELGIN, ILL.—The Fox River Light, Heat & Power Company, of Elgin, Ill., it is stated, has purchased the Aurora, Elgin and Chicago Power Company from the Aurora, Elgin and Chicago Railway.

O'FALLON, ILL.—The O'Fallon Electric Light, Power, Heat & Water Company is changing its arc light system over to the alternating current system. Mr. G. W. Tidemann is president and superintendent.

NEVADA, ILL.—The Nevada Electric Company has let the contract for the extension of its power station. The electrical apparatus will be supplied by the Westinghouse Company and the engine by the Murray Iron Works, of Burlington.

QUINCY, ILL.—The Quincy Gas & Electric Company will extend its power plant in this city. A larger boiler, a new 2000-hp engine and a new General Electric generator will be installed. The improvements will cost $25,000. Mr. H. O. Channon is superintendent of the electric light plant.

NOBLESVILLE, IND.—The city council is asking for bids for a ten-years' contract to light the city.

NEW HARMONY, IND.—Bids are wanted May 16 for furnishing material and constructing an electric light plant.

FLORA, IND.—It is proposed to construct water works and an electric light plant, at a cost of $20,000. Address M. W. Eaton is president town board.

FT. WAYNE, IND.—The Ft. Wayne Electric Light & Power Company has completed its organization and will at once begin the reconstruction of its plant.

JASPER, IND.—The local electric light plant has been purchased by the town board for $7,000. The town will make extensive improvements and betterments.

BOONVILLE, IND.—The City Light & Power Company has been incorporated with a capital stock of $12,000, by J. F. Katterjohn, John E. Madden, Dorsey Reed, Louis J. Meyer and William Roth.

NEWBURY, IND.—The Newbury Electric Light & Power plant will install some new apparatus during this year, including a generator, engine and boiler. A water works system will also be introduced. Mr. G. F. Lacke is the owner.

ROANOKE, IND.—The town council has made arrangement with the Ft. Wayne and South Western Traction Company for electric lighting for the streets and business houses. The company will move a sub-station now a mile east of Roanoke to the city and will build another sub-station.

ARDMORE, IND. TER.—The Ardmore Ice, Light & Power Co., of Ardmore, has been incorporated with a capital of $125,000, by A. Ruemmeli, of St. Louis, Mo.; Henry Brann and L. P. Anderson, of Ardmore, and others.

WINFIELD, KAN.—The citizens have voted to issue $30,000 bonds for electric lighting.

GREAT BEND, KAN.—The Grimes Light, Telephone & Power Company will install another alternator before next fall.

BALTIMORE, MD.—A strong fight is being made in the city council for and against the petition of the Maryland Telephone Company for an electric light franchise. Mayor McLane a few days ago received a petition 24 yards long and containing over 1,500 signatures of corporations, firms and individuals who asked that the ordinance be passed. The ordinance has already passed the second branch of the city council and is now before the first branch for consideration.

WESTFIELD, MASS.—An appropriation of $10,500 has been voted by this town for a new electric power plant, and $1,000 for motors for use in heating and ventilating school buildings.

EATON RAPIDS, MICH.—The citizens have voted to issue water and lighting bonds.

KALAMAZOO, MICH.—The Kalamazoo Valley Electric Co. will soon begin the construction of a power plant at Ceresco on Kalamazoo River, at an estimated cost of $200,000.

ALLEGAN, MICH.—The Allegan Light & Power Company's plant has been sold to Messrs. S. Baker, H. A. Delano, George E. Delano, of Otsego, and F. M. Van Auken of Allegan. The change will take effect on May 1. The price paid is understood to be about $15,000. It is stated that the Kalamazoo Valley Electric Company will ask for a franchise to do commercial and domestic lighting in this city.

FARIBAULT, MINN.—The Faribault Gas & Electric Co. contemplates the installation of improvements at its manufacturing plant, and engineers are now figuring on the best methods of installation, probable cost, etc. Among the many improvements under consideration is the installation of a steam turbine.

CHARLESTON, MO.—The Southwest Missouri Ice, Light & Power Co. has been incorporated with a capital of $100,000. J. E. Armstrong and R. B. Boyce, of Charleston, are among the incorporators.

ROSWELL, N. M.—A franchise has been granted to Maynard Gunsul to furnish electricity for power, heat and illuminating purposes in this city.

CORTLAND, N. Y.—It is stated that the Cortland & Homer Electric Co. is to improve and enlarge its plant.

SAG HARBOR, L. I., N. Y.—Bids will be received by the Village Trustees until May 3 for $24,000 electric light bonds.

GOUVERNEUR, N. Y.—The Village Trustees have granted J. Henry Abbott a franchise for an electric light plant.

MANLIUS, N. Y.—The Manlius Gas & Electric Co. has been incorporated with a capital of $10,000. M. Murphy and Wm. Murphy, of Manlius, and G. M. Corwin, of Oswego, are the directors.

KING'S PARK, N. Y.—The contract for installing new electric conduits and cables in buildings at the Long Island State Hospital here has been awarded to the Commercial Construction Co., New York City, for $5,235.

KINGSTON, N. Y.—Contracts have been awarded for the construction of a complete power plant and water works at the home of Colonel Astor at Ferncliff. The electrical equipment will include two 50-kw turbo-generators and a storage battery outfit.

NEW YORK, N. Y.—Bids will be received May 3, at the Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for furnishing at the navy yard here a quantity of electric motors, batteries, incandescent lamps and other material. H. T. B. Harris, Paymaster Gen., U. S. N., Washington, D. C.

WAYNESVILLE, N. C.—Engineers Ladshaw & Ladshaw, of Spartanburg, S. C., have received the contract for developing 1,000-hp on Pigeon River for B. G. Sloan, proprietor of the White Sulphur Springs Hotel. This power will be transmitted to Waynesville, N. C., and will be used for lighting and other purposes. W. C. Willard will have charge of the field work in the development at Waynesville.

VALLEY CITY, N. D.—At the recent city election the proposition to sell the electric light plant was not carried.

MOOSE JAW, N. W. TER.—Bids will be received May 14 by W. A. Munns, secretary and treasurer, Moose Jaw, for electric lighting equipment and engines. Willis Chipman is chief engineer, address 103 Bay St., Toronto, Ont.

NAPOLEON, OHIO.—Bids are wanted May 3 for $25,000 water and light enlargement bonds. E. W. Hilgendorff, is village clerk.

DAYTON, OHIO.—The Board of Public Service has adopted the report of the light committee and the city solicitor declaring the legality of the contract between the city and the Dayton Electric Light Company. It was noted in our issue of April 16 that Mayor Snyder had vetoed the ordinance granting the franchise.

WILMERDING, PA.—The Wilmerding Electric Light Co. is reported to have purchased a site on which it is proposed to construct a power plant.

SHENANDOAH, PA.—At a meeting between the stockholders of the People's Light, Heat & Power Co., of Shenandoah, and the People's Light, Heat & Power Co. of Mahanoy Township, it was agreed to merge the two companies into one and erect a plant with power enough to furnish light, heat and power for Shenandoah, Mahanoy City and other towns nearby. D. M. Graham is president.

BRYAN, TEX.—H. B. Dorsey writes that later on he may be in the market for electrical equipment for a lighting plant.

SHERMAN, TEX.—The Sherman Light & Power Co., of Sherman, has been incorporated with a capital of $100,000. Incorporators: M. B. Pitts, W. R. Brents and C. N. Roberts.

CASTLEDALE, UTAH.—W. E. Raines, of the Salt Lake Electric Supply Co., Salt Lake City, has submitted figures to the town boards of Orangeville and Castledale for an electric light plant to be used for lighting both towns. The probable cost will be $10,000

DAYTON, TENN.—The Dayton Lighting & Power Company is rebuilding its plant in this place.

WOODSTOCK, VA.—The Woodstock Electric Light & Power Company has been incorporated with a capital stock of $2,000 to $10,000.

VANCOUVER, WASH.—The Department of Columbia has decided to install electric light at the post here. The Vancouver Electric Light Company will probably receive the contract for a term of years. Arrangements are being made to purchase a new 500-hp engine to supply the required power.

SPOKANE, WASH.—George Nixon has been awarded the contract for the complete installation of the Waterville transmission plant. The available water power on the Enteat river is 3,000-hp, and the present development is for 250-hp. Three-phase current at 6,600 volts will be transmitted to Waterville, 9 miles distant.

WESTON, W. VA.—The Weston Electric Light, Power & Water Company will double the capacity of its plant during the coming summer and will install either a turbine or gas engine, direct-connected.

FENNIMORE, WIS.—The City Council has decided to install an electric light plant in connection with the city water works.

FOUNTAIN CITY, WIS.—Messrs. H. and F. Roettiger, owners of the electric light plant here, propose to install another dynamo.

HARTFORD, WIS.—The Hartford Electric Company may get the contract for street lighting, in which case its plant will have to be remodeled.

EAU CLAIRE, WIS.—The question of constructing a municipal electric light plant is under consideration. Emmet Horan is chairman of the committee.

WAUSAU, WIS.—The Hackworthy Construction Co., of Appleton, has secured the contract for building the new electric light plant at Wausau, for about $20,000.

ST. FRANCIS, WIS.—The board of directors of the St. Aemilianus Orphan Asylum has voted to install a new electric light plant including generating outfit and probably some changes in the heating system. George W. Colles, of Milwaukee, is engineer.

MANITOWOC, WIS.—The West Side Electric Power & Lighting Company has been organized with a capital of $25,000. A large plant will be erected here, which will be equipped by the Milwaukee Electric Co. Incorporators: Wm. Rahr, Sr., and Wm. Rahr, Jr.

THE ELECTRIC RAILWAY.

WOODBURY, CONN.—The Woodbury & Seymour Street Railway Company will establish an electric lighting plant and has developed for that purpose a water power.

MIDDLETOWN, CONN.—The franchise of the East Lynne Street Railway Company has been purchased by Morgan & Phelps, a New York firm. The company will be capitalized at $150,000. The new owners are having surveys made, after which the contracts will be let.

CHICAGO, ILL.—The contract has been let to the Arnold Electric Power Station Company, of Chicago, for the new power station of the Chicago & Milwaukee Electric Railway at Highwood, Ill. The building will cost about $150,000 and the equipment will include Allis-Chalmers engines, the electrical apparatus being of the General Electric Company's make.

BLOOMINGTON, ILL.—The stockholders of the Bloomington-Lincoln-Springfield-Peoria Interurban Company held their first annual meeting here a few days ago. The newly elected directors elected the following-named officers: President, La Fayette Funk; vice-president, S. E. Prather. A preliminary survey and the securing of right of way will be undertaken at once.

ALEXANDRIA, IND.—The promoters of the Oil Belt Traction Company are having a survey made of the line to connect Alexandria, Hartford City and Celina, Ohio.

MOORESVILLE, IND.—The Town Council is attempting to extend the city limits so as to include the power house and car houses of the Indianapolis & Martinsville Traction Company for taxation purposes. The company has $100,000 worth of machinery in the power house. It is said the company has threatened to dismantle and remove the power house if the town limits are extended.

CLINTON, IA.—The State Electric Street Railway Company has been granted a franchise and will spend $150,000 in rebuilding and equipping the line. The Illinois & Iowa Company has let contracts for power and operating equipment.

NEW ORLEANS, LA.—An ordinance has been introduced in the City Council of New Orleans authorizing the sale of a franchise for the construction of an electric railway in Algiers.

NEW ORLEANS, LA.—At a special meeting of the New Orleans & Carrollton Railroad Light & Power Company and the St. Charles Railroad Company it was separately decided to grant to the New Orleans Railways Company a lease of their properties until 1962. The lease will not be executed, however, until the injunction now pending against such action has been dissolved.

SKOWHEGAN, ME.—The Skowhegan & Norridgewock Electric Railway has been sold at auction to Amos K. Butler for $10,500. This road was built in 1894 at a cost of $56,000, and over $10,000 has been expended on it since. The town has $10,000 worth of stock.

WORCESTER, MASS.—The Boston & Worcester Street Railway Company is installing two 500-kw rotaries, one at the South Framingham power station, the other at the Westboro sub-station.

NORTH ADAMS, MASS.—Vice-President A. H. Rice, of the Hoosac Valley Street Railway Company, will, on May 1. it is announced, succeed Col. F. S. Richardson as president. The directors have voted to ask for authority to increase the capital stock by $100,000.

WORCESTER, MASS.—At the annual meeting of the Worcester & Webster Street Railway Company the following officers were elected: Edgar S. Hill, president; J. B. Potter, treasurer; Harry E. Back, clerk; the above and George A. Carmichael and W. F. Little, Worcester; E. N. Sanderson, New York; Harry E. Back and Samuel Anderson, of Danielson, Conn., directors. The general statement was made that the company has had a successful year. The company's property is used as a portion of the Worcester & Connecticut Eastern Railway Company.

GREENWOOD, MISS.—A meeting of the incorporators of the Greenwood Electric Railway Company was held here. A temporary organization was perfected and the subscription books closed. The officers elected were Gen. Monroe McClurg, president; Samuel J. Stein, first vice-president; Richard T. Jones, second vice-president; Rowan Thayer, secretary and treasurer; H. G. Kitchell, consulting engineer. A part of the capital was paid in, and the work will be given immediate attention.

JEFFERSON CITY, MO.—The Lexington & Suburban Railway Company, of Lexington, has been chartered with a capital of $250,000, owned chiefly by Mr. Gustave Haerle, of Lexington. The other stockholders are G. Hedrick, A. G. Sutherland, L. R. Ash and V. H. Cochrane, of Kansas City. The road is to be 25 miles in length, and will be run from Mayview.

TOLEDO, OHIO.—The Toledo & Northwestern Railway Company has been incorporated, with $10,000 capital stock, by C. W. Merrill, J. O. Ormond, R. W. Barton, Walter Gayhart and H. C. Adams.

WAUSEON, OHIO.—Samuel A. Wright, president of the Ohio Northern Traction Company, has obtained a franchise for the line through Wauseon. The road will extend from Adrian, Mich., to Defiance, Ohio.

WEST ALEXANDRIA, OHIO.—The Dayton & Western Traction Company is extending its power station at this place. The new equipment will include two 450-hp Hamilton-Corliss engines, two 250-kw generators and two 250-hp boilers.

TOLEDO, OHIO.—It is said that William Ford, of the Ohio & Michigan Traction Company, has just succeeded in floating the company's bonds to the extent of $4,500,000 in New York. The company proposes to build to Ann Arbor, Mich. Hirsch & Company are said to have taken the bonds.

TOLEDO, OHIO.—The Toledo Railways & Light Company is extending the boiler house at its main station in this city. A new smokestack will be erected. The Ricard Boiler Company, of Toledo, has been given the contract for four 650-hp water tube boilers. The plant will be equipped with automatic stokers, coal conveyors, etc., for the latter of which contracts have not yet been given out.

COLUMBUS, OHIO.—The Ohio Union Traction Company, the title of the company under which it is proposed to consolidate the various Appleyard interests in Ohio, has increased its capital stock from $10,000 to $700,000. This is to cover the mortgage recently given on the proposed new line from Findlay to Kenton, the last link required to complete the system between Cincinnati and Toledo.

GREENVILLE, PA.—S. G Bailey, of Pittsburg, has applied to the Borough Council for a street railway franchise.

HARRISBURG, PA.—Col. P. Russ, of this city, has a force of engineers surveying for the proposed electric railway from Mount Holly Springs to Gettysburg, a distance of about 22 miles.

COATESVILLE, PA.—Borough Council has passed the ordinance transferring the rights granted the Brandywine Electric Railway Company to the Philadelphia, Coatesville & Lancaster Street Railway Company.

CHAMBERSBURG, PA.—An extension of the town line of the Chambersburg & Gettysburg Electric Railway Company to Wilson College, a short distance from town, will be built this summer. The company's power house will be ready by June 1.

WASHINGTON, PA.—Ordinances asking for franchises for a proposed electric railway to connect Washington with Pittsburg will be introduced at the next meeting of Council. The line will connect with the Pittsburg & Charleroi line at Liberty, in Allegheny, and will be 15.4 miles long. The line is to form a link in a trolley system from Pittsburg to Wheeling.

LITTLE COMPTON, R. I.—The Town Council of Little Compton has granted to the South Shore Street Railway Company a franchise to lay rails and operate a railway in the town.

ANDERSON, S. C.—This place is to have an electric railway. J. A. Brock, R. S. Ligon and others are the promoters. One hundred thousand dollars is the estimated cost. The line will be extended to the mill villages, near the city.

SAN ANTONIO, TEX.—The San Antonio Traction Company contemplates making extensive improvements in its lines. Chief among these will be the rebuilding of the entire West End line. The making of these and other improvements by the Traction Company depends on the action of the City Council, and if that body reports favorably on the petitions of the Traction Company, operations are to be started immediately after the Carnival.

RICHMOND, VA.—Leading negro editors, physicians and ministers have formed a permanent organization here to boycott the street cars on account of the law recently passed allowing conductors to compel passengers to take such seats as they may designate. The negroes were advised to keep away from the theatres, which they must enter by a side entrance leading to a small gallery. The negro ministers are preaching sermons on the proposed boycott.

GUELPH, ONT.—The Street Railway Commissioners are considering the installation of a storage battery plant.

New Industrial Companies.

THE JONES FAN & MOTOR COMPANY has been incorporated in New York with a capital stock of $2,500. The directors are C. D. Marsh, L. A. Landau and James Jones, Jr., all of New York.

THE INDUSTRIAL TRANSPORTATION COMPANY has been incorporated at Washington, D. C., with a capital stock of $1,000,000. The incorporators are Edward Lugo-Vina, Edward D. N. Whitney, W. A. Copenhaver, Samuel H. Moore and E. L. Mattice.

THE AMERICAN SWITCH & SIGNAL COMPANY has been incorporated in Yuma, Ariz., for the purpose of building railroads, telegraph and telephone lines, electric railways and operating devices pertaining to switches. The capital stock is $1,000,000, and the incorporators are A. J. Gutzler, W. A. Bondurant, H. MacDavenport and others.

THE INDIANA & MICHIGAN ELECTRIC COMPANY has been incorporated in Jersey City, N. J., with a capital stock of $2,000,000. The incorporators are George W. Flaake, Jr., H. H. Porter, Francis Blossom, H. L. Cranford, Lyman L. Dyer Frederick V. Delafield, Frederick W. Longfellow, Henry S. Colwell and Harold S. Mackays.

THE AUTOMATIC MONITOR COMPANY has been incorporated at Toledo, Ohio, by Charles D. Miller, Morgan Levi, E. M. Taylor, H. R. Ashbrook, D. A. Yoder and S. Sanger. The company will manufacture a device to register the time consumed after the telephone receiver is lifted from the hook until the operator answers the call, and also record the time consumed in conversation over a long distance line.

Legal.

TELEPHONE WAR TAXES.—The United States Circuit Court of Appeals, sitting in New York City, has held that Spanish War taxes to the amount of $21,492, paid up on messages by the New York Telephone Company, are not to be refunded. The company sued Internal Revenue Collector Treat for the recovery of the money, on the ground that the fees for messages, at 15 cents each, according to the contracts with subscribers, were really based on the cost of maintaining wires and other expenses. It was held that the Government, in taxing messages, should not have levied its tax upon the full amount which the company collected from subscribers. The Court ruled that the company, by altering the phraseology of its contracts, might have escaped the tax but had not done so and was clearly liable.

LIGHTING AT DAVENPORT, IA.—An interesting case of some years standing has just been decided on appeal by the Supreme Court of Iowa. In 1896 the Davenport Gas & Electric Company made a contract with the city for 25 years which it proceeded to carry out until 1901, when it was ordered to install an alternating current system with alternating enclosed arcs in place of its direct current system. It did not do this, whereupon the city council nullified the contract franchise. The company has been sustained in its defense of its rights. The court says: "But, in addition to the finding of fact, which would alone determine the question in favor of plaintiff, we do not believe the ordinance contemplated such a change as was demanded. It will be remembered that the plaintiff installed a plant complying with the specification of the ordinance, and put in a large amount of new machinery at great expense, which the evidence shows would he rendered useless by the installation of the alternating system. The ordinance provides that at the commencement of each five-year period the city may require 'that all such machinery and appurtenances are in good condition and of such approved design as shall efficiently and properly produce gas and electric light of the required standard and power, and give the city and the citizens thereof the advantages of all improvements in the production of gas and electricity.' The machinery and appurtenances supplied under the required direction of the city were to be inspected, and required to be in good condition, and of such design as to furnish light of the 'standard and power' already designated, so that the city should have the advantage of all the improvements calculated to increase the efficiency of the system then in use. This construction is warranted from a consideration of the entire ordinance and in view of the fact that it is very improbable that either the city or the plaintiff contemplated that demands might be made at the beginning of each five-year period which would require an entire change of machinery and appurtenances, no matter how great the expense."

Personal.

M. FRANK TRUMBULL, of the Trumbull Electric Company, has gone on an extended trip to Cuba, Porta Rico and Mexico.

MR. C. H. HINES has severed his connection with the Canadian Pacific Railway Company as electrical engineer of the mechanical department, etc.

DR. CARY T. HUTCHINSON, consulting electrical engineer, has sailed for Europe, and will, it is said, spend two or three months on the other side.

MR. M. I. WILBERT, of the German Hospital, Philadelphia, is to lecture this week before the Franklin Institute on the phenomena of radioactivity and their applications, with illustrations.

MR. JOHN B. ALLAN, general manager of sales of the Allis-Chalmers Company, has resigned his position and expresses his intention of taking a vacation for a couple of months, in order to recuperate.

MR. J. T. P. KENYON has resigned from the engineering department of the New York Edison Company to become chief draughtsman of the electrical department of the New York Central & Hudson River Railroad.

MR. ANDREW CARNEGIE has created a $5,000,000 pension fund, the income of which is to be devoted to the relief from immediate suffering of the heroes in private life who sacrifice themselves in performing acts of courage to save others.

MR. C. C. GARRISON is now president of the Northern Engineering Company, Incorporated, White Building, Liberty Street, New York. Mr. C. Blake Garrison has been elected treasurer and Mr. B. R. Andrews has been appointed secretary of the concern.

MR. ARTHUR WEST, assistant chief engineer of the Allis-Chalmers Company, has resigned his position, and will go to the Mediterranean for a holiday trip. In his letter of resignation he says: "For the last couple of years I have been regularly overworked and my most urgent need is rest."

LIEUT. G. L. CARDEN, of the Department of Machinery, St. Louis World's Fair, lectured at Yale University on April 22, and the following evening in the auditorium of the new Y. M. C. A. building, New York, the subject being "Power Plant at St. Louis, and Some European Observations."

MR. SEYMOUR FOLWELL, at one time manager of the New York office of the British electrical engineering and contracting firm of Robert W. Blackwell & Company, Limited, and until recently connected with the sales department of the Cutter Company, of Philadelphia, is again on this side.

MR. WM. BARCLAY PARSONS, chief engineer of the New York Subway after an inspection of the Panama property, says the waterway can be successfully operated. Colon and Panama can be made healthful, he says, by sanitary precautions. He is a member of the U. S. Panama Canal Commission.

MR. WM. STANLEY, of Great Barrington, Mass., has recently taken a trip to Paris, France, in connection with some recent important work. The Pittsfield newspaper says that these new patents "propose to give the sun more vim and hang a new moon." We had thought that to be Mr. Tesla's special prerogative.

MR. A. M. MATTICE, chief engineer of the Allis-Chalmers Company has sailed for England this week on a brief business trip. He was accompanied by Mr. Fullagar, of the British turbine syndicate, who has been here for a few weeks, at Milwaukee, etc., in connection with Allis-Chalmers steam turbine development.

MR. FRANCIS BLOSSOM, of Sanderson & Porter, Kuhn-Loeb Building, New York, is expected back from New Orleans early next week where he went recently in connection with the New Orleans Railway Company's project to construct a new power plant to have an initial capacity of 7,000-hp and an ultimate development of 20,000-hp.

MR. WILLIAM N. SCOTT, manager of the Cutter Company of Philadelphia, has sailed for Europe for the purpose of closing some important contracts for circuit breakers, notably with the British Admiralty. The Cutter Company is represented in England by Robert W. Blackwell & Company, Limited. Mr. Scott expects to be abroad for about two months.

MR. JOHN I. BEGGS, president and general manager of the Milwaukee Electric Railway and Light Company, was presented by the officers and directors with a silver service in token of the esteem in which he is held by them at a banquet given for him on April 16. The silver is intended to form part of the equipment of a private car which is now being built for the use of Mr. Beggs.

MR. G. MARCONI.—Mr. Marconi, who has been interviewed by the *St. James's Gazette* on the question of his transatlantic "wireless" service says that his agreement with the Post Office which will be signed almost immediately, concedes all that his company has been asking for during the past few years. "As soon as the agreement has been signed," he added, "we shall start the service both to Canada and the United States."

MR. UGARTE, of the Mexican electrical engineering firm of Ugarte & Garcia, of Guadalajara, State of Jalisco, is now on his way to the States. His firm recently secured the contract for the construction of the electric lighting system in Colima, capital of the State of that name. Contracts have also been taken for the equipment of various hydraulic plants in the States of Jalisco and Coahuila, which will mean the purchase of considerable quantities of Yankee machinery, etc. Mr. Ugarte will visit St. Louis, Chicago, Pittsburg, and New York.

MR. C. A. MORENO, chief engineer of the St. Louis Transit Company, read a paper before the Engineers' Club of St. Louis, at its recent meeting, on the proposed method of handling visitors at the exposition. "The Transit Company, alone," he said, "will be able to take care of 50,000 passengers every hour. The Suburban Company has estimated its capacity of 10,000 per hour. The shuttle trains of the Wabash will accommodate 15,000 passengers per hour, making the total of 75,000. In fact, it would seem that the chief difficulty of the three Exposition lines will be—not how to take care of the people, but rather how to obtain enough passengers to take care of the new equipment that has been provided."

MR. ERVIN DRYER has resigned his position in connection with the Westinghouse Electric & Manufacturing Company, and has accepted an appointment with the Allis-Chalmers Company. Mr. Dryer's connection with the Westinghouse Company extended over a period of 16 years. He is one of the most competent salesmen in the electrical and mechanical field, and his wide acquaintance throughout the western part of the United States will be of great service to the Allis-Chalmers Company in the extensive new developments which they have undertaken. He has already entered upon his new duties with the Allis-Chalmers Company, and his headquarters will be at their offices in the New York Life Building, Chicago. He will give his attention to their engine work as well as to the sale of Bullock electrical apparatus, which the Allis-Chalmers Company now control through their acquisition of the Bullock Electrical Manufacturing Company, of Cincinnati.

DR. W. J. MORTON, the celebrated electro therapist of this city, has just sustained a deep personal bereavement in the death of his mother, Mrs. Elizabeth Morton, widow of Dr. W. T. G. Morton, discoverer of anesthesia, who died last week in this city at the Hotel Martha Washington, of pneumonia, following an illness of more than a year. Mrs. Morton, born in 1826, was married in 1844 to Dr. Morton, of Boston, Mass. A year of quiet married life had scarcely elapsed when her husband began that series of experiments upon lower animals, upon himself, and, finally, upon patients, which culminated in the great public demonstration that painless surgery by the inhalation of ether vapor was safe and practicable. No recognition of any sort from the American Government ever came to his widow, although the reports of six Congressional committees during her husband's lifetime had recommended an appropriation of several hundred thousand dollars be made in compensation for the Government's use of ether anesthesia during the civil war. A monument to his memory was erected on Boston Common, and other public tributes have since been made.

LORD KELVIN.—We quote the following from the *Manchester Guardian:* Lord Kelvin's election to the lord chancellorship of Glasgow University has loosened the flood of anecdotes which have gathered round his great name. I may be allowed to add two stories to that respectable record which have not, I think, seen print. Most Kelvin stories which obtain in Glasgow are founded upon the occasional inability of the great man who lisped in logarithms to bring his mind to a childish sum. The famous one tells how on his blackboard he once made two and two five, and, hearing the chuckles of his delighted class, altered it hastily to three. He was, however, once heard to say, in his characteristic slow way, with his beautiful use of the soft Irish r, "Seven times nine, Mr. Mac-far-lane, are a hundred and what? [Pause.] But, no: seven times nine cannot be a hundred and anything, Mr. Mac-far-lane, for the square of a hundred is ten." It is also told of him that, walking one day with a friend in Largs, he noticed that it had begun to rain. He questioned his friend closely as to where his coat and his umbrella were, and having satisfied himself that his friend had not these articles with him, he said: "Well, in that case, doctor, we will walk back beneath this belt of trees, for the rain will not per-colate the leaves, doctor, for twen-ty minutes."

MR. G. C. LLOYD.—Mr. George C. Lloyd has been appointed to the secretaryship of the British Institution of Electrical Engineers. Born in Lincolnshire in 1862, his father being the Rev. C. A. Lloyd, Rector of Rand, near Lincoln, Mr. Lloyd was educated partly in Germany, and on returning to England at the age of 17, he entered the works of Robert Stephenson & Co., locomotive and marine engine builders, Newcastle-upon-Tyne, as an apprentice. In 1884 he joined the firm of Messrs. Lamport and Holt, of Liverpool, in the capacity of marine engineer, and subsequently entered the service of the Spanish Royal Mail Steamship Co. (Compañia Transatlantica de Barcelona). He holds an extra first-class Board of Trade certificate. In the course of his voyages he visited the Philippine Islands five times, making a stay of one month on each occasion, and has also been in India, Brazil, the Argentine Republic and the West Indies, spending some three months in Cuba before the outbreak of the rebellion. He returned to England in 1891, and for the next nine years was engaged in engineering work in Glasgow and London. Since 1900, Mr. Lloyd has acted as chief assistant to the secretary of the Iron and Steel Institute. Mr. Lloyd is an excellent linguist. He enters on his duties on May 12th. Mr. Percy F. Rowell, chief assistant to the late Mr. McMillan, has been appointed assistant secretary.

NEW INSTITUTE MEMBERS.—At the April meeting of the Council of the American Institute of Electrical Engineers the following were elected to associate membership: Allen, Claxton Edmonds, assistant engineer General Electric Co., Lynn, Mass.; Appleton, Joseph, manager of construction, Electric Storage Battery Co., Philadelphia, Pa.; Berg, Edwin Victor, draughtsman, Telluride Power Co., Provo, Utah; Bott, George Robert, chief draughtsman, American Elevator Co., Columbus, Ohio; Boyd, Alexander A., general manager Michigan City Electric Co., Michigan City, Ind.; Bryant, Arthur Horace, tester Lamp Testing Bureau, New York City; Coggin, William Lord, tester General Electric Co., Lynn, Mass.; Cope, Albert Nathan, electrical engineer, Columbus Public Service Co., Columbus, Ohio; Costa, Louis J., manager, Jandus Electric Co., 1419 Real Estate Building, Philadelphia, Pa.; Crankshaw, J. B., resident engineer, Cincinnati Engineering and Investment Co., 1406 Traction Building, Cincinnati, Ohio; Crane, Charles Eugene, president and manager, Mutual Light & Heat Co., Seattle, Wash.; Davenport, Alfred La Rue, tester, Edison Electric Co. of Los Angeles, Long Beach, Cal.; Davis, Richmond Pearson, instructor, School of Submarine Defense, Fort Totten, N. Y.; Fenn, Ernest James, Steuart & Fenn, Dunedin, N. Z.; Fletcher, Raymond Fennimore, electrical engineer, McMaster and Fletcher, Columbus, Ohio; Griffin, Frank Albee, engineer, General Electric Co., Schenectady, N. Y.; Gillet, Louis Allston, assistant to secretary, American Society of Mechanical Engineers, New York City; Gresham, William Andrew, chief dynamo man, Georgia Electric Co., Atlanta, Ga.; Griffin, Thomas Lloyd, agent, General Electric Co., Wilkesbarre, Pa.; Hale, William Buell, laboratory chief, Western Electric Co., 259 S. Clinton St., Chicago, Ill.; Hedin, Kaleb, electrical engineer, Vesteras, Sweden; Hilbert, Alfred, draughtsman, S. M. Bixby, 1173 Fulton Ave., Bronx, New York City; Holland, Newman Henry, telephone engineer, Holtzer Cabot Electric Co., Wollaston, Mass.; Hulme, Frederick Wendell, electrical engineer, Hydro-electric Co., West End Hotel, St. Louis, Mo.; Johnston, D. McG., electrical engineer, The United Electric Co., Ltd., Toronto, Can.; Kaiser, Louis Theo., chief engineer, Thos. Emery's Sons, Hotel Emery, Cincinnati, Ohio; Kenyon, A. D., patent counsel, Kenyon and Kenyon, 49 Wall St., New York City; Kenyon, William Houston, patent lawyer, 49 Wall St., New York City; Lohman, Frank Henry, electrician, Calumet and Arizona Mining Co., Douglas, Ariz.; McBurney, Bruce Gordon, salesman, Canadian General Electric Co., Toronto, Ont.; McCall, Joseph B., president, The Philadelphia Electric Co., Philadelphia, Pa.; McMasters, James Clayton, McMasters and Fletcher, Columbus, Ohio; McNamee, Thomas Wilson, superintendent, Wabash Electric Light Co., Wabash, Ind.; Merrill, Meldon Humphrey, sales engineer, Westinghouse Electric and Mfg. Co., 716 Board of Trade Building, Boston, Mass.; Mettler, Hans Willi, draughtsman, Chicago Edison Co., Chicago, Ill.; Milch, Maurice, engineer, General Electric Co., Schenectady, N. Y.; Mitchell, Arthur Jesse, Southern representative, Adams Bagnall Electric Co., 323 Empire Building, Atlanta, Ga.; Mustard, John, manager, Wagner Electric Mfg. Co., 1617 Real Estate Trust Co., Philadelphia, Pa.; Newman, Mortimer Lewis, electrician, Dept. of Yards and Docks, Navy Yard, New York City; Nishikawa, Kikei, chief electrical engineer, Bessi Copper Mine, Iyo, Japan; Ovington, Earle Lewis, president, Ovington Mfg. Co., 4 Newcastle Court, Boston, Mass.; Phillips, Irving Wadsworth, student, General Electric Co., West Lynn, Mass.; Plaisted, Arthur I., engineering inspector, Metropolitan Water and Sewer Board, E. Somerville, Mass.; Reed, Frederick Holly, vice-president, J. G. White & Co., 43 Exchange Place, New York City; Richardson, Joseph W. A., contractor, 715 Union St., New Orleans, La.; Riggs, Walter Merritt, professor, Electrical Engineering, Clemson Agricultural College, Clemson College, S. C.; Salomon, Arthur F., manager, World's Fair Office, Nernst Lamp Co., St. Louis, Mo.; Schafer, Oliver Milton, superintendent, Fire Alarm and Police Telegraph, Trenton, N. J.; Shaw, Fred Menzies, tester, General Electric Co., Lynn, Mass.; Strohman, William, designer, Westinghouse Electric and Mfg. Co., Pittsburg, Pa.; Snyder, Henry Nicholas, superintendent, Santa Paula Electric Co., Santa Paula, Cal.; ter Meulen, F. W. von Lilienstern, assistant engineering, Westinghouse, Church, Kerr & Co., New York City; Tobey Jesse Orion, superintendent, Northern California Power Co., Manton, Cal.; Tomlinson, Harvey Strout, tester, General Electric Co., Lynn; res. Salem, Mass.; Tsukamoto, Chuzaburo, calculator, General Electric Co., Schenectady, N. Y.; Van Etten, Herbert Briant, assistant engineer, New York Telephone Co.; Vickers, Frederick Elwood, expert, General Electric Co., Los Angeles, Cal.; Wheeler, Burr, student, Columbia University, New York City; Wilgus, William John, fifth vice-president, New York Central and Hudson River R. R., New York City; Wilmerding, Charles Henry, consulting engineer, Room 1100, 84 Van Buren St., Chicago, Ill.; Yundt, George Jacob, electrical engineer, Southern Bell Telephone and Telegraph Co., Atlanta, Ga.; Zimmerman, Clarence Irving, assistant chemist, Nernst Lamp Co., Pittsburg, Pa.

Trade Notes.

BUFFALO FORGE COMPANY, of Buffalo, N. Y., has brought out a new eight-page, small size pamphlet devoted to its Buffalo hand blowers. Copies can be obtained on application.

THE FORT WAYNE ELECTRIC WORKS have opened a Pacific Coast branch office in San Francisco, Cal. Mr. F. V. T. Lee is manager of this office, which is located at 69-75 New Montgomery Street.

THE MACKAY ENGINEERING COMPANY, 149 Broadway, New York, announces that it has withdrawn from the arrangement whereby it represented the dynamos and motors of the Akron Electrical Mfg. Company.

YOST SOCKETS.—The Electrical Equipment & Supply Company, of 215½ Fourth Avenue, Pittsburg, Pa., has just assumed the representation of the Yost Electric Mfg. Company, for its socket specialties, etc., in Pittsburg and vicinity.

EMERSON ELEC. MFG. CO., St. Louis, Mo., has just issued a new bulletin as to its bi-polar direct current motors, ⅛ to ⅓-hp. These are of the enclosed cylindrical types TD62 and TD52 and are stout power motors with a heavy reserve, overload capacity. Two sizes of frames are used.

THE BROWN HOISTING MACHINERY COMPANY, of Cleveland, Ohio, has closed a contract for electric coal trimming machinery for the docks of the Hocking Valley Railway Company, at Toledo, Ohio. It is stated that this will be the first trimming coal machinery installed on the Lakes. It will effect a great saving in the handling of fuel.

THE BURT MANUFACTURING COMPANY, Akron, Ohio, manufacturer of the Cross oil filter, has just received an order from the Russian government for six oil filters, this being the tenth order from that government. These filters have acquired a reputation throughout Europe and the company is constantly making continental shipments.

GOULD STORAGE BATTERY COMPANY.—Mr. W. W. Donaldson, sales manager of the Gould Storage Battery Company, of 25 West 33d St., New York, announces that the company will move about May 1, and that on and after that date it will occupy the entire eighth floor of the New Century Building, 1 West 34th Street.

THE NEWMAN-WILLSON COMPANY, Lambertville, N. J., is manufacturing an oil filter which is claimed to save 50 per cent on an oil bill; saves 90 per cent of the oil, and, being automatic, requires little attention. Its merits will prove of interest to all having use for such a device. This company is composed of Messrs. W. S. Newman and E. L. Willson.

THE INTERNATIONAL TELEPHONE MANUFACTURING CO., Chicago, reports a constantly increasing demand for its long distance bridging toll line and country party line telephones for four-party selective signalling systems. The "International" bridging instrument is said to be, mechanically as well as electrically, one of the very best instruments of its kind.

THE UNITED TELPHERAGE COMPANY, 20 Broad Street, New York City, which has already done a large amount of heavy and light telpherage work with motor traveling on an aerial line, has now brought out an ingenious modification of its system for advertising purposes. The "ad" is suspended below the telpher, which travels up and down its track parallel to any railroad trolley line, highway, etc., thus attracting attention.

NILES-BEMENT-POND COMPANY, 136 Liberty Street, New York City, is issuing a neat "Progressive Reporter," illustrative and descriptive of its latest machine tools. The issue just received shows a 48-inch double planer, 60 inch double rotary planer hydraulic bar shear, hydraulic punching machine, horizontal milling machine, 68-inch slotting machine, new model turret lathe, 400-ton hydraulic wheel press, Corliss cylinder boring machine and motor driven horizontal machines.

THE ELECTRICAL TESTING LABORATORIES.—The fact should be generally known that the title of the corporation heretofore known as the Lamp Testing Bureau has been legally changed to be Electrical Testing Laboratories, and that the new corporation is in every respect the legal successor of the other, without change of officers or functions. The offices and laboratories have now been removed from No. 14 Jay Street to Eightieth Street and East End Avenue, New York.

WARNING.—We are advised by the General Electric Co. that a person calling himself Geo. E. McCante, and describing himself on his card as chief electrician of the General Electric Co., Schenectady, N. Y., is traveling in Texas and making representations that he is connected with the company. We are requested to state that there is no one of this name on the payroll of the General Electric Co. It is needless to add that no such person was ever its chief electrician.

BISSELL SIGN FLASHER.—The F. Bissell Company, of Toledo, O., reports that it is having a large sale of its new sign flasher for advertising purposes, etc. The regular design has 24 circuits, all or part of which may be used, while more circuits can be added. The contracts are made and broken by quick-break knife switches. The regular switch throws in lights one at a time until the entire sign is illuminated; but this effect can be varied. A catalogue will be sent on application.

LAMBERT SCHMIDT TELEPHONE MFG. COMPANY, of 85-93 Maple Street, Hoboken, N. J., has just issued catalogue No. 11 devoted to its well-known interior telephones. It is a handsome pamphlet of 24 pages and illustrates and describes its apparatus fully, all being intended to work primarily on the company's patented central energy circuit which requires but one bank of batteries, located at any convenient point. Only three more wires than telephones are necessary. A long list of users is also given.

CROCKER-WHEELER BRANCH IN NEW ORLEANS.—Crocker-Wheeler Company, manufacturers of electric generators and motors, will on May 10, open a branch office in the Hibernia Bank Building in New Orleans. Mr. W. P. Field, of the St. Louis office of the company, will be the representative in charge. Although there are 15 Crocker-Wheeler branches from Boston to San Francisco, including St. Louis and Atlanta, the establishment of this new office has become necessary in order to accommodate the steadily increasing market for electric machinery in the South and Southwest.

LAMP CONTRACTS.—"The contract method every time," says the Electric Appliance Company, Chicago, to people who are going to purchase lamps. "Whether a consumer's requirements call for one thousand, ten thousand or a hundred thousand lamps, he should buy them on contract and so be assured of the best price and best service." The company has just closed contracts with two of the largest consumers in the west for the Packard high-grade lamps and recommends all its customers to secure lamps on the contract basis.

THE WIRT ELECTRIC COMPANY is making arrangements to move into its new plant at the corner of Germantown Avenue and Pennsylvania Railroad tracks at North Philadelphia. It expects to get into its new building by May 1. This building gives it much more space than it at present has, and is arranged so that it has light on every side on every floor. The building is brick, of the modern mill construction. It may take the Wirt Electric Company a few days to get settled in its new shop, but it expects by May 7 to be running in its new quarters to its fullest capacity.

THE PUBLICATION DEPARTMENT of the B. F. Sturtevant Company is to receive generous recognition in the allotment of space in the new office building at Hyde Park, Mass. A portion of the high basement, about 40 ft. square, will be devoted to a press room and storage space for paper stock and printed matter. A full equipment of type and of jobbing and catalogue presses will be installed. Immediately above this room and occupying one end of the first story of the same building, will be the offices with a full complement of artists, clerks, etc. The Sturtevant Company has for several years maintained a printing plant of its own, and is to-day carrying through all the work required in connection with its publications except the engraving. This department will be one of the most extensive and progressive connected with any manufacturing concern of its character in the country.

LOW-SERVICE COMPRESSORS FOR AIR AND CARBONIC-ACID GAS. A 12-page pamphlet, published by the Laidlaw-Dunn-Gordon Company, of 114 Liberty St., New York City, describes compressors intended for pressures of 30 lbs. and under. These compressors are built with open suction for supplying air at low pressure, or with closed suction for handling carbonic acid and other gasses. The inlet valves are of the semi-rotary type, while the outlet valves are of the poppet type. Rotary valves are considered superior for inlet service, not only because of their greater efficiency and durability, but furthermore because they open promptly and offer no resistance to the incoming air, which the poppet valve held down by a spring must necessarily do, thus cutting down the volume capacity of the compressor. The discharge valves, on the other hand, present a different problem, owing to the fact that the point of opening should vary with variations in pressure, and the poppet type has been adopted for this service.

"BIAS LINOTAPE."—The Mica Insulator Company, of New York and Chicago, is now placing on the market an entirely new product under the trade name "Bias Linotape." This material is, as its name suggests, a tape cut on the true bias and coated with a film of its Empire oxidized linseed oil. It is extremely flexible and can be wrapped around sharp corners and turns where straight tape cannot be used. It is designed especially for use in insulating armatures, field magnet coils, cables, switchboards and high tension work, as well as in other places where a high grade of electrical and mechanical insulating tape is required. The manufacturer is distributing small samples of this tape and announces its willingness to mail the same upon application. It filled some very large orders for the goods recently, and the trade seem to be very enthusiastic regarding them. This company reports increased sales in its standard lines of micanite, Empire and M. I. C. compound materials which it originated and brought out ten years ago.

BRISTOL EXHIBIT AT ST. LOUIS.—The Bristol Company, of Waterbury, Conn., is sending an exhibit to St. Louis which will be placed in Electricity Building, in space 36, near the main entrance. The company will show a complete line of its recording instruments for pressure, temperature and electricity. These instruments will be shown in various styles and sizes and in different finishes. The construction and operative parts will also be shown and a large number of the instruments will be in actual operation, enabling visitors to observe the manner of operation and the records the instruments make, also the extreme simplicity of the different instruments and the delicacy and accuracy which it is possible to obtain without sacrificing any of the necessary elements which are essential in a commercial form of a recording instrument. There will also be shown a complete line of specimens of Bristol patent steel belt lacing which comprises over 150 different sizes for all kinds of belting from the thinnest to the heaviest that is made, such as is used for conveying belts.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 19, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

757,557. ELECTROLYTIC DEPOSITION APPARATUS; William J. Joly O. App. filed June 18, 1903. Where the terminals of main wires are to be moved from time to time to follow the movements of a machine supplied through branch wires from the mains, the mains terminate in coils wound upon spools, which are supported upon a portable bracket; as the bracket is moved about the reels give off the main wires.

757,441. CLUSTER SOCKET; John H. Dale, New York, N. Y. App. filed Feb. 18, 1904. The finishing cap containing the openings for the lamp bases, supports inside, a block of insulating material to which all of the lamp terminals are attached, and by removing the cap from its support, the two binding posts for the line wires are exposed.

757,495. ELECTRIC SOLE SHOE; Adam Reed, St. Joseph, Mo. App. filed Feb. 4, 1904. Copper and zinc plates are arranged in a porous insole.

757,503. TELEGRAPH SYSTEM; Harry O. Rugh, Chicago, Ill. App. filed Aug. 31, 1903. This patent and those following in the same name provide a system and apparatus whereby wave-form current, as alternating current of suitably high frequency, may be employed in effecting telegraphic signals. The same circuit may be employed simultaneously for both direct and wave-form currents.

757,504. TELEGRAPHIC SYSTEM; Harry O. Rugh, Chicago, Ill. App. filed Aug. 21, 1903. See No. 757,503.

757,505. TELEGRAPHY Harry O. Rugh, Chicago, Ill. App. filed Aug. 31, 1903. See patent 757,503.

757,515. PHASE REGULATION; Egbert M. Tingley, Wilkinsburg, Pa. App. filed May 9, 1896. This patent and those following in the same name provide for securing a desired phase angle between the shunt and series fields when there is no current lag in the work circuit by displacing the current in one of the field coils with reference to that in the other or in both of said coils.

757,516. PHASE ANGLE ADJUSTING MEANS; Egbert M. Tingley, Pittsburg, Pa. App. filed April 24, 1900. See preceding patent.

757,517. METHOD OF PHASE ANGLE ADJUSTMENT; Egbert M. Tingley, Pittsburg, Pa. App. filed April 24, 1900. See patent 757,515.

757,518. METHOD OF PHASE ANGLE ADJUSTMENT; Egbert M. Tingley, Pittsburg, Pa. App. filed Feb. 4, 1901. See patent 757,515.

757,523. INDUCTION COIL; Richard Varley, Providence, R. I. App. filed Dec. 14, 1903. The sectional secondary winding is placed as usual axially over the primary winding and core and is inclosed in a porcelain cylinder having an inwardly projecting flange which enters between the sections of the secondary winding, the latter being so wound that the sections are connected together at the inner layers, so that the points of greatest difference of potential will be separated by the partition

757,524. INDUCTION COIL; Richard Varley, Providence, R. I. App. filed Dec. 30, 1903. A porcelain or glass cup passes over one end of the primary winding and core and is itself surrounded by one section of the secondary winding, the other section being placed around the uncovered portion of the primary and core, the whole being inclosed in a porcelain cylinder or cup.

757,525. INDUCTION COIL; Richard Varley, Providence, R. I. App. filed Jan. 12, 1904. A number of Ruhmkorff coils are placed in a single box and their armatures arranged to act upon a vibrator common to all of them.

757,527. VIBRATOR FOR INDUCTION COILS; Richard Varley, Providence, R. I. App. filed Jan. 20, 1904. The contact screw of the vibrator is arranged to be tipped so that its platinum point can be exposed for inspection and cleaning whenever necessary.

757,537. METHOD OF SIGNALING FOR ELECTRIC RAILWAYS; Samuel M. Young, New York, N. Y. App. filed Nov. 6, 1903. Consists in creating a difference of potential between the traffic rails of the system which separately form return paths for the power circuit and over which a current differing in character is flowing, actuating signal devices by the current due to such difference of potential and shunting said current around certain of the signalling devices by the aid of apparatus actuated by the power current.

757,541. PUSH BUTTON SWITCH; Walter A. Church, Binghamton, N. Y. App. filed June 17, 1903. Details.

757,557. ELECTROLYTIC DEPOSITION APPARATUS; William J. Joly and Joseph H. Joly, San Francisco, Cal. App. filed April 7, 1903. (See page 821.)

757,559. WIRELESS TELEGRAPH SYSTEM; Guglielmo Marconi, London, England. App. filed Nov. 19, 1901. At a station employed in wireless telegraphy, a conductor, a number of open circuits electrically connected with the conductor, a corresponding number of instruments, one electrically connected with each open circuit and means whereby the time periods of the open circuit are caused to differ from each other.

757,564. ELECTRIC HEADLIGHT; William H. Northall, Elwood, Ind. App. filed March 20, 1903. The lamp can be "turned down" by adjusting the length of the arc between the carbons.

757,609. ELECTRICAL TELEPHONE APPARATUS; Pliny H. Fisk, Clay, Ia. App. filed June 13, 1903. (See page 822.)

757,617. PROCESS OF PRODUCING CARBIDE; William Smith Horry, Niagara Falls, N. Y. App. filed March 29, 1902. (See page 821.)

757,618. PROCESS OF ELECTRIC HEATING; William Smith Horry, Niagara Falls, N. Y. App. filed April 5, 1902. (See page 821.)

757,619. PROCESS OF ELECTRIC HEATING; William Smith Horry, Niagara Falls, N. Y. App. filed April 28, 1902. (See page 821.)

757,620. METHOD OF ELECTRIC HEATING; William Smith Horry, Niagara Falls, N. Y. App. filed June 6, 1902. (See page 821.)

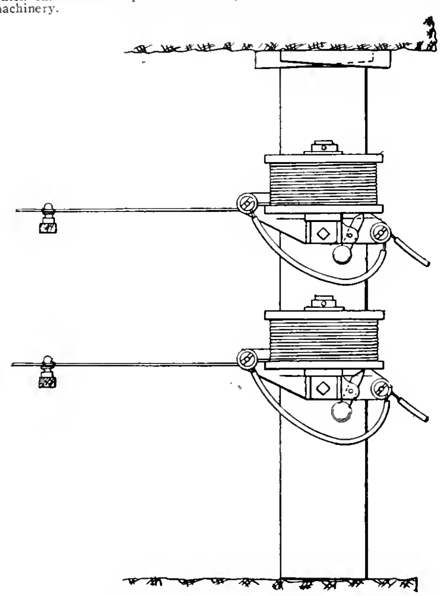
757,621. ELECTRIC FURNACE; William Smith Horry and Edgar F. Price, Niagara Falls, N. Y. App. filed Oct. 11, 1902. (See page 821.)

757,630. SAFETY DEVICE FOR TROLLEY POLES; Phelam McCullough, Thomas Planey and Robert Baron, Liverpool, Eng. App. filed Jan. 22, 1901. Details of a trolley retriever.

757,633. ELECTRIC HEATING; Edgar F. Price, Niagara Falls, N. Y. App. filed April 30, 1903. (See page 821.)

757,634. ELECTRIC RESISTANCE FURNACE; Edgar F. Price, Niagara Falls, N. Y. App. filed April 30, 1903. (See page 821.)

757,636. FLY WHEEL FOR QUICK-RUNNING INTERNAL COMBUSTION ENGINES; Firtz Reichenbach, Charlottenburg, Germany. App. filed June 19, 1903. The fly-wheel is combined with the field magnet of the inductor which furnishes the sparks in the engine cylinder, to reduce weight of the machinery.



756,850.—Electrical Wire Station.

757,637. GAS BATTERY; James H. Reid, Newark, N. J. App. filed Aug. 3, 1903. (See page 821.)

757,659. ELECTRIC ARC LAMP; Robert Hopfelt, Berlin, Germany. App. filed May 13, 1902. The negative carbon is placed above and the positive below, and the electrodes contain certain proportions of metal for lessening the formation of slag.

757,670. ELECTRICALLY HEATER SOLDERING IRON; Alfred C. McCloskey, Philadelphia, Pa. App. filed May 6, 1903. Details.

757,687. RHEOSTAT; Imle E. Storey, Amsterdam, N. Y. App. filed Sept. 2, 1903. A plurality of tubular resistance elements, metallic end-pieces connecting them together in series and insulated rods extending through the tube and in contact alternately with end pieces at opposite ends of the tube, whereby connections are made from one side only of the rheostat.

757,692. BLOCK SYSTEM EMERGENCY APPARATUS; Frederick V. Thomson, Philadelphia, Pa. App. filed Jan. 10, 1903. Details.

757,695. ELECTRIC LIGHTING AND POWER SYSTEM; William A. Turnbayne, Buffalo, N. Y. App. filed Sept. 29, 1903. An electric motor driving an exciter for a generator driven from a car axle, is so connected up as to ensure a constant e.m.f. at the terminals of the generator.

757,715. PROPULSION OF ELECTRIC AUTOMOBILES; Jonas W. Aylsworth, East Orange, N. J. App. filed June 24, 1903. Both the field and armature are rotative and can be geared to the driving wheels as desired to maintain a uniform relative speed of the parts, notwithstanding changes in the load.

757,782. ELECTRIC ARC RUPTURING DEVICE; Sidney H. Short, London, Eng. App. filed Feb. 11, 1902. The contact points between which the arc is likely to be formed are placed between the bare poles of an electromagnet, the pole-pieces being insulated from the magnet core, so that the arc in deflecting will not find a path through the magnet core.

757,785. SPRING JACK FOR TELEGRAPH SWITCHBOARDS; John F. Skirrow, East Orange, N. J. App. filed Dec. 16, 1903. The jack is adapted to receive an identification card.

757,786. TROLLEY; Cyrus E. Smith, Fall River, Mass. App. filed Sept. 25, 1903. Details.

757,789. ELEVATOR BRAKE MECHANISM; August Sundh, Yonkers, N. Y. App. filed Aug. 5, 1903. A compound brake mechanism whereby the rotary force of the motor becomes directly applied to the hoisting drums through the previous setting of primary brakes upon a friction disk carried by the rotary motor armature shaft.

757,792. CIRCUIT CONTROLLER FOR INDUCTION COILS; Richard Varley, Providence, R. I. App. filed Jan. 20, 1904. There are two sets of platinum contacts for the vibrator, one of which may be thrown into service when the other becomes defective.

757,799. TELEPHONE TRANSMITTER; Walter L. Wilhelm, Buffalo, N. Y. App. filed Jan. 23, 1902. (See page 822.)

757,802. WAVE RESPONSIVE DEVICE; Albert E. Woodward, Nashua, N. H. App. filed July 9, 1903. The device comprises an aluminum disk in contact on each side with two polished steel balls, all held together by pressure.

757,809. BINDING POST; Stephen C. Houghton, San Francisco, Cal. App. filed Dec. 30, 1903. A pointed screw clamps the wire against an inclined surface.

757,817. PROCESS OF ELECTROLYTICALLY EXTRACTING COPPER AND ZINC FROM ORES; Stanislaw Laszczynski, Kielce, Russia. App. filed Oct. 10, 1902. (See page 821.)

757,824. TROLLEY BASE; Frederick S. Martin, Pittsburg, Pa. App. filed Sept. 4, 1903. A ring-shaped trolley base having a ball bearing upon a ring-shaped platform.

757,826. TELEPHONY; Albert Meinema, Chicago, Ill. App. filed Jan. 16, 1904. (See page 822.)

757,830. MEANS FOR PROTECTING LIVE PARTS OF ELECTRIC SWITCHES OR THE LIKE; William McDevitt, Philadelphia, Pa. App. filed Sept. 26, 1903. The metallic parts are sunken in grooves and cavities in the base.

757,847. ELECTRIC ARC LAMP; Frederik Sindingchristensen, New York, N. Y. App. filed May 4, 1903. Two armatures actuated by a single magnet and respectively controlling the arc-forming and the feeding mechanism.

757,850. ANTISEPTIC ATTACHMENT FOR TELEPHONES; Hugh L. Thompson. App. filed March 1, 1904. (See page 822.)

757,853. ELECTRIC SWITCH; George H. Whittingham, New York, N. Y. App. filed Oct. 29, 1903. The switch comprises opening and closing devices for supply and armature circuits, that for the supply circuit including a blow-out device, a second blow-out device designed to be included in a brake resistance circuit and means for actuating the blow-out devices alternately.

757,880. ELECTRIC RHEOSTAT; Roy W. Brown, Amsterdam, N. Y. App. filed April 21, 1903. Details.

757,884. THERMAL CUT OUT; Henry P. Clausen, Chicago, Ill. App. filed July 18, 1903. A thin sheet of solder separates two sharp edged members which have a shearing action as soon as the solder becomes slightly softened.

757,898. ELECTRIC CONTROLLER; Arthur C. Eastwood, Cleveland, Ohio. App. filed Jan. 30, 1904. Details.

757,906. ELECTRIC RAILWAY; George H. Fretts, Springfield, Mass. App. filed July 14, 1903. A switch point in the trolley wire can be moved at will by the motorman operating certain electric switches.

757,925. ELECTRIC SWITCH; Charles F. Hopewell, Cambridge, Mass. App. filed Oct. 7, 1903. Details of a tappet switch for trolley wires.

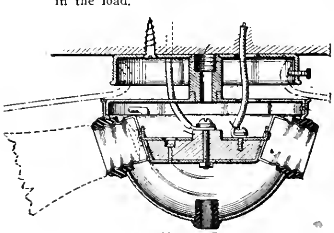
757,942. AUTOMATIC COMMUTATOR; Julien Henri Mercadier, Louvres, France. App. filed Oct. 16, 1903. Details.

757,943. STORAGE BATTERY; Abraham V. Meserole, New York, N. Y. App. filed July 13, 1903. (See page 821.)

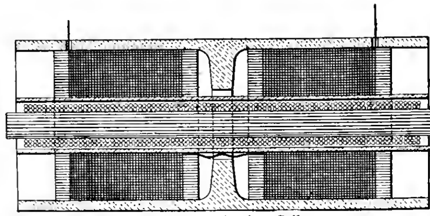
757,958. ELECTRIC ARC LAMP; Isaac W. Percival, St. Louis, Mo. App. filed Jan. 23, 1899. Two sets of carbons placed in one lamp and each designed to take 110 volts in series on a 220-volt circuit.

757,971. THERMAL CUT OUT; Michael Setter, Chicago, Ill. App. filed Aug. 5, 1903. Two telescoping members are held normally apart by a body of solder.

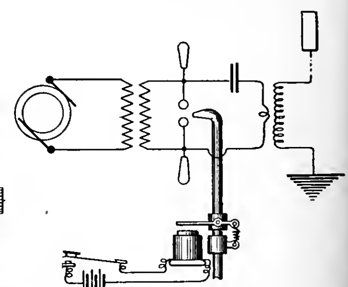
757,972. THERMAL CUT OUT; Michael Setter, Chicago, Ill. App. filed Aug. 5, 1903. Two members normally pulled apart by a spring are held together by solder.



757,441.—Cluster Socket.



757,523.—Induction Coil.



758,005.—Apparatus Employed in Wireless Telegraphy.

757,718. PROCESS OF MAKING STORAGE BATTERY PLATES; Joseph Bijur, New York, N. Y. App. filed Feb. 10, 1903. (See page 821.)

757,722. ELECTRIC SEMAPHORE; Dona Boisvert, Providence, R. I. App. filed Oct. 13, 1902. Details.

757,736. MULTIPLEX TELEGRAPHY; John J. Ghegan, Newark, N. J. App. filed July 3, 1902. A main line, two sets of transmitters and receivers at a number of stations, and means operated by the main line current for switching the corresponding sides of said sets alternately into and out of the main line.

757,765. INSULATOR; John W. Osborne, Winchester, Ill. App. filed Aug. 15, 1903. Details.

757,768. SIGNAL APPARATUS; Jonathan D. Price, Aurora, Ill. App. filed Jan. 21, 1902. Details of the mechanism and apparatus in a railway block signal system.

757,991. RECIPROCATING ELECTRIC MOTOR; Adolph F. Christmas, Pittsburg, Pa. App. filed March 16, 1903. Details of a circuit changer.

758,004. DEVICE FOR WIRELESS TELEGRAPHY; John Ambrose Fleming, London, Eng. App. filed April 8, 1901. The signal key is used to vary the current in the primary which is otherwise continuous, the signals being thus effected.

758,005. APPARATUS EMPLOYED IN WIRELESS TELEGRAPHY; John Ambrose Fleming, London, Eng. App. filed Nov. 9, 1901. A constant stream of sparks across the terminals are broken up into signals by intermittent blasts of air.

758,006. WIRELESS TELEGRAPHY; Francis J. Green, Detroit, Mich. App. filed Jan. 9, 1903. An application of wireless telegraphy to railway signaling.

758,031. TELEPHONE DESK SET; Henry P. Clausen, Chicago, Ill. App. filed May 26, 1902. (See page 821.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, MAY 7, 1904. No. 19.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
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NEW YORK, SATURDAY, MAY 7, 1904.

CONTENTS.

SIXTY YEARS OF THE TELEGRAPH.

The past week has witnessed the sixtieth anniversary of the electromagnetic telegraph, it being May 1, 1844, when Prof. Morse was able to demonstrate the use of his invention in reporting at Washington the proceedings of the Whig Convention at Baltimore. Since that time the history of the telegraph in this country and elsewhere has been one of steady advance and of universal benefit. It is certainly a moot question whether of late years the telegraph has advanced as rapidly as it might have done, and whether it has not become more or less crystallized and fossilized in its apparatus and methods. Yet even this statement must be made guardedly, for while the great telegraph systems the world over appear to look askance on automatic and machine methods, the wireless telegraph inventions have been generally taken up and pushed with great success; and if there is anything more wonderful and stimulating in the domain of electrical advance at the present time than the wireless we do not know what it is.

The amount of service rendered to the public by the telegraph sixty years after its practical inception may be gauged from the fact that in only four or five of the leading countries, 400,000,000 or 500,000,000 authentic messages are dispatched annually exclusive of those handled by leased private wires. In this country the record is now probably about 100,000,000 a year, while Great Britain does not fall very far behind that. Germany and France together are good for another 100,000,000, while Russia, Italy, Austria and Spain will probably account for another batch of equal magnitude. The telephone to-day has asserted for itself the function of knitting closely together the various communities in which it is used, but it is still the proud boast of the telegraph and the submarine cable that they have been the great instrumentality in annihilating distance, promoting intercourse and commerce and bringing the nations together.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION

We are very glad to be able to present on another page the programme of the National Electric Light Convention, to be held in Boston at the end of this month. President Edgar and the officials are to be congratulated upon the excellent list of papers they have secured. In fact, it is a matter for wonder how they expect to get through it in the brief time available, for so far as we can judge, it far exceeds anything the Association has attempted for years past. The programme of entertainment is also very alluring, and there is no question as to the warmth of the welcome which awaits the electric lighting fraternity at Boston this month.

It is rather remarkable that the Electric Light Convention has not been held in Boston since 1887. A great deal of water has run under the bridge since then, and it was certainly high time that the Association visited again a city of so many attractions—from whatever standpoint it be regarded. The early Brush arc lighting work done there by the late Mr. Gilbert will not soon be forgotten; the fact that Boston was so long the headquarters of the Thomson-Houston Company gave it special importance for many years, while of late the aggressive and intelligent work of Mr. Edgar has made the city the center of remarkably rapid development and improvement in the applications of electric light and power. Altogether a better choice of convention city could not have been made, and we venture to believe that the convention will be one of the largest and best that the Association has ever conducted.

Large Electrical Manufacture.

We publish elsewhere in this issue a synopsis of the annual report of the General Electric Company just issued. It is naturally a most interesting document, and in its fullness of detail may well be commended as an example of the kind of statement to which the public is entitled respecting the affairs of industrial corporations whose stocks are quoted on the exchange. The General Electric Company, in spite of the slackness and dullness of last year, enjoyed wonderful prosperity, with gross receipts reaching nearly $43,000,000, or more than $4,500,000 above those of last year. At the same time the net earnings were by no means so high, amounting after payment of interest on debentures to $7,789,300, against $10,232,800 in the preceding year. There were various reasons for this, but it may be noted also that the amount of orders billed was also nearly $900,000 less. The company in the last ten years has written off nearly $12,000,000 on its factories and carries them now at $6,500,000, which is extremely conservative. As a matter of fact, the company would appear to be doing about 25 per cent. of the entire electrical manufacturing of the country, and of course a very much larger percentage of that which falls within its own special fields. Moreover, the net profits of the year before writing off depreciation were equal to over 22 per cent. on the stock and 18 per cent. after charging off depreciation. Many of the details given in our synopsis, as well as in the full document, are of great interest and suggestiveness, particularly the items with regard to power transmission, the development of the multiple-unit system, the introduction of the steam turbine and the equipment of steam railroads with electricity. Some idea of the expansion of the company's business may be inferred from the fact that as recently as 1901 the gross receipts were below $30,000,000. Within the three years they are nearly half as much again.

Our Patent System.

We are glad to publish the important suggestions of ex-Commissioner of Patents Seymour on reform in our present system. In justice to ourselves, however, we must correct some apparent misconceptions. In the first place, we have, and have freely expressed, a very bad opinion of "working" as customarily practiced. It is a solemn farce in most cases and does not serve to protect the public. The plan which we have advocated is a very different process of elimination. It practically makes the original issue for a short term subject to extension for suitable cause. The patentee at the end of, say, six or seven years, would have to come forward and show either that the invention was being so manufactured as to meet public demand fully and squarely, or in default of such working that there was complete and adequate cause for the default. In the hypothetical case of a patented torpedo boat cited by Mr. Seymour, the inventor would have to show that he had diligently and in good faith prosecuted the invention, endeavoring to procure its adoption and manufacture. If it had been steadily turned down by all those who had investigated it, it would be safe to conclude that it did not possess such merit as would warrant an extension. There are many inventions which require large expenditure for reduction to practice, and in all such cases the inventor should have the benefit of the doubt, but such cases form a very small proportion of the total of unused patents. Most of these are either without merit in a commercial sense or are obstructive patents held by the owners, generally large corporations to prevent competition at the hands of rivals. All these ought in the public interest to be extinguished once for all.

We are well aware of the provisions of the law in the case of prior publication whether in an expired patent or elsewhere, but there is a vast difference between falling afoul of these and infringing a patent in being. The latter, whether of public use or not, holds all improvements tributary and hence discourages them, while the former only serve to obstruct broad claims. Every large corporation holds patents which it does not use nor intend to use, but which serve to prohibit improvements along similar lines. As a matter of justice to the public, the whole crew of useless or shelved patents ought to be put out of the way, and we know of no more effective way of doing it than by requiring the owners to show just cause for an extension of term. Mr. Seymour's comments on the compulsory licenses are to the point, but they do not go in our judgment quite far enough, since they compel the public to pay tribute for a right which the owner does not himself deign to use. The poor inventor does not need to be clubbed into giving a license. If compulsory license is needed anywhere, it is in behalf of improvements blocked by earlier patents, used or unused. We heartily agree with Mr. Seymour in the necessity for more care in the Patent Office searches with respect to novelty, and in his appreciation of the need for greater liberality in the case of broad inventions, hitherto only patentable in detached segments sometimes very hard to protect singly. In fact, we think the office overhauling of applications should be so thorough as to bar lack of invention as a defense in infringement cases, and to make anticipation very difficult to establish. But the public needs protection against the use of patents to obstruct improvements. There is a deal of Buncombe over justice to the struggling inventor, for that needy person has generally sold his birthright for a mess of pottage long before the invention has come into common use; and a show-down of ownership in patents of actual or potential importance would disclose most of them in the hands of sleek promoters or of corporations using them to minimize competition from improvements. This is commercially legitimate, but it is far from the primary purpose of a patent system.

Municipal Improvement Loans.

We note that several of the English financial authorities are calling attention to the grave position of municipal credit in the British Isles and expressing concern over the heavy strain that principal corporations are undergoing in their efforts to meet the enormous liabilities imposed upon them by the various trading operations upon which so many of them have launched. The London *Argus* enumerates some instances of the kind, and mentions the fact, as an example, that all the Birkenhead loans are at a discount. Glasgow, which runs everything for itself, including the cradle and the grave, is offering a half per cent. over the deposit rate of the Scotch banks on loans for a month. In no fewer than 18 large municipalities the 3 per cent. loans that eight years ago were at a premium are now at a discount, and appeals are being made right and left for loans even in small sums, predicated on mortgages of corporation revenues. In London, where all kinds of enterprises have been indulged in, some electrical, a halt has been called, and none too soon. It is bad enough to have a score or two of nations load themselves with debt in order to destroy each other's savings by bloody warfare. It is worse to have hundreds of municipalities plunging headlong into crazy financing and obligation, the sole object of which is to check and choke the enterprise and thrift of their own citizens. There is as little excuse for the one form of borrowing as for the other.

The indebtedness of local authorities in the United Kingdom has nearly doubled in ten years, and in 1902 was already $2,000,000,000.

Terrific as these figures appear, we can match them in the United States, although the sturdy individualism of our people has not yet yielded so fully as that of the European to the rule of others mightier than ourselves which makes for bankruptcy. We have lots of cities with a debt of over $10,000,000. Boston and Philadelphia have both over $50,000,000. Chicago has but $15,000,000, yet is always hard up. St. Louis has nearly $25,000,000. But these figures are child's play alongside the returns from Gotham. The budget for 1902 for Greater New York City provided over $23,000,000 for interest and redemption of city debt, and since then it has been piled up higher and higher. Some enthusiastic New York socialists would like to throw away several hundred millions more even now on lighting plants and trolley lines; but there is a limit, and there will soon be a sharp jolt and halt. The *World's Work* points out that the city budget is bigger than that of any five other cities in the country; that the city employs 46,000 persons, and that it pays wages and salaries amounting to $55,000,000 a year, at the highest rates known in the vicinity. Well may the magazine we quote say: "No company or private business could afford such a drain upon its resources." We are no alarmists. The strong, healthy optimism of American growth is ours, but we do not hesitate to say that such exhibitions of the unmitigated tendency to have the municipality do everything, and to put every citizen in buttons is both dangerous and disgraceful to our nation.

American Industries and the Metric System.

The National Association of Manufacturers has recently published in a supplement to *American Industries*, for April 15, 1904, a detailed analysis of replies elicited by a circular letter addressed at the end of last year to about 2,800 members of the Association, on the subject of the metric system bill. The tone of the circular letter shows that the circular letter was devised in a spirit of antagonism to the metric system, and that its purpose was to elicit as far as possible the hostile sentiments of the Association members towards the metric system bill, which, as drafted in 1903, contemplated compulsory adoption of the system by the United States at large. Consequently, while there is no reason to suppose that the Association management has in any way misrepresented the returns to the letter, it seems probable that the tone and purpose of the letter have elicited the greatest hostility that the bill can evoke from the membership, and that if a circular letter had been drawn up in the opposite spirit of eliciting as far as possible the favorable spirit of the membership towards the adoption of the metric system in some manner, as distinguished from compulsory adoption at the date of January 1, 1907, a much more favorable set of returns for the metric system might have been looked for. Nevertheless, the results published are very encouraging, and we owe our thanks to the National Association of Manufacturers for their pains in issuing the letter and in tabulating the published returns.

It seems that 774 replies were returned, or from about 36 per cent. of the members addressed. Eleven questions were asked in the letter. There is no fault to find with these questions, considered independently of the letter accompanying them. We need only consider the last question, which was: "Should the metric system be made the legal standard of the country?" There are 707 recorded answers tabulated for this question, and 141 were affirmative, 87 were noncommittal, and 479 negative. This means that 20 per cent. of the answers as tabulated were in favor of the metric system as a legal standard, and 67.7 per cent. were against the metric system. Broadly speaking, therefore, two-thirds of those who voted, voted against the metric system, while one-fifth voted for it. The percentage in favor of the metric system as a legal standard in the tabulated return is 25.5 per cent. in the metal group and 15 per cent. in the non-metal group of manufacturers. It reaches a maximum of 32 per cent. among manufacturers of electric machinery, and is lowest in boots (4.5 per cent.). The boot industry is clearly wedded to the English foot. So far as the favor of the metric system in industry is concerned, it seems that electricity is at the head of the procession.

Altogether, the result is very encouraging and satisfactory, from the standpoint of international unity of weights and measures. Ten years ago had such a ballot been taken, the returns in favor of the metric system would probably have been only about 5 per cent., and evidences are abundant that the metric system makes steady progress towards favor. Three engineering societies are down as favoring the bill; namely, the Boston Society of Civil Engineers, the Engineers' Society of Western Pennsylvania and the Western Society of Engineers. We know at least three more among the most prominent in the country that might have been included in the list if they had been consulted, their pro-metric votes having been officially published. Seven engineering societies are tabulated as against the measure. Among commercial associations, 9 are down as in favor of the bill, and 14 against it. Among manufacturers' associations, 2 for and 21 against. If the same incompleteness of returns exists in the two latter classes as we know to exist in the first class,, material changes in these numbers might also be looked for. But the result of any canvass of the metric system among manufacturers is necessarily a limited criterion of the value of the system to the country at large, and even of its ultimate value to the manufacturers themselves. In these days of keen competition, a profitable business implies a skillful adjustment with respect to numerous factors, and a favorable balance sheet is the question of the hour, not of the distant future. Opportunism is thus almost necessarily the guiding policy in manufacturing, and even though personally recognizing the intrinsic merits of the metric system, a manufacturer as such is apt to view its adoption only in the light of involving an expense without prospect of any immediate return, and as menacing a delicately balanced factory organization.

Electrical Methods of Determining Torque.

There are various well-known methods of measuring torque mechanically. For example, a pair of pulleys set independently side by side and connected by a spring or springs, enable the torque communicated from one to the other to be measured, during rotation, by the distortion of the springs. Every mechanical transmission dynamometer is, in fact, a torque measurer. The electric motor is generally considered as the most convenient and reliable transmission dynamometer, since the power transmitted is capable of being readily measured in watts, and this power, divided by the angular velocity of the motor shaft, in radians per second, gives the torque at once in dyne-centimeters, and thus, by conversion, in pounds-feet or other desired unit. The method is very convenient, and its accuracy is limited only by the accuracy of the wattmeter and of the speed measurer. Prof. McAllister's article on page 871 refers to a refinement in the method of torque measurement by the use of the shunt electric motor. The refinement consists in the elimination of the extra torque to the conditions of measurement, such as that due to the belt connection between the machine to be tested and the shunt machine, which gives the measurement. The shunt machine first drives both machines, taking from its mains the power required to overcome the frictions of both. Next the machine to be tested takes power from its mains and assumes a share of the load, the amount of its load being adjustable. The change in the current of the shunt machine measures the mechanical torque exerted by the tested machine. That is to say, the formula yields the torque which the tested machine gives to its shaft and bearings, after paying for internal electrical and mechanical frictions.

Programme of the National Electric Light Convention.

The following is the programme of papers and reports to be presented at the twenty-seventh convention of the National Electric Light Association, to be held in Boston May 24, 25, 26 and 27:

"The Sale of Electrical Energy," W. F. White; "Economy Test of a 5,500-hp, Three-Cylinder Compound Engine and Generator," J. D. Andrew and W. F. Wells; "A One-Hundred-Mile Transmission Line," Robert Howes; "The Mechanical Stoker and the Human Operator," Edwin Yawger; "The Organization and Equipment of an Arc Lamp Department," Samuel G. Rhodes; "Practical Notes on Steam Turbines," Francis Hodgkinson; "Electric Light and Power Plants in Connection with Ice Plants," C. L. Wakefield; "Single-Phase Power Motors for Electric Lighting Stations," W. A. Layman; "A Three-Wire, 500-Volt Lighting System," Walter I. Barnes; "Notes on the Internal Combustion Engine as Applied to Central Station Service," E. E. Arnold; "A Proposed System of Standard Instruments for Operating Companies," H. P. Davis; "Remote Control of Electrical Apparatus," William H. Cole.

In addition to these papers, which are already in print, are three or four others on timely subjects which have not yet gone to press, among them one by Dr. F. A. C. Perrine, on "Types of Large Water Power Installations." The reports are as follows: Report on Progress, T. Commerford Martin; report of Committee on District Heating, E. F. McCabe, chairman; report on Lost and Unaccounted-for Current, C. W. Humphrey; report on Purchased Electric Power in Factories, W. H. Atkins, chairman; report on Office Methods and Accounting, Frank W. Frueauff; report on Advertising, La Rue Vredenburgh; report on Sign and Decorative Lighting, Arthur Williams; report on Analysis of Flue Gases, Henry L. Doherty, chairman; report on Standard Rules for Electrical Construction and Operation, Capt. William Brophy, chairman; report of Committee Appointed to Investigate the Steam Turbine, William C. L. Eglin, chairman; Wrinkle Department, edited by Charles H. Williams; Question Box, edited by H. T. Hartman. There are 100 or more "wrinkles" submitted, and the Question Box contains nearly 450 questions, nearly every one of which has been answered. In addition to the papers above enumerated will be the paper on "Underground Construction," for which Past President Doherty will present a gold medal.

The following-named gentlemen comprise the local entertainment committee: James I. Ayer, chairman; Prof. C. A. Adams, Albert Anderson, William H. Atkins, F. E. Barker, F. P. Barnes, R. N. C. Barnes, George H. Berg, H. Bottomley, Capt. William Brophy, F. E. Cabot, C. W. Cartwright, A. E. Childs, A. T. Clark, Prof. Henry E. Clifford, D. P. Robinson, Charles B. Davis, George C. Ewing, H. H. Fairbanks, H. C. Farnsworth, George H. Finn, Almon Foster, W. C. Fish, Charles J. Hatch, Percy Hodges, W. E. Holmes, G. W. Holtzer, Sydney Hosmer, P. J. Kennedy, A. H. Kimball, George B. Lauder, F. W. Lord, Emil C. Lundin, Norman Marshall, E. H. Mather, Everett Morse, H. W. Moses, W. L. Mulligan, J. H. Parker, H. S. Potter, C. B. Price, C. F. Pritchard, Andrew Raeburn, F. H. Raymond, F. S. Richardson, S. B. Condit, Jr., Frank Ridlon, F. P. Royce, G. L. Sadler, F. S. V. Sias, F. E. Smith, Prof. H. B. Smith, J. A. Smith, J. Brodie Smith, George R. Stetson, F. J. Stone, G. M. Stuart, La Rue Vredenburgh, Thomas C. Wales, R. L. Warner, N. T. Wilcox, S. B. Wetherbee, F. S. Wilson, W. C. Woodward.

The following programme will be carried out for the entertainment of the visitors: On Tuesday afternoon the ladies in attendance will take carriages and drive through the Fenway and possibly to some points of interest about Boston. Committee, Charles J. Hatch, W. E. Holmes, D. P. Robinson. On Tuesday evening there will be given at Hotel Vendome a lecture on "Historical and Electrical Boston," under the charge of La Rue Vredenburgh. On Wednesday morning the ladies will visit the shopping district. Committee, H. S. Potter, F. S. Wilson, F. S. V. Sias. On Wednesday afternoon there will be a trip down the harbor, and on return a visit to the L street station of the Boston Edison Company. Committee, Sydney Hosmer, Percy Hodges, W. C. Woodward, Prof. H. E. Clifford. Wednesday evening will be spent at Symphony Hall, attending a popular concert. All the space within the rail has been reserved for the use of the guests and their friends. Committee, R. L. Warner, Thomas C. Wales, R. N. C. Barnes, George C. Ewing, F. W. Lord. On Thursday there will be provided for the ladies a trip in automobiles to Wayside Inn, Lexington and Concord. Committee, C. B. Davis, George H. Berg, F. S. Wilson. On Friday the entire day will be devoted to personally-conducted trips in and about Boston. The business sessions of the association will close on Thursday evening, leaving Friday to be devoted purely to entertainment in the manner above outlined.

A general information bureau will be established at Hotel Vendome, in charge of Messrs. Vose and Peasley, and in addition to the usual duties that such a bureau is called upon to perform, it is intended to have during the week lists made of those desiring to take any particular trips or see any particular points on Friday, so that adequate arrangement may be made for properly personally conducting the visitors to such places as they desire to go.

Mr. W. H. Atkins will have general charge of the entertainment on Friday, and the following committees have been selected to arrange details for the excursions as listed below: Institute of Technology, Prof. H. E. Clifford; Harvard University, Prof. C. A. Adams; Bunker Hill Monument and Navy Yard, P. J. Kennedy; Fore River Ship and Engine Company, Charles H. Parker; Simplex Electric Company, Everett Morss; Holtzer-Cabot Electric Company, C. W. Holtzer; power stations, Boston, I. E. Moultrop; trolley trips, Paul Winsor; N. E. Gas & Coke Company, George H. Finn.

The above briefly outlines the general plan, more definite details of which will be incorporated in the programme, which will be printed a short time in advance of the meeting.

Underwriters to Investigate Fire Causes.

The announcement is made that the National Board of Fire Underwriters—a body comprising about 120 of the most important fire insurance companies, doing business in the United States (which companies have paid out in losses in this country during the last ten years over $750,000,000, not including the recent conflagrations in Baltimore, Rochester and Toronto)—being thoroughly aroused by the continued great and apparently unnecessary fire waste of this country and especially the frequency of sweeping conflagrations in recent years, has undertaken to carefully investigate conditions existing throughout the country, in order to determine if possible more accurately than heretofore, where conditions exist which are conducive to the origin or spread of fire and to co-operate with the government—Federal, State and Municipal—by suggestions for the elimination of such conditions in order to check the present destruction of property so impoverishing to the nation and its citizens.

To carry out this object, a committee has been appointed, known as the Committee of Twenty of the National Board of Fire Underwriters, with instructions to define the congested districts of cities and determine their conflagration hazard, and for that purpose this committee is now organizing a staff of fire protection engineers, who will, after careful inspection, make reports on the construction, fire protection, electric hazard and other local conditions of cities, so that recommendations may be made for the adoption of better building laws, the improvement of water supplies and fire departments and the general safeguarding of hazards including electricity, handling of explosives, etc., etc.

For this work the committee will employ a number of men having had a technical education or training in the different branches of engineering which may fit them for work in such a cause. It is believed that the importance of this work will rapidly increase and that this engineering bureau will be a permanent adjunct of the national board. Men of ability, graduates of technical schools, will, therefore, probably find in such work an agreeable field for their ambitions, especially as few men at the present time have entered the profession of fire protection engineering, in which there seems to be such a promising future. Application blanks for employment on this corps of engineers have been prepared by the committee and can be procured by addressing Mr. Herbert Wilmerding, secretary of the committee, 46 Cedar Street, New York.

Submarine Boat for Japan.

It is reported from Bridgeport, Conn., that the Japanese Government has practically purchased the Lake submarine torpedo boat *Protector*. It is stated that both Russia and Japan made offers for the vessel, but Japan outbid her rival. The *Protector* is now at Newport, R. I.

The Snoqualmie Falls and White River Power Developments.

THE newly organized Snoqualmie Falls and White River Power Company, capitalized at $3,000,000, has acquired by purchase the properties of the noted Snoqualmie Falls Power Company, the Seattle Cataract Company and the Tacoma Cataract Company.

The Snoqualmie Falls Power Company was the pioneer long-distance transmission company in the Pacific Northwest, having a developed capacity of 11,000 hp, which has been in operation three years.

The power generated at Snoqualmie Falls has been distributed through the agency of the Seattle Cataract Company and Tacoma Cataract Company. These two companies owned the franchises and the right to sell Snoqualmie power in the two cities, respectively. They owned the large and handsome sub-stations at these points and the distribution systems throughout the cities, and they marketed the product of the generating plants.

FIG. 1.—GENERAL VIEW AT THE FALLS.

There has been an unprecedented demand for the power generated by the Snoqualmie Falls Power Company. Indeed, this company, both from the viewpoint of the electrical engineer and of the financier, has been an unqualified success. The company's gross earnings have been at the rate of $244,000 a year, and although its prices have been most moderate, its net earnings have been $120,000 per annum, which will be more than doubled after additional capacity is installed. Snoqualmie power is turning the wheels of the many factories and workshops of Seattle and Tacoma, and is running the trolley cars of Seattle, which carry 40,000,000 passengers annually. It supplies power to the Puget Sound Railway Company, commonly known as the "Interurban," which conveys more than a million people between Seattle and Tacoma yearly, and to the Seattle & Renton Railway Company, which carries 1,140,000 passengers annually.

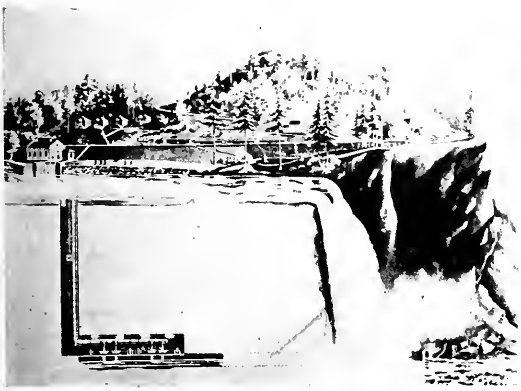


FIG. 2.—SECTIONAL DRAWING OF HEAD WORKS.

To mention divers uses, this power grinds 9,000 bushels of wheat a day at the Centennial Mill and 2,200 bushels at the Hammond Mill, both of which plants are located in Seattle, treats 650 tons of ore a day at the Tacoma Smelter, and runs dentist's burrs in Seattle and Tacoma. It furnishes power for the Washington Iron Works Company, the largest industry of this sort in the Pacific Northwest, and for the Metropolitan Press, of Seattle, which prints most of the papers and periodicals published in this part of the country. It grinds spices and roasts coffee for the Crescent Manufacturing Company, and is the motive force of the Washington Shoe Company, which sends its products all through the Northwest and Alaska. Among other large users of power are the Seattle Electric Laundry, the flour and feed mill, operated by Lehman Bros. in Seattle, and the Tacoma Mill and Fransiola Mill in Tacoma, the hay presses and large feed mill of the Galbraith-Bacon Company and the smelting works and machinery of the large jewelry factory of Joseph Mayer & Bros., of Seattle.

Snoqualmie current furnishes light to the American Steel & Wire Company, for all of the Seattle tracks of the Northern Pacific Railway Company, and runs the motors of its machine shops; to many of the public buildings, stores, saloons and offices in Seattle and Tacoma; and it operates the motors of the numerous small industries of both cities.

Current is supplied to Renton, Kent, Puyallup, Sumner, Swansea, Issaquah and Auburn; and the two last-mentioned cities also obtain their street lighting from this source. Besides supplying Tacoma with most of the power and light for its factories, stores and residences, the Snoqualmie Company also has a contract for the entire city lighting, concerning which the Mayor of Tacoma recently wrote to Mr. Charles H. Baker, president of the Snoqualmie Falls Power Company. "If, throughout your five-year contract with the city, you continue to supply this character of current, you will greatly benefit the city and retain the advanced position you now hold."

FIG. 3.—UNDERGROUND POWER STATION.

Snoqualmie power is also being used by the Great Northern Railway Company in the construction of the important tunnel which it is carrying under the heart of Seattle in order to get its trains off of the main waterfront street of the city, and will light the tunnel both during the creative period and after it is in operation.

Mr. Charles H. Baker, who, in connection with his father, the late William T. Baker, promoted and built the Snoqualmie plant, has taken upon himself an entirely new promotion and development, in harnessing the water power of White River. For this purpose he has organized the White River Power Company, of which he is the chief engineer, and the active manager of its constructional operations. Mr. Baker's Snoqualmie plant is already overloaded owing to the rapid development of the Puget Sound country, and he, therefore, expects to find little difficulty in marketing the product of his White River Company, which already has applications for a considerable portion of its initial capacity. The White River power plant will supply current to the same sub-stations that the Snoqualmie plant does in addition to such new points of distribution as may be determined upon, the radius of profitable distribution being 250 miles in this territory already abundantly supplied with cheap coal and wood fuels. The White River Power Company was formerly owned by the Westinghouse Electric & Manufacturing Company, of Pittsburg.

It is now generally conceded that Snoqualmie River and White River afford the best commercial water powers tributary to the Puget Sound communities. While there are numerous streams in this section of the country—and any stream which has positive direction of flow may theoretically be a water power—yet practically it is unsafe to consider any stream as a commercial possibility unless its volume at minimum flow is ample and unless Nature has, figuratively speaking, done most of the work in the proposed power development, as in the case at both the Snoqualmie and the White River plants. It must not be lost sight of that Puget Sound already affords the cheapest fuels in the world for power in the shape of nearby coal and wood, and the first serious point to be considered by the hydraulic engineer, therefore, in order to protect investors is whether the proposed water power can successfully compete in cost. It is the careful consideration of this condition which bars nearly all the rivers and the streams in the Northwest from having significance as power possibilities. Streams which must be discarded for consideration in Puget Sound, would, if they could be shifted to other fields like California, Nevada and the Central States, where fuels are high, become important industrial factors and wealth producing agencies.

In the foothills of the Cascade Mountains, under the shadow of the snow-capped peak of Mt. Rainier, the White River Power Company is constructing a power plant which is destined to play a very important part in the development of that country, wonderfully rich in natural resources, lying between Portland, Ore., on the south, Vancouver, B. C., on the north, the Cascade Mountains on the east and the shores of Puget Sound on the west. Utilizing the water power of White River, a glacial stream having its source in Mt. Rainier, the company is constructing near Sumner, Wash., a power plant having a capacity of 50,000 electrical hp, of which 10,000 hp will be ready for distribution within one year's time. It will be unequaled in America in size, simplicity and first cost. The varied and multiple uses to which the Snoqualmie power is now being put give, however, only a hint of the demand that exists for electric current in the rapidly-growing section which will be fed by the White River Power Company.

The territory covered by the construction crews of the White River power development extends from Buckley (elevation 660 ft.) in the foothills of the Cascades to Sumner (elevation 65 ft.) lying in the level and fertile lower valley at the White River, a distance of ten miles. The headworks are located about three-quarters of a mile above the Northern Pacific Railway Company's trestle over the White River at Buckley. A concrete dam is being built across the river 9 ft. high and 500 ft. long. This dam will be provided with a sluice gate and automatic flash boards, which will eliminate injury to the dam from floating logs during the periods of high water. An intake 120 ft. wide, located on the south bank of the river, will lead the water into the first section of an open canal. This canal, which is 50 ft. wide and is 5 miles long from the intake to the storage basin at Lake Dorothy, follows an old channel of the White River; and owing to this provision by Nature of a ready-made canal site, it will not be necessary to build flumes at any point of the entire length of the construction work. By the use of four of the largest steam shovels obtainable and 1,500 men this part of the work will be pushed to a speedy conclusion.

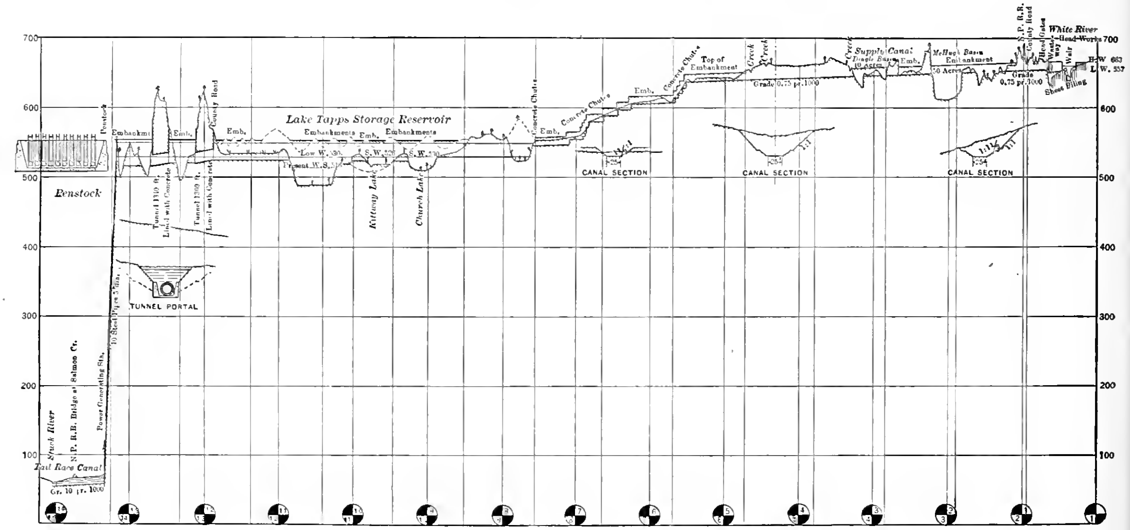


Fig. 4.—General Profile of Snoqualmie Hydraulic Development.

The company is most fortunate in being enabled by the natural conditions to develop an engineering plan entirely eliminating all fluming. All wooden flume features are a disastrous attribute of any power plant, particularly where there is not an extensive storage system as a guarantee of continuous service. The Bakersfield plant in California, which depended upon a two-mile flume, found the service so unreliable on account of the land slides and rock slides taking out the flume, that it penetrated a mountain with a two-mile tunnel through solid granite in order to abandon the flume construction. The longer the flume, the greater the liability to disorders.

The White River plant and the Snoqualmie plant have practically the same elevation of intake, viz.: 660 ft. above sea level. This is a most fortunate situation, for if they were any lower it would be at the expense of head, and any increase in elevation would proportionately reduce the area of watershed and particularly of the rain-fed portion of the watershed. It must be remembered that the Puget Sound rivers derive their winter flow from rains and springs, and their summer flow from snow and glaciers. The higher the intake elevation, therefore, the less the rain area controlled, and consequently the less the power capacity of the river for winter service. Under the load conditions in Seattle and Tacoma, the power requirements are thirty-five per cent. greater in winter than in summer, and the flow at the Snoqualmie and White River intakes responds to these conditions. Another favorable feature of the White River watershed is that the snow and glacier portion of it faces the north, and being thus sheltered from the hot summer sun, the melting is more gradual and later in the year, thus promoting a higher low water stage in the late summer. The Puyallup and Cowlitz glaciers lying upon the southern slope of the mountain disappear much earlier, so that these rivers suffer a more marked and protracted summer low water proportionately.

The first 1,300 ft. of the canal is being excavated along a side hill and will be lined with rubble stones. At the bottom this part of the canal is 25 ft. wide with slopes of ½ to 1, and the water will have a depth of 10 ft. From this point the canal, lined with concrete, crosses the county road, which will be bridged, and tunnels the embankment of the Northern Pacific Railway. Then the canal passes on to a series of alternately narrow and broad benches, which at some remote period formed the bed of the White River itself. These benches are open on the north, the river side, and sloping towards the south they are surrounded on three sides by a higher bench forming the flat part of the main land or plateau. The geological formation of the country, through which the canal passes, is cement and boulder gravel. On this foundation will be deposited by the natural action of the water the white sediment, from which the river gets its name. This sediment is a glacial silt, formed by the scraping of the glaciers of Mt. Rainier on the rock, and its characteristics are such that after it becomes caked it is practically as impervious to water as rubber. By the use of this substance the seepage of the canal will be reduced to a minimum at the outset, and it is expected that within two or three years it will be entirely eliminated.

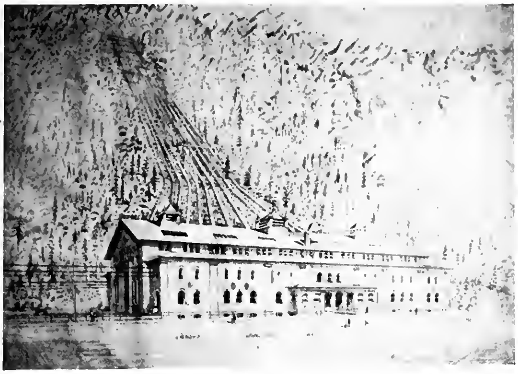


FIG. 5.—WHITE RIVER POWER HOUSE.

The elevation of the intake was so established that it made it possible to lead the canal into four lakes—respectively, Hart Lake, of 8 acres; the McHenry Lake, of 68 acres; the McHugh, of 11 acres, and the Campbell Lake, of 35 acres. In order to supplement the work of Nature it will only be necessary to build several low embankments, the material for which will be furnished by the earth taken from short cuts between the respective lakes. Like the canal these lakes will be rendered water-tight by the deposits of glacial silt. In them the white sediment will be made to settle in order that none of the silt shall be carried into the storage basin at Lake Dorothy.

After leaving the settling basins the water is carried from the intermediate bench through a cut to the high bench, and from this point traverses the main flat country in a westerly direction for 3½ miles until it reaches the Lake Dorothy storage basin. This section of the canal is 100 ft. wide on the surface and 50 ft. wide at the bottom, with slopes of 2 to 1; the depth of water will be 11 ft. To utilize the settling basins, previously mentioned, the location of the intake was so determined that the canal emerges at an elevation of 100 ft. higher than the storage basin. This difference in level will be overcome by guiding the water down over successive chutes to the storage basin. Had the intake been placed so as to avoid the use of these chutes, the canal would necessarily have had to be built along the steep side hills of the White River canyon, thereby entailing the construction of several miles of flumes, a structure that would have been enormously expensive in first cost and maintenance and neither permanent nor reliable.

The White River, while glacial in its origin, is also largely fed by rain and melting snow. During the winter the flow of water is the largest, for it is rarely cold in this part of the country for any length of time, and the warm Chinook winds cause the snow falling on Mt. Rainier and the Cascades to melt rapidly. The floods vary with the precipitation of snow and rain, but the highest flood recorded is 60,000 c.f.s. Only in one month of the year is the flow less than 2,000 c.f.s., the quantity required for the operations of the company on a basis of 120,000 theoretical hp. In October the flow drops as low as 600 c.f.s., and all of this will be taken with the exception of 30 c.f.s., which the federal law requires shall be left in the river to keep the fish alive and for domestic use. During the other months of the year the control gates of the intake will admit only the 2,000 c.f.s. needed to run the company's water wheels.

Through the magnitude of the Lake Dorothy storage basins, however, the company will always have in reserve a vast volume of water for the use of its generating station, which will be constructed in the White River valley, near Sumner below the storage basins. This basin is the most important feature of the whole plan of the White River Power Company, as it is the largest storage basin controlled by any power company in the United States, being only exceeded in capacity by the Great Lakes, which feed Niagara Falls. Another great advantage that this basin has is that it is situated directly over the station in which the water will be used for generating power.

FIG. 6.—VIEW OF TRANSMISSION LINE.

Its location, unlike that of some storage basin remote from the power plant, removes the supply of water from all uncertainties. By the time that the water has reached the storage basin, all dangers from logs and log jams, from breaks in the dam or in the canal or from other causes, are entirely obviated. The Lake Dorothy basin is, therefore, the principal factor in the undertaking of the company.

Until the White River Power Company secured the ownership of the territory surrounding the largest lake, which will be used for a storage basin, it was known as Lake Tapps, the present area of which is 620 acres. In its close proximity are three other lakes, respectively Kirtley Lake, of 80 acres; Church Lake, of 40 acres, and Crawford

Lake, of 20 acres. Like that of the canal right of way and the settling basins, the natural contour of the country around the storage basin is such that it might appear as if Nature intended these lakes for the purpose that the company now proposes to utilize them. The present elevation of Lake Tapps is 515 ft. above the sea level; Church Lake, 530 ft., and that of Kirtley Lake is 526 ft.; but work is now progressing on a series of embankments, making it possible to raise the level of Lake Tapps 35 ft., thus securing a water area of 4,000 acres, which is about seven times larger than the present area. The storage capacity of the Lake Dorothy basin, roughly computed, will be 5,227,200,000 cu. ft., as the average draw-down of water in the basin will be 30 ft. and this means 50,000 hp for two months.

The land controlled by the company, extending from Buckley to Sumner, comprises an area of 6,500 acres. Of this total area 4,000 acres are used for the storage basin, 120 acres are required for the canal and the three settling basins; the headworks cover an area of 10 acres; and the generating station and other buildings in connection with the power plant require 10 acres. A total of 4,140 acres will, therefore, be used in the actual operations of the power company. The balance, 2,360 acres, is controlled by the Lake Dorothy Improvement Company, a corporation organized under the laws of the State of Washington, and will be developed as a pleasure resort by that company.

The power company has a valuable asset in the vast quantity of timber standing on the lands that it has acquired. It has been estimated that the company owns 200,000,000 ft. of timber, 50,000,000 ft. of which is classed among the best cedar standing in the State, and there are over 100,000,000 ft. of fir in prime condition. The canal right of way and basins have been so commonly submerged by the high waters of the White River that forest fires have done very little damage to the timber. Therefore, taken as a whole it is in a better state of preservation than that in most of the sections of the State. To utilize this "by-product," the power company will erect a saw-mill in the White River valley, near the Northern Pacific Railway, which will have a daily capacity of 100,000 ft. It is expected that this saw-mill will be ready for use about the time that the power plant is in actual operation, which will be in one year's time. The output of the saw-mill will be disposed of in the open market, and will largely enhance the company's revenues.

As a result of the submersion of the ranches contiguous to the storage basin, which will be done as soon as the embankments surrounding the lakes are completed, the whole contour of the country will be very much changed. What are now little hills will then be islands, and the valleys between them will be covered with water. These islands and the shores of the lake, an area of 2,360 acres, are controlled by the Lake Dorothy Improvement Company for improvement purposes, which has before it an unparalleled opportunity of building up one of the famous summer resorts of the country. Nature has surrounded the field of its operations with scenery of marvelous beauty. The country, lying as it does in the foot hills of the mountains, is varied in character, commanding a wide view of the Cascade Range and of the fertile White River valley as well. The waters of Lake Dorothy will be studded with twenty-two islands of various sizes, but all of them large enough to be susceptible of improvement for summer residences and pleasure resorts. Lake Tapps now has, for a small lake, a widely diversified aspect, owing to the fact that it has many coves and several long arms, which afford abundant opportunity for exploration by the adventurous, whether in a launch or in a canoe. This feature of the lake will, of course, be greatly intensified when the waters of the storage basins are raised 35 ft., bringing about a seven-fold in-

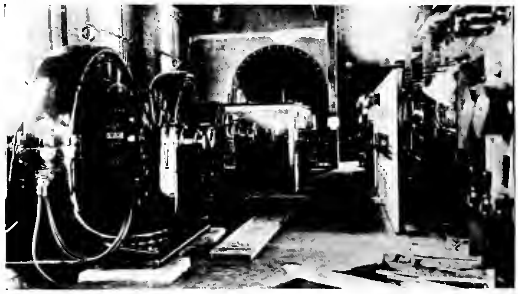


FIG. 8.—INTERIOR OF TACOMA SUB-STATION.

crease in its area. Owing to the fact that Lake Dorothy is only ten miles from Tacoma and twenty-four miles from Seattle, the principal cities of Puget Sound, it will easily be possible to make it a great summer resort. It is estimated that 50,000 people have visited the falls since the company secured the property which it controls. At Lake Dorothy it will be particularly easy to handle large crowds, as the main line of the Puget Sound Electric Railway now runs within two miles of the company's camp, making it necessary to construct only a short spur to reach the lake.

Besides erecting cottages, pavilions and the like, the company will construct a bungalow 68 by 52 ft. on one of the islands, which will be ready for occupancy next summer.

The generating station near Sumner, in the White River valley, will be housed in a two-story building, of which the main dimensions are 219 by 116 ft. This structure will be built of brick, stone and iron, so that it will be practically indestructible. In this building will be located, on the first floor, the office, a carpenter shop, a machine shop and a blacksmith shop. Railroad tracks run through the center of the station to facilitate the handling of the machinery. These will have a spur connection with the main line of the Northern Pacific Railway Company. A traveling crane of 50-tons capacity will be installed which can be operated with ease in any part of the building.

Leading from the Lake Dorothy storage basin provision will be made for ten 48-in. pipes, which will carry water to ten water wheels operating ten generators of 5,000-hp capacity each. All of the electrical equipment of the plant will be of the Westinghouse type. The

FIG. 7.—TACOMA SUB-STATION.

FIG. 9.—SEATTLE SUB-STATION AND OFFICE BUILDING.

water flowing through the penstock will have a net fall of 485 ft. Each bank of three transformers will be housed in a fire-proof compartment. On the second floor of the station will be located the high-tension and operating galleries and the switchboard.

The generators and transformers are connected for operating each set of transformers on their own generators, and also for operating a set of transformers on any generator for emergency cases. Under ordinary operating conditions the generators will be in parallel. Double-break oil switches having a vertical lift of the plunger will be used and will be operated by electric pneumatic control. Integrating wattmeters will be placed on each machine to record

FIG. 10.—BRINK OF THE FALLS.

the total output. Lightning arresters will be connected to the line through switches controlled by electropneumatic cylinders from the switchboard, ammeters being placed in the lightning arrester leads to show when current is flowing through them. In the event of current passing through the lightning arresters, they will be opened by the oil switch and immediately closed, which will usually have the effect of discontinuing any possible arcing and will avoid frequent shut-downs, which occur by the short-circuiting of light-

FIG. 11.—ICE FORMATION AT MOUTH OF TAIL RACE.

ning arresters. A very sensitive center zero reading voltmeter with adjustable resistance in its circuit will be used for watching and holding constant the voltage of the plant.

The face of the switchboard will carry upon it between the instruments a diagram of the connections, the voltmeter being used to represent the generator. Breaks are made in the red line diagram which is thus painted upon the instrument board, and these are backed by red incandescent lamps, the lighting of which will make the appearance of a continuous line through the otherwise open break in the line or bus-bars.

For the use of the officers and employees of the company a two-story building, known as the men's barracks, will be erected near the power house, the main dimensions of which will be 68 ft. by 45 ft. The first floor of the building will provide for a library, a kitchen, a dark room and a chemical room. On the second floor there will be rooms for the president, the superintendent and the housekeeper and seven bed chambers, besides the usual conveniences in way of baths and toilets. There will also be a large attic, which can be utilized for sleeping purposes in cases of emergency.

The White River generating plant will deliver its power into the same transmission system, which is supplied by the Snoqualmie Falls generating plant. This is a most elaborate and substantially constructed system, there being two independent pole lines and two circuits from each generating station, to the two terminals. The transmission is seven-strand aluminum cables, supported on "Imperial" porcelain insulators and the spacing of the wires in each circuit is 9 ft. in the triangle between centers. The aluminum conductors have given most marked satisfaction and the reliability of the service has proved itself unexcelled by any other plant in the country. The transmission is soon to be extended south in the direction of Portland, and north in the direction of Bellingham.

Mr. Baker and his associates have something like two million and a half dollars invested in the various enterprises which he has exploited, and the completion of the plans as they will progress from time to time with the development of the country upon the general scope laid down by Mr. Baker will aggregate an investment exceeding $8,000,000.

New German-American Cable.

The new cable steamship *Stephan* arrived at New York this week from Bremen, bringing 2,300 miles of Siemens cable (4,100 tons) to complete the New York-Fayal section of the German-American duplicate cable. After taking on coal and supplies here the *Stephan* will proceed to the buoy marking the end of the 100-mile stretch of the cable laid last autumn by another of the company's vessels. When the end of the cable is picked up it will be spliced and the *Stephan* will complete the connection with the Azores. The *Stephan* is commanded by Capt. Cornelius and carries a crew of 138 men. She was especially constructed for her present work and is provided with all the modern conveniences and improvements for laying cables. Her displacement is nearly three times that of the cable steamer *Von Podbielski*, her predecessor in the work, while her carrying capacity is nearly five times that of the older vessel. The *Stephan's* capacity is 5,000 tons.

The present German cable by way of the Azores was laid in 1900. It runs from Emden, Germany, to Fayal, and thence to the company's station on Coney Island, just east of the Oriental Hotel. It was determined last year to lay a duplicate cable over the same route. The section from Emden to Fayal has been completed. Only 100 of the 2,400 miles from Coney Island to Fayal has been covered at this end. The system is closely allied with that of the Commercial Cable Company controlled by the Mackays, and Mr. G. G. Ward has given special personal attention to the development of it.

Poolroom Wires.

A sharp and vigorous attack was made last week by the City Club of New York upon the Western Union Telegraph Company for its practice of supplying poolrooms—or race betting resorts forbidden by law—with telegraph service. The club asserts that if the company did not lease its wires to the pool rooms they would have to close their doors. The company asserts that its business requires it to give service to all and sundry without discrimination; at least this appears to be the attitude of the officials and the administration. Some of the newspapers have put in "caps" the names of the directors and have inquired what they mean by it and what they are going to do about it. The rate is said to be $30 per day, and $10 for the operator, and the company, or one of its officers, guarantees "a man who has a large experience, who knows the ropes and knows enough to climb out of the window when trouble comes."

Electricity at the St. Louis Exposition, 1904.

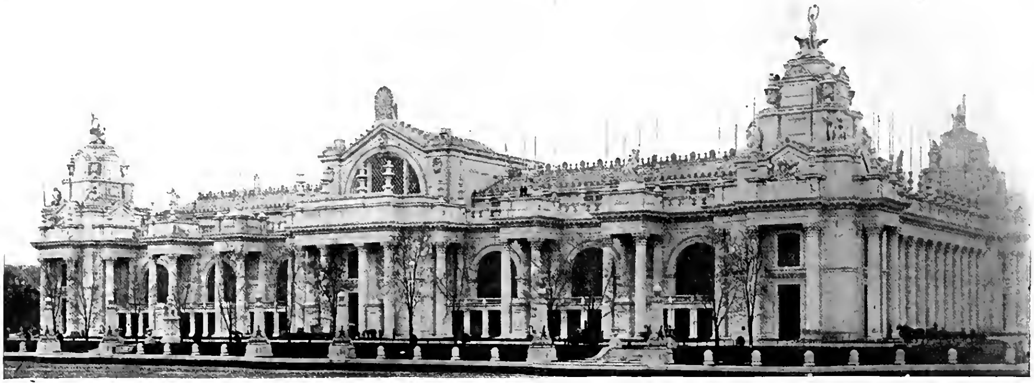


Fig. 1.—Electricity Building.

THE St. Louis Exposition celebrating the purchase of the Louisiana Territory from the Emperor Napoleon by the United States was opened with great ceremony and rejoicing on April 30. Over a hundred thousand people were present on the grounds and elaborate ceremonies marked the occasion, while President Roosevelt, in Washington, in the presence of a large gathering, closed the electrical circuit which released and set the machinery in motion. Our columns have already contained a large number of illustrated and descriptive articles as to this latest and largest World's Fair and we now supplement them by a series of four special articles of a most interesting character with regard to the status of the Exposition at the moment of opening. As will be seen, these articles deal in a general way with the Exposition, outlining its features and comparing it with its predecessors, not only with respect to the application of electricity but also in respect to other details. As usual, the Exposition is not quite ready. One or two of the views which we present are sufficient to demonstrate this fact. No exposition ever was ready when its doors were thrown open to the public and probably none ever will be. There is every indication, however, that when it is at last in full running order the St. Louis Exposition will compare favorably with those which have gone before, particularly in regard to its technical and engineering features. We present herewith also a list of the exhibitors in Electricity Building, although the lists for the various foreign countries are not yet complete. It will be understood that a great many of the electrical exhibitors are also to be found in Machinery Building.

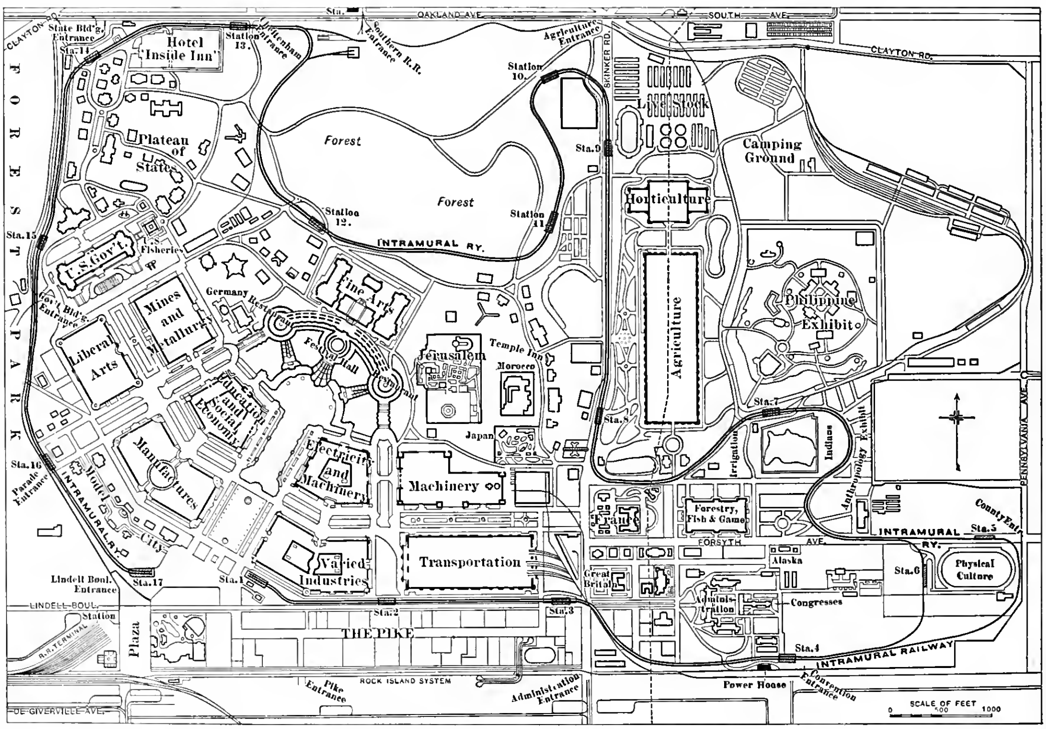


Fig. 2.—Plan of Exposition Grounds, Showing Intramural Electric Railway Line.

Electricity at the Paris and St. Louis Expositions.

By Franz Welz.

THE great international expositions give a splendid opportunity to follow the development of every special branch of human activity. The last one was that held at Paris in 1900. In the time which has elapsed between that and the International Exposition in St. Louis in 1904 much progress has been made along some lines, especially electricity. It must be remembered that, even the Paris Exposition, which was in many respects the most complete representation of the civilization of the whole world, could not give an entire picture of the development in every line of human activity. As to electricity, only Germany, France, Belgium and Switzerland really showed fully what they were able to do in this line; whereas, the electrical industry of the United States and Great Britain was not sufficiently represented to give a proper conception of their standing in this special branch. England was handicapped by the South African war; in the case of the United States, the great distance between the two countries, in addition to the loss of the *Pauillac,* was the principal reason of inadequate display. At the St. Louis Exposition, as to the European countries, the long distance and the high cost of transportation has excluded all the heavy pieces of machinery and apparatus. The Russian-Japanese war and the depression in the commerce of Europe explain fully why the European exhibits in the Electricity Building at the World's Fair at St. Louis, do not give a full idea of the standing and the possibilities of the electrical industry in the countries on the other side of the ocean. On the other hand, it is noticeable that progressive Japan and the South American countries are participating to a larger degree in the electrical display at the St. Louis Exposition than they did in Paris. Whereas, Japan exhibited in Paris only some drawings, etc., concerning the governmental telegraph system, this country occupies at St. Louis a space of twelve hundred square feet in which several Japanese firms exhibit dynamos, motors, chandeliers, electroliers, telegraphic instruments, measuring instruments, instruments for electromedical use, etc., which are all designed by Japanese engineers and manufactured in that country. How far Japan has advanced in the electrical industry is shown by the fact that it is also exhibiting a high-tension transformer for 150,000 volts for testing purposes.

The St. Louis Exposition impresses the visitor especially by its magnitude. While the Paris Exposition occupied altogether an area of only five hundred and twenty-five acres, the World's Fair at St. Louis is extended over 1,240 acres; that is, two and one-half times the area of the Exposition at Paris. The total cost of the Paris Exposition has been calculated at $21,500,000. As to the St. Louis Exposition, no definite figures are yet available, but it is estimated that the total expense will amount to nearly $50,000,000.

A special feature of the St. Louis Exposition is the magnitude of the power station, generating current for the decorative illumination of the buildings and also the electric light and power for commercial use of the exhibitors. A summation of the output of the machines installed in the Machinery Hall, with the added energy furnished by the Union Electric Light & Power Company, of St. Louis, results in a total of 46,000 hp for this purpose. At Paris the total amount available for light and power purposes was 20,000 hp, of which 7,000 hp was generally used in day time and the full amount of 20,000 hp only on special days for illumination purposes.

The incandescent lamp is used to a very large extent at St. Louis for decorative lighting of the buildings, the Cascades, the main feature of the Fair, the bridges and lagoons surrounding these buildings. The architectural lines of each building are brought out into bold relief by thousands of 8-cp incandescent lamps, and 250,000 of these lamps are altogether used for this purpose, not including the energy used for the illumination of the Cascades, which amounts to 2,100 kw. Compared with these figures, the electric lighting display at the Paris Exposition does not make a very great show. With the exception of the "Chateau d'Eau," where about 1,200 hp was utilized for lighting effects, the statue of "L'Electricité" and the statue of "La Parisienne," very few incandescent lamps were used for decorative illumination at Paris; and outside the energy for commercial use, most of the current was employed for arc lighting in the streets of the Exposition. The total number of incandescent lamps used for decorative illumination at Paris was 76,720.

FIG. 3.—STATUE OF FRANKLIN IN FRONT OF ELECTRICITY BUILDING.

FIG. 4.—STATUE OF JOSEPH HENRY.

As to the means of transportation on the Exposition Grounds, St. Louis shows some new features compared with Paris. Besides the Intramural Railway, common to most of the Expositions, there will be an extensive use of electric automobiles and the electric push chair.

In regard to the electrical exhibits themselves, St. Louis also brings forth several new ideas. In most of the former expositions, the exhibits consisted of finished machinery and apparatus which were merely brought before the public as "dead" exhibits (not in operation), but at St. Louis it is the endeavor to show to the public the methods of the manufacture and this way of exhibiting is always far more instructive and attractive. There will be in St. Louis quite a number of these working exhibits. One of the most striking of these is an incandescent lamp factory in full operation.

In comparing the Exposition of 1889 at Paris with the 1900 Paris Exposition, the most striking fact was the increase in size of direct-current and alternating-current machines. It was the aim of the large European electrical concerns to have the largest electrical machines possible at the 1900 Exposition. But since 1900 the size of the alternators shown at Paris has been increased nearly three times, and the engineering world has become so much accustomed to large units, this phase of the development does not constitute any longer a feature for an exposition. The alternators generating the power at the Exposition in St. Louis are not of exceptionally large capacity, and the only new features in this respect are the large steam turbines and gas engines, both of which have increased considerably in size since the Paris Exposition. These two prime-movers are entering more and more into the field of machines for generating power. Different systems of both these types will be seen at St. Louis and there will be ample opportunity to study their advantages and mechanism. In the construction of alternating-current dynamos the tendency prevailed to produce as near as possible sine waves, and many

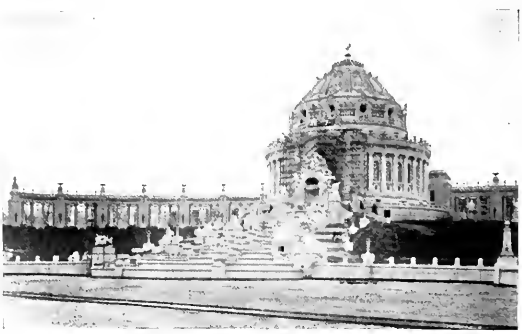


FIG. 5.—CASCADES—THE ELECTRIC FOUNTAIN.

new devices have been proposed and accomplished in this direction since the Paris Exposition. Another remarkable change in the construction of electrical machinery since the Paris Exposition is in the decrease of weight and price of electrical dynamos and motors sustaining at the same time the same quality and durability. This fact is illustrated in a very striking manner by the two sets of curves shown taken from the data of one of the most successful German electrical firms. These curves are laid out in such a way that two of them give the number of kilograms used per kilowatt, whereas the others give the cost in marks (4.2 marks equal $1.00) per kilowatt. In order to make the comparison correct, the kilowatts are reduced to thousand revolutions. These curves show that, compared

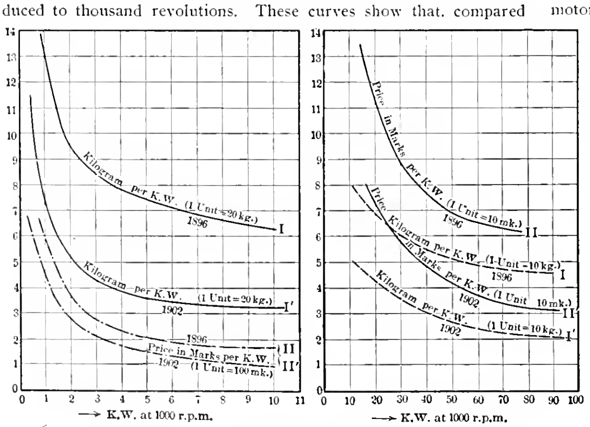


FIG. 6.—CURVES SHOWING CHANGES IN CONSTRUCTION OF ELECTRICAL MACHINERY.

with the year 1896, the same output of kilowatts is now obtained with only half the material used at that time.

As to direct-current dynamos, we see some improvements since 1900, inasmuch as the armature reaction and the distortion of the magnetic field have been remedied by the compensation winding of Déri and others, and a very important use has been made of this new feature in employing electric machinery for hoisting in mines, where it is necessary to regulate, under the full current, the voltage in the shunt from full voltage down to zero, and then reverse. This gives new possibilities for the employment of electricity in mines, etc. The greatest progress which has been made since the Paris Exposition, and to which the Exposition at St. Louis will bear eloquent testimony, lies in the single-phase field. The cause for this advance was the increasing demand for a practicable electric system for long-distance electric railways. The variable-speed, single-phase motor was the long-looked-for solution of this vital problem. It is gratifying to state that several types of this motor have been devised recently both on this side of the ocean and in Europe. At St. Louis

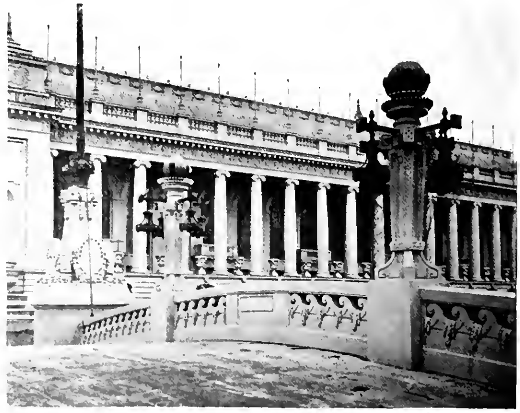


FIG. 7.—BRIDGE, SHOWING ILLUMINATION LAMPS USED ON GROUNDS.

there will be ample opportunity to see these new motors in operation and engineers will have a chance to convince themselves as to their fitness for the railway service. The experience gained by the trials at the Berlin-Zossen high-speed electric railway seems to indicate that the system best adapted for this purpose is that which allows the direct application of high voltage to the motors. This system decreases the weight of the car, as no transformers have to be carried; it has the added advantage of making the erection of transformer sub-stations unnecessary at different points of the line, the whole line being under high tension. These considerations led at the Berlin-Zossen trials to the construction of 10,000-volt, three-phase motors, which were tested on this line in the beginning of 1902, and gave entirely satisfactory results. Another new step in the alternating-current field which will be demonstrated at St. Louis, and which will probably prove to be of far-reaching importance, is the compensating of alternators worked out by Mr. Heyland, and his still more promising latest invention: the compounding of synchronous machines. The results obtained with these machines were so favorable that several European firms and also one of the American electrical manufacturers have taken up the construction of these new types, which are now being built up to a capacity of 1,500 kw.

Quite a new departure in central station development promises to become the commercial application of the Cooper Hewitt converter. The reports which so far have been obtainable show such remarkable advantages as to efficiency and size, that, if these reports hold practicable, it would mean a revolution in a large part of the electrical industry. It is understood that the company exploiting these patents will give at the St. Louis Exposition full proof of the promised qualities of this new apparatus.

Other forms of converter which aroused new interest lately are the Noden and Grisson-Walter electrolytic types, which seem to have an efficiency of 75 per cent. The rotary converter, which was exhibited at the Paris Exposition, only to a very small extent, will be a large feature at the coming fair, and European engineers less familiar with this type of machine will have opportunities of getting convinced of the excellent qualities of these machines and their feasibility for sub-station work. As is well known, the European practice tends more to the motor-generator, and the general opinion there is that it is in many respects superior to the rotary converter.

FIG. 8.—MONUMENTAL FOUNTAIN, PARIS EXPOSITION, 1889.

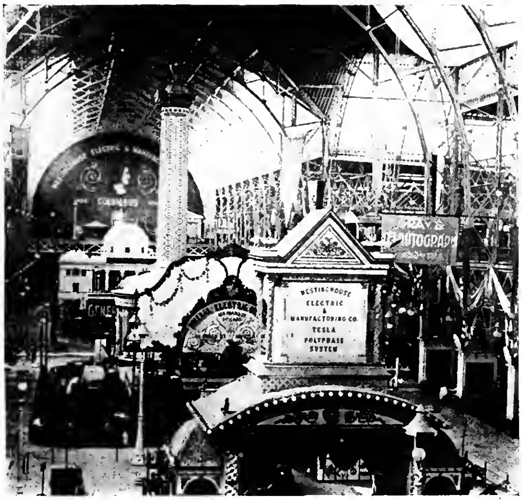


FIG. 9.—INTERIOR ELECTRICITY BUILDING, CHICAGO, 1893.

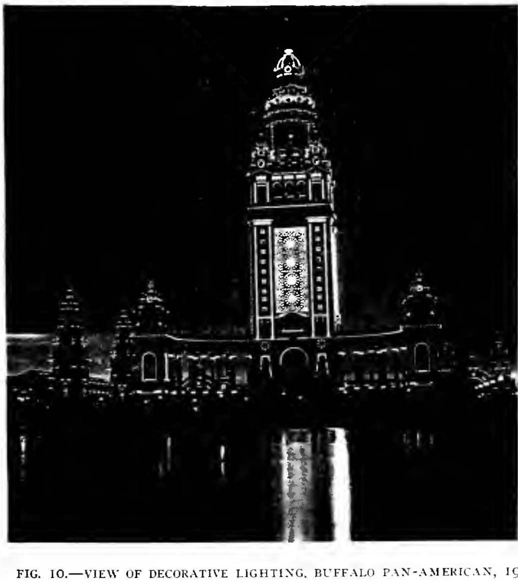


FIG. 10.—VIEW OF DECORATIVE LIGHTING, BUFFALO PAN-AMERICAN, 1902.

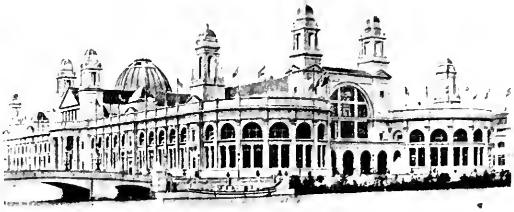


FIG. 11.—ELECTRICITY BUILDING, CHICAGO, 1893.

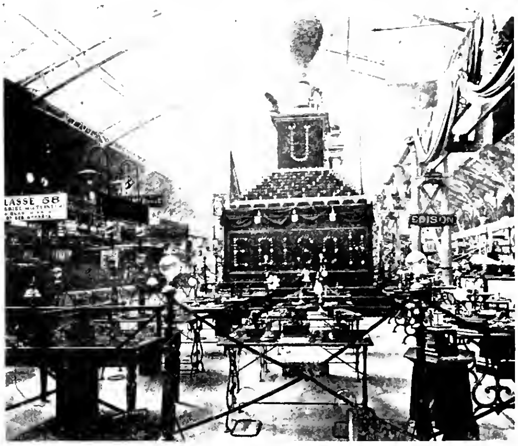


FIG. 12.—VIEW OF ELECTRICAL EXHIBITS, PARIS EXPOSITION, 1889.

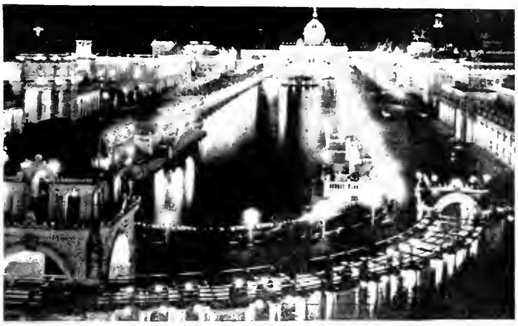


FIG. 13.—DECORATIVE LIGHTING, COURT OF HONOR, OMAHA, 1898.

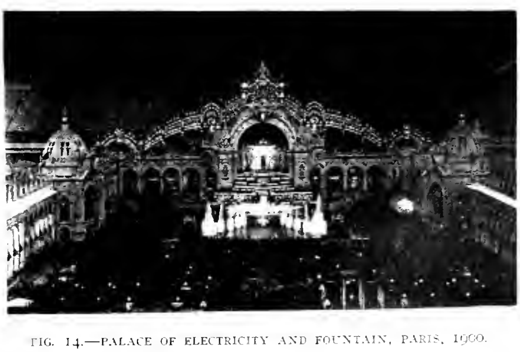


FIG. 14.—PALACE OF ELECTRICITY AND FOUNTAIN, PARIS, 1900.

EXAMPLES OF BUILDINGS, LIGHTING EFFECTS, ETC., AT FORMER EXPOSITIONS.

A very interesting and novel exhibit in the line of electric machinery will be a model testing floor in the Bullock space, which will be equipped with the most modern instruments, and will give a fair idea of the excellent equipment of American electrical factories.

Some additional new features will be seen at the St. Louis Exposition concerning the development of the electric railway since the Paris Exposition. These are largely along the line of high-speed and will be represented at St. Louis by models and drawings, such as the mono-railway "Behr" system, for 110 miles per hour, the suspended electric railway system of Langen employed in Elberfeld, the high-speed electric railway system employed at Berlin-Zossen, and several other suspended electric railway methods. The question at present is as to whether or not such high speeds as 125 miles per hour are practical; and, as soon as this question is fully decided, the superiority of either one of these systems must be proved. According to recent reports, the Langen system affords the possibility of speeds up to 200 miles per hour with perfect safety, disregarding other advantages.

At the Paris Exposition there was manifested a marked tendency for creating uniform types of electrical machinery and apparatus, all over the world. Since that time this tendency has taken more practical form, and the proposition has been made to treat this question elaborately at the Electrical Congress during the St. Louis Exposition. This proposition tends to establish standard rules for measuring and testing electrical machinery, and it is to be hoped that this end can be reached, as it would simplify to a very great extent the commercial and scientific negotiations between different nations, and greatly help the advancement of the science and industry.

In the field of electrochemistry the Edison iron-nickel storage battery will make its appearance at the Exposition. The methods of storing electricity are not as yet of very high efficiency, and it would mean a very great advance if an accumulator could be built which, with small weight and great durability would permit the storing and quick discharge of a considerable amount of electricity. Whether or not the Edison accumulator possesses these qualities to the extent that has been reported will be proven by the results obtained from the exhibit at St. Louis, and definite facts will doubtless replace the hypothetical opinions concerning this battery. In comparing the electrochemical display in St. Louis with Paris, it may be remembered that at the Paris Exposition electrochemistry formed for the first time a special group, and many of the electrochemical processes were only shown in their very first beginnings. At St. Louis will be exhibited many of these processes, such as electrical water purifying, electroengraving, electrical gold extraction, etc., that have been developed to a great state of perfection, and the names of Goldschmidt, Nernst, Ostwald, Drude, Siemens & Halske, Bradley, Hall, Cowles, Acheson, etc., will stand at St. Louis for the great advance made in this line.

In the field of electric illumination, the perfection of incandescent lighting and similar systems has not yet been reached to the full extent. Progress has not been as rapid as was hoped, but still it must be said that the Nernst lamp has been improved greatly since Paris. This lamp appeared publicly for the first time at Paris, being there lighted primarily with a match, and showing very many imperfections, so that it could be only employed to a small extent even as an exhibit. As the Nernst lamp stands to-day, it is already holding a very important place between the incandescent lamp and the arc lamp as a pure, brilliant illuminant. The state of practical perfection at which this lamp has arrived is best illustrated by the fact that it does not by any means figure at St. Louis merely as an exhibit, but is employed commercially for numerous electrical installations; while there will be used altogether more than 12,000 Nernst lamp glowers in buildings and exhibit pavilions on the World's Fair grounds. It is much to be regretted that the invention of Auer, the "osmium lamp" has not yet proved to be a full success, and hence the St. Louis Exposition will be deprived of the opportunity to show this lamp. Instead of this, however, the Cooper Hewitt mercury lamp will be brought for the first time before the eyes of the public, in a large way in its various applications for lighting and other purposes. There is no doubt that this strange, brilliant illuminant will attract the attention, not only of the great public, but also of the artisan and engineer.

FIG. 15.—NIGHT VIEW OF ELECTRICITY BUILDING, ST. LOUIS.

A very attractive novelty in decorative lighting with incandescent lamps will be demonstrated in the so-called "pearl system," an invention of Mr. G. Weismann, of Paris. This adapts itself very nicely to all kinds of electroliers and specialties for garlands. The circuit is formed by bare wires, each one surrounded by small pearls creating a very effective insulation. In connecting the lamps it is only necessary to introduce between two pearls a wire attached to the main wire by a hook, the two wires leading to the incandescent lamp also being insulated by small pearls. The lamp does not possess any socket, and the wires enter the bulb directly.

As to arc lamps, some progress has been made in bringing out small types of high reliability. The greatest difficulty is that this system does not possess the same simplicity in operation and construction as the incandescent lamp. Considerable improvement has been made in these respects and the inventions of the Italian engineer, Rignon, and others, will prove the fact at St. Louis. The Bremer arc lamp was shown for the first time at the Paris Exposition, as at that time one of the latest inventions in the art of electric lighting. Since then many improvements have been made in it and the lamp has found large application all over Europe. The Westinghouse Company has acquired the patents and will show this new type of lamp at the St. Louis Exposition in its latest state of perfection. It may be remembered that, in these lamps, carbons of special preparation are used for the purpose of increasing very considerably the amount of light per watt. This special treatment of the carbons has the added effect of softening the light and making it more agreeable to the eye. Other types of lamps of foreign construction will be exhibited by Siemens & Halske, etc., and M. Blondel, of Paris, who will show his new type of flame arc lamps.

An interesting feature at the St. Louis Exposition for the European electrical engineers will be the largely represented series alternating arc systems, as worked out by the General Electric Company, the Western Electric Company, the Fort Wayne Electric Works, and others. This system is very seldom employed in Europe, where for arc lighting installations on a large scale the shunt system is mostly used.

Nothing of especial importance has been invented in the way of distribution; but it might be mentioned that, since the Paris Exposition, the 220-volt incandescent lamp has come into more extensive use and has attained a very high efficiency. The improvement of this type of lamp has developed the more extensive erection of central stations of 220-volt voltage, and the use of a three-wire system of 440 volts between the outside wires and 220 between the outside and neutral. To the list of lightning arresters, a valuable addition has been made in the Siemens & Halske so-called "Hoernerblitzableiter." Another new invention in this direction is that of the Italian engineer, Fala, who will show at the St. Louis Exposition his new lightning arresters in series, with which very good results have been obtained in the large Italian high-tension central stations.

Telephony and telegraphy will make a very creditable showing at the 1904 Exposition. The great advance in these branches is largely due to the liberal patronage accorded them in the United States. The American Telephone & Telegraph Company, of Boston, will demonstrate in a special building with a very artistic exterior the development of the inventions of Prof. Bell and others from the very beginning up to the present time; and several other "independent" American companies are exhibiting their latest and best types of apparatus, including automatic telephone systems, in which class the Faller takes a very prominent place. At the time of the Paris Exposition, these automatic systems had not reached a very high grade of perfection, but at the present time the solution of this problem becomes more and more imperative, and such systems are being worked out in great numbers, and of notable ingenuity.

One of the prominent places in the Electricity Building and the Exposition at St. Louis as a whole, will be occupied by the wireless

FIG. 16.—VARIED INDUSTRIES BUILDING AT NIGHT.

telegraph stations of the American De Forest Wireless Telegraph Company, of New York. At the time of the Paris Exposition the principles of wireless telegraph were known, and quite a number of apparatii were shown there. The De Forest wireless station at St. Louis is of considerable magnitude. In the Electricity Building three towers of seventy-five feet each in height have been erected, whence messages will be sent to the wireless telegraph station in the "Model City" of the World's Fair grounds. Another mast of 200 ft. high with 50-ft. outriggers, is put up near the site of "Jerusalem," and a steel tower of 325 ft. near the Press Building. From these stations it is expected to send messages to the neighboring cities. In addition to the De Forest Company, the wireless transmission of electrical waves has been exploited by many inventors and firms, since 1900, and wireless apparatus for different purposes are shown at St. Louis by the French engineer, M. E. Ducretet, by T. E. Clark, of Detroit, and the Italian, Professor A. Artom. Besides wireless telegraphy, a new feature will be the demonstration of wireless telephony by A. F. Collins and M. R. Hutchison. It may be remembered that at the time of the Paris Exposition none of these systems were in use, thus giving St. Louis the distinction of showing them as part of the practical art for the first time. It is to be regretted that in addition to these systems the German inventor, Ernst Ruhmer, has

FIG. 17.—LOOKING TOWARD ELECTRICITY BUILDING.

not been able to bring to this country his apparatus for wireless telephony, based upon the action of light rays upon the selenium cells. This inventor has succeeded in talking over a distance of about six miles and has also succeeded in effecting long-distance telephonic communication between ships.

In the section of various applications of electricity there are also some new departures comparing St. Louis with Paris. The great number and variety of electrotherapeutic apparatus is striking and gives the best proof of the high value of electricity for special medical examinations and treatment of certain cancerous diseases. For the first time it will be shown publicly at the St. Louis Exposition how the ultra-violet rays of the arc lamps, the chemical rays, can be used successfully for the cure of the most obstinate cases of "lupus vulgaris" and similar diseases. The Danish physician, Prof. Niels R. Finsen, must be credited with having introduced this new method for the first time, and its application is quickly spreading all over the world. France, in which country the radium was discovered and thoroughly studied, has the honor of exhibiting for the first time in St. Louis the different apparatus for the investigation of this wonderful element, of which apparatus the "Spinthariscope," showing the scintillations of the radium, is the most interesting. Another new application of electricity in the medical field is the "Acousticon" and the "Massacon" inventions of Mr. M. R. Hutchison, which aroused so much admiration all over the world. These apparatii make it possible to teach the deaf mutes to hear and to speak.

In the line of electrical instruction the St. Louis Exposition can also show a typical American novelty, nearly unknown to the European practice; that is, "the American School of Correspondence." The exhibit of this institution will give full testimony of the success which has been attained by this unique method of teaching, speaking for its excellency and the ability of the promoters. It must be admitted that for a certain class of students and under the peculiar conditions of such a large country as the United States, this method of teaching certainly has its right of existence.

When the most prominent electrical engineers of the world assemble in St. Louis during September, for the International Electrical Congress, they will look with pride upon the brilliant electrical display; and in viewing the exhibits in the Electricity Palace, they will be impressed with their highly technical value, and the imposing and systematic arrangement. The whole will be a full and worthy demonstration of the progress made in electrical science and industry since the Paris Exposition of 1900.

The Installation of Exhibits in the Electricity Building, St. Louis.

By Cloyd Marshall.

The construction of booths and the installation of exhibits are proceeding rapidly in the Palace of Electricity and on the opening day, April 30, this building was ready for the reception of visitors. To get all the exhibitors to ship machinery and begin construction in time for completion, before the gates open, is one of the difficult problems of every exposition. At St. Louis the department buildings have been constructed for some time and the Palace of Electricity has been under cover for ten months. Every effort has been made to impress upon the exhibitors the advantage of coming early to avoid the rush of the last one or two weeks before the opening. The Electrical Department has met with ready response and co-operation from the electrical manufacturers.

By reference to the installation plan of the Electricity Building the outline of exhibits may be followed. In the gallery over Sections 1 and 2 are the offices of the department, jury and committee rooms. With this exception there is no second floor to any part of the building, all exhibits being on the ground floor with ample head room. The cone of the roof is about 75 ft. above the floor, with skylights and monitors which give abundant light and ventilation. In Section 1 facing Aisle B are the offices of the Electrical World and Engineer. Telegraph exhibits and the main Exposition offices of the Postal and Western Union Telegraph offices occupy the same locality. High-speed telegraph systems are to be shown in operation by Patrick B. Delany and Walter P. Phillips, while Charles E. Yetman will exhibit a transmitting typewriter applied to telegraphic work. The Gray telautograph, or writing telegraph, reproducing at a distance writing and drawings, will be in operation.

Near the center of Section 4 is located the sub-station which contains transformers, switchboards and rotary converters through which the high-potential alternating current is received from the service power plant and transformed to a lower voltage or converted to a direct current for distribution throughout the building, to be used for lighting and the operation of exhibits. This machinery was furnished chiefly by the General Electric and Westinghouse Electric & Manufacturing Companies. Adjoining the station the latter company is installing one of the largest exhibits in the building, embracing the varied branches of electrical machinery and apparatus. Across Aisle B will be the electric railway trucks and locomotives of Burnham, Williams & Co. Along the north side of Section 3 the Standard Underground Cable Company and the McRoy Conduit Company are installing a model conduit system, as used in the best city construction, and will show the method of placing cables in the conduits. A very conspicuous object is to be a Burdette-Rowntree electric dumb waiter running from the floor to the roof above Section 3. Its operation is automatic, starting or stopping in response to a push button.

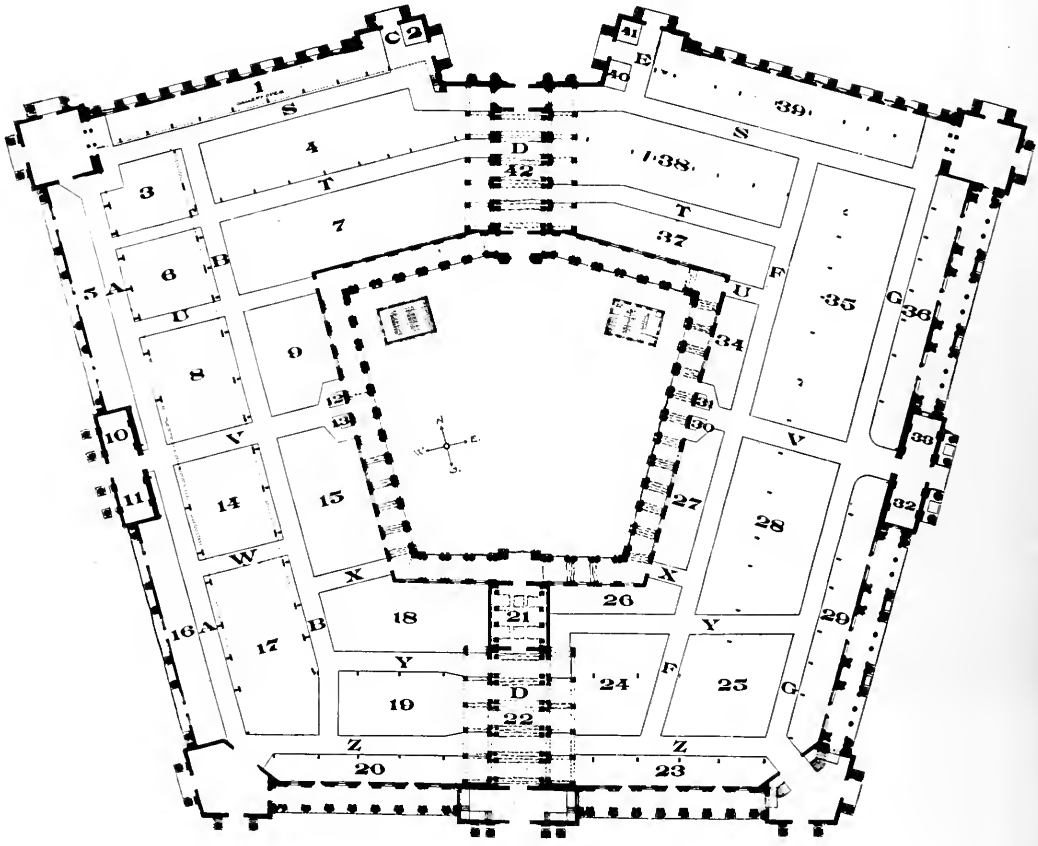


Fig. 18.—Plan of Electricity Building.

Over Sections 3 to 17, along the west side of the building, is the craneway with a span of 57 ft. 5½ in. Upon this is a four-motor, 30-ton electric traveling crane furnished by Pawling & Harnischfeger. A 20-hp, 220-volt motor gives a horizontal speed of 250 ft. per minute, and an 8-hp motor gives a trolley transverse speed of 150 ft. The main hoist is equipped with a 30-hp motor with a speed of 25 ft., and the auxiliary hoist with a 15-hp motor, and has a travel from 30 to 90 ft. per minute. The crane has proved very serviceable in the installation of exhibits and will be used in handling heavy machinery when exhibits are dismantled. With one exception the heavy exhibits are to be installed under or adjoining the craneway.

In the northwest corner are several displays of electric railway equipment. The electric and air brake apparatus of the National

Electric Company is shown as well as a line of alternating and direct-current generators and motors. Block 9 is equally divided between the Fort Wayne Electric Works and the Wagner Electric Manufacturing Company, both putting in working exhibits. The Fort Wayne display consists of a line of direct-current machinery, transformers, fan motors, wattmeters and a series arc light system. The Wagner space contains a variety of single-phase alternating-current power motors running under different conditions, motor-generator sets charging a storage battery, static transformers and indicating switchboard instruments.

The remaining space adjoining the court is occupied by the Bullock Electric Company and it is one of the notable machinery exhibits. A 6,600-volt alternating current is received and transformed to 340 volts for a rotary converter to supply 500-volt direct current for operating street railway apparatus. Other motor-generators and balancing sets furnish current for multivoltage systems as applied to speed control for machine tools. The individual feature of this exhibit is a model testing floor, indicating the best methods of testing electrical machinery before it goes to the customer. Under the traveling crane the Northern Electrical Manufacturing Company will have the most complete demonstration of the adaptation of electric motors to every form of tool. In this exhibit the manufacturing of motors is to be carried out in a way to show the convenience and increased efficiency of motor-driven tools. All of Block 17 under the crane-way is taken by the Western Electric Company. Near the center is a large 100-kw motor-generator set which, with a compensator, furnishes 110 and 220-volt direct current throughout the exhibit. Next Aisle B is a small machine shop in operation, showing the direct application of motors to tools. There are to be several direct-connected marine sets, transformers and regulating apparatus. On the opposite side is to be a series alternating arc light equipment with ornamental lamps and stands.

There are two collective exhibits, embracing nearly all electrical classifications, one by the Wesco Supply Company, of St. Louis, in Block 8, and another by Ewing-Merkle covering a portion of Block 14. In the former a large Warren synchronous motor drives a Triumph generator supplying power for the motors and apparatus in operation. In the second exhibit the Commercial Electric Company will have a number of direct-current motors from 1¼ to 35 hp, a 30-kw, three-bearing generator direct-connected to a gas engine, furnish power for the other exhibit items. A special feature is a line of variable-speed motors designed for operating on any standard two-wire system, with single voltage, and which will give speed variations of from 4 to 1, with horse-power and efficiency practically constant at all speeds, and little if any variation of speed at all loads with the controller set at a given point.

The western entrance embraces two large spaces, which are occupied by unique exhibits. The Carman Projector & Specialty Company will show stereopticons, lanterns, projectors and automatic electric curtain hoists in operation. Opposite is the electroplating exhibit of the Hall Gold & Silver Plating Works. The different processes of plating and finishing of plated wares are to be shown in a most attractive manner. The Gould Storage Battery Company and the Gould Coupler Company are installing a fine combination exhibit in Section 16, which includes motor-generator sets and rotary transformers to charge storage batteries, to be arranged so that many ingenious applications of batteries to different lines of work will be illustrated. An interesting item is a motor-driven unipolar dynamo, charging two immense cells at from 3,000 to 5,000 amp. at about 5 volts. In the northern half of Block 16 is being placed the artistic exhibit of Japan. This electrical apparatus was designed and made by Japanese, most of whom received their education and training in this country. The Italian space, occupying Block 18, is especially worthy of notice on account of the scientific and electrical measuring instruments therein. A model central station storage battery plant in a fire and acid-proof enclosure is now being placed by the Electric Storage Battery Company. A conspicuous feature is an immense map of the United States showing the location of between 1,600 and 1,700 plants installed by this company, the railway, lighting, telephone and isolated installations being indicated by different colored

FIG. 19.—ENTRANCE TO ELECTRICITY BUILDING.

lamps. The Porter Battery Company will have a battery on exhibition which has been in constant service over eight years, and another which made a record automobile run of 187 miles on one charge.

The three 75-ft. towers of the De Forest Wireless Telegraph Company are erected and will support the antenna from which wireless messages can be sent and received from other stations in the building and the large station in the model city. The T. E. Clark Wireless Telegraph-Telephone Company shows a line of wireless apparatus in operation, and the adaptation of such apparatus to fire alarms and safety signalling on railroads. Two wireless telephone stations at opposite ends of the building will be used by A. F. Collins to demonstrate the newest application of electricity to the transmission of intelligence. Two telephone operating exchanges are in the south side of the building, both enclosed by handsome booths. Section 17, not covered by the crane, is occupied by the exchange of the American Telephone & Telegraph Company. This connects with the local and long-distance lines of the Bell Company, so that there is direct communication from the building to all parts of the grounds, city and all points reached by telephone lines. In Section 24 the exchange of the Kellogg Switchboard & Supply Company gives a floor space. A great variety of electrical apparatus manufactured by this company is now being installed and will be shown in operation. The Edison exhibits are in Sections 26 and 27, and include the iron-nickel storage battery and a historical collection of great merit.

The purification of water by electricity is shown by the Standard Water Purifying Company, in Block 33, and water absolutely free from all forms of organic life will be served to visitors. Electro-therapeutic apparatus represents one of the most beneficial adaptations of electricity, and the latest developments in this line are shown in Section 4, by the representative manufacturers of such apparatus. In the northeast part of the building are the German and French collections of electrical exhibits; the former is especially strong in electrochemistry. France has the most comprehensive display of any foreign country, covering as it does every classification. In the eastern half of Block 7 England is making an excellent showing of its electrical products.

This outline of the exhibits being placed in the Electrical Building is of necessity incomplete at this time. Many companies now preparing displays have not proceeded far enough with their installations in the building that an account can be given of their displays.

Fig. 20.—A View of Electricity Building by Night.

similar service through its connection with the Kinloch system, of St. Louis. Recent developments of automatic and semi-automatic telephone systems are to be shown in a thorough manner by the Automatic Electric and the Fuller Automatic Telephone Exchange Companies. An instructive historical collection of telephone apparatus is to be arranged by B. F. Wasson in Block 25.

In a fine booth erected by the Hutchison Acoustic Company will be exhibited the "Acousticon" and "Massacon," giving daily exhibitions of deaf mutes being made to hear and taught to speak through their instrumentality. M. R. Hutchison will also demonstrate a wonderful adaptation of the wireless telephone. Around the court of the Electricity Building is a circuit of wires connected to the booth in Block 23. Before a telephone transmitter in the booth, music will be played. In the court no sound of this is heard until a pocket telephone receiver, without any wire connection is placed to the ear and then the music becomes audible. At any point in the court music can be heard by the aid of the receiver.

Two beautiful booths in Section 25 are those of the Holophane Glass Company and the Weston Electric Instrument Company, the latter showing a full line of standardizing electrical instruments. The brilliant illumination of the Holophane exhibit will be most conspicuous, as 1,000 incandescent lamps cover the exterior and interior of their handsome structure. The laboratories of the National Bureau of Standards, covering a space of 23 by 200 ft., will contain over $50,000 worth of instruments for testing every kind of electrical machine and apparatus. About twenty government experts are connected with the laboratories to conduct tests and investigations. No preceding Exposition ever had such facilities for making complete records or assisting the juries in their awards.

The largest individual exhibit is that of the General Electric Company, embracing Section 28, and covering a quarter of an acre of However, it will be apparent by the foregoing that American manufacturers will far surpass any previous effort, and that the electrical exhibits at St. Louis will be a source of pride to all those interested in the industry. By the time this article appears most if not all of the exhibits will be in good shape, ready for inspection.

The "Pike" at St. Louis.

One of the most famous features at the World's Fair in Chicago, in 1893 was the Midway. It is safe to say that everybody went there, whatever else they did not see. In like manner the St. Louis Exposition has its happily named "Pike," and a more extraordinary or fascinating collection of side shows was never got together under the sun. It is estimated that $5,000,000 has been spent on the attractions, while the number of performers is put at 6,000. Forty or fifty dollars can easily be spent doing all the attractions properly. It is true that many of these shows have been seen at other Expositions, but they will probably be new to a majority of the visitors, and some of them are well worth a visit more than once. It is interesting to note that in nearly all of them, electric lights and motors are freely used; in fact some of the most novel and brilliant effects depend upon applications of electricity. An example of this will be found in the spectacle of the Galveston Flood; while in the thrilling pictures of "Fire Fighting," no actual fire is used, but the effects are obtained with electricity, steam, stained glass and electromechanical appliances. Such names as "Creation," "Hereafter," "Haunted Castle," "Submarine Diving" "Wireless Telegraphy," also suggest a variety of means by which electricity is to be brought into play to please or fascinate the multitude.

Electrical and Mechanical Engineering in the Exposition Plant.

By J. R. CRAVATH.

AT the Louisiana Purchase Exposition there will be of interest to engineers all the great electrical and mechanical exhibits coming under the Division of Exhibits and the application of mechanical and electrical engineering in the operation of the Exposition coming under the Division of Works. These two divisions overlap in so far as exhibit apparatus is used in the service of the Exposition. It is the purpose of the present article to summarize the work of the electrical and mechanical department of the Division of Works. The Division of Works builds and operates the Exposition, including the construction and operation of the necessary steam, electric and hydraulic machinery to properly serve the needs of the Exposition. This latter apparatus comes under the mechanical and electrical department of the Division of Works. All of the work in the Division of Works is in charge of Director Isaac S. Taylor. Mr. Henry Rustin was chief of the mechanical and electrical department until ill health compelled him to drop this work. His place was taken by Mr. E. B. Ellicott, city electrician of Chicago, who associated with him R. H. Moore, electrical engineer, and H. F. Smith, mechanical engineer.

SOURCES OF ENERGY.

Those having in charge the electric light and power service of the Exposition have had placed at their disposal three sources of energy: The Union Light & Power Company, of St. Louis, has agreed to deliver at the Exposition grounds, before the opening of the Exposition, 7,500 kw, in three-phase, 25-cycle, 6,600-volt current. In the Machinery Building the Exposition has a service plant of 8,000 kw, for which it contracted with the Westinghouse Electric & Manufacturing Company. This service plant was described in ELECTRICAL WORLD AND ENGINEER of January 23, 1903, and February 27, 1903. This plant also gives 25-cycle, 6,600-volt, three-phase current. In addition to this there will be in the Machinery Building exhibitors' apparatus, capable of supplying 8,000 kw in similar current for the service of the Exposition. The total amount of 6,600-volt, three-phase, 25-cycle current will, therefore, be about 23,500 kw. Besides this, exhibitors' apparatus is expected to furnish 2,400 kw in 550-volt direct current and 600 kw in 250-volt direct current. In the various buildings where necessary, rotary converters operated from the standard three-phase circuits of the Exposition are placed and will be used to supply 110-volt direct current for the use of exhibitors.

Both service and exhibit plants are to be supplied with steam from boilers in the Steam and Fuels Building. The distance that steam will have to be piped for some of the large units will be over 700 ft., and more than this for some of the smaller units. In the Steam and Fuels Building are sixteen 400-hp Babcock & Wilcox boilers equipped with Roney stokers.

The exhibit boiler plant will probably have 300 hp in Derr boilers, 550 hp in Clonbrock, 800 hp in Niclausse, 900 hp in Belleville, 3,200 hp in Heine, 7,200 hp in Cahall, and possibly 800 hp more. The rated boiler capacity for the entire building will, therefore, be about 19,350 hp. The Heine boilers will be equipped with Greene link grates, and the Cahall boilers with Aultman & Taylor chain grates.

The stacks for the boiler plant are all 90 ft. high and induced draft will be used throughout. The erection of buildings falls to the work of this division of the Exposition. Much of the work is being done by the Exposition company's own men, but steam piping contracts to the amount of $160,000 have been let in connection with the Exposition steam plant. The three concerns with which contracts have been made for steam piping are the Hanley Casey Company, Kroeschell Bros. and W. A. Pope. A detailed description of the Westinghouse service plant has already been given, as above mentioned.

CONDENSING PLANT.

Most of the large engines will be run condensing. The Westinghouse service plant is equipped with its own cooling towers. The exhibitors' service plant will take condensing water from the lagoons. An interesting engineering feature of the Exposition will be the fact that the Cascades, which is the name applied to the great artificial waterfall, which is to form the central feature of the Exposition panorama, will act, as at Paris, as a cooling tower for the condensing water used by the exhibitors' power plant. The condensers in the Machinery Building will discharge hot water into a tunnel, which runs 1,100 ft. from the Machinery Building to the suction of the Cascade pumps. Much of this tunnel is under the lagoon. From the Machinery Building to the lagoon a short distance away the water is taken through two 24-in. vitrified tile pipes. Under the lagoon the tunnel is 6 ft. by 6 ft., with board walls.

FIG. 21.—A NIGHT EFFECT NEAR ELECTRICITY BUILDING.

The intake for the condensers, which runs from the lagoon to the Machinery Building, is of 36-in. vitrified pipe. This pipe is 400 ft. long over all. Water runs through it by gravity to four cold wells in the Machinery Building, from which wells it is drawn by the condensers. Two of these cold wells are 8 ft. by 8 ft., and two are 14 ft. 8 in. by 14 ft. 8 in.

The Cascade pumping plant is to consist of three 2,000-hp Westinghouse induction motors running at 365 r.p.m., direct-connected to Worthington centrifugal pumps, each with 36-in. discharge and 40-in. suction. The water will probably be pumped over the Cascades at the rate of about 15,000 gallons per minute. The total fall is about 154 ft.

DISTRIBUTION FOR LIGHT AND POWER.

This is to be an exposition of "magnificent distances." The distribution of electric light and power will, therefore, be carried on along much the same lines as the distribution for electric light and

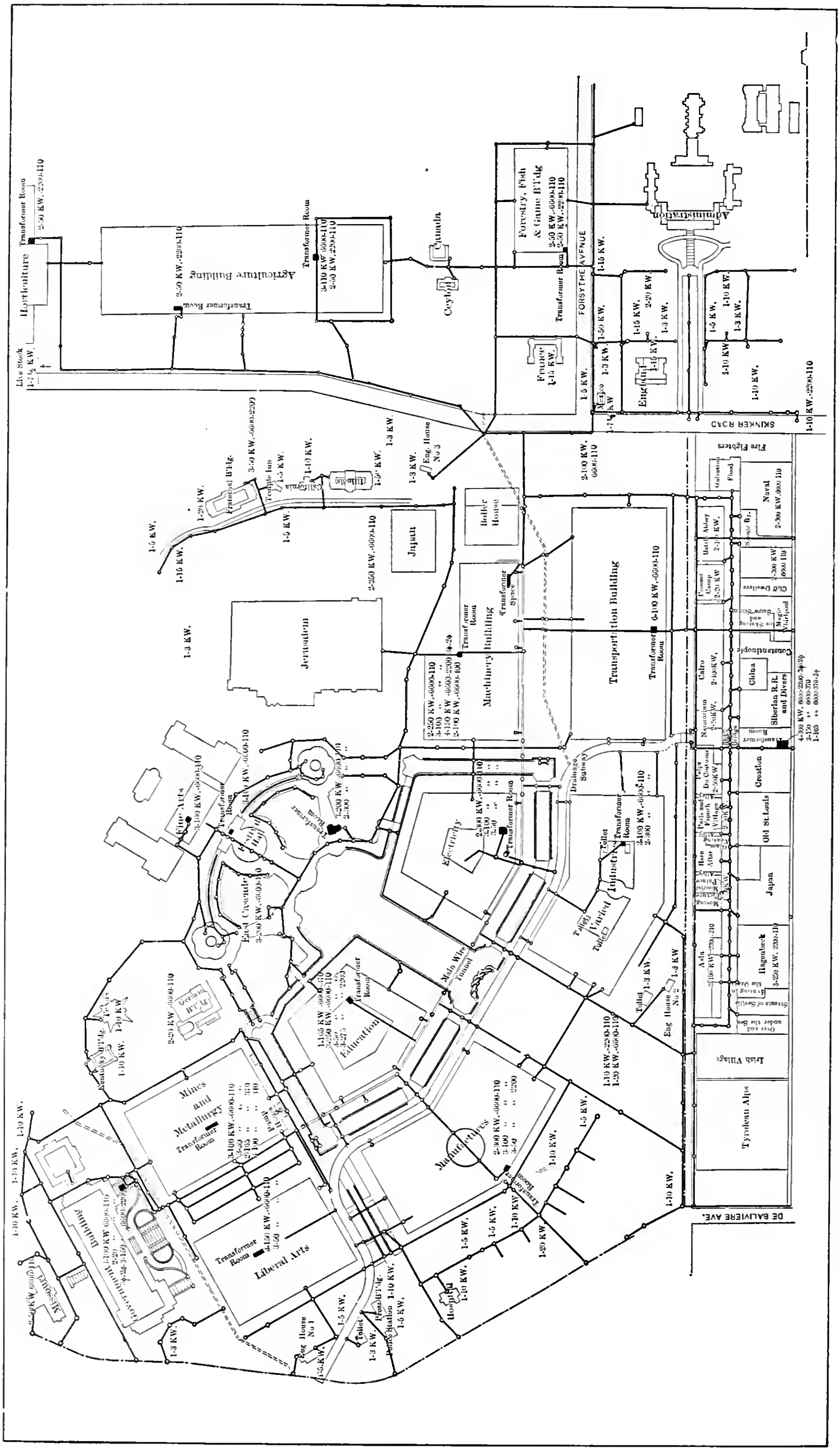


Fig. 22.—Ground Plan of the Louisiana Purchase Exposition.

Showing Distribution System with Location of Power Plants, Sub-Stations, Transformer Rooms and Output Capacity.

power in a large city. As said before, most of the current available is in the shape of 6,600-volt, 25-cycle, three-phase current. From a large switchboard in the west end of Machinery Building, through which switchboard all current used in the service of the exposition must pass, the distribution is by lead-covered cables in pump log ducts.

In each building will be a sub-station consisting of a transformer room and switchboard. If direct current is required, a rotary con verter will also be placed in the sub-station.

About 5,000 kw is to be used on the decorative lighting of the exterior of the buildings. Each of the large buildings will have a separate feeder supplying the transformers for the decorative lighting of that building. The decorative lighting will be run on a 400-volt, four-wire system of distribution. From the four-wire distri buting centers two-wire circuits, carrying about 1,300 watts each in 8-cp lamps, are run. Most of the wiring for decorative lighting is on knob and in tube. Open work has been wired with slow-burning weather-proof insulation on the wires, and concealed work has bee wired with rubber-covered wire.

The interior lighting of buildings by the Exposition is designed simply to be sufficient for patrol purposes. Additional lighting will be contracted and paid for by individual exhibitors, according to their needs. The lighting of building interiors is to be done by 50-cycle, alternating-current enclosed arcs. These arcs are to be 6.5 amp., run on circuits of about 3,500 volts maximum. The constant-current transformers for arc lighting are to be located in Machinery Building. About 1,200 kw is to be used in such arc lighting. This lighting will be run from alternating-current generators in the exhibitors' power plant. A limited amount of 110, 220 and 500-volt direct current will be available in each principal building. The three-phase alternating-current circuits for general commercial uses in each building, such as exhibitors' lights and motors, will be supplied by a feeder to each building run independently of the decorative lighting for that building.

It is the intention to use the current supplied by the Union Light & Power Company on the decorative lighting. The Union Light & Power Company's current is thus taken first to the main switchboard in Machinery Building over three feeders. Where these feeders enter the Fair grounds there is a terminal house, in which are located water rheostats, which will be employed for putting the decorative lighting load on gradually. This same plan was tried at the Pan-American Exposition at Buffalo with great success, both from the standpoint of the public and that of the operating engineers. The gradual bringing up of all the decorative Exposition lighting from darkness to a full brilliancy was one of the most popular and beautiful features of the Pan-American Exposition. This method of bringing on the load was also highly desirable from the power company's standpoint, as it gave the governors time to act and obviated strain on the apparatus.

The great switchboard extending entirely across the central bay in the west end of Machinery Building is designed for the control of all the 6,600-volt, three-phase current used on the Exposition grounds. It is a brick masonry structure supported upon timber work and occupying a height of two galleries. It consists mainly of feeder panels, as most of the generator panels will be located near the machines which they control. The four generators in the service plant have control panels in this switchboard. There are in all 17 feeder panels, four generator panels, three total load panels, three exciter panels, two incoming feeder panels from the Union Light & Power Circuits, and one rheostat panel for controlling the water rheostats employed in connection with the decorative lighting. This board has been built in a very thorough manner, as the handling of such high-pressure current would be inadvisable around anything in the way of a make-shift. It was designed by the staff of the Exhibition in association with the Westinghouse Electric & Manufacturing Company, and the actual construction of the board was under the direction of Mr. K. Nurian. The features of safety and quick handling have been carefully attended to and the board is in itself a worthy exhibit of some of the latest developments in this branch of electrical work.

During the last week or two a large proportion of the service above described has gone into successful operation, and as many of the pictures furnished show, the illumination of the buildings is attended by some very rich and beautiful effects. All the work in Machinery Hall has also been pushed vigorously and the large plant there has already taken shape. It will not be long before the equipment is all in full running order.

The World's Fair Machinery Display.

BY LIEUT. G. L. CARDEN, U. S. REVENUE SERVICE.

THE late President McKinley declared that expositions are the landmarks of progress, and these memorable words uttered so shortly before his death are strikingly emphasized by the opening on the 30th day of April, 1904, of the greatest Exposition the world has ever seen. This Exposition has for its historical motive the commemoration of the centenary of the purchase from France of the Louisiana territory, and because of its geographical fitness with relation to the acquired territory St. Louis was early selected as the logical site for the holding of the Exposition.

The World's Fair, of 1904, covers 1,240 acres. The World's Co-

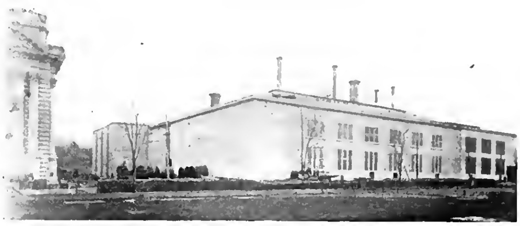


FIG. 23.—BOILER HOUSE.

lumbian Exposition at Chicago covered 636 acres. The exhibit buildings at Chicago embraced 82 acres of housed flooring. The main exhibit palaces at St. Louis have under roof 128 acres, and in addition more than 100 acres have been set apart for outside exhibits. With the foregoing facts in mind let us consider the machinery display of the Exposition.

The Machinery Department at St. Louis embraces exhibits collected from the masters in trade. This is the policy which was inaugurated from the first by Mr. Thomas M. Moore, chief of the Department of Machinery, and it has been successfully carried forward

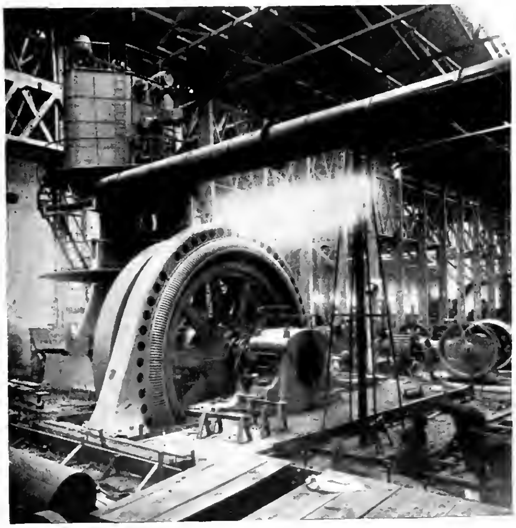


FIG. 24.—ALLIS-CHALMERS ENGINE, MACHINERY HALL.

to a final issue. The floor area in the Machinery Department embraces something like nine acres, and nearly a year ago this total floor area was applied for many times over. With Mr. Moore the idea has been uppermost that a duty existed with reference to both the trade and the public, and that a broader policy should be pursued than the mere filling of the floor space with a confused mass of odds and ends of machinery. The idea has been to secure only the latest and the most up-to-date items, and with this object in view only the leaders have been encouraged to make displays. The Machinery Hall is a superb structure measuring 1,000 ft in length, and for at least half of this distance its width is 500 ft. In the eastern half of the building is installed the great power plant of the World's Fair, involving something like 45,000 hp. In the western half of the building is installed machinery for making machinery. In close proximity to the eastern end of Machinery Hall is the Steam, Gas and Fuels Building. This is a steel, fire-proof structure measuring 320 ft. in length by 300 ft. in width, and comprising within its enclosure all the steam and gas generating forces for the great power plant. For the first time in Exposition history, an exhibit feature has been made of this adjunct of the power assemblage, and at St. Louis the visitor will find boilers of the latest types from different countries of the world all working in unison. All stoking will be mechanically operated, and it is aimed to have the building as free from dust and dirt as modern mechanical appliances can make it.

In the summer of 1902 the writer, acting under the instructions of the chief of the Machinery Department, began a systematic inspection among the most distinguished of the great iron and steel and machinery houses of Europe for the purpose of collecting items of a special interest for service in connection with the power plant of the Exposition. More than 350 plants were visited in Germany, and the total number of plants visited or directly communicated with throughout Europe totaled more than 1,000. As fast as offerings were secured of desirable topics the facts were reported to St. Louis, and the acceptance or rejection of the same rested with the chief of the machinery display. So keen were the European builders of machinery and accessories to make exhibits at St. Louis that it is the firm belief of the writer that had it been necessary practically all the horsepower that might have been required could have been secured from the Old World. As the situation now exists, the great power plant at St. Louis will embrace some superb engines, boilers and accessories, which have originated from abroad, and it will be especially interesting to observe that in the items which come from the Old World their distinguishing features will be in economical attachments and economical devices. The German exhibits will show the superlative in what has been attained in economics, and the writer cannot refrain from remarking that the man is very blind indeed who can travel to-day among 350 German iron, steel and machinery works without seeing much to learn. It must not be forgotten that Germany's position in machinery development has practically been taken within the past decade, and so great has been this advance that to-day the transatlantic ocean record is held by a Stettin-built ship, the *Deutschland*. When this great vessel made her record run to the eastward, a record which stands to-day, the story is told that on entering the first English port she hoisted to her mast heads a great band of canvas stretching between her foremast head and mainmast head, and on this big banner of canvas in huge black letters, which could be read with the naked eye more than a mile distant, was this inscription: "Made in Germany." The German exhibits at St. Louis in the Machinery Department will call for the most careful study on the part of the visitor, and so keen have been the German manufacturers to make displays that it is not at all uncertain that the Machinery Hall could, if desired, have been filled with German exhibits alone.

But for the superlative in the high-speed steam engine line, the visitor will naturally turn to machines bearing British stamps, for it is a fact that in the high-speed steam engine line the British lead in the world to-day. This statement, it must be understood, applies to engines of large power; and despite the magnificent showing of engines at the Dusseldorf Exposition there was no high-speed steam engine there comparable to the engines of large power such as are turned out by, for example, Behlis, of Birmingham; W. H. Allen & Co., of Bedford, England, or Willans & Robinson, of Rugby, England. In the machinery display at St. Louis there will be found a beautiful engine of the last-named make furnished through the medium of the American builders of this machine, the C. H. Bradley, Jr., Co., Pittsburg, Pa.

FIG. 25.—GENERAL VIEW OF MACHINERY HALL.

In his inspection of the various shops abroad, the writer found the most marked difference between home and foreign shop practices. At the great Krupp works at Essen car wheels were observed being loaded onto trucks by hand. In fact, there appeared to be as a general rule a lack of labor-saving devices at least to the extent with which one is familiar with such equipment in American shops. Take, for example, the Curtis system of overhead trams. Although one does find tram systems in some German shops, still the writer found no such superb installation schemes as one observes, for example, a the Illinois Steel Works shops near Chicago. In the Machinery Hall display there will be found an exhibit of this overhead system of tramway runs. In one of the first boiler shops in all Germany the writer observed that the work was carried on for the most part by hand. It seemed almost incredible, especially when one considers the possibilities afforded to-day by pneumatic tools. In the machinery tool end of Machinery Hall there will be a very fine display of pneumatic tools.

Ten years ago one might have traveled up and down the Rhenish provinces and in all the principal German shops one would have found for the most part English machine tools. To-day all this is changed, and in lieu of English tools one finds for the most part German stock tools, but one also finds almost invariably, in all the leading German plants, a small group of American machine tools for the high-grade work. It is a silent tribute to the excellence of our output.

Among the various makes of American machine tools which the writer observed abroad those of the Niles firm were very much in evidence, and this house will make a diplay at St. Louis which will excel anything of the kind ever heretofore attempted. Some of these Niles tools for the Machinery Hall exhibit will weigh not less than 300 tons. There will be, for example, a huge universal radial drilling machine, capable of drilling to the center of a 20-ft. circle. Then, there will be a great horizontal boring, drilling and milling machine, with adjustments admitting of test readings in thousandths of an inch. All these Niles tools will be motor-driven, and in this connection the writer is reminded of a remark recently made to him by a leading German manufacturer, which was in effect that the presence of a belt on a machine tool to-day was an occasion for an apology. The Niles firm will also show a massive steam hammer, its ram and attached parts weighing 24,000 pounds. Then there will be a 120-in. engine lathe and an enormous plate-bending machine, capable of bending a plate 20 ft. long by one inch thick, or its equivalent, and as a further contribution there will be found an extra heavy planer designed for planing armor plate and other work requiring the greatest power. The shipping weight of this last machine, alone, with a 35-ft. table, is 300 tons.

Space will not permit in this article to enumerate all the topics in Machinery Hall, but with reference to the boiler display it can be said roughly that the exhibit will include generators from practically all the distinguished makers of both the Old and New World. Among the names are Derr, Belleville, Conti, Niclausse, Aultman-Taylor, Babcock & Wilcox, Cahall, Clonbrock, Hohenstein, Geary and others. As an idea of what work is demanded of the boilers, it may be interesting to know that when the generators are working at full load they will evaporate 700,000 pounds of water per hour. This means that 350 tons of water will be hourly changed into steam, pass through the engines, return to the form of water by passing through condensers, and then be re-delivered to the boilers to be again transformed into live steam. The steam from the boilers before reaching the main engine must be conveyed through pipe lines having lengths some instances of 400 ft. A tunnel 7 ft. broad and 8 ft. deep will receive the pipes, one of which is 18 in. in diameter, another 16 in., and none less than 10 in.

In taking note of the handling of material in foreign shops, the writer found electric cranes in general use, but he found no crane service quite as rapid as, or more efficient, than that afforded by the best American cranes. In Machinery Hall there will be a number of electric traveling cranes, and one of the most interesting of the lot will be a superb Shaw crane. As is well understood, such cranes have played a most important part in the development of modern heavy manufacturing, and the makers of the Shaw crane were practically the first to utilize the three-motor service. This type has been in use in the United States ever since 1889. It is an interesting fact that the greatest difficulty is not met in designing a crane that will hoist a load, but in providing means for lowering it rapidly and at the same time keeping it under perfect control. This is accomplished by means of an automatic load brake. Different types are used, but the essential feature of all is that the weight of the load applies the brake, and running the motor in the lowering direction releases it, either entirely or sufficiently, so that it slips and allows the load to descend. A magnetic brake is also provided.

All the principal electric manufacturing houses in America have been called upon to do service in connection with the power plant. The total amount of electric energy required is about 45,000 hp. Of this amount about 32,000 hp will be delivered in alternating current at 25 cycles. This energy is supplied in varying amounts by plants all installed in the western division of Machinery Hall. One of the largest pieces of electric apparatus in this installation is a 3,500-kw 6,600 volts, 25 cycles, three-phase, engine type generator running at 75 r.p.m., built by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. This is direct-connected to a 5,500-hp single-crank compound Allis-Chalmers engine, the total height of which, including its base, is 54 ft. The total weight of engine complete and the generator is over 500 tons, the generator alone without the shaft weighing 150 tons. The overall dimensions of the floor space taken up by this generating set are approximately 35 by 45 ft. Both in the electrical and mechanical design of this machine many novel and interesting features have been embodied. The yoke is cast in four sections, securely held together by body-bound bolts; the outside diameter of the yoke is 27 ft., while its overall dimension is 33 ft., the total weight of the casting being 58,000 pounds. This machine will attract much attention.

The engine cylinders measure 44 in. for the high-pressure cylinder

FIG. 26.—GENERAL VIEW IN MACHINERY BUILDING.

and 94 in. for the low-pressure cylinder. The stroke of both is 60 in. The wheel is 25 ft. in diameter and weighs 300,000 pounds. The speed of the engine is 75 r.p.m.

Nearly all the electric generators in connection with the engines for the Intramural Railway are furnished by the Crocker-Wheeler Company, as already shown in these pages. This Intramural Railway is a double-track trolley standard gauge road some seven miles in length and equipped throughout with cars and other accessories on an exhibit basis. There is one unit of 900-kw capacity running at 110 r.p.m.; a 600-kw generator running at 85 r.p.m.; and three units of 500-kw capacity, one with a speed of 100 r.p.m., and two at a speed of 135 r.p.m. There is a seventh unit of 400-kw capacity, which will be operated at 150 r.p.m.

The Westinghouse Company is taking care of one installation of 12,000 hp, while from the General Electric Company comes, in addition to other items, a Curtis turbine of 5,000-kw capacity. This latter unit will probably be one of the most instructive in all the assemblage of great engines.

At the Paris Exposition of 1900 the pumping requirements demanded 4,500 gallons of water per minute. At St. Louis three enormous centrifugal pumps will force up, and send rolling down the face of Art Hill 90,000 gallons of water per minute. The Cascade pumps for the Exposition are supplied by the Worthington Company and the stipulations in connection with the same set forth that each of the three pumps must be capable for forcing 30,000 gallons of water per minute against a head of 158 ft. As a matter of fact, these pumps are designed for an overload of 25 per cent., which brings their maximum capacity up to 115,000 gallons of water per minute. Large volumes of water have been handled to a lesser elevation, but no such amount of water has ever been artificially moved to such a height as is required in the case of the Cascades of this Exposition.

Electrical Exhibitors at St. Louis.

We give below a list of electrical exhibitors at the St. Louis Exposition, furnished by Prof. W. E. Goldsborough, in charge of that department of the work. It will be noted that the lists for foreign countries have not been extended in full.

Adams-Bagnall Electric Company, Cleveland; A. S. Aloe, St. Louis; American Carbon & Battery Company, St. Louis; American Circular Loom Company, Chelsea, Mass.; American Electric Fuse Company, Chicago; American Electrical Heater Company, Detroit; American Electrical Novelty & Manufacturing Company, New York; American School of Correspondence, Chicago; American Telephone & Telegraph Company, Boston; the American Watchman's Time Detector Company, New York; American Watchman's Time Detector Company, Cleveland; Bion J. Arnold, Chicago; Association of Edison Illuminating Companies, Chicago; Martin Armstrong, St. Louis; Atlanta Utility Works, East Point, Ga.; the Automatic Electric Company, Chicago; Automatic Fire Alarm Company, New York City; Argentine Republic.

Baird Manufacturing Company, Chicago; Carl Bajohr, St. Louis; Bario Vacuum Company, New York; M. V. Barlow, Chicago; W. M. Bashlin, Warren, Pa.; Mrs. Alexander Baumgart, New York City; Benjamin Electric Manufacturing Company, Chicago; The Bristol Company, Waterbury, Conn.; The Browning Company, Milwaukee; The Bryant Electric Company, Bridgeport, Conn.; Bullock Electric Manufacturing Company, Cincinnati; Burdett-Rowntree Manufacturing Company, Chicago; Burnham-Williams & Co., Philadelphia.

H. B. Camp Company, Chicago; Carbondale Machine Company, Carbondale; Cassidy & Son Manufacturing Company, New York; Carman Projector & Specialty Company, Chicago; Central Telephone & Electric Company, St. Louis; Chicago Fuse Wire & Manufacturing Company, Chicago; Colonial Sign Company, Akron, Ohio; Chicago X-Ray Company, Chicago; James Clark, Jr., & Co., Louisville; A. Frederick Collins, New York; Commercial Electric Company, Indianapolis; Controller Company of America, St. Louis; Cooper Hewitt Electric Company, New York; Crocker-Wheeler Company, Ampere, N. J.

The Dayton Autoelectric Company, New York City; De Forest Wireless Telegraph Company, New York; Patrick B. Delany, South Orange, N. J.; The Dayton Electrical Manufacturing Company, Dayton, Ohio; Dialt Motor Company, Philadelphia; Dicke Tool Company, Downers' Grove, Ill.; Dodd & Struthers, Des Moines, Iowa; S. R. Dresser, Bradford, Pa.

Economical Electric Lamp Company, New York; Thomas A. Edison, Orange, N. J.; Electra Water Purifier Company, St. Louis; Electric Circulator Company, Chicago; Electric Contract Company, New York; Electric Controller & Supply Company, Cleveland, Ohio; Electric Railway Equipment Company, Cincinnati; Electric Storage Battery Company, Philadelphia; Eureka Tempered Copper Works, North East, Pa.; Electrical World and Engineer.

Faller Automatic Telephone Exchange Company, New York; Federal Electric Company, Chicago; C. J. Field, New York; Fort Wayne Electric Works, Fort Wayne, Ind.; France.

Germany; The Gardner Electric Drill & Machinery Company, Cleveland; General Electric Company, Schenectady, New York; Gervais Manufacturing Company, Edgewater, N. J.; G. M. Gest, Cincinnati; W. E. Goldsborough, La Fayette, Ind.; Gould Coupler Company, New York; Gould Storage Battery Company, Depew, N. Y.; Gray National Telautograph Company, New York; Gray Telephone Pay Station Company, Hartford, Conn.; A. Grothwell, San Francisco, Cal.

C. F. Hall, Chicago; Robert E. Haward, Kansas City, Mo.; The Heinze Electric Company, Lowell, Mass.; Hellesens, Enke & V. Ludvigsen, Copenhagen, Denmark; Hinton & Tarkington, Hot Springs, Ark.; Holmes, Booth & Haydens Company, New York; Holophane Glass Company, New York; C. W. Hunt, West New Brighton, New York; Miller Reese Hutchison, New York City; Hutchison Acoustic Company, New York.

Italy; Indiana Novelty Company, Muncie, Ind.; International Acheson Graphite Company, Niagara Falls, New York; J. Van Inwagen, Momence, Ill.

The Jackson Electric Drill & Supply Company, Denver, Colo.; The Jandus Electric Company, Cleveland.

Charles Kaestner & Co., Chicago; Kellogg Switchboard & Supply Company, Chicago; Kester Electrical Manufacturing Company, Chicago; Keystone Electrical Instrument Company, Philadelphia; The Kny-Scheerer Company, New York; H. E. King, Chicago; D. A. Kusel Telephone & Electric Manufacturing Company, St. Louis.

The Leclanche Battery Company, New York; Lincoln Electric Company, Cleveland; Lionel Manufacturing Company, New York; Locke Insulator Manufacturing Company, Victor, N. Y.

Mexico; McGraw Publishing Company, New York; McRoy Clay Works, Chicago; Marshall-Sanders Company, Boston; W. E. Matthews & Brother, St. Louis; The Miller Anchor Company, Norwalk, Ohio; Mystic Electric Gas Lighter Company, New York; Moloney Electric Company, St. Louis.

National Carbon Company, Cleveland; National Battery Company, New York; National Cash Register Company, Dayton, Ohio; National Electric Company, Milwaukee, Wis.; Nernst Lamp Company, Pittsburg; National Clock Works, St. Louis; Northern Electrical Manufacturing Company, Madison, Wis.; Norton Emery Wheel Company, Worcester, Mass.; Nungesser Electric Battery Company, Cleveland.

The Organ Power Company, Hartford, Conn.

Pawling & Harnischfeger, Milwaukee, Wis.; The Peerless Electric Company, Warren, Ohio; Perkins Electric Switch Manufacturing Company, Bridgeport, Conn.; The Phelps Company, Detroit, Mich.; Walter P. Phillips, Bridgeport, Conn.; Pittsburg Blue Print Company, Pittsburg; Pneumatic Signal Company, Rochester, N. Y.; Postal Telegraph Cable Company, St. Louis; Printing Telegraph News Company, St. Louis; Prometheus Electric Company, New York City; Purdue Research Laboratory, La Fayette, Ind.; Portugal.

Queen & Co., Philadelphia; F. Herrero y Ruix, Albacete, Spain.

Reynolds Electric Flasher Manufacturing Company, Chicago; The Robbins & Myers Company, Springfield, Ohio; Chicago Röntgen X-Ray Laboratory, Chicago; Roth Brothers & Co., Inc., Chicago.

St. Louis Brass Manufacturing Company, St. Louis.

The Safety Insulated Wire & Cable Company, New York; Sawyer-Man Electric Company, New York; W. Scheidel & Co., Chicago; M. Shearer, Akron, Ohio; Shedd Electric & Manufacturing Company, New York; Standard Underground Cable Company, Pittsburg; Standard Water Purifying Company, Cleveland; Sterling Electric Company, New York; Sterling Electric Motor Company, Dayton, Ohio; S. W. Stratton, Washington, D. C.; William F. Stilz & Co., Philadelphia; Sumter Telephone Manufacturing Company, Sumter, S. C.

Telephone Hygienic Company, Los Angeles, Cal.; C. H. Thordarson, Chicago; C. J. Toerring Company, Philadelphia; Triumph Electric Company, Cincinnati, Ohio.

Underwriters' Laboratories, Chicago; U. S. Incandescent Lamp Company, St. Louis; United States Electric Signal Company, West Newton, Mass.

E. C. Van Nort Electric Company, St. Louis.

Wagner Electric Manufacturing Company, St. Louis; R. V. Wagner & Co., Chicago; Waite & Bartlett, New York; Warren Ball-Bearing Fixture Company, New York; Warren Electric & Specialty Company, Warren, Ohio; Warren Electric Manufacturing Company, Sandusky, Ohio; B. F. Wasson, Clinton, Ill.; Western Electric Company, Chicago; Wesco Supply Company, St. Louis; *Western Electrician*, Chicago; Western Union Telegraph Company, St. Louis; Weston Electrical Instrument Company, Newark, N. J.; Westinghouse Electric & Manufacturing Company, Pittsburg; Wheel Truing Brake Shoe Company, Detroit, Mich.; Windsor & Kenfield Publishing Company, Chicago; Wireless Railway Company, Philadelphia; Westinghouse Traction Brake Co., New York; The Wyckoff Pipe & Creosoting Company, Stamford, Conn.

Charles E. Yetman, New York.

A Trolley Line Up Mount Vesuvius.

The famous volcano at Mount Vesuvius has hitherto been quite difficult of access from Naples, although when once the foot of the mountain was attained, the cable road has been there, beginning at the base of the lava cone 2,450 ft. above the sea and running up to a height of 3,700 ft. in the vicinity of the old crater and about 360 ft. below the new one. One can have a "hot time" there, and until recently one had a "hot time" getting there. But the great tourist firm of Messrs. Cook, who own the cable road, have now installed a very interesting trolley line from Resina on the outskirts of Naples right to the foot of the cableway, and the distance of $4\frac{1}{2}$ miles is covered in 48 minutes, with all stops included.

The grades between Resina and San Vito do not exceed 8 per cent. About the same grades are found between the Government Observatory and the cable railway. It was determined, therefore, to

FIG. 1.—GENERAL VIEW OF MT. VESUVIUS; ELECTRIC RAILWAY IN THE FOREGROUND.

operate both of these divisions by an electric railway. For the section between the power station and the observatory a rack road was chosen, as that division includes grades as high as 25 per cent. On this division the motor car of the electric railway is hauled by an electically-driven rack locomotive. The Vesuvius Railway, as now completed, has a gauge of 1 meter and is divided into three sections, having a total length of 4.5 miles. The first section is an electric railway starting at Pugliano (the upper part of Resina), and extending 1.0 miles to the power house and car house. The minimum curve radius is 164 ft. The second section, as stated, is a rack road, and runs from the power house to the observatory. Its length is about 1 mile and its highest point nearly 1,950 ft. above the sea. The third section is an ordinary electric railway, similar to the first, and is 1.62 miles long. The roadbed in general is built in accordance with the practice adopted on the later Swiss mountain railways.

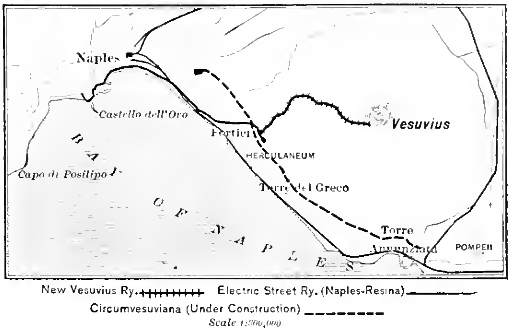


FIG. 2.—MAP OF MT. VESUVIUS ELECTRIC RAILWAY LINE.

From Pugliano the line traverses a very fertile agricultural district, and just before reaching the rack road passes through a number of petrified lava streams. The first station, San Vito, is in the middle of the garden district, about .87 mile from the beginning of the line. From this point the railway runs for 1.02 miles in an almost straight line to the rack road. The lower portion of the latter road passes through inhabited territory, but soon enters a large forest, from which it does not emerge until it reaches the observatory. The observatory railway station lies very near the large hotel which has been built at this point by Messrs. Cook. There is also close to the station a little chapel and park. From this station the line is again of the ordinary electric railway construction, and traverses a distance of approximately 1.62 miles before reaching the lower station of the old cable railway.

The track construction of the electric line consists of rails 3.94 in.

FIG. 3.—BUILDING THE RACK RAIL DIVISION.

high, weighing about 40 pounds per yard. The rack rails are laid on 11-ft. 3-in. sections, while the outside rails are 33 ft. 9 in. long. The rails on the rack road and the curves on the other divisions are anchored by means of iron tie plates. On straight track of the electric railway divisions the joints are furnished with the usual base plates as well as angle plates. Oak ties are used throughout rather than metal ones, as they can be replaced more quickly in case of lava overflows, and because the Strub rack system operates equally well with metal or wooden ties. These ties are 6 ft. long, 6.3 in. to 7 in. wide and 4.73 in. to 5.52 in. high. Plastic bonds are used for bonding in the rail return except at special work, where wire bonds are used.

To make possible a 35-minute headway turnouts have been built at each end of the rack division. The present equipment consists of three motor cars and two rack locomotives. The cars have single trucks of 6.2 ft. wheel base, and weigh 4,200 pounds (8,400 kg.) each, without motors. The motors are of the direct-current series type, and are built somewhat larger than would otherwise be required, on account of the heavy grades and warm climate. All cars are built in three sections, each of which has a separate side door. The seating capacity is eight passengers per section, with additional room for six passengers on the platform. The sides of the car are cut off half-way to the roof, but in stormy weather the openings may be closed by water-proof curtains. The cars are equipped with bow trolleys. Owing to the severe grades each car is furnished with two independent sets of braking apparatus. The first consists of a powerful spindle brake, furnished with eight brake shoes, which can be operated from either platform. The second consists of an electric short-circuiting brake combined with an electromagnetic track brake. To overcome slippery rails two sanders are supplied at each end of the car. When the motor cars are used on the rack division they are pushed by the electric locomotive, so that no brakes are required; the rack locomotive is equipped with four independent brakes, each of which is capable of controlling both locomotive and car.

The rack locomotive weighs about 5,200 pounds and is capable of running at about 5 miles per hour when propelling a load of 5,500 pounds on a 25 per cent. grade. It is equipped with two 80-hp shunt-wound motors, which run at 650 r.p.m. to 700 r.p.m., and operate the rack-driving wheels through gearing. The rack wheels are made of crucible steel and weigh about 40 pounds each. As the motors are shunt-wound, current is returned to the line when the locomotive is running down grade.

The power plant is furnished with two 67.5-kw, 550-volt, direct-current generators, running at 700 r p.m., and operated by belting from the fly-wheel of two 100-hp, 160-r.p.m. gas engines, using producer gas. The generators may be connected in parallel to a Tudor storage battery having 300 elements and a capacity of 256 amp.-hours. These generators are wired according to the C. E. L. Brown system, which enables them to deliver current to the storage battery without the use of a booster. The full-load efficiency of each generator is 92 per cent. and the half-load efficiency 89 per cent. There are two gas producers, and as each is of 200-hp capacity only one is used at a time. There are also two boilers for these producers, one of which may also be held in reserve. The gas engines are started by compressed air, but can also be started by supplying the generators with battery current and momentarily operating the latter as motors. The power transmission line is divided into two sections by a section insulator, these divisions being respectively that from the power station to Pugliano, and from the power station to the cable railway. The third circuit leaving the switchboard was intended originally to be a feeder for the power house cable railway division or to furnish current for the electric motor which is to operate the cable railway. It has been found, however, that this feeder is unnecessary at present.

A circuit-breaker has been placed at the upper end of the rack railway near the observatory, dividing the power house cable railway section into two parts. In case of an eruption it will be possible, therefore, to cut off all current from the electric railway division between the observatory and the cable railway. The power circuits are protected by Wurts lightning arresters, which are mounted on poles along the line at intervals of about .6 mile. The lightning arresters are grounded through the rails. In addition to the power wires there are two telephone wires and one telegraph wire, used for dispatching and other purposes. All of the electrical apparatus throughout the system was furnished by Brown, Boveri & Co., of Baden. The general plan was that of Mr. E. Strub, of Zurich, Switzerland.

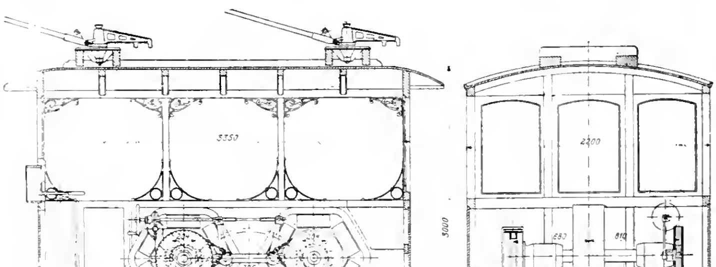


FIG. 4.—SECTION VIEWS OF ELECTRICALLY-DRIVEN RACK LOCOMOTIVE.

A Convenient and Economical Electrical Method for Determining Mechanical Torque.

By A. S. McAllister.

A LITTLE experience with the well-known mechanical and electrical methods for determining torque convinces one that the latter method is far preferable to the former with reference to ease of adjustment, flexibility of operation and reliability of results. For ascertaining the output from either mechanical or electrical motors, perhaps, the most familiar method is one which involves the use of a direct-current generator, of which the sum of the input and transmission losses is taken as the value of the output desired. The input to the direct-current generator is found as the sum of its output and its internal losses. In order to determine the internal losses of the generator, it is necessary to find the value of the individual iron, friction and copper losses. When the resistances of the separate circuits of the generator and the currents flowing therethrough are known, the copper losses may readily be calculated. The armature iron loss varies both with the speed and the density of magnetism. That the effect of any change in the latter may be

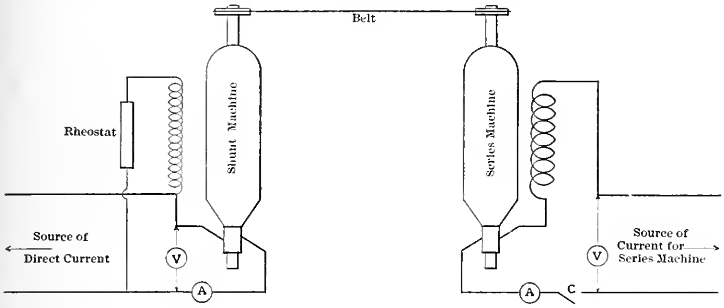


FIG. 1.—DIAGRAM OF TESTING CIRCUITS.

eliminated, it is usual to operate the generator as a shunt-wound machine with constant field excitation and with the armature brushes at the mechanical neutral point, under which conditions the iron loss will vary at a rate but slightly greater than the first power of the speed, and, where the nature of the test so dictates, the value may accurately be determined throughout any desired range of speed.

In cases where the load generator and the driving motor are constructed for the same e.m.f. and capacity, the output from the generator may be fed back into the supply line, the test thereby using only that amount of energy necessary to overcome the losses of the two machines. In these latter cases the individual losses of each machine are calculated as formerly and each is subject to the same errors as before, but the sum of the losses, being directly measured, is accurately determined and may be used as a check on the separate losses.

The method given below combines the convenience and economy of the "loading back" method, is subject to a less number of sources of errors and is applicable to all types of motors, either direct or alternating current, which may possess either the series or shunt motor characteristics, and in many cases it may with equally desirable results be applied to the testing of either mechanical or electrical motors.

The circuit diagram of Fig. 1 will serve to make clear the method of connecting the apparatus for the test and may be used to explain the theory upon which the test depends. In Fig. 1 the load generator is shown as a constant-potential, shunt-wound, direct-current machine, while the driving motor, as shown, is a series-wound machine, and may be of either the direct or alternating-current type. It is desired to find the torque of the series machine at various speeds. If the shunt machine be operated as a motor—being belted to the series machine which is run, with circuit switch C open, at a speed somewhat below that at which the value of the torque is desired to be obtained—it will require a certain armature current, I_0, at a certain impressed e.m.f., E. If now the switch, C, in the circuit to the series machine, be closed, the shunt machine will be driven at an increased speed and will require an armature current smaller than before—perhaps of negative value—due to the accelerating torque transmitted to the belt, and, if the e.m.f., E, and the field current of the shunt machine, remain constant, the value of the torque excited by the series machine, expressed in equivalent watts per revolution per minute, will be:

$$T = \frac{(I_o - I_L)\,E}{S},$$

where I_o is amp. taken by armature of shunt machine with switch, C, open;

I_L is amp. taken by armature of shunt machine with switch, C, closed;

and S is the "synchronous" speed of the set, as determined by the relation of the e.m.f. and field strength of the shunt machine.

The equation above expresses the value of the torque by which the series machine assists the shunt-wound machine, and gives the true value of the torque which the series machine delivers to its own shaft.

The convenience of this method in comparison with one which uses the shunt machine as a generator will be appreciated when it is considered that no account need be taken of the internal losses or of the output of the machine and that the field current of the shunt machine and therewith the speed of the set may be adjusted to any desired value for each determination of torque without affecting the results. The economy of the method is due to the fact that the set dissipates only that amount of energy represented by the losses of the two machines, all excess of power being returned through the constant potential supply circuit by means of the current, produced by the generator action of the shunt machine.

The accuracy of the method depends upon the following facts: A direct-current motor runs at a speed such as to generate an e.m.f. less than the impressed by an amount sufficient to force through the resistance of its armature a current of a value such that its product with the field magnetism gives the torque demanded at its shaft. With constant field magnetism the electrical torque of a direct-current machine, operated as either a motor or a generator, is given by the expression:

$$T = \frac{I\,E}{S},$$

where I is the armature current,

E is the impressed e.m.f.,

and S is that speed at which the counter e.m.f. of rotation of the armature windings in the field magnetism equals the impressed e.m.f.; that is, the "synchronous" speed as used above.

If Wo = watts output (electrical),

R = resistance of armature,

$r.p.m.$ = actual speed of armature,

then $T = \dfrac{Wo}{r.p.m.} = \dfrac{I\,E - I^2R}{r.p.m.} = \dfrac{I\,(E - I\,R)}{r.p.m.} = \dfrac{I\,Ec}{r.p.m.}$, where Ec is the counter e.m.f. of rotation. But $\dfrac{Ec}{r.p.m.} = \dfrac{E}{S}$ for constant field strength; hence, $T = \dfrac{I\,E}{S}$, as given above.

Since for a certain impressed e.m.f. S has a definite fixed value for each adjustment of field strength, with constant field magnetism, the internal electrical torque of the shunt machine varies directly with the armature current, and any change in the value of this current serves at once as a measure of the change in torque exerted by the shunt machine, quite independent of all other conditions.

It remains now to show why the change in torque of the shunt machine may be used to determine the torque exerted by the driving motor. The torque delivered to the shaft of the series motor is less than the internal electrical torque of the shunt machine by that necessary to overcome the iron and friction losses of the shunt machine and the transmission losses in the belt. Since the belt and friction losses vary directly with the speed, it will be evident that the counter torque due thereto will be constant. For constant field magnetism, the armature hysteresis loss varies as the first power, and the eddy current loss as the square, of the speed. Since in comparison with the other loss. that due to the eddy currents is relatively small, the sum of the iron, friction and transmission losses varies at a rate inappreciably greater than the first power of the speed and the torque necessary to overcome these losses may, for practical purposes, be taken as being independent of the slight change in speed. The change in the internal electrical torque of the shunt machine, when switch C, of Fig. 1, is closed, gives at once the value of the torque delivered to its shaft by the series motor.

The method outlined above may be used to determine the torque exerted by a machine when such torque is much less than that necessary to drive a generator of any capacity whatsoever and is, therefore, especially advantageous for tests where it is desired to find the torque, at high speeds of machines possessing series motor characteristics.

In Fig. 1 is shown a series-wound driving motor, but it will be evident that the change in torque, as given by the variation of the current taken by the shunt machine, may be produced by any type of motor. A little consideration will show that since, at any given speed, the torque exerted by the shunt machine of Fig. 1 may be adjusted throughout any desired range by use of the field rheostat, the method may conveniently be applied to motors possessing practically constant load speed characteristics, such as those of the direct-current, shunt-wound type or of the alternating-current induction type, and that alternating-current synchronous motors may be similarly tested, if after adjustment of the load on the synchronous motor by means of the rheostat in the field circuit of the shunt machine the supply of electric power be cut off from the synchronous machine in order to obtain the change in torque excited by the shunt machine.

Annual Report of the General Electric Company.

The reports of the General Electric Company for the year ending January 31, 1904, have just been issued. The financial condition is summarized in the report of President Coffin, which shows, after writing off $553,733 from patent account and $2,027,841 from factory plants and machinery a profit, less $76,007 interest on debentures of $7,789,369. From this is deducted a debit to profit and loss of $1,470,098 in writing off patents, etc., of Stanley Electric Manufacturing Company, the balance due on turbine patents, etc., making a net of $6,319,270. There was paid in dividends during the year a sum of $4,482,701, which deducted from the $10,801,972, representing last year's net profits, and the 1902 surplus of $4,482,972 left a surplus on January 31 of $7,293,688. Mr. Coffin in noting the fact that the percentage of profit was smaller in 1902 gives as reasons the disturbed financial conditions, the increased cost of copper, higher priced and less effective labor, lower selling prices and the expense of developing the steam turbine.

First Vice-President Griffin gives an interesting statement as to the business done. The total amount billed to customers reached the impressive sum of $41,699,617, as compared with $36,685,598 in 1902-3, although the orders received, due to lower prices, were $39,060,038, as compared with $30,944,454, showing that the company by increased capacity had been able to catch up with its orders. The gigantic output included about 900,000 hp of generators, rotaries and turbines; more than 7,000 railway motors aggregating over 300,000-hp capacity; transformers of over 650,000-hp capacity; more than 15,000 alternating and direct-current motors, aggregating over 200,000 hp; more than 75,000 arc lamps and 110,000 meters. General Griffin points with deserved pride to the brilliant success of the Manhattan Elevated equipment carrying over 1,000,000 passengers daily and takes occasion to point out that the "deadly third rail" did not kill or hurt a single passenger. Attention is also directed to the large order from the New York Central system for apparatus to operate as far out as Croton, 34 miles from New York City. It is shown that the percentage of operation has thus been cut down by the adoption of electricity: South Side Elevated, Chicago, 1895 steam, 69.1 per cent. of operating expenses to gross receipts; 1899, electricity, 44.1 per cent. Lake Street Elevated, 1895 steam, 56.1 per cent.; 1899 electricity, 47.5 per cent. Manhattan Elevated, 1901 steam, 55.8; 1903 electricity, 44.7. The detailed figures of the Manhattan, already familiar, are recited. General Griffin also calls attention to the great success of the Sprague-General Electric multiple-unit control now in use on 53 roads and 2,595 cars and adopted for London and Paris. The striking statement is made that since 1892 the company has sold 92,557 railway motors of a total capacity of 3,420,537 hp. As to power transmission, including steam and water plants, the company has installed or under contract 1,230,270 hp in polyphase generators, of which 514,910 hp is driven hydraulically. The number of orders received during the year was 176,834, or about 570 per cent. It appears elsewhere in the report that there were 15,500 regular customers on the books—more than 1,000 increase over 1902-3. General Griffin does not give the output of incandescent lamps.

Vice-President Rice presents an interesting report from the production end. The floor space has increased 700,000 ft. in 1903 and is now 3,700,000 ft., as compared with 1,800,000 ft. in 1899. The employees are 17,000, as compared with 8,000 in 1899; but are 1,000 fewer than in 1902-3, a fact that may quite largely be attributed to increased use of automatic machinery. To the incandescent lamp factory at Harrison, N. J., 4,200,089 ft., were added. The new turbine shop at Schenectady is 237,000 sq. ft., and one for the same work at Lynn has 137,000 sq. ft.

Mr. Rice notes the average increase of transformers in transmission plants from 100 kw to 1,000 kw, and the maximum size from 300 kw to 2,500 kw. The company had five large plants under construction with line pressures of 60,000 volts. One interesting item is the order from the government of Mysore, India, for 5,000 hp of generators, thus nearly doubling the original Cauvery-Kolar plant. At Niagara power plant the General Electric Company now has eleven generators of a total of 55,000-hp capacity; it has shipped the first 10,000-hp machine for the Canadian side of Niagara and has two more coming along for delivery.

Attention is called by Mr. Rice to the increase in the Baltimore & Ohio plant of two large multiple-unit locomotives; the order for 30 locomotives, each of 2,500 hp, for the New York Central, "the forerunner of many others to be placed by steam railroads," the introduction of single-phase railway motors, and the large exploitation of the Curtis turbine. "We made an arrangement with the inventor (Mr. C. G. Curtis) of this turbine a number of years ago, and as a result of his work and of that of our engineers, a type of prime-mover has been developed especially adapted for driving electrical generators. A large line of turbo-generators varying in size from 1½ hp to 7,500 hp has been developed. We have sold about 350,000 hp, of which 35,000 hp have been installed and are in successful operation. It is believed that the low cost, simplicity, small space and many other advantages of the Curtis turbine will result in a greatly increased sale of electrical apparatus." Mr. Rice mentions the fact that $2,500,000, exclusive of tools and patterns, was spent on the new shops in the year.

The financial report of the company states that outside of the Stanley "deal" the sum of $553,733 was spent on patents and patent litigation. It appears that the factory plants are carried on the books at $6,500,000. The total book value is $18,254,046, but in 11 years not less than $11,754,046 has been written off against them. Stocks and bonds of the company of a value of $24,340,000 are carried at a book value of $14,665,346, including 104 lots carried at $1 each. During the year securities carried at $1,156,812 were sold at a profit of $138,644. Collections during the year in cash exceeded $39,000,000. The unmatured and unsettled balances for the year are $14,548,450 and the total book value of all notes and accounts receivable was $15,207,480. The company had a balance of $2,046,488 engaged in work in progress on 816 incomplete installations. The office furniture, etc., of an appraised value of $166,059 is carried at $1. Finished apparatus worth $139,798 for novel uses had been delivered to various concerns subject to purchase if its operation is successful, such apparatus consigned and loaned being carried at $69,899. The company has no notes out and has virtually had no such obligations since 1895. Practically all purchases have been paid for in cash, although the company would appear to allow on an average slightly better than three months' credit to its customers, gauged by the accounts receivable. The total stock outstanding is $43,866,700, including $1,972,100 for the Stanley purchase. The total debentures is $2,131,400, including $2,049,400 for the Sprague purchase. A foot note to the financial statement by Messrs. H. W. Darling, treasurer, and E. Clark, general auditor, says: "The Stanley Electric Manufacturing Company, the stock of which was acquired by the General Electric Company early in 1903, carries a floating indebtedness of about $2,500,000, which it is proposed to liquidate in the near future." The balance sheet gives the cash on hand as $3,298,445 and the stocks and bonds owned as $14,665,346.

Chicago Meeting of the A. I. E. E.—Transmission Lines.

The Chicago branch of the American Institute of Electrical Engineers met April 26 to discuss the general subject of "High-Tension Transmission Circuits." At this meeting it was announced that the regular June meeting of the Institute will be held in Chicago on or about June 21, the programme to be confined to the transmission subjects. The date given was selected so that members could take advantage of the railroad rates to the Republican National Convention, as the meeting is expected to bring together transmission men from both East and West. Mr. James Lyman, chief engineer of the Chicago office of the General Electric Company, is chairman of the local committee on arrangements.

Mr. G. H. Lukes, general superintendent of the North Shore Electric Company, abstracted his paper on "Overhead High-Tension Distributing Systems in Suburban Districts," which was read at the New York meeting December 18 last. He also abstracted the paper of W. C. L. Eglin on "Automatic Apparatus for Regulating Generator and Feeder Potentials," which was read at the same New York meeting.

In discussing these papers, Mr. Lukes mentioned trees as an uncompromising source of trouble on overhead lines, and said that there was no tree insulator which was worth anything on high-tension circuits. The only way out of the difficulty was to keep the lines entirely away from the trees. As to the recent suggestion of the fire underwriters that crossing of overhead lines be made with poles so high and of such a short span that a wire breaking at one pole should not hang down far enough to reach the line crossing below, he did not think this advisable, because poles high enough to accomplish this would make the weakest point in the line. He thought it better to take some other risk than to introduce such weak points in the line. The grounded network of guard wires under the high-tension wires, if made sufficiently strong, would cause a serious additional strain on the pole supporting it, which he considered an element of danger.

Mr. H. B. Gear gave some of the practice of the Commonwealth Electric Company as regards constant-potential, alternating-current distribution lines. He said that in former days when circuits were operated at 1,000 volts and when there would be not over 20 or 25 kw load on a branch circuit, link fuses on a porcelain base for branch circuits were tolerably satisfactory; and when these fuses blew they caused no more inconvenience than the cutting off of service on that branch until a lineman could replace the fuses. On the present 2,000-volt circuits, however, the load on a branch was likely to be from 50 to 70 kw. The blowing of fuses on a 2,000-volt circuit of this capacity nearly always resulted in the destruction of the fuse box. Enclosed fuses were good, but when exposed on a pole line for some months the filling of the cartridge would become packed and the results when the fuse blew were nearly as bad as with an open fuse. The question, therefore, resolved itself into using as few fuses as possible. This company had adopted the practice of connecting various circuits solidly into junction box distributing centers without fuses. Small branch circuits were sometimes fused, the first pole away from the junction box, but the station fuses on a feeder were mainly depended upon to open short-circuits, and in case of a short-circuit on the lines, all of the customers on a feeder would be cut off for two or three minutes, while a fuse was being replaced at the station, as against the old arrangement of cutting off possibly one-third of the consumers on a feeder for two or three hours, while the lineman could reach the fuse box and repair the damage, perhaps being obliged to put a jumper around the destroyed fuse box.

Lightning arresters give satisfaction, but must be cleaned and repainted often. When old the collection of rust and dust is likely to cause trouble. They must be cleaned and painted at regular intervals. It is the custom of some companies to disconnect lightning arresters in the fall, connecting them up again before the spring thunderstorms. In a large system regular inspection of arresters by inspectors is absolutely necessary to good service. The greatest trouble which is found with wires is caused by boys, as they threw light wire across the lines with highly fascinating results. With the use of a suitable hook, an inspector could remove strings thrown across the line which were likely to cause trouble. He criticised the location of the various circuits on a pole which was suggested by Mr. Eglin. That arrangement was to place the alternating-current distributing circuit on the top cross arm, leaving arc circuits on the lower and outside arm, with the idea that these circuits would be dead during the day and that the lineman could work upon them. Mr. Gear said his company found it more satisfactory to place the alternating-current distributing circuit on the lower cross arm, where taps to transformers could be easily taken off and brought direct to the transformer. If the distributing circuit was placed on the top cross arm it was very difficult to make transformer connections to it. Furthermore, this distributing circuit was the one upon which most of the work had to be done, so that it was desirable to have it in the handiest place.

This company made an inspection of the oil in transformers about a year ago, and found that a large per cent. of them needed filling, the oil being from three to ten inches low. Many cases of transformer burn-outs were due to the absence of oil in transformers.

As regards the use of head guys from one pole to another, he considered them worthless as protection against wind storms, and cited examples of pole lines in Chicago protected by head guys, which had entirely gone down where pole lines alongside protected by side guys had remained intact.

Mr. E. P. Warner, chief engineer of the Western Electric Company, in discussing question of guys and their insulation, thought that no strain insulator was made which would protect a guy wire from circuits of 1,000 volts and over. Guy wires should all be grounded. He also thought that confidence should not be placed on an absolute cut-out on a series arc lamp, but that the lamp should be treated as if it were connected to the line.

Mr. Lukes agreed with Mr. Warren that guys should be grounded and that no dependence should be placed on absolute cut-outs in a large circuit. His instructions to men were to use an insulating stool whenever handling arc lamps on a live circuit. If it was a rainy night it was best to leave the lamp out all night than to risk handling it even then. For a strain insulator in a guy wire he thought a long stick of wood soaked in some water-proofing compound the best thing yet proposed.

Mr. J. D. Nies, instructor in Lewis Institute, gave an abstract of a paper by Harris J. Ryan, on "The Conductivity of the Atmosphere at High Voltages," read at New York, February 26, 1904. This paper was discussed by Prof. C. E. Freeman, of Armour Institute.

The paper on "European Practice in the Construction and Operation of High-Pressure Transmission Lines and Insulators," by Guido Semenza, read in New York, February 26, was given in abstract by W. A. Blanck.

Mr. Blanck said that the designing engineer in this country has been brought to seriously consider a more substantial pole line construction, which consideration culminates in the question of wooden versus iron poles. Most of the troubles on the present high-tension lines in this country with wooden poles and cross arms can be traced to the following causes: 1. Breaking of insulators. 2. Burning of pins and cross arms. 3. Damage to wooden poles by lightning, prairie or incendiary fires, and also loss by theft where fuel and building materials are scarce. A transmission line with iron poles set about 600 ft. apart reduces the number of line supports to about 20 per cent., as compared with that of wooden poles. It is, therefore, obvious that the points where break-downs may occur are reduced at the same rate, and considerably less maintenance is required. Difficulties as noted under two and three are avoided with iron poles and cross arms. The insulating capacity of a wood cross arm, in case of a broken glass insulator, for line potentials from 40,000 to 60,000 volts seems often to be overestimated. A proper form of porcelain insulator, made up of very tough material, firmly cemented to an iron pin, which, in case of a shot or blow, is not completely shattered but only chipped, will surely prove just as satisfactory as the above-mentioned insulating properties of the wooden cross arm. If the iron poles are set 600 ft. apart, the sag for the hard-drawn copper wire or cable should not be less than 2 per cent. of the span, or 12 ft. at 10° F., allowing the factor of safety to be about four. At 100° F. the deflection of the wires will be 20 ft., thus requiring 45-ft. towers. Assuming that the strongest wind sway takes place at the highest temperature just before a thunder storm and spacing the wires in an equilateral triangle with 7-ft. base, a contact of the two lower wires swinging in opposite directions could occur with only 10° deflection over the vertical plane. This deflection is very small and involves a great risk, and a considerably larger spacing would require very heavy cross arms. A suitable staggered position of the wires determined by the striking distance of the line pressure appears more advantageous for spans of 600 ft.

The tendency in this country is to build steel poles for power transmission lines, with a much larger base than the cuts indicate in Mr. Semenza's paper, thus doing away with the extra concrete foundations and considerable labor in erection of the poles. In order to keep the poles free from rust, all steel parts should be heavily galvanized after all punching, shearing or other machine work is done. Such a manipulation involves a higher first cost, but reduces immensely the maintenance or renewing of preserving paint.

Looking over Mr. Semenza's comparative figures for wooden vs. iron poles, the peculiar item for right of land occupation is to be noted. This differs materially from conditions in the United States. It is not considered good practice here to secure less than a full right-of-way for the complete transmission line, because nothing short of this enables the patrol gang an easy access to all parts of the line. In general, the territory for power transmission lines in the United States is more scantily settled and heavily wooded than abroad, so that highways are the most favored routes, allowing the best access to all parts of the line with the least expenditure for the right of way. These conditions for full private right of way require, therefore, the same investment for wooden and iron poles, and the table corrected for American prices and iron poles as specified would be as follows:

53 wooden poles, 35 ft. with cross arms and pins	$6.00	$318.00	9 steel towers with cross arms and pins 45 ft.	$60.00	$540.00
Erection	1.20	63.60	Assembling & erection	7.00	63.00
3x53 insulators	1.50	238.50	3x9 insulators	1.50	40.50
		$620.10			$643.50

"These figures certainly bespeak for the iron poles most careful consideration in long-distance transmission work. Through the courtesy of Mr. Dyer, of the Aermotor Company, Chicago, I am pleased to be able to show you this evening some lantern slides of steel towers built by this company for the Guanajuato Power & Electric Company, Mexico." (See Figs. 1 and 2.)

Mr. L. A. Sanford, who was connected with the construction of the Guanajuato 100-mile steel tower transmission line, then gave a very interesting description of this new departure in transmission line construction. From the power house at Zamora the line passes through thirty miles of rough mountainous country covered with lava rock and cut by deep ravines. The remaining seventy miles lie in a clear rolling country mostly under cultivation. With the exception of a few angles near Guanajuato, the line is almost straight. Three methods of construction were available: wood poles, iron poles and towers. Since native timber is not durable enough for pole line purposes, and Texas timber is expensive to import, many high-tension lines in Mexico are built of tubular steel poles.

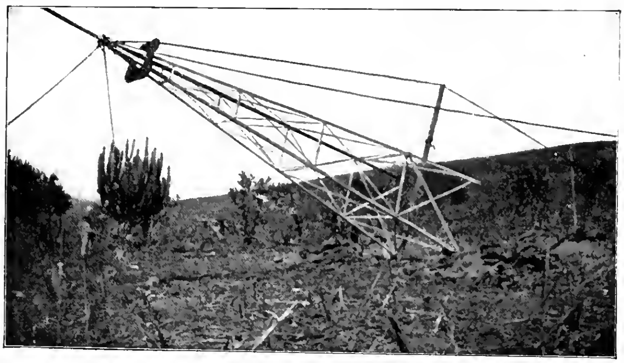


FIG. 1.—RAISING A TRANSMISSION LINE TOWER TO POSITION.

FIG. 2.—ONE OF THE TRANSMISSION LINE TOWERS.

As the line was one of the vital points of this installation, it was desirable to make it both electrically and mechanically as strong and durable as possible. Each insulator of a high-tension line is liable to puncture and breakage, and is, therefore, a point of weakness. By long spans the number of insulators and consequent weak points may be decreased, but it is necessary at the same time to increase the strength of supports and cables.

The Locke insulator used (see ELECTRICAL WORLD AND ENGINEER, January 24, 1903), consisted of three pieces. The pin sleeves and petticoats already cemented together were shipped in barrels separate from the tops. After arrival on the line, the two parts of each insulator and the pin had to be cemented and allowed to stand for forty-eight hours before they could be distributed to the respective towers. The tower construction requires 108 insulators less than a wood pole construction with forty-eight poles to the mile. Here is a large saving in cementing the insulators and in breakage, as it is almost impossible to pack large insulators in baskets on mules and burros for two or three miles without some damage.

Transportation was a big item, both from the States and after the material was unloaded from the cars. On the rough section of the line wagon roads were very scarce, and it was often necessary to pack construction materials for four or five miles over rough trails. The Guanajuato towers (Figs. 1 and 2) weigh 1,500 pounds apiece, and are of the four-post wind mill type, standing 40 ft. above the ground, on a base 8 ft. square. As in wind mill towers, about the top is a square wooden platform extremely convenient to work on. The top insulator pin screws on the end of a 3-in. iron pipe extending 6 ft. above the top of the tower. The two 4-in. channels forming the cross arm clamp about the base of this pipe, and the square bases of the cross arm pins fit between these channels. The towers are not set in concrete, as is sometimes the custom with iron poles, but the four legs each carry a 3-in. piece of angle iron, which rests on the bottom of the post holes. These cross pieces answer the purpose of both supports and anchors. The four post holes are filled and tamped in the ordinary manner.

At the present price of steel, the tower weighing 1,500 pounds complete with cross arms and pins, in lots of 500, cost $53 apiece. They are claimed to withstand safely a transverse strain of 3,500 pounds applied at the apex. Locke insulators No. 329, as used, cost approximately $1.50 each; thirty-six insulators at $1.50 and twelve towers at $53 bring the cost of insulators and towers to $690 per mile. The cost of excavating for these towers consists of the following items: First, excavation of four holes 1½ ft. x 3 ft. x 4 ft. deep, the cost of which will vary with the nature of the ground. Second, bolting the towers together. Third, erection of the towers.

"We found that a gang of six Mexicans could assemble three towers in a day. I do not doubt but that one man and three laborers here in the States could assemble four in the same time. In raising the towers one gang of twelve Mexicans with an American foreman frequently put up twelve towers a day. Cables of 19-strand hard-drawn copper about equal to No. 1 B. & S. came from the States on reels, each reel containing about two miles. Every four miles along the line six of these reels were unloaded from the wagon, and the cables strung each way over rollers placed on the cross arms of the towers. Our chief trouble lay with loose strands, due to injury in shipment and improper soldering of the loose ends at the factory. When a loose strand would catch in a roller it would strip from the cable, tangle and soon wedge tight.

"Two to five miles were used to pull each cable. Seven and one-half feet of sag was allowed between towers. In the rough country the slack was pulled up every mile and held with steel guy wires until the next pull could be made. In the level country a two-mile pull gave very good results. On an average, a camp could make four miles a day stringing, pulling up slack and tying in at insulators. Some difficulty was experienced in lifting the middle cable from the cross arm to the top insulator pins on towers situated on the summits of hills. In this case the weight of the cable is considerably greater than one-half the span at each side. All insulator tie wires were of No. 14 B. & S. soft copper, the idea being that the danger of nicking the cables was less with small tie wires, and in case of the cable parting it was better to break four or five tie wires than to loosen the tower. The cables were not transposed the total length of the line, but the telephone wires situated about seven feet below the cross arm were transposed every two towers."

When the voltage was first thrown on the line five or six cracked insulators were located and replaced. These insulator faults were probably due to injury in putting up, or after the line was completed. This would certainly seem a remarkable result considering the length of the line. On one occasion the strain of two cables under line tension was thrown at almost the same instant on the cross arms of a tower, by the breaking of two steel guy wires. The only effect was to twist the cross arm slightly and raise the tower out of the ground about six inches.

Mr. H. H. Wait was chairman of the meeting and many favorable comments were made on the excellence of the discussion for which he had arranged and the way the meeting was conducted, all of the discussions being full of meat and to the point.

New Telephone Patents.

SEMI-AUTOMATIC TELEPHONE SYSTEM.

Now that the telephone density, if it may be so called, is becoming so great that even with the multiple switchboard increased to a capacity far beyond the contemplation of its originators, the number of central offices required is ominously large, many inventors are turning their attention to the problem of attaining a satisfactory telephone switchboard of an ultimate capacity commensurate with the present demands. Divided multiples have been tried and recently there have been developed purely automatic systems arranged for numbers of subscribers approaching ten thousand. Another system has now been brought forward under the name "semi-automatic," this the invention of E. A. Fuller, of New York City. In this system the subscriber's line terminates in answering jack and line lamp at the central office, and is provided with an automatic sender at the outside end. When it is desired to send a call, the subscriber sets his sender to the desired number and starts the call, this being indicated to his operator by the lighting of his line lamp. The operator responds by cord and plug, as is usual with manual boards. She has no listening key, however, but instead a key which when thrown connects a number receiving device to the line and also automatically starts the subscriber's sender. The sender does not complete its signal, but merely records the thousands and hundreds numbers of the desired line upon the receiving device of the answering operator. She, noticing these, selects a trunk to the operator having the desired line, and completes the connection thereto, causing a calling-in lamp to light. This operator responds in a manner similar to the first, except that she receives on her recorder the tens and units digits and may, therefore, complete the desired connection and ring both subscribers. The taking down of a connection proceeds in the reverse direction, the placing of a receiver on the hook controlling lamps at the position of the connection completing operator.

REPEATER.

Under the name "Megaplex Relay," R. A. Engler, of Dubuque, Iowa, has patented a repeating system. The repeater is a multiple affair, each element consisting of an open magnetic circuit induction coil, opposed to one pole of which is an armature. This armature is supported from the diaphragm of a transmitter, which, therefore, is subjected to a vibration corresponding to the currents passing in the induction coil. A series of these units are interconnected, the primary of the first coil being connected to the incoming line, while the primary of the coil of the second unit is in circuit with a battery and the transmitter of the first unit, and so on until the last unit, the transmitter part of which is omitted. The induction coil secondaries are all wired in series and then connected to the outgoing line.

AN ODD TELEPHONE APPARATUS.

An odd telephone apparatus has been patented by M. Beck, of Minneapolis. There are three parts concerned in its working, two substation sets and an intermediate contact-maker and battery. The combined receiver and transmitter is peculiar, as the mouthpiece is of sheet iron so flanged that a recess is provided for an annular coil. The diaphragm is immediately behind the coil, the rearward surface of the flange of the mouthpiece serving as a support for it, while the inner edge of the orifice serves as the receiver pole. Contacting with the diaphragm is an insulating ring wound with bare wire. The contact of the diaphragm with this bare wire coil of high resistance depends upon the convexity of the former. The primary current is carried through this coil of wire, the shunting of its turns by the diaphragm serving to set up the undulating voice currents. The receiver coil and this transmitting contact are in series. An ear tube extends from the rear of the diaphragm for conveying the received sounds to the user. The talking currents are furnished primarily from the intermediate battery, the efficiency of transmission being controlled, it is stated, by the aid of rheostats at the end stations.

A step-by-step selective device and a receiver support are the subjects of the two remaining patents. Of these the former was invented by L. E. Brock, of Celina, Ohio, and the latter by J. A. Brown, of Warren, Ohio. Each includes the features usual with apparatus of their respective kinds.

A NEW SYSTEM OF SUPERVISING SIGNALS.

While in most cases the present standard two-lamp supervisory signal system is amply sufficient, its indications sufficiently informing the operator of the progress of a connection, there is one condition of indefiniteness included in it. The appearance of the signals is exactly the same before the called subscriber answers as it is after either one of the subscribers has, without the other, hung up his receiver; and further, while the first of these demands additional ringing on the part of the operator, the second signifies probably just the opposite, namely, that the subscriber remaining on the lines desires the operator to get him a second subscriber. It may be argued that there is little likelihood of confusion occurring in practice, because the interval of time which would usually occur between this condition of signals. However, that such confusion undoubtedly does arise is best testified to by the fact that a system of signals has been invented to overcome the difficulty. The inventor of this system is E. H. Smythe, of Freeport, Ill., the patent being assigned to the Western Electric Company. The invention lies in providing means for automatically controlling the current supply to the supervisory circuits, so that the lamp glows steadily, or gives flashes at different rates, to signify more positively the exact condition of the connections. The ringing signal is steady; a fast flash is used to indicate "disconnect," being introduced by the simple replacement of the receiver on the hook, while a slow flash is used for a "recalling signal," being introduced by the mere removal of the receiver after once depressing it. The removal of the operator's plug or her "listening-in," restores the circuits to the proper condition for subsequent use.

OFFICE DESK TELEPHONE SET.

Mr. A. R. Ferguson, of New York City, has patented a swinging arm telephone set of rather novel design, in that the plane of swing is vertical. The base is adapted to clamp upon the top of a desk, and it carries on a hinge a straight telescoping tube, upon the end of which is carried the hook switch and transmitter. A perforated ear on the receiver engages a button on the hook switch lever, and thus it hangs in a vertical position irrespective of the angle of the arm with the horizontal. The weight of the receiver is, on the other hand, effective in depressing the hook switch only when the arm is vertical. Therefore, after using the set the arm must be pushed up out of the way. The patent for this arm has been assigned to the Electro-Mechanical Specialty Company, of New York City.

ADJUSTABLE RECEIVER.

In ordinary telephone practice it is not thought necessary to adjust the sensitiveness of the receiver for different users; in fact, the present tendency seems to be toward having no adjustment at all. However, when used to assist the deaf to hear, the sensitiveness of various ears or the different degrees of deafness, render an adjustment at times advisable if not necessary. M. R. Hutchison, of Norwood, N. J., has patented an adjustable receiver for this work, adjustment of the air-gap between diaphragm and pole faces being effected by screwing the cap piece farther or less upon the body. An arbitrary scale of adjustment enables one to reset to the same position at different times, while a friction pin lock prevents any accidental change of adjustment.

HOOK SWITCH ESCUTCHEON PLATE.

The peculiar shape of a hook switch has always rendered it difficult to use other than a two-piece escutcheon plate where it passes through the side of telephone box. This of course renders it necessary to use four screws to secure the plate. A one-piece plate has now been invented and patented by A. C. Christopher, of Chicago. In this plate a slit is cut from the slot to the edge of the escutcheon in a line at right angles to the slot for the lever. By suitably turning and twisting the plate, the lever may be threaded through the slit into the slot, the plate being temporarily distorted to permit of this. The Kellogg Switchboard & Supply Company has obtained the patent for this device, by assignment.

Some New Data on the Edison Storage Battery.

In a very interesting lecture delivered before the New York Electrical Society at the rooms of the American Institute, New York City, on April 27th, on the occasion of the Society's two hundred and forty-second meeting, Mr. R. A. Fliess, who for some years past has been associated with Mr. Edison in the development of the nickel-iron cell, outlined the steps that led up to the discovery of the Edison cell, and then described its gradual development to its present state of perfection.

The various steps that have marked progress in the development of the cell were illustrated by means of lantern slides. Several curves were shown in which are recorded the progress made in the development of the active materials at different periods in the development of the cell; also a number of photographs taken at different times during the past few years by Mr. Fliess, in which vital moments during the period of development are preserved.

Mr. Fliess began by pointing out the great amount of preliminary work that had to be gone through before Mr. Edison had reached the point in his search after a secondary cell such as he desired where he felt justified in beginning operations on a large scale. Mr. Edison set himself the task at the outset of his search after a commercial solution of the light-weight secondary cell that should possess as many as possible of the following desirable features: 1. Absence of deterioration by work. 2. Large storage capacity per unit of mass. 3. Capability of being rapidly charged or discharged. 4. Capability of withstanding careless treatment.

Mr. Fliess pointed out that among his early attempts Mr. Edison made an attempt to develop his well-known Edison-Leclanche primary cell into a commercial secondary cell, and that consequently at an early date Mr. Edison already had under close observation two of the three elements that composed his first solution of the light-weight secondary cell problem, i. e., the copper pole and the alkaline electrolyte. They, in connection with cadmium, comprised his cadmium copper cell—the first of several solutions of the light-weight secondary cell problem reached by Mr. Edison before he hit upon his nickel-iron combination.

The general method of investigation adhered to by Mr. Edison throughout his search for a solution of his problem was described and photographs of the apparatus used were shown. Mr. Edison used little pockets stuffed with the active material he wished to investigate during his early experiments. These were subjected to the oxidizing or reducing action of the electric current and were then discharged against an excess of active material of the opposite kind. By means of an elaborate system of testing Mr. Edison followed very accurately and quickly all improvements made in the ampere-hour and watt-hour capacities of the active materials, and curves were presented that showed at a glance the improvements that were made during the period in which Mr. Edison was attempting to develop the ampere-hour and watt-hour capacities of his nickel and iron elements.

In six months an increase of over 72 per cent. was recorded in the ampere-hour capacity of the nickel and over 83 per cent. in its watt-hour capacity. In another six months a 33 per cent. advance was made in its ampere-hour and a 35 per cent. advance in its watt-hour capacity; or, in other words, in the short space of one year an increase in the ampere-hour capacity of the nickel per gram was made of over 128 per cent., and an increase in its watt-hour capacity of over 148 per cent.

The improvement recorded in the ampere-hour and watt-hour capacities of the iron was equally remarkable. In six months an increase in its ampere-hour capacity of over 40 per cent. was recorded and in its watt-hour capacity of over 48 per cent.; while in another six months an increase of over 70 per cent. in ampere-hour and of over 75 per cent. in watt-hour capacity was made; or, in other words, in the short space of one year an increase of over 139 per cent. was made in its ampere-hour capacity and of over 159 per cent. in its watt-hour capacity.

During the course of this development over 10,000 separate tests were made on little test grids containing samples of iron and nickel and as between 80 and 100 observations had to be made during a single test more than 100,000 observations were made and recorded while the improvements mentioned above were being made. Mr. Fliess mentioned this to give an idea of the enormous amount of detailed work that the development of an invention of any pretentions involves.

It was not until about the first of February, 1902, that Mr. Edison had advanced far enough to make up a large-sized cell with automatic tools. About this time, however, he received at his laboratory in West Orange the first large-sized cell ever made completely with automatic tools. The mechanical parts of this cell had been made at the mechanical works at Glen Ridge, N. J., and the active materials at the chemical plant at Silver Lake, N. J.

This cell was composed of nine nickel and nine iron plates, contained in a steel jar, and covered by a steel cover through which the binding posts protruded. A number of cells soon followed and on the 3d of April, 1902, a little Baker electric vehicle equipped with twenty-one cells started out for a first spin in which an automobile had ever been propelled by power obtained from Edison cells. A picture of the vehicle at the moment of starting was shown.

TABLE I.

Type.	Discharge rate.	Output.
C	30 amperes	229.6 watt hours
C	120 amperes	175.25 watt hours
D	30 amperes	212.2 watt hours
D	120 amperes	191.5 watt hours
E	30 amperes	272.5 watt hours
E	120 amperes	240.6 watt hours

This first type of cell was called the "C" type. It had one or two characteristics that Mr. Edison did not consider desirable, so he soon set out to produce a cell that should not possess the features of the "C" type he wished eliminated. The result was the "D" type cell. The "C" type cell, however, even though Mr. Edison did not approve of it entirely, still showed marked improvement over the light-weight automobile type of lead cell to-day. Mr. Fliess supported his statements by means of curves. The objection Mr. Edison had to his "C" type of cell was that it did not stand up well under high rates of discharge. That is to say, it lost something over 37 per cent. of its normal capacity when discharged at five times its normal rate. A lead cell under similar conditions, however, Mr. Fliess pointed out, loses over 50 per cent. of the capacity it has at its normal rate.

Some "D" type cells were ready about May, 1903, and were at once subjected to a very severe test in automobiles. This cell was composed of fourteen nickel and fourteen iron plates. It occupied the same space as did the "C" cell, but the active plate surface was over 35 per cent. greater, consequently the discharge rate should be much greater. That this was so, the curves that were shown by Mr. Fliess demonstrated very clearly. Instead of the 37 per cent. loss in capacity suffered by the "C" cell at a five times normal discharge rate, it showed but a 10 per cent. loss under similar conditions. This high discharge rate feature had been obtained, tests showed, at the sacrifice of ampere-hour capacity. Consequently, the weight per hp-hour had gone up as compared to that shown by the "C" type cell. Also, Mr. Edison found by experience that the very high discharge capacity of the "D" type cell was seldom called upon in practice. He therefore decided to build a third type of cell in which the great ampere-hour capacity of the "C" type and the high discharge rate capacity of the "D" type should be preserved in just the right proportions. The result was the "E" type cell. This cell is made up with two nickel plates for every iron plate. In external appearance, however, it looks just like the two types it has superseded.

Its electrical properties, however, are a great improvement over the two earlier types, as the preceding table will show.

As the weights of the "C", "D" and "E" types, data from which are recorded in the table are exactly the same, a direct comparison may be made. It will be noticed that the "E" type cell is capable of giving out a greater amount of energy per unit of weight and volume at a 120-amp. rate of discharge than either the "C" or "D" types were able to give out at their normal rates of discharge.

An analysis of the figures just given in the table show the following results in pounds per hp-hour:

TABLE II.

Type.	Discharge rate.	Lbs. per H.P.H.
C	30 amperes	56.87
C	120 amperes	74.48
D	30 amperes	61.6
D	120 amperes	68.25
E	30 amperes	47.75
E	120 amperes	54.25

From the figures in Table II it will be seen that the "E" type cell is very much superior to the two types that preceded it, and would seem amply to justify Mr. Edison in his determination to delay the commercial production of his cell on a large scale until he could complete tools and factory facilities for turning out his "E" type cell in large numbers. These preparations were finally completed some little time ago.

Mr. Fliess then showed curves that illustrated very clearly the remarkable life and endurance that the Edison cell seems to possess. Curves were shown taken from a cell at different periods during the past three years and after three years of knocking about the laboratory, during which time the cell received absolutely no attention or care. The curves showed the cell to be in absolutely the same condition that it was when first tested. Another slide was shown in which curves of the 1st, 350th, 804th and 970th discharges on a little endurance test, kept running night and day at Mr. Edison's laboratory for over a year, were recorded. These curves showed that in this time absolutely no change had taken place in the capacity of the unit or in the shape of its discharge curve. Curves were then shown that had been obtained from a standard "D" type Edison cell just before and just after a 4,000-mile test in an automobile under the most severe conditions that could be imposed upon both the vehicle and the cells. The curves showed that after this severe 4,000-mile test the cell ran, if anything, slightly better than it did when first placed in the automobile; certainly a very refreshing result as compared to those we have been familiar with in the past. Curves were then shown taken from a cell that had traveled over 5,000 miles in an automobile under most severe conditions. The first curve was obtained from the cell before it had ever been put in the vehicle. The second after it had completed its 5,000-mile test. The curves showed that at the end of the test the cell gave over 13 per cent. greater capacity than it had done before it went into the vehicle.

This cell was exhibited with its can removed and the plates appeared to be in identically the same condition as new ones exhibited beside it.

A bottle was shown in which the deposit found in a cell after a 4,000-mile test was preserved. It was so small in amount that no accurate weight could be obtained of it on a scale weighing in ounces. In fact, the deposit amounted to but a few grams in weight, and, as Mr. Fliess pointed out, had probably nearly all been in the bottom of the cell before it ever went into the vehicle.

An interesting discussion followed, in which some criticisms made on the cell were directed chiefly against its great bulk and its high price. Mr. Fliess replied briefly.

CURRENT NEWS AND NOTES.

WIRELESS IN THE WAR.—With regard to the brilliant work of the little steamer *Hai-Mun* off Port Arthur, a cable dispatch from London of April 26 says: "The steamship *Hai-Mun*, on which is the De Forest wireless telegraphy apparatus by means of which dispatches from the seat of war are sent to the London *Times* and the New York *Times*, has gone to Nagasaki to clean up and refit. The *Hai-Mun* had been in continuous service for six weeks."

THE STEAM TURBINE DEFINED.—A local newspaper describing the new Westinghouse turbine plant installed at the works of the Union Metallic Cartridge Company, Bridgeport, Conn., says: "An interesting feature of the equipment is a steel turbine equipment of 3,000 hp. The turbine is a reciprocating engine with a piston rod that extends back and forth instead of in a circle and is the most modern. It is compact and takes up less room than other styles, and is now in use in many of the first-class manufacturing establishments."

A STATE TROLLEY LINE has recently been put in operation at Bismarck, N. D. The State Capitol is a little over a mile from the hotels and depots and it did not pay to operate a trolley line out to it, so that hack charges have been heavy, while on account of limited accommodation in the building many committee rooms have had to be rented in the city. Under these circumstances, which reflect no credit on the locaters and designers of the Capitol, the building is being enlarged and the State itself has equipped and is operating a trolley line with one car, while the exhaust steam from the power plant is to be used in winter for the new wing of the capitol.

AUTOMOBILE PARADE.—A parade of automobiles was given last week in New York City under the auspices of the Automobile Club of America. Over 225 vehicles were in line and double that number were ready, but a heavy rain storm spoiled things considerably, while the slow speed maintained caused many of the big gasoline touring machines to drop out on account of heating up. The line through the parks and drives included 39 foreign vehicles, and there were 8 American electrics. The commercial division traveling outside the Park made a remarkable appearance. There were nearly 80 such vehicles in line, of which no fewer than 59 were electric and 2 were combination electric-gasoline. It was a fine demonstration of electric capabilities in this direction. Mr. J. D. Rainier was marshal of this division, which included several of the service vehicles employed by the New York Edison Company.

IOWA TROLLEY ASSOCIATION.—The Iowa Street & Interurban Railway Association was formed at Des Moines April 21, at a meeting of the representatives of seventeen such companies operating in Iowa, held at the Kirkwood Hotel. The creation of this association is due to the efforts of George B. Hippee, general manager of the Des Moines City Railway. It was at first thought, as already noted in these columns, that the street railway men might join in with the Iowa Electrical Association, which held its regular annual convention in Des Moines at the same time. After a conference between representatives of both, however, it was decided that it would be better to keep the two organizations separate, with the understanding that for the present the conventions of the Iowa Street and Interurban Railway Association and the Iowa Electrical Association shall be held at the same place the same week; and made to overlap one day so that topics of interest to both lighting and railway men can be taken up that day. The officers elected were: George B. Hippee, of Des Moines, president; J. F. Lardner, of Davenport, vice-president, and L. D. Mathes, of Dubuque, secretary and treasurer. The constitution provides that the membership shall consist of companies or individuals operating street or interurban railways in the State of Iowa. The admission fee is $10 and the annual dues are $10.

LETTERS TO THE EDITORS.

Patent Law Reform.

To the Editors of Electrical World and Engineer:

SIRS:—I was much interested in your editorial on "Patent Law Reform" and would suggest an extension to its recommendations, namely, that where a patent is found inoperative, as fully one-half of the patents now in force are, the said patent shall, by the government, be declared invalid; and if a subsequent inventor should embody some of its features in an operative device, he shall be allowed a patent thereon as though the invention were new in all of its details. Many of the inoperative patents now in force are a bar to useful invention. It is true that even now, if one can prove a patent inoperative, it may be annulled, but this is an expense that the majority of inventors cannot afford.

In conclusion, I may call attention to the fact that the State will now pursue a horse thief and try him in court and imprison him at the expense of the State; but if a party pirates an invention, for the patenting of which the inventor has paid all that the government demands, he must, at his own expense, bring suit to secure the right which he is told in his letters patent the government has granted for his money. This seems to me wrong in justice and equity.

Bellefontaine, Ohio. D. F. Tanger.

Our Patent System.

To the Editors of Electrical World and Engineer:

Sirs:—Your impressive editorial on April 16 on "Weak Spots in the Patent System" deplores the absence of any provision of law compelling patents to be worked as a condition of their continuing in force. With your general contention that patents might contribute even more powerfully than at present to the advancement of science and the useful arts, I cordially agree, but nevertheless I am constrained to think that you have mistaken the remedy.

That a patent has not been worked does not mean that the public gets no advantage from it. It enters into the art as really for the purposes of disclosure of the idea, of barring the way to a future patent, of limiting the claims of future patents, as though it were actually in practice in every workshop in the land. It is thus a stepping-stone to future advances. Again, a patent forfeited for non-user would just as effectually bar the way to another patent for the same invention as though it were in full force, and your suggestion that an unworked patent is sufficiently in the way to hinder material improvements or make it difficult to get proper claims or even claims sufficient actually to protect the new invention, ignores the principles that a prior publication as well as a patent is equally a bar to another patent upon the same subject matter, and so is an expired or invalid patent.

Returning to the remedy proposed, the compulsory working of patents within one, two or three years after they are granted, it must not be forgotten that the requirement cannot be applied to large classes of patents and those for the most important inventions.

A patent for a torpedo boat, a large gun or its projectile, an armor plate, a submarine cable, a railway construction or for the Parsons turbine could not be worked without an expenditure that would ruin most inventors. The Elmore process for recovering gold was worked on a commercial scale only by the expenditure of 50,000 pounds sterling. The Bessemer process was delayed for some time after the invention and could not have been worked for less than a ruinous sum to the inventor.

Only the trifles can be brought before the public by a compulsory requirement for working. Other inventions of importance at first are displaced and superseded by a later invention, as the making of aluminum by the aid of sodium was displaced by the introduction of the electrolytic process, yet to require the owners of the chemical patent to proceed with working on a commercial scale or forfeit their patent altogether would be a manifest injustice, for the patent was nevertheless valuable as a stepping-stone in the art to further inventions in the same direction.

This is not a new proposal, but has been repeatedly before Congresses and Parliaments with the result that the laws of England and the United States, the two greatest manufacturing countries in the world, contain no such provision.

At the Congress of the International Association for the Protection of Industrial Property, held in Vienna in 1897, it was unanimously resolved that it would in future be necessary to give up the principle of compulsory working; and where not altogether given up it has been unanimously agreed, for example, by the International Convention that the working of an invention in one State ought to be the equivalent of working in all; and in the countries of continental Europe adhering to this principle, there is a notable disposition to relax the requirement, and the whole trend of continental opinion is now adverse to compulsory working.

Germany, Switzerland and Italy have entered into an arrangement such that if an invention is worked in any one of these countries it is deemed to be worked in all.

But the fullest discussion arose in England two years ago, when the Manchester Chamber of Commerce, under the stimulus of the analine dye interests, pressed upon the Board of Trade the compulsory working feature as a provision to be inserted in the revised English patent law.

It is well known that England that year adopted the examination system for the grant of patents, and as the revision of her law was thoroughgoing this question of the compulsory working of patents was strongly urged and well considered.

The discussion eliminated many erroneous impressions and compulsory working was not only not adopted, but the body of opinion was strongly against it, and I believe unanimously against it, both in the Board of Trade and in the Parliamentary Committee.

One of the objections to a compulsory working clause in the patent laws is foreshadowed in your editorial—that it is difficult to determine to what extent and in what way a patent must be worked to satisfy the requirements of the law, and the owners of a patent can never know with certainty whether their patent is valid or not after the period for correcting their mistakes in this regard has passed. Men are thus dissuaded from risking capital in the invention on account of a new danger confronting them from this requirement.

Again, the inventor may not have the experience and practical capacity to work his patents even if he has the funds, for some of the most meritorious inventions have been made by people unfamiliar with the art.

The great advantage to a country of having as in America thousands of gifted men at work to improve the arts, machines, processes and compositions of matter which make up the world of the industrial arts is a resource and asset of the country that is too little prized.

Their reward is the exclusive use of their inventions and discoveries for the limited term of seventeen years upon the condition that they will fully disclose to the public all that appertains to them, and that the public may freely use them after the limited term has expired. The wisest policy is to give the patentee the best patent possible under the circumstances of his case divested of every embarrassment to enlisting capital in the undertaking and with every doubt upon his patent removed that the most competent administration of the patent system can remove.

Indeed, a serious complaint against any patent system is the fact that the seal of the government cannot be final as regards the question of novelty and patentability, because no country can tolerate the grant of a patent for what is already in the possession of the public. It must ever remain, therefore, a judicial question whether a patent once issued is in reality for that which is new and patentable or whether it was already within the knowledge of the public by former disclosures or by prior use, and to add this new danger to capital embarking on untried seas is to forbid and not to encourage the evolution and growth of the useful arts.

There are improvements in the issue of patents that are entirely within the scope of immediate useful reform. Both are in the process of development at the present time in our system. The collection and the classification of all material in print relative to the industrial arts is the requirement of the law as it stands, not only in this country, but in others. The practical realization is not yet fully reduced to fact in any country, not even in our own.

Yet great progress has been made and is now making and we may fairly anticipate that in reasonable further time every application for a new invention or discovery will be compared with everything that is in print upon the same subject matter—with the 2,000,000 patents in the aggregate granted in all civilized countries, with the scientific books, with the printed disclosures in the technical press and in other publications, and so grouped and classified that the examiner passing upon the new application as well as the applicant himself may expeditiously turn to that part of this matter which pertains to his invention and make the comparison himself.

It could, therefore, rarely happen that a patent would be wrongfully withheld, but in the absence of a direct interest opposing the patent some would issue that ought not. But with the record showing what was cited against it, the evils pertaining to the issue of invalid patents would be reduced to a minimum.

Second, the requirement of the Patent Office that inventions should be dismembered and split up into numerous applications and finally numerous patents upon related parts of the invention because they are capable of separate use, will ultimately pass away and should pass away.

The Supreme Court of the United States in the recent case of United States ex rel. Steinmetz against the Commissioner of Patents, decided February 23, 1904, cleared away a vast accumulation of error. It was there held that the statute gives the right to join inventions in one application in cases where the inventions are related, and that it cannot be denied by hard and fixed rule which prevents such joinder in all cases.

It may, therefore, be regarded as the settled policy of the law as interpreted by the highest court in the land that the applicant has rights in this matter of division and may come before the office with all that he has invented at one time concerning the same subject matter, and if the elements are related and co-operate, he may include them in one patent. What harm? None whatsoever. It is the desire of the applicant to have his subject matter in one patent. It is for the benefit of the public that it should be so, thus exhibiting to the world these various elements in their proper relation. The public are also freed from the embarrassment of having one element owned by one interest and another by another and perhaps conflicting interest.

Finally, there is a direct remedy for most of the evils which compulsory working is intended to eliminate, and that is a provision, not found in our law, for compulsory licenses. This has been a feature of the English law and in the revision two years ago simpler, quicker and cheaper procedure was provided to meet all cases where the inventor allowed his patent to slumber, either for justifiable reasons or because the patent had passed into hands that were interested in smothering it.

Any person interested may present a petition to the Board of Trade alleging that the reasonable requirements of the public with respect to a patented invention have not been satisfied and praying for the grant of a compulsory license or in the alternative for the revocation of the patent. If it is proved that the reasonable requirements of the public have not been satisfied, the patentee may be ordered to grant a license, or if the reasonable requirements of the public will not be satisfied by the grant of a license the patent may be revoked after three years from its date, unless the patentee gives satisfactory reasons for his default. And if it is proved that the patent is worked or the patented article is manufactured exclusively or mainly outside of the United Kingdom then also unless the patentee can show that the reasonable requirements of the public have been satisfied, an order will be entered for a compulsory license or for the revocation of the patent.

And the reasonable requirements of the public are defined to be that existing industries or new industries shall not be unfairly prejudiced and that the demand for the patented article is reasonably met.

These are the directions in which improvement may be found—perfect searches upon the question of novelty, a high degree of probability for the validity of the patent once issued, and second, the dangers of mutilation by the issue of several patents at successive times for the same invention, absolutely removed by abandoning the compulsory division of applications except where to grant one patent for the whole subject matter would be invalid by reason of the inclusion of distinct and unrelated subjects of invention.

New York. John S. Seymour.

Molecular Conductivities.

To the Editors of Electrical World and Engineer:

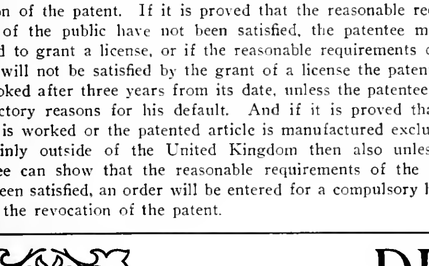
Sirs:—I would like to call your attention to the fact that in your editorial on page 719 of the issue of April 16 you have misquoted and misunderstood my paper on "Molecular Conductivity." If you had carefully read the paper and understood it, you would have found your criticism unnecessary. I was very particular to state exactly what I meant in the paper, which was "that all theoretical deductions based on investigations of molecular conductivities of different degrees of dilution have no physical significance." In your editorial you make me say "all theoretical deductions, based on investigations of molecular conductivities have no physical significance," omitting the very important words which distinguish my statement from yours. If you will take the trouble to examine my statement in connection with the facts, you will find it is absolutely correct.

Philadelphia, Pa. C. J. Reed.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Transformers.—Loewy.—In a continuation of his serial on recent progress in the design of electric machines he discusses advances made in transformer construction. Besides various new constructions of the General Electric Company and the Westinghouse Company, the following European designs are described: Fig. 1 shows



FIGS. 1 AND 2.—TRANSFORMER DIAGRAMS.

a three-phase transformer of the Schwarzkopff Company, in which the windings are so arranged that the magnetic circuits produced by the different phases do not influence each other so that an overload in one phase does not react upon the others. The transformer consists of a rectangular iron frame, *a*, with two iron cross-connections, *c*, parallel to the small sides, *b*. Each primary and secondary phase has two windings arranged opposite each other, as shown in the diagram. A similar transformer for two-phase currents, built by the Union Electric Company, is shown in Fig. 2. It has three iron cores, *a*, *b*, *c*. The winding of one phase is placed one-half on *a* and one-half on *c* in such a way that the current flowing through them has either the direction indicated by the arrows or the opposite direction. The winding of the second phase is placed on core *b*. It will be seen that those lines of force which are produced in *a* and *c* by the first phase and pass through the core, *b*, act against each other in *b* so that here only the flux produced by the second phase is effective. In the same way it may be seen that the second phase does not act upon the first phase. A single-phase transformer of the Thomson-Houston Company is shown in Fig. 3 for supplying two separate secondary networks or a secondary three-wire network in such a way that for any load in the secondary network the secondary voltages remain constant. The transformer consists of an iron frame, *C*, on the two long side arms of which the two parts, *Px* and *Py*, of the primary winding are placed. These two parts are in parallel with the circuit, 1, 2, and are so connected that the current flowing through them produces a magnetic flux closed in the iron frame as indicated by the arrows. The two secondary windings are arranged concentrically with the primary windings, *Px* and *Py*. If the load in one of the two secondary windings increases, then this winding will counteract its primary winding with greater force; that is, it will diminish the strength of the magnetic flux so that the counter e.m.f. of the primary windings decreases. For this reason the network will now send more current into this primary winding, so that the strength of the flux, common to the two secondary windings, is maintained. On account of this automatic regulation, the voltage in the secondary windings is maintained constant.—*Zeit. f. Elek.* (Vienna), April 17.

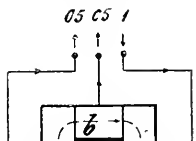


FIG. 3.—WINDING OF SINGLE-PHASE TRANSFORMER.

Electric Resistances of Bearings.—Dettmar.—A communication referring to the recent letter of Zorawski and the former tests of Kennelly (see page 231, Electrical World and Engineer, February 7.

1903). He has twice made a series of measurements of the resistance of bearings of electric machines and has always obtained results which did not agree at all with each other. While he tested the friction coefficient of various lubricating oils, he found that this coefficient decreases with increasing speed of the machines, and increases again afterwards. The minimum point of friction corresponds to the moment when a continuous layer of oil has been formed. When the machine is at rest, this layer of oil is broken at the bottom. He tried to determine the same minimum point by resistance measurements, but could not get any consistent results, since the values of the resistances varied greatly. An investigation whether the sort of oil used had any influence did not yield any conclusive results, since no exact relations could be obtained. He sums up his experience in the statement that the electric resistance of the bearing may be very high in operation under special circumstances, but is generally very low.—*Elek. Zeit.*, April 14.

REFERENCES.

Equipotential Connections.—Müller.—The first part of an article in which he says that of the various means for counteracting the formation of sparks at the commutator, so-called equipotential connections have recently attained a greater importance. There are connections between points which should be at equal potential if the symmetry was complete. In case of dissymmetrical distribution of the magnetic field or of a non-uniform load in the different armature circuit, due to non-uniform transition resistances of the brushes, currents will flow in these equipotential connections so that the strain is taken from the brushes and the formation of sparks and overheating is prevented. The author gives a mathematical theory of the calculation of such equipotential connections in a special case.—*Zeit. f. Elek.* (Vienna), April 17.

Diagram of Alternators.—Niethammer.—With reference to Behrend's article on an experimental basis for the theory of the regulation of alternators, the author gives a description of a general three-phase diagram which he has used successfully for determining the regulation and other characteristic properties of the alternating-current machinery made by the Union Electric Company. Since the article consists only of diagrams and formulas it cannot be abstracted. —Lond. *Elec.*, April 15.

Surging of Alternators Connected in Parallel.—Sommerfeld.—The conclusion of his theoretical article. He gives the integration of his pendulum equation and considers the phenomena of resonance and interference. He then gives a numerical example and finally takes into account those points which he has neglected in his former more approximate calculations.—*Elek. Zeit.*, April 14.

France.—Liouville.—A statistical article on the import and export of dynamo-electric machines in France in recent years.—*L'Ind. Elec.*, April 10.

Lights and Lighting.

REFERENCE.

Differential Arc Lamp.—Von Zudnochowski.—A mathematical article on the behavior of movable cylindrical iron cores in double solenoids, with applications of the results to the theory of the differential arc lamp.—*Phys. Zeit.*, April 15.

Power.

Utilization of Peat and Lignite.—Wotherspoon.—An account of recent advances, made especially in Germany, in the utilization of the calorific value of peat and lignite. The output in 1902 of briquettes made from lignite in Germany was 12,438,000 metric tons; most of this fuel was consumed in the larger cities of Europe. The wholesale selling price of the briquettes in the larger German cities is between $2.10 and $2.25 per metric ton. The brown coal of Alabama has been briquetted by this process quite successfully and has been declared by the German experts to be superior to the best product from their own mines. It is also stated that remarkable advances have been made in Germany in the manufacture of fuel from peat by means of special mechanical processes. Fuel bricks are clean to handle and practically smokeless and have a calorific value between 8,500 and 10,000 B.T.U. per pound, while the thermal value of American bogs is said to range between 9,000 and 14,000 B.T.U. when bone-dry.—*Eng'ing & Min. Jour.*, April 7.

Electric Lifts for Blast Furnace Plants.—Schiebler.—An illustrated article on electric lifts for blast furnaces. With direct-current supply two motors with series parallel control are now generally used. The motors are compound-wound, the series winding giving a high proportion of the total field, so that at no load the speed is about 75 to 100 per cent. higher than at full load. A capacity of 120 to 140 hp is now often required for lifting ores. The author describes electric lifts built by two German companies. An automatic interrupter is provided for breaking the current at the end of the lift to prevent accidents in case of lack of attendance by the engineer, and this is done by means of a switch which does not interrupt directly the main current, but operates a relay circuit in which a small current flows. The latter passes through the magnet coils of a high-current switch, on the armature of which the high-current contacts are mounted. Since the armature is attracted instantaneously and also drops off instantaneously on account of its weight, switching is instantaneous. The lift for blast furnaces is mostly built with an inclined road, but a vertical lift is also described which is used as reserve. It is operated by a single motor. Since its capacity is 140 hp, the controller does not act directly upon the main current, but regulates small relay currents.—*Stahl und Eisen*, April 15.

REFERENCES.

Turbo-Generator.—An article giving the results of tests of a 900-kw turbo-generator recently installed in a German mine. The steam turbine is built by Brown, Boveri & Co., and is direct-connected to a 325-amp., 2,000-volt, three-phase dynamo with a power factor of 0.8 and a frequency of 50, and to a 110-volt, 105-amp. exciter. The number of revolutions is 1,500—*Glückauf*, April 16.

Mining Locomotive.—Perkins.—An illustrated article on the development of the electric mining locomotive.—*Sc. Am. Sup.*, April 23, 30.

Traction.

High-Speed Railways.—Peterson.—The first part of an article on the importance of the road construction for high-speed electric railways. The success of the experimental Zossen line of the German Studiengesellschaft has shown that to get a speed of 200 km. per hour with one car, a power consumption of 1,600 hp is sufficient. This shows that the pure cost of current remains within a limit which renders the financial success of such a road possible. However, the idea of sending single cars at short intervals over such a road, appears impossible on account of the prohibitive cost, since the consumption of 1,600 hp for a car of about 100 tons of weight, could not be covered by the receipts from about 80 passengers. If, however, a train of about 5 cars is used, the author estimates that 400 passengers, with a weight of train of about 250 tons, could be carried at a speed of 200 km. per hour with a power consumption of about 2,400 hp. In this case the current per passenger would be only three-tenths of that with single car operation. He thinks it would be preferable to make each car a motor car. In case the length of the train varies it would, then, however, be impossible to maintain the speed of the trains absolutely the same. While Reichel's arrangement of the three trolley wires, one above the other, has been shown to be an engineering success, he considers the great height to be a disadvantage. At street crossings the railway road would have to be carried above the streets. The whole construction of the road would be expensive. The most difficult question is, however, whether the construction of the track will be satisfactory for speeds of 200 km per hour. The results so far obtained on the Zossen road do not allow any decisive answer to this question. The problem is not whether the position of the rails is changed by a relatively small number of high-speed runs, but the real question is whether the road can be maintained continually in satisfactory condition without extravagant expense. He points out that for the Langen suspended railroad (as used in Elberfeld) the claim is made that the road is far superior to ordinary railway roads with regard to safety, to the possible speed and to the cost of maintenance. He estimates that with the ordinary track construction for a speed of 200 km. per hour, the smallest allowable radius of curve of the road would be between 2,500 and 1,600 meters. This seems to make the construction of such a road impossible within built-up districts. For a suspended road this condition does not exist. The article is to be continued.—*Elek. Bahnen.*, April, No. 8.

Storage Battery Traction.—Pallitsch.—A description of a storage battery car used on the suburban railroads of Dresden, Germany. The car has a capacity for 98 passengers and is provided with a battery of 184 double cells, each double cell having a capacity of 430 amp.-hours at a discharge rate of 140 amp. The average discharge voltage is 365. The cells are charged from a station connected to the Dresden tramway system, by connecting the cells in series, at an average of 480 volts. In order to charge the cells from a 120-volt circuit, the cells are connected in 4 parallel groups. The car is provided with four 360-volt, 27-hp series motors. The car weighs, without passengers, 44,000 kg. The speed is 45 km. per hour.—*Elek. Bahnen.*, April, No. 8.

REFERENCES.

Far East.—An article on electric railway development in the Far East. In spite of the large population there are now only six electric railways in operation outside of those in Japan. From a financial standpoint, the roads have been satisfactory, although the track mileage is very much smaller than that for cities of similar population in either Europe or America.—*St. R'y Jour.*, April 23.

Single-Phase Trolley.—Detailed descriptions of the method devised by the Oerlikon Company for collecting the current by means of a trolley from an overhead wire at the side of the road, for use on single-phase railways. The method has already been referred to in the Digest.—*Elek. Zeit.*, April 14; *St. R'y Jour.*, April 23.

Adjusting Car Resistances.—GOUGH.—A description of a practical method of adjusting the resistances of a K-10 controller, so that in going from one step to another the differences in the resistances will not be great enough to cause any violent shocks in car movement.—*St. R'y Jour.*, April 23.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCE.

Electricity on Board Ship.—LEBOND.—A continuation of his serial. In the present installment he discusses the installation of electric searchlights on battleships.—*L'Ind. Elec.*, April 10.

WIRES, WIRING AND CONDUITS.

Eddy Currents in Cable Sheaths.—FIELD.—The first part of a paper read before the (British) Institute of Electrical Engineers. Single-core cables designed for carrying alternating currents of any magnitude cannot be laid in separate iron pipes, owing to the strong alternating magnetic field which will be created in the mass of the pipe by the current and the hysteresis and eddy current losses consequent thereon. On the other hand, it is considered quite permissible to lay concentric or three-core cables (for three-phase currents) in iron pipes or troughs, for wherever there is included in the same cable both the "go" and the "return" conductors so that at every instant the algebraic sum of the currents within the pipe or trough flowing in either direction is zero, there cannot be any closed magnetic lines entirely surrounding that cable created by the currents within it. However, it would be wrong to believe that there is no external magnetic field produced by a three-phase current in a three-core cable; indeed, a very considerable field may exist giving rise to telephonic disturbances in neighboring circuits, eddy currents in the lead sheath or the iron pipe itself, and even earth currents. Similarly, if the "inner" so-called concentric cable be not truly concentric with the "outer," an external field will result, while if several concentric or three-core cables be connected in parallel at both ends, and for any reason the resistance of one conductor be unduly increased (e. g., through a bad connection), so that the algebraic sum of the currents included in this cable is not zero, not only will an external field exist, but there will be magnetic lines entirely surrounding the cable in question giving rise to losses if laid in an iron pipe. The author considers the external fields produced near single, concentric, three-core cables and the like, and investigates the losses occasioned thereby. In the special case of two lead-sheathed cables whose centers are separated by a distance of 12 in., the mean radius of sheath in each case being 0.587 in., he finds for a frequency of 60 and an effective current of 200 amp. that the mean effective e.m.f. in the sheath in volts per mile will be approximately 73 volts. Taking the cross-section of the sheath as equal to 0.46 sq. in., and the specific resistance of lead at 21 michrom, the sheath current will be 64.5 amp., representing a loss of 4.7 kw per mile length of cable. The paper is to be continued.—Lond. *Elec.*, April 15.

REFERENCES.

Calculating Networks.—MÜLLENDORFF.—The first part of a mathematical article on the rational calculation of distributing networks. The author starts from the case that a consumer is to be connected to one of two stations. In order to get a minimum of copper that station will be selected which is nearest to the consumer. If, however, there are other consumers between the two stations, the choice depends upon certain considerations. The author develops them mathematically and shows that before a distributing network can be calculated it is necessary to choose the position of the central station, and that this position must be taken into consideration when the different consumers are to be assigned to the various feeding points. After the position of the central station has been determined, it is possible to assign to each feeding point a certain district of action, so that all consumers within this district can be supplied more economically from this feeding point than from any other. He gives a method for calculating the network, so that the copper becomes a minimum. The article is to be concluded.—*Elek. Zeit.*, April 14.

Calculating Networks.—VERHÖCKX.—The first part of a highly mathematical article in which the author develops a method for the solution of the series of linear equations, to be solved in the calculation of closed network. It permits to proceed readily as well by analysis as by a purely graphical method. Another advantage claimed for this method is that it gives directly a general solution of the system of equations.—*L'Eclairoge Elec.*, April 16.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetic Effect of Electric Convection.—SUTHERLAND.—An article pointing out that by the co-operation of Cremieu and Pender practically the whole of the difficulty in reconciling the apparently contradictory results obtained by various investigators concerning the magnetic effects of electric convection, has been traced to the one fact that Cremieu covered his metallic electrified surfaces with a solid dielectric. A solid dielectric rotating with a charged metallic disc reduces the magnetic effect considerably, so as in some experiments to make it appear to vanish. He refers to some theoretical investigations concerning electrolysis and shows that in ordinary electrostatics the displacement of the ether is not taken into account. It seems that the magnetic effect of electric convection is due to the slip between electricity and ether, and not to the relative motion of electricity and motor ether, although further experiments must be made in this direction.—*Phil. Mag.*, April.

Differential Method of Observing N-Rays.—MACE DE LEPINAY.—A description of a contrast method, by means of which a number of people who could not observe N-ray effects before have now been enabled to confirm them. The method is based upon Blondlot's observation that the impact of N-rays changes the distribution of the radiation from a sulphide screen, increasing it in a direction normal to the surface and diminishing it in a direction tangential to the surface. The author mounts two strips of sulphide close together, one of them being a narrow line 2 mm. thick, and the other a strip 25 cm. long, but inclined at an angle of 1° to the line of vision, so as to appear about the same thickness as the former. The two strips are mounted in such a manner that they appear to form the figure 7, the oblique branch being viewed normally. The strip viewed tangentially is made somewhat more luminous than the other, so that the two strips appear equally bright under normal conditions. If now they are simultaneously exposed to a source of N-rays, such as a sounding body, the strip viewed normally is seen to shine out, while the other darkens, and sometimes disappears altogether. It is possible, and even advantageous, to employ a luminosity much greater than that ordinarily used in N-ray experiments. The surface viewed tangentially must have a very fine grain. The best way of mounting the sulphide powder is to fix it by means of collodion or a rubber solution on a copper plate slightly roughened by an electrolytic deposit. Radiation from one surface to the other must be intercepted by means of a lead screen.—*Comptes Rendus*, March 28; Lond *Elec.*, April 15.

Dielectric Capacity of Atoms.—SUTHERLAND.—A theoretical paper in which he calculates the dielectric capacity of the ions on the basis of a theory formerly developed by him and by means of the mobilities of the ions, determined experimentally by Kohlrausch. He finds the law that the dielectric capacity of an atom is directly proportional to the valency and inversely proportional to the square root of the volume of the atom. The ionic velocity is then directly proportional to the square root of the radius. This explains the old paradox of ionic velocities. Hitherto it has been assumed that the ionic velocities have been measured by the same driving force for all ions. The result that a large ion like that of K travels faster than a small one, like that of Li under the same driving force in the resisting medium, seems puzzling, until, in taking account of the dielectric capacity of the atom, it is seen that the driving forces assumed equal are in reality not so at all.—*Phil. Mag.*, April.

Disintegration of Platinum Metals at High Temperatures.—HOLBORN AND AUSTIN.—An account of an investigation of the disintegration of platinum metals in different gases. Their results have a practical bearing on high temperature work in general. Platinum heating coils when brought too near the melting point of the metal are rapidly destroyed, and the case is still worse with iridium, which otherwise on account of its high melting point would be particularly suited for use in producing high temperatures. Some of their results indicate means by which the platinum metals may be protected from disintegration.—*Phil. Mag.*, April.

ELECTRO-CHEMISTRY AND BATTERIES.

Applications of Electricity to Metallurgy.—RICHARDS.—A lecture considering the mechanical, thermal and electrolytic applications of electricity to metallurgy. In the first class are the electromagnetic and electrostatic processes for dressing and concentrating ores. The thermal methods use the electric furnace, the chief features of which are first that heat can be generated up to 3,500° C., which is at least 1,500° higher than can be obtained in fuel-fed furnaces; secondly, the heat is applied internally in such close contact with the material to be heated that the efficiency is much higher than with the ordinary forms of heating. Electric heating will in general cost less if coal costs per ton over one-half of the price paid per electric hp-hour, without considering any other advantages of electric heating. The general principle on which Hall's aluminum process is based, is thought to be applicable for application to the reduction of many other metallic oxides; it is to dissolve the oxide in a solvent which is electrically more stable than the oxide.—*Technology Quarterly*, March.

Manufacture of Iron and Steel in the Electric Furnace.—NEUBURGER.—A review of the process of Stassano, Heroult and Keller. The opinion of Goldschmidt is quoted that the electric manufacture of special steels may compete in Germany with the ordinary method of making crucible steels. Gin is quoted as considering the following arrangement to be of nearly ideal perfection: it is the combination of the ordinary blast furnace for making pig iron, of the Bessemer converter for making the cheaper grades of steel and of an electric furnace for making fine steels, the electrical energy being obtained from generators coupled to gas engines which are operated by the waste gases from the blast furnace.—*Dingler's Polytech. Jour.*, April 2 and 9.

Ozonizer.—ELWORTHY.—A description of his ozonizer, which differs from the Siemens & Halske ozonizer in so far as the low temperature required for getting a sufficient yield of ozone is not produced by water cooling but by passing the air through the ozonizer at a high speed; the air is passed twice through a field of silent discharges. The apparatus is illustrated and the yield of ozone is said to be 60 to 70 grams per kw-hour, the concentration being 0.4 to 0.5 gram of ozone per cubic meter of the mixture of air and ozone.—*Elektrochem. Zeit.*, April.

Primary Cell.—BOUSFIELD.—A Faraday Society paper on a cell which consists of a central porous pot with nitric acid and a carbon pole, and of an outer vessel containing sodium hydrate solution and a metal pole, preferably of zinc. The best results are obtained with nitric acid with maximum conductivity—31 per cent. solution—and a sodium hydrate of maximum conductivity or of a strength slightly below this—a solution from 12 to 50 per cent. The e.m.f. is 2.6 volts at open circuit and as a special advantage of the cell it is claimed that it may be short-circuited far longer than most cells before it runs down. Various other metals, as substitute for zinc, and other acids, as substitutes for nitric acid, were also tested.—Lond. *Elec.*, April 15.

REFERENCES.

Electrolytic Rectifiers.—BURGESS.—A complete reprint of his paper on electrolytic rectifiers for charging storage batteries with alternating currents.—*Sc. Am. Sup.*, April 30.

Non-Aqueous Solutions.—DUTOIT.—A summary of our present knowledge of the electric conductivity, dissociation and other properties of electrolytes in solvents other than water, with an appendix giving a long list of papers on this subject.—*Jour. de Chimie Phys.*, February.

Ozone.—ERLWEIN.—The first part of an illustrated article on the Siemens & Halske system for producing ozone from air by silent discharges and utilizing the ozone for the sterilization of water. The application of the system in connection with German water works is described.—*Sc. Am. Sup.*, April 30.

Primary Cell.—HEINTZ.—An illustrated description of a primary cell in which the depolarizer may be regenerated when it is used up. For this purpose about one-eighth of the depolarizer is removed and a regenerating solution is added. No further details are given except the statement that the electrodes are zinc and carbon.—*Elektrochem. Zeit.*, April.

Determination of Latent Heats of Fusion.—GLASER.—A description of a calorimeter with an electric furnace for determining the specific heats of solid and fluid substances at temperatures up to 1,100° C. The author has used it for measuring the specific heats of lead, zinc, aluminum, copper and tin, and for determining the latent heat of fusion of these metals.—*Metallurgie*, March 22 and April 8.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Localization of Faults on Low-Tension Networks.—GROVES.—An illustrated paper read before the Birmingham Section of the (British) Institute of Electrical Engineers. His remarks refer particularly to a three-wire, low-tension network, with a neutral earthed at the generating station or sub-station through a resistance of two ohms. The more closely a network is "netted" the more troublesome it is to localize faults and from this point of view it is very desirable that each feeder should have its own defined network and be only linked to other similar networks where necessary for balancing and equalizing purposes. He considers it desirable, in addition to the feeder fuses in the station, to fuse at all points where it is found advisable to effect a function between the networks supplied by different feeders, and generally at these points only. The obvious danger of connecting two or more feeders through a distributor without fusing is that in the event of a short-circuit or bad fault, the faulty feeder fuse in the station may blow, and the "short" be fed through a small distributor of sufficient resistance to prevent another heavy feeder fuse from blowing immediately, but carrying enough current to overheat it and destroy it. The fuses at the interconnecting points can be comparatively light, because, if the system is properly arranged, the balancing currents will be small. During summer it is usually no disadvantage to work with many of the linking points

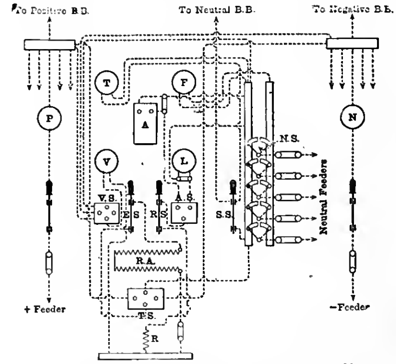


FIG. 4.—DIAGRAM OF TESTING APPARATUS.

open, which provides an excellent opportunity for overhauling the various networks. The neutrals, at points where fuses are inserted on the outers, will, of course be connected up solid. By the use of interchangeable blocks it is possible to fuse any line which may become an object of suspicion. The author describes the following tests which he has found convenient: *a*, observance of reading of recording ammeter permanently connecting the neutral to earth through a low resistance; *b*, join insulation test by Russel's method; *c*, checking polarity of fault by observance of feeder ammeter when "flashed"; *d*, detection of faulty feeder by "flashing"; *e*, partial localization by means of "transferring"; *f*, location by disconnection by shortest length. While these tests fail to indicate the exact position of the fault, final localization may be made by means of an interrupter and induction coil. Various methods of connecting the interrupter are illustrated by diagrams. Concerning Russel's test he says that this is most convenient for a rapid and frequent test. The formula is: $F = (V_2/c) - R$. In Fig. 4 R is the resistance in series with the recording ammeter, A (say 2 ohms), so that the test resolves itself into the reading of c on the ammeter, L, in series with or substituted for A at the time of testing and a momentary opening of the switch, RS, to read V_2 on the voltmeter, V. For moderately high resistances the value of R may be ignored. V should theoretically be of infinite resistance—i. e., electrostatic—but the results of this test are quite sufficiently accurate if any high-resistance voltmeter is taken. The author has experimented with a combined instrument which, if satisfactory, would replace V and L on the panel. The object of this instrument is to read F directly on an ohm scale when RS is momentarily opened. If the recording ammeter fails to notify any leakage and the test indicates that the insulation is "down," it is fairly safe to assume that the neutral is at fault, although occasionally a balance may occur.—Lond. *Elec.*, April 15.

REFERENCE.

Thermostat.—DARWIN.—A description, with detailed drawings, of an electric thermostat which was designed and first constructed as an adjunct to the spectrograph of the 24-in. refractor of the Royal Observatory at the Cape of Good Hope, the object being to maintain the prisms and other parts as accurately as possible at a constant temperature, day and night, over a considerble period. Two heating coils in oil are provided and a test of resistances is arranged like a Wheatstone bridge. Through its deviation from balance and the consequent deflections of a galvanometer the supply of current for the heating coils is controlled.—*Phil. Mag.*, April.

New Books.

VORLESUNGEN ÜBER TECHNISCHE MECHANIK. By Dr. Aug. Foppl. Leipzig: B. G. Teubner. 471 pages, 176 illustrations. Price, 10 marks.

The fact that the "Vorlesungen über Technische Mechanik" has passed through a complete edition within three years is a strong endorsement of its value. It is the second volume in a series of books upon technical mechanics adopted by the Hochschule in München, and, as its name indicates, is devoted to an exposition of the graphical methods of determining static strains. There are two methods adopted in works upon this subject. One deals with the matter entirely from the theoretical standpoint, which assumes forces acting upon bodies which may or may not, as the case may be, correspond to those which are met with in practice. The other method consists in taking existing structures and analyzing them to determine the relation between the forces and the structures.

Naturally, the present volume has adopted, according to the German fashion, the first method. It discusses at length the various theorems of the stresses produced in theoretical bodies by the application of hypothetic forces, and deals very little with the actual practice as encountered by the engineer in his every-day experience. To some this may appear something of a defect, but on the other hand the volume is replete with theoretical research. It contains numerous well-selected diagrams, which, if carefully analyzed and judiciously applied, will be a material aid to the engineer. As its name indicates, little symbolic analysis is used, but graphical methods are employed for everything so far as it is possible. Considerable attention has been given to the stresses in domes and similar roof structures, and an interesting graphical analysis is given of the stresses in an ordinary railway rail. Cranes and hoisting structures come in for a share of attention, but one misses many of the familiar bridge designs which are often seen in this country. Presumably the reader is expected to extend the principle's of the analyses given, to structures which do not receive specific illustrations.

STEAM BOILERS, THEIR THEORY AND DESIGN. By H. De B. Parsons. New York: Longmans, Green & Co. 375 pages, 155 illustrations.

In the preface to "Steam Boilers," Mr. Parsons states that it would be "almost impossible to write a work on the subject which could be considered original." In so far as the exhibition of data, which is new and unfamiliar, is concerned, the author is probably correct, but he has certainly produced a volume which is decidedly different from, and in many respects can make claim to originality over, previous text-books upon the subject. The preface further states that the volume comprises in book form a series of lectures delivered to the Senior Class of the Rensselaer Polytechnic Institute, and the students are certainly to be congratulated upon having their intellectual aliment present in so compact and consise a form, for it is rare to find a scientific text-book in which there is so little that is superfluous. In some respects there is apparently too much condensation, for unless one is prepared either by the perusal of previous treatises upon boilers, or has had considerable practical experience in steam engineering, there is much that might be incomprehensible.

The four opening chapters deal respectively with the physical properties of matter, such as the differences between liquids and gases, and the equations which govern the changes produced in a gas by variation of temperature and pressure; the laws of combustion and quantity of air supply, a classification and description of fuels, solid, liquid and gaseous; and the efficiency of furnaces.

Next comes a general chapter upon steam boilers, which in Chapter VI is succeeded by some pages upon chimney draught, which, apparently, would have been more logically located directly after the description of furnaces. Chapter VII detals with the materials used in boilers, describing and giving specifications for the various irons and steels which are employed.

Chapters VIII and IX take up boiler construction and are replete with matter of value to the designer and the draughtsman, but are almost too technical for a college text-book, excepting for those who intend to make a specialty of steam engineering. In Chapter X mechanical stokers are dealt with, but in an exceedingly brief and cursory manner, so much so as to hardly convey a fair idea of the value of mechanical appliances in firing.

The succeeding portion of the book is chiefly devoted to operation, discussing the questions of scale, corrosion and the testing and care of boilers. Chapters XIV and XV deal respectively with chimney design and smoke prevention, and apparently should have been included in Chapter VI upon chimney draught.

The typography of the volume is excellent; the illustrations are thoughtfully and carefully chosen, largely from actual working drawings, and include much practical information. The volume will take high rank as a brief epitome of modern boiler practice.

LUFTVERUNREINIGUNG UND VENTILATION. By Dr. Josef Rambousek. Liepzig: A. Hartleben. 244 pages, 48 illustrations. Price, 7 marks 50 pfennigs.

A somewhat free translation of the title of this pamphlet would be "Impure Air and Ventilation," and the author attempts to deal with the subject both pathologically and from the engineering standpoint.

The first 95 pages take up the theory of ventilation, showing some of the apparatus and machinery wherewith ventilation may be accomplished and the amount of air supply measured. In some cases, particularly when the author applies calculus to determine the amount of air pollution, the treatment appears to be a little forced.

In the next section the physiological effects of impure air are given considerable attention. Here mathematics are discarded and the work is purely descriptive. Finally, the last third of the pamphlet is devoted particularly to the description of the methods and appliances to be employed in ventilating factories and buildings in which there are many employees and wherein the avocations are such as to be particularly contaminative to the atmosphere, as for example such operations as matchmaking, the production of ammonia, the manufacture of nitroglycerine, and such of the textile arts as are likely to fill the atmosphere with lint or other organic particles.

The subject of air filtration is taken up and the various forms of screens and other methods discussed, although there appears to be no mention of the American device of washing air to effect purification.

As American literature is not overburdened with text-books and descriptions of ventilating appliances, this German exhibition will not encounter an overcrowded market and will, therefore be welcome.

GRUNDRISS DER REINEN UND ANGEWANDTEN ELEKTROCHEMIE. By P. Ferchland. Halle: Wilhelm Knapp. 271 pages, 59 illustrations. Price, 5 marks.

Of the 266 pages of the text, 234 are devoted to the discussion of electrochemical theory, and it may be said that here the author has taken great pains to be exact. He first discusses the theory of electrolysis. After some general remarks on electrolytic conduction, the author gives the laws of Faraday, the determination of the transport numbers of Hittorf, and the principles of conductivity. After a brief review of the theories of Grotthus, Clausius and Arrhenius he passes to the discussion of the relations between the theory of electrolytic dissociation, the gas laws and the modern theory of solutions. He gives the method for calculating the degree of ioniation from conductivity measurements, and finally gives Kohlrausch's law for the mobilities of ions.

The author then deals with the changes of energy in electrolytic processes He gives Thomson's rule and the Gibbs-Helmholtz equation for calculating the e.m.f. of an electrochemical process, and passes to Nernst's osmotic theory of electrolysis. Chapters on measurements of absolute potentials, on the electromotive behavior of non-metals, and on polarization conclude this part.

It must be acknowledged that these first parts of the book should be useful for the introduction into theoretical electrochemistry, since the author has taken care to state the theory exactly and fully, even in its most elementary parts, and to refrain from loose statements—which cannot be said about all elementary books on electrochemical theory. In a later edition the author would do good in adding references on the original papers since such notes on the literature of the subject would render his work valuable as a reference book. The arrangement of the theoretical part is logical, and after one has read the book over it is not difficult to find something in it.

The part on industrial electrochemistry comprises 30 pages, of which 13 are devoted to furnace processes, 11 to electrolytic processes and 5 to the generation of electrical from chemical energy. Even in these pages the author deals more with questions of theory, and the description of industrial electrochemical accomplishments is entirely inadequate. In a later edition the author should either leave out this part altogether or re-write it entirely and attempt to be complete up to a definite point.

PHÉNOMÈNES FONDAMENTAUX ET PRINCIPALES APPLICATIÖNS DU COURANT ALTERNATIF (Fundamental Phenomena and Principal Applications of Alternating Currents). By R. Swyngedauw. Paris: Dunod. 1904. Paper, 173 pages, 62 illustrations.

This is an elementary text-book of alternating-current principles. It is clearly and systematically written, but is intended for advanced students, since it employs algebra and elementary calculus.

The book is divided into an introduction and four parts, comprising nineteen chapters in all. The type is good, but the cuts are inferior. In some respects the book is well up to date, as, for example, in respect to the Cooper Hewitt converter; but in some other matters the treatment is archaic and very elementary.

ELEKTROMECHANISCHE KONSTRUKTIONSELEMENTE. By Dr. G. Klingenberg. Blatt 1-30, Apparate; Blatt 51-60, Maschinen. Berlin: Julius Springer. 36 tables, 114 illustrations. Price per installment, 2.40 marks.

This work will be completed in ten parts, of which Sections 1, 2, 3 and 6 are now issued. Upon the completion of the series, the author proposes to publish occasional supplementary numbers, as they are needed to maintain the series in harmony with advancement in design and construction. Each section consists of ten plates, 8 x 13 inches in size, with an index; the plates are unbound and contained in a convenient folder and envelope.

This publication presents a series of sketches which propose to the student and designing engineer the details of the elements of electrical design and construction. Unquestionably this series will meet the needs and desires of a large number of students and engineers. In masonry, steel construction and work of such character plates of this description have long been available; and recently hand-books for machine design have covered the same ground in their appropriate lines. In electrical construction there are yet difficulties in the way of the presentation of an adequate work of examples of design, from which the older lines of engineering are now free. There is still an absence of universality in electrical design, and much of modern construction is still hampered by the idiosyncrasy of the manufacturer.

Prof. Klingenberg has selected his examples from thirteen of the more prominent German manufacturers. It is a matter of surprise, in this connection, that these firms have been sufficiently broad and progressive to have permitted the use of their designs and drawings for general circulation. From this very cause, however, the work suffers its most marked limitation; the sketches are reproduced from assembly drawings: for the most part each device is given in elevation and plan, and there are few sections and details shown. While the drawings are dimensioned to a limited extent, the essential dimensions which student and designer alike would desire are not given—evidently for commercial reasons.

The series covers the entire field of approved electrical design. The selection of examples is judicious and fully representative. The plates are of a convenient size for use and are printed and reproduced with remarkable sharpness of line. They are, perhaps, too crowded in appearance, and their usefulness would have been enhanced had fewer sketches been placed on the plate, and these had been more intelligently arranged.

The series as a whole is an important contribution to the literature of electrotechnics, and will be useful to a large class of readers. It is to be hoped that it will suggest a similar work covering American practice.

Climax Arc Lamps.

A new form of enclosed arc lamp herewith illustrated and described has been brought out under the name of "Climax" by the Keystone Electric & Manufacturing Company, Allegheny, Pa. The cuts, Figs. 1, 2 and 3, show it complete and in detail. A special feature shown in Fig. 1 is the regulating coil made by machinery designed for the purpose. A flat copper strip is wound spirally about a solid mica core and each layer of the spiral is separated from the adjacent layer by mica washers. The spiral is then surrounded by another mica tube, and all is encased in a metal tube, with metal heads, to which are fastened the necessary terminals and a clamping device to adjust the coil with. The whole forms a solid indestructible fire-proof coil. Fig. 2 is a view of the mechanical movement of the lamp, with the dash-pot and the flat spiral connectors, the latter being regarded as a decided advance in current-carrying devices for such work.


FIG. 1.—REGULATING COIL.

The upper carbon holder and the carbon-carrying tube have but one motion and cannot be turned, avoiding disarrangement of the spiral conductor during operation. In the direct-current lamp the dash-pot is constituted with a loose-fitting piston of large diameter in the gas diffusing chamber. This piston is fastened to the clutch

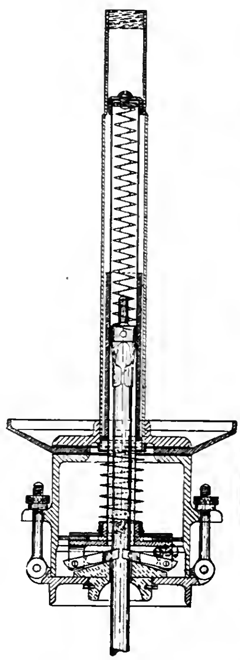


FIG. 2.—DASH-POT MOVEMENT.


FIG. 3.—ENCLOSED ARC LAMP.

plate in such a manner as to have a lateral motion, thus permitting it to find its own free path and avoiding all possibility of wear and sticking, due to friction.

The enclosing globe cap forms the bottom of the gas-diffusing chamber and dash-pot, and carries the indestructible insulating bushing and negative carbon support. It is held in place by two outwardly-swinging arms engaged by two lugs on opposite sides of the gas chamber, and fastened by thumb nuts. This feature in connection with the sealed tube in which the armature operates furnishes a perfect enclosure with resultant long burning of 200 hours. The clutch is composed of two cast-iron parts—duplicates—hung on two cotter pins in such a manner that when they fall toward each other the opening becomes less than the diameter of the carbon. Hence, when the clutch plate is raised they grip the carbon securely.

The porcelain resistance holder has a thread moulded on its outer surface, in which the wire is carefully wound. A special clamping device is placed to one side with a sliding member, by which the adjustment for proper arc voltage is achieved. The company will also furnish an external resistance, in a separate case, for 220 to 250-volt lamps, which may be placed at any convenient point; or the lamp may be suspended from it. A switch is provided in the top of the lamp to cut it out of circuit when burning; and will be found to do its work effectively, breaking 250-volt circuit, without any perceptible arc.

The housing, with its colonial design, has a pleasing appearance. It is made of copper and riveted, no solder being used on any part of the lamp. The outside globe holder is fitted to an internal sleeve of the main shell by three bayonet locks, and is easily removed or replaced. Housings of steel or brass can be furnished, if so desired. The inner globe is of large diameter, allowing the whole hand to enter for cleaning. It is of the closed end type, and is readily removed and replaced, when trimming.

1,500-K. W. Alternator for St. Louis.

Following is a description of a National alternating-current generator to be installed at the central power station at St. Louis. This alternator will be direct-connected to a 2,250-hp Hamilton Corliss vertical cross-compound engine. The rated output is 1,500 kw, 25 cycles, 6,600 volts, running at 83 r.p.m., and the current generated will be used for various purposes.

Like all standard alternators built by the National Electric Company, it is of the revolving field type, thus leaving the armature stationary and easily accessible, and the difficulty of properly insulating the armature coils is eliminated as the windings are not subject to any mechanical strains whatever. The revolving field is of large diameter, giving additional fly-wheel effect to the engine, and the construction of the field coils makes them practically indestructible. All parts are accessible and the method of ventilation insures low temperatures.

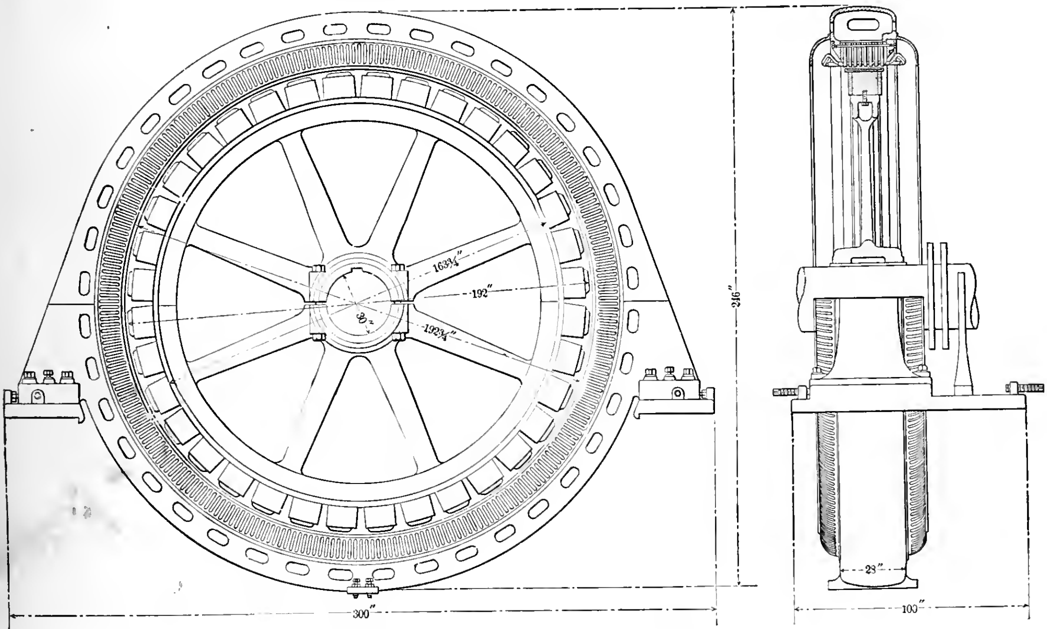
The revolving field is made up of cast steel in halves, which are bolted and secured together by shrunk links. The rim of the wheel is of channel cross-section to which the cast-steel pole pieces are bolted. The field coils comprise 65 turns of 1½ x ⅛-in. copper strap, wound on edge and thoroughly insulated, the outer edge of the coil being exposed to the atmosphere for cooling. Laminated pole shoes are secured to the ends of the pole pieces and serve to hold the field coils in position. These shoes cover a large polar arc, distributing the magnetic flux evenly.

The field coils are insulated from the pole pieces by fuller board, and from the pole shoes and spider ring by heavy fibre. The revolving field is 16 in. in diameter and weighs approximately 50,000 pounds.

The frame is a circular cast-iron housing into which laminated punchings with inwardly projecting teeth are assembled, for the reception of the armature windings. The frame is extremely heavy and stiff, not requiring any external support, and is divided horizontally, the halves being firmly bolted and keyed together. Bolts and keys are contained entirely within the cross-section, obviating the use of side lugs. Large open spaces are provided in the sides of the frames, allowing a free passage of air from the ventilating ducts in the core.

The armature core is built up of laminated soft steel punchings, being annealed and japanned before assembling; ventilating space blocks are inserted at suitable intervals, providing openings extending around the circumference and allowing a free passage for the heat generated in the windings. There are six slots per pole, 2½ in. deep by 1½ in. wide, each being wound with 14 conductors of .37 by .28-in. compressed copper strand. The external diameter of the armature is 16 ft. ¾ in. and the width of the core 16 in.

Cast-iron collector rings and carbon brushes are used, enabling the machine to be operated with a minimum amount of attention and at the same time providing a collector gear which will carry a heavy temporary overload.



ELEVATION AND SECTION VIEWS OF 1,500-KW ALTERNATOR.

The net weight of this alternator is 135,000 pounds, and following are the guarantees on this machine:

Efficiency—1¼ load, 95.5; full load, 95.5; one-half load, 94.75. Regulation—0.5 per cent. on power factor, 1; 22 per cent. on power factor, zero. The temperature will not exceed 30° on the armature and magnets on a continuous run at full load and 40° on the armature and magnets on a continuous run at 25 per cent. overload. This generator has been built by the National Electric Company, at their Milwaukee (Wis.) shops.

A Circumferential Velocity Indicator.

We illustrate herewith an interesting speed indicator, known as the "Cut-Meter," and manufactured by the Warner Instrument Company, Beloit, Mich., which is particularly useful in determining cutting speeds in machine tool work. The radical feature is that instead of being actuated by gearing there is an Arago disc arrangement whereby a revolving magnet imparts a torque to a disc connected to the indicating dial pointer. The instrument is a combination of a tachometer and a wheel, the calibration being such that every foot traveled by the circumference of a wheel bearing on the revolving surface, the circumferential speed of which is to be determined, registers one foot upon the dial. If the wheel is 6 in. in

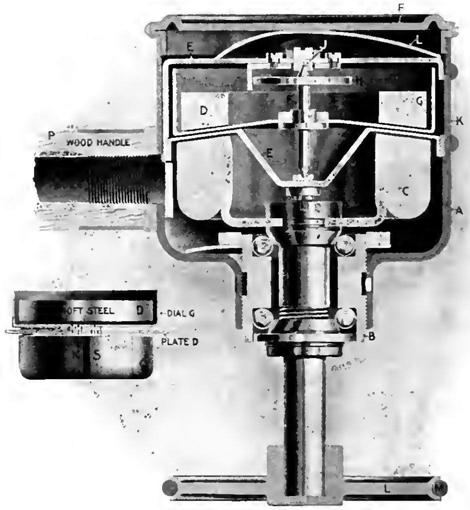


FIG. I.—SECTIONAL VIEW OF CUT-METER.

circumference, for example, two revolutions of the tachometer shaft will be required to indicate one foot on the dial, so that it is only necessary to properly calibrate the instrument in order to get a direct reading in feet per minute.

Referring to the accompanying illustration, Fig. 1, the magnet, *c*, is carried by the ball bearing, *b*. The outside is threaded and screws into the outer case, *a*. The ball bearing is secured by a spring washer and is finally adjusted at the factory. In front of the magnet is a soft steel ring, *d*, which deflects the lines of force through the aluminum disc, *g*. This disc is mounted on a hardened steel shaft and supported by the jewels, *j*. On the outside edge of the aluminum disc are engraved the fingers indicating the speed. Also attached to this shaft is a hair spring, *h*, so adjusted that it resists the turning of the aluminum dial and brings it back to the zero point when the magnet is at rest. The jewel bearings and the steel ring are carried by the inner case, *e*, which telescopes into the outer case and can be removed at will. The inner case also serves the purpose of protecting the dial, *g*, from the air currents set up by the magnet when revolving. Through both outer and inner case is an opening covered by a glass, *k*, through which the figures on the aluminum dial can be read. Attached to the main shaft is the driving wheel or disc, I, of proper diameter, having a grooved periphery, into which is snapped a miniature rubber tire, *m*.

Fig. 1 illustrates the arrangement of the poles on the permanent magnet. The lines of force flow from the north pole through the aluminum dial, *g*, to the steel plate and back again through the dial to the south pole of the magnet, *c*. When the magnet is revolved it sets up a dragging or accessory action in the dial, *g*, this action or rotation being in proportion to the speed of the magnet; and as the hair spring is subject to the same law, it is evident that increasing the speed of the magnet will increase the displacement of the dial in exact proportion. The dial or scale can, therefore, be marked by equal divisions from the lowest to the highest reading. Since adjusting the magnet closer to the steel ring increases the torque or dragging effect, it is only necessary to select a hair spring of proper stiffness, to revolve the magnet at a known speed, at the same time adjusting the ball bearing until the scale indicates the correct speed. The instrument will then be accurate on the entire range of the scale and will remain so permanently, there being no necessity for subsequent adjustment or recalibration.

As there are no mechanical connections between the magnet and the indicating dial, and as the magnet runs very easily (there being always an abundance of power to drive it), there can be no inaccuracy up to this point.

The indicating dial is mounted on a steel shaft, the points of which are hardened and supported in sapphire jewels, practically eliminating all friction or retardation. How perfectly this is accomplished can be judged from the fact that a change in speed of one-fifth of 1 per cent. is shown on the dial. Since the dial and shaft are very light, the strength of the jewels and pivot is great in comparison to the weight, and experience has shown that they will stand indefinitely the regular service likely to be given in any ordinary machine shop.

Fig. 3 shows a "cut-meter" complete, full size. The instrument is sufficiently small and light, so that it can be carried in the pocket without inconvenience. It presents a very handsome appearance, being substantially constructed of brass and nickel-plated. The handle is turned from a hard tropical wood and is highly polished.

The material of the ball bearings is a superior quality of soft steel, which is first finished to shape and then case-hardened. Each

FIG. 2.—THE CUT-METER IN USE.

piece is ground on a specially-constructed machine, so that every part may be true and in perfect alignment. After being ground, each part is carefully tested, and imperfect or soft pieces discarded.

Fig. 1 shows the details of bearings. In a test several of the bearings were run at a speed of 15,000 r.p.m. for a sufficient length of time to equal several years actual work on the instrument; at the end of this crucial test, the bearings were found to be in as perfect condition as before.

The magnet is practically permanent under all conditions. The air-gap is only about 1/32 of an inch, or about one-half of 1 per cent. of the entire length of the magnet. This narrow air-gap effectually prevents the instrument from being influenced by outside magnetic forces, and the strongest field does not affect its accuracy in the slightest degree. The steel used is of a special quality and is made to order. The pieces are first hardened, then magnetized, and then aged by a process which prevents further change in strength. They are carefully tested and laid aside for a considerable interval before being retested. This test is so delicate that a change too slight to be appreciable in actual work is at once detected.

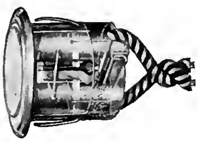
This meter is of particular value to the machine shop manager, for by its use he will probably find in a large majority of tests made that the working speeds in his shop are from 25 to 50 per cent. lower than they ought to be in order to obtain the most profitable results. In a factory recently inspected, equipped with a multi-voltage drive, one tool was found running on soft steel at a speed of 150 ft. per minute, while the average speed throughout the entire factory on the same stock was about 24 ft. On another occasion, of two boring mills inspected of the same make working on the same stock, the speed of one mill was 150 ft. and the other 22 ft., the cut

FIG. 3.—CUT-METER, FULL SIZE.

and feed being practically the same in both cases. With the use of an apparatus such as that described there is no guesswork, since it indicates the cutting speed instantly, accurately and with a dead-beat register. The meter is available for a number of other uses besides determining the cutting speed of machine tools. When held on the outside of a paper mill dryer it instantly indicates the exact speed at which the machine is making paper. It can also be applied for determining the speed of elevators, since it is not necessary with it to make any calculations, and at the same time indicates when the elevator car is traveling at its maximum speed.

Screwless Electrical Fixtures.

A novel departure in the method of connecting wires to appliances has been made in the "Noscru" midget push button, manufactured by the Sarco Company, No. 906 Sixth Avenue, New York City. The circuit wires are simply threaded through the rubber bottom of the button, bent over, and by one twist the button is ready to set in position. A yielding plunger of phosphor-bronze makes a direct wiping contact on the wires, thus obviating the necessity of using screws, clips or other fastenings; and it takes less than ten seconds to connect the button, without the use of tools. The illustration readily explains the method to the practical electrician.



SCREWLESS PUSH BUTTON.

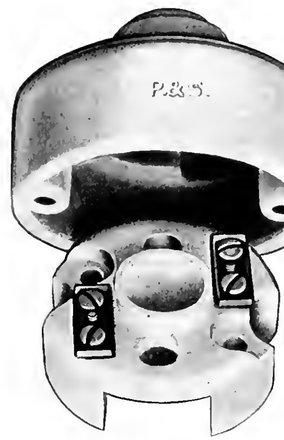
One of the chief features of the Noscru button is that it can be taken apart by bending the two pins at the bottom in a vertical position and the inside part falls out. It can be engraved or stamped and inserted again and made fast by two ordinary pins.

The Noscru midget push is made in standard sizes, while the Pee-Wee takes a No. 18 wire, and yet is really the smallest button in the world. The "Pee-Wee" fits a 3/8-in. hole, and can, therefore, be used in many places to a greater advantage than anything else of its kind on the market. The Noscru button has the contact concealed in the rubber body and therefore is readily adaptable for any kind of exposed work, such as outside door plates, marine work, etc.

The makers inform us that they have had the Noscru button under a perfect test for three years, and that it has never failed to work. The Sarco Company promise a Noscru key arm switch in a few weeks which will have the same advantages in itself as the Noscru button, for the purposes for which it is intended.

Fuseless Rosette for Concealed Work.

We illustrate herewith a new fuseless rosette for concealed work, which has just been placed on the market by Pass & Seymour, Inc., at Solvay, N. Y. It embodies a number of neat features. The bot-

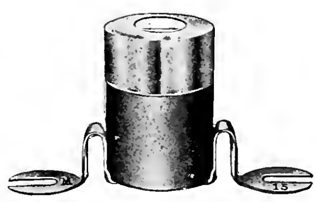


FUSELESS ROSETTE.

tom of the base is recessed to permit the heads of tubes to extend half an inch from the ceiling, and it covers them up completely. A closed porcelain cover then slips over the whole, with perfect concealment, making a very finished and complete installation. The material used is of the high grade with which the manufacturers' name has so long been associated, while the finish and smoothness of the rosette are in every way admirable. The trade is supplied with this device from headquarters or from the various branch offices.

New Form of Fuse.

A new fuse that has just been introduced by the Horton-Massnick Company, of Detroit, Mich., is herewith illustrated. The fuse is especially for set-screw contacts with centers which engineering practice has established. Both terminals are flexible and will take any centers from $1\frac{3}{4}$ in. to 3 in. The fusing material is formed in the shape of the letter U and is entirely surrounded by finely divided refractory material, with the exception of a very short portion, which



NEW FUSE.

is exposed to view through a hole in the bottom of a brass cap, which seals the open end of the fuse case or tube.

The hole in the brass cap is covered by a transparent disc and the fuse is so constructed that the fusing material will blow exactly under this window. The user can determine at a glance whether or not the fuse is blown, because he can see the fusing material itself or the blackened window resulting from the blown fuse. The fuse is designed for 250-volt work and can be furnished in capacities from 1 to 30 amp.

A New Testing Set.

Machado & Roller, the selling agents of the Whitney Electrical Instrument Company, are marketing a new form of testing set, illustrated in Figs. 1 and 2 herewith. It is of the decade pattern, in which the drawbacks incident to the great number of plugs necessitated by the old post-office form of construction are eliminated, there being but four plugs in the rheostat itself. It will be noticed that

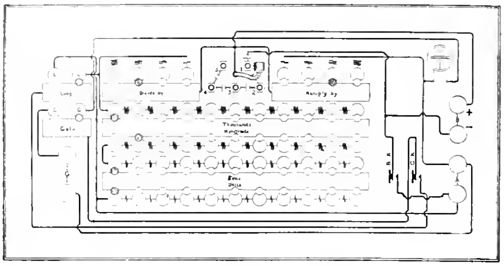


FIG. 1.—DIAGRAM OF CONNECTIONS.

the use of reversing blocks in the bridge arms has been done away with by adding an extra coil to each arm. This expedient eliminates two plugs and makes the operation of the set much more easy to understand. The keys are of a novel form which can be operated independently or like the conventional combination key, whichever is desired. Five large dry cells are built into the containing case and a flexible cord with plug is arranged so that any number of them can

FIG. 2.—GENERAL VIEW OF TESTING SET.

be used at will. An ingenious modification of the ordinary construction of decade and post-office sets is used to shift the internal connections from those employed in making ordinary resistance measurements and the Murray test to the connections for the Varley test, so that the two "X" posts common to every bridge are the ones to which the outside line is always attached no matter what test is being made thereon. A pair of binding posts to which an external galvanometer of the reflecting form may be attached for high sensibility work is also provided: and by shifting one plug, either this external galvanometer or the one that is built into the set is brought into play. Another pair of posts allows of the use of an external source of e.m.f. where this is desired. Instead of following the conventional procedure of marking the ratio arm blocks "A" and "B," they are stamped "Divide by" and "Multiply by," respectively. The connections are such that, when a plug is inserted in the gap between the "divide by" block and any one of the four circular blocks opposite thereto, the readings as indicated by the position of the plugs in the rheostat are to be divided by the number stamped on the circular block to get the correct reading. Similarly, the resistance plugged in the rheostat is to be multiplied by the number indicated by the position of the plug in the "multiply by" ratio arm block. The plug blocks for changing over the loop and galvanometer connections are marked with similar clearness, so that practically any one can use the bridge without chance of confusion. The actual diagram of connections is as shown by Fig. 1.

An accuracy of adjustment of a tenth of one per cent. throughout is claimed, and it is also stated that the galvanometer is sufficiently sensitive to give a marked deflection with a tenth of a per cent. resistance variation when working with full battery power on a resistance of moderate value. The galvanometer is not affected by external fields and can be used with the set in any position. It is thought that a moderate-priced set having the above characteristics will meet with considerable favor from a large class of users.

Sheet Metal Stamping Press.

A machine tool of large utility in the electrical field is the sheet metal stamping press, and we illustrate herewith the 1904 type brought out recently by the Perkins Machine Company, of South Boston, Mass. It weighs 1,275 pounds, is made with jigs throughout, and has each part interchangeable. The shaft is of large diameter and supported by large bearings bored out from the press body. The clutch is of special design, giving a high rate of speed, from 50 to 300 revolutions. There are three shelves which can be detached from the machine. One shelf is for the screw driver, oil can, wrenches, etc. The other shelves are to receive tin, one before stamping, and after stamping the scrap is thrown on the other shelf. This makes the

STAMPING PRESS.

press fire-proof, and does away with the combustible boxes and other matter that accumulates under the press, inasmuch as every manufacturer who uses a press is obliged to have a table of some kind to put the scrap on.

The Perkins Machine Company makes over 200 varieties of press, from those for light jewelry work to presses that stamp out battleship plates. The hermetically-sealed steel caskets are made on them, as well as the well-known Oneida steel pulley. The parts for the Edison storage battery are made on these presses, and even the small mica washers so familiar in electrical goods are made in quantities on Perkins presses in North Carolina.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Dullness prevailed in the stock market and speculation was quiet, there being an absence of outside interest. Unfavorable railroad earnings, the quietness of trade and uncertainty regarding crop prospects, with the unsettled situation in the Northern Securities matter, all contributed to this end. Money was exceptionally easy; in fact, it was a drug on the market and prices for it were low. During the week Metropolitan Street Railway placed a loan for $2,500,000 on short-term notes at 5 per cent. There was no movement of any consequence in the standard stocks, but in the Steel shares there was some activity, preferred receding somewhat on the pessimistic reports as to iron and steel trade. In industrials nothing of a noteworthy character occurred excepting the rise in gas stocks, although Rubber preferred held its own on the resumption of dividends. The curb market dwindled to small proportions, and was without feature except for a rise of nearly 20 points in Brooklyn Union Gas 6 per cent. convertible bonds on sales of $120,000. Some of the copper stocks are a little higher, and Interborough Railway advanced over 2 points. Electric and traction stocks are all lower than a week ago, the greatest decline being 4¾ in General Electric, Allis-Chalmers preferred and Westinghouse common following with 3 points each. All three of these stocks closed at the lowest prices of the week for each, namely, General Electric, 159¾; Allis-Chalmers 40 and Westinghouse 155. While the tractions were weak they did not lose quite so heavily as the electric stocks above named, although they too closed at the lowest figures. Brooklyn Rapid Transit closed at 46¼, being a net loss of 1¼, and Metropolitan Street Railway 112¼, a net loss of 1⅞. Following are the closing quotations of May 3:

NEW YORK.

	Apl.26	May 5		Apl.26	May 5
Allis-Chalmers Co.	6½	6⅞	Electric Vehicle	5	8¾
Allis-Chalmers Co. pfd.	39	39	Electric Vehicle pfd.	8	9
American Tel. & Cable	86	86	General Electric	161	157½
American Tel. & Tel.	126	126	Hudson River Tel.	..	
American Dist. Tel.	23	23	Metropolitan St. Ry.	113	109¾
Brooklyn Rapid Transit	46⅛	45⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	185	175	Marconi Tel.	..	..
Electric Boat	25	25	Western Union Tel.	88⅝	88¼
Electric Boat pfd.	61	60	Westinghouse com.	158	153¼
Electric Lead Reduction	½	½	Westinghouse pfd.	175	175

BOSTON.

	Apl.26	May 6		Apl.26	May 5
American Tel. & Tel	126	126¼	Western Tel. & Tel. pfd.	*80	77
Cumberland Telephone	113	113½	Mexican Telephone	1¼	1⅜
Edison Elec. Illum.	238	236	New England Telephone	*123	*122½
General Electric	160¼	156½	Mass. Elec. Ry.	20	19¾
Western Tel. & Tel	..	8	Mass. Elec. Ry. pfd.	73	72¾

PHILADELPHIA.

	Apl.26	May 5		Apl.26	May 5
American Railways	44	44	Phila. Traction	..	96
Elec. Storage Battery	57	57	Phila. Electric	6⅜	5¼
Elec. Storage Battery pfd.	57	57	Phila. Rapid Trans.	13½	13¼
Elec. Co. of America	7⅛	7⅛			

CHICAGO

	Apl.20	May 5		Apl.26	May 5
Central Union Tel.	..	..	National Carbon pfd.	102½	103
Chicago Edison	..	..	Metropolitan Elev. com.	15	15
Chicago City Ry.	155	158	Union Traction	5½	5½
Chicago Tel. Co.	..		Union Traction pfd.	30¼	30¼
National Carbon	28	30			

*Asked

SAN FRANCISCO GAS AND ELECTRIC COMPANY makes the following report for the year ended December 31, 1903:

	1903.	1902.	Changes.
Total income	$2,504,771	$1,989,834	Inc. $514,937
Operating expenses	1,534,814	1,285,897	Inc. 248,917
Net	$969,957	$703,937	Inc. $266,020
Depreciation, etc., funds	395,000	282,101	Inc. 112,899
Balance	$574,957	$421,836	Inc. $153,121
Dividends	396,211	....	....
Surplus	$178,746	....	....

Net profits and consumers for the last four years follow:

	1903.	1902.	1901.	1900.
Net profits	$969,957	$703,937	$458,440	$675,556
Consumers Dec. 31:				
Gas	65,710	35,791	34,271	30,800
Electricity	9,771	5,238	4,286	2,325

NEBRASKA TELEPHONE COMPANY.—The Nebraska Telephone Company reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.
Gross	$1,049,907	$905,660	$754,971
Expenses	857,310	737,220	617,345
Net	$192,597	$168,440	$137,626
Dividends	115,768	99,000	81,222
Surplus	$76,829	$69,440	$56,040

SAO PAULO LIGHT & POWER.—The Sao Paulo (Brazil) Tramway, Light & Power Company, in which Canadian and American capital is interested, reports as follows for the year ended December 31, 1903, Canadian currency equivalent:

	1903.	1902.	1901.
Gross Railway Company	$962,941	$879,907	$630,282
Gross earn. Light & Power Co., etc.	340,234	243,378	119,394
Total gross	$1,303,175	$1,123,285	$749,676
Expenses (both)	403,747	417,916	486,719
Net	$899,428	$705,369	$262,957
Charges	286,885	250,000	....
Surplus	$612,543	$455,349	$262,957
Dividends	391,379	239,019	....
Surplus	$221,164	$216,350	$262,957

PITTSBURGH TROLLEY YEAR.— The Pittsburg Railways Company in its report for the year ended March 31, 1904, shows gross $8,661,394, net income $3,612,169, deductions and fixed charges, $3,628,246, leaving a deficit of $16,077 as against a surplus last year of $1,152,251, out of which $870,000 was paid in dividends. The traffic statistics are as follows:

Passengers carried	174,400,055	164,407,446	Inc.	9,992,609
Car mileage	34,748,836	33,577,214	Inc.	1,171,622
Earn per car mile	25.32c	24.65c	Inc.	1.07c
Exp. & tax per car m.	14.92c	14.33c	Inc.	.59c
Net per car mile	10.40c	10.32c	Inc.	.08c

The company's business was seriously affected by the hard winter with respect to lower receipts and higher operating expenses. It built 34.53 miles of new track and bought 200 cars.

STANDARD UNDERGROUND CABLE COMPANY shows as follows for the year ending December 31, 1903:

Gross	$8,685,294
Material on hand	507,325
Total	$9,192,619
Exp., disc., factory cost, etc.	8,488,181
Net	$704,438
Dividends	229,732
Surplus	$474,706
Previous surplus	754,407
Total	$1,229,113

MICHIGAN TELEPHONE DIVIDEND.—The Michigan State Telephone Company has declared a quarterly dividend of 1½ per cent. on the preferred stock, payable June 1 to stockholders of record May 1. Detroit Telephone bondholders participate in this dividend, as under the settlement they got $480 in bonds of the Michigan State Company, $206.25 preferred stock and $428.75 common and $2.50 in cash, in lieu of January interest, on each $1,000 Detroit Telephone bond. A voluntary payment of some kind will be made to minority stockholders of Michigan Telephone Company when other matters are cleared up.

BELL TELEPHONE STOCKHOLDERS.—The following figures will show the number of stockholders of the American Telephone & Telegraph Company.

Jan. 1	Amt. capital stock.	No. shareholders.
1903	$87,836,100	10,802
1904	127,068,900	15,743

Since January 1, 1904, the number of shareholders has increased over four hundred.

THE NEW ENGLAND (BELL) TELEPHONE AND TELEGRAPH COMPANY reports as follows for the year ended December 31, 1903:

	1903	1902.	1901.	1900.
Gross	$6,092,865	$6,024,610	$5,177,412	$4,518,396
Exp. & tax	4,677,726	4,855,841	4,139,930	3,621,644
Net	$1,415,139	$1,168,769	$1,037,482	$896,752
Dividends	1,297,002	1,108,726	947,406	838,635
Surplus	$118,137	$60,043	$90,076	$58,117

MARCONI WIRELESS.—At a meeting of the directors of the Marconi Wireless Telegraph Company of America, John D. Oppe was elected second vice-president and general manager, vice William H. Bentley, resigned. Mr. Bentley remains a member of the board and will continue his interest in the affairs of the company. Mr. Oppe is also general manager of the Canadian Marconi Company.

NEW YORK METROPOLITAN.—Kuhn, Loeb & Company have purchased $2,250,000 Central Crosstown Railroad Company 2-year 5-per-cent notes, secured by bonds of that company, which are guaranteed by the Metropolitan Street Railway Company.

Commercial Intelligence.

THE WEEK IN TRADE.—There are signs of improvement in trade, and with the advent of the belated spring weather it will no doubt be realized. At most markets distribution is quiet, and trade for April, the country over, does not equal that for the same month last year. In the northwest, conditions are somewhat improved and business has been helped by the more seasonable weather. Pacific Coast trade and crop advices are better than of late, and while weather and crop conditions are backward in the South the outlook for the future is very hopeful. Collections are still backward, though some improvement is noted at centres where the weather has permitted a better distribution of goods. Among the industries the demand for pig iron is rather dull. Finished products are quieter, but it is pointed out that the demand for the smaller products is inducing a production of steel not much below the high record of a year ago. Export trade is expanding, thus removing the fear of a burdensome surplus of products. The demand for building materials is improving with the better weather conditions, and cessation of strikes, special activity being reported at Western cities and on the Pacific Coast. In short, trade in general reflects the weather conditions, improvement being reported from some localities, and stagnation from others. The business failures do not appear to exceed the normal number, the aggregate for the week ending April 28, as reported by Bradstreet's being 197, against 199 the week previous and 173 the corresponding week last year. The copper market continues dull, although it is stated that some good-sized orders have been placed during the past few days for electrolytic and casting copper by wire and brass makers. Holders of the metal, however, are firm in their views as to its market value and are not disposed to make any concessions. Lake stiffened ¼c. during the week, closing officially, at 13⅜c. @ 13⅝c; electrolytic 13⅛c. @ 13¼c.; casting stock 12⅞ @ 13⅛c. The London market has advanced.

CAMPECHE TO HAVE ELECTRIC LIGHT.—Campeche, capital of the State of Campeche, Mexico, is to have an up-to-date Yankee electric lighting plant. A concession has already been granted by the State authorities which sanctions the construction and operation of the system for a period of twenty years. The franchise was originally made out in the name of Jose de las Munecas Zimavilla, a prominent Campeche lawyer, who has made over the permit to a joint stock company, which has been organized under Mexican laws, with a capital of $150,000. W. E. Herrmann, of Mexico City, is largely interested in the enterprise. The electrical expert who will have charge of the construction and equipment of the Campeche plant is A. A. Chaillet, at present located in Mexico City, at one time technical director of the Shelby (Ohio) Electric Company. He is now managing director of a company formed last year in Mexico for manufacturing incandescent lamps. The initial capacity of the Campeche plant will be 40 arc and 2,000 incandescent lamps.

THE FIBRE CONDUIT COMPANY, of Orangeburg, N. Y., find that between March of 1903 and March of 1904 their business increased near 300 per cent., and that during that period they had the most successful year in the history of the company. The most successful month they have experienced was April, 1904. Among their recent orders for conduit, which orders have been shipped in carload lots or nearly so, were those for the Edison Electric Illuminating Company, of Brooklyn; Citizens' Telephone Company, of Grand Rapids, Mich.; Merchants' Heat and Light Company, of Indianapolis; the Boston Edison Company; the Detroit Edison Company; the Suffolk Light, Heat and Power Company, of Southhampton, L. I.; the General Electric Company; Westinghouse Electric and Manufacturing Company, and the United States Naval Academy at Annapolis.

BUFFALO FORGE ORDERS.—The Buffalo Forge Company, Taylor Building, Cortlandt Street, has secured contracts from the Lehigh Valley Railroad for a big lot of exhaust fans, etc., which will be electrically operated. For the forge shops at Sayre, Pa., two 10-ft. exhaust fans and four No. 11 blowers have been ordered. The fans are to be belted to motors of 50-hp capacity each and the blowers will be direct-connected to 30-hp motors. For the locomotive shops, ten 10-ft. fans have been ordered. These fans will each be driven by 20-hp motors. The American Malting Company, New York, has ordered a 40-hp Buffalo engine for direct connection to a Westinghouse generator.

STEEL BY ELECTRICITY.—The government commission sent to Europe by the Canadian Government to investigate the electro-thermic processes employed in the smelting of iron ores and the making of steel has returned. It is reported from Toronto that the commission has found the process feasible and reports that steel can be produced by the electro-thermic process at a total cost of $8 per ton. This is taken to mean that the smelting of iron ores by electricity is commercially feasible in Canada and that the development of Canada's water power and iron deposits is a thing of the near future.

OLD EQUIPMENT TO GO TO CUBA.—The old equipment in the Central Building, 143 Liberty Street, consisting of six United States Electric belted generators and three Westinghouse engine aggregating about 200-kw capacity, is to be shipped to C. H. Thrall & Co., engineers and contractors, Havana, Cuba, in which firm J. P. Hall, the electrical contractor, is interested. The new plant to be put in the Ceneral Building, the contract for which Mr. Hall has secured, will be of 300-kw capacity and will consist of three 100-kw C. & C. generators direct-connected to Ball & Wood engines of 150-hp capacity each.

HAVANA LIGHTING PLANT ENLARGED.—A reorganization scheme is contemplated regarding the Spanish-American Light & Power Company Consolidated, which holds the exclusive franchise for lighting Havana and Matanzas, Cuba. Mr. Hayward, of the Baltimore gas plant, engineering and contracting firm of Bartlett, Hayward & Co., is president of the company. It is planned to reduce the capital of the company and to incorporate the concern under Cuban laws. The plant at Havana will be considerably enlarged. M. Jiminez is the electrical engineer of the company.

LAMP POOL.—Another meeting of the incandescent lamp manufacturers is, it is said, to be held in Cleveland this week, again bringing together the working forces of the National Electric Lamp Company and the "Independent" companies. The purpose of the meeting has not been divulged, but it is presumed to be for the purpose of further adjusting the agreement entered into at the meeting of the same parties held at the Manhattan Hotel a few weeks ago. The action of the "pool" are being watched with great interest.

MOTORS FOR CENTRAL AMERICAN MINES.—The Mine and Smelter Supply Company, 139 Liberty Street, is shipping large lots of concentrating tables to Mexico, Honduras and Costa Rico, which are to be operated by small motors built by the General Electric Company, the Triumph Electric Company and the Northern Electrical Manufacturing Company. The company has also some orders in hand for electric drilling equipments to be driven by General Electric motors.

1500 HP FOR MEAT PLANT.—The New York Butchers' Dressed Meat Company has just placed contracts for 1500 hp of electrical equipment to be installed in its plant at 39th Street and 11th Avenue. The engines will be built by the Fitchburg Engine Company. There will be two 600-hp tandem compound direct-connected machines and one of 300-hp capacity. The generators will be General Electric of 400-kw and 200-kw capacity respectively.

EQUIPMENT FOR TUXTLA GUTIERREZ.—The municipal lighting plant at Tuxtla Gutierrez, the capital of the state of Chiapàs, Mexico, is to be doubled. The existing equipment takes care of 1,500 incandescent and 50 arc lamps. General Rafael Pimentel, governor of the state, is now perfecting financial arrangements for the additional machinery. Mexican advices also state that he has other electrical projects in view.

HUGE CUBAN SUGAR PLANT.—The Colonial Sugar Company, of which M. R. Spelman, 33 Wall Street, is president, is about to construct the largest sugar plant in the world at Constancia, Santa Clara, Cuba, in which electricity will play an important part. The centrifugal pumps will be operated by electric power, as also the sugar cars. The capacity of the plant will be 5000 tons of cane per day.

CONSOLIDATION AT ROCHESTER, N. Y.—It is stated that negotiations are under way to merge the Rochester Gas and Electric Company, Rochester Light and Power and Rochester Railway Company. This city was the scene not long ago of a large electric lighting consolidation. Rochester is one of the pioneer trolley cities and has a large system.

HEINE AFTER MEXICAN BOILER CONTRACTS.—The Heine Safety Boiler Company is closing some fair-sized orders through the engineering and contracting firm of Van Voorhis & Sanford, of Monterey, Nuevo Leon, for boilers to be installed in Mexican power plants.

EQUIPMENT FOR FEDERAL SUGAR PLANT.—The Federal Sugar Refining Company's plant at Yonkers, N. Y., is to be equipped with considerable electrical machinery. Three 160-hp American Ball single engine, direct connected to General Electric generators of 100-kw capacity each will be installed.

LIGHTING EQUIPMENT FOR NEW JERSEY DRUG FACTORY.—The Northern Engineering Company, incorporated, White Building, has secured the contract for lighting equipment to be installed in Dodge & Olcott's new drug factory at Bayonne, N. J.

TRUMBULL SPECIALTIES FOR CUBA.—The Trumbull Electric Company, 136 Liberty Street, has secured a large contract for its various specialties from the Spanish-American Light and Power Company, Consolidated, of Hàvana, Cuba.

MANUFACTURED U. S. EXPORTS.—Exports of manufactures still promise to exceed in the fiscal year 1904 those of any preceding year. The nine months' figures of the fiscal year, just announced by the Department of Commerce and Labor, through its Bureau of Statistics, show a total of 17 million dollars greater than the corresponding months of the fiscal year 1900, in which the exports of manufactures reached their highest figures. In 1900 the exports of domestic manufactures amounted to 433 million dollars for the whole fiscal year, which was the highest figure ever recorded for the exports of domestic manufactures from the United States. In 1901 the figures showed 411 million dollars, in 1902, 403 million dollars, and in 1903, 407 million dollars. In this comparison it must not be forgotten that the 1904 figures exclude the exports of Porto Rico and Hawaii. Imports of manufactures show a decided falling off in the nine months ending with March, 1904, as compared with the corresponding period of 1903. To obtain a statement of the imports of manufactures, the Bureau of Statistics groups in three classes, viz., wholly or partially manufactured materials for use in manufacture; manufactured ready for consumption; and the group articles of voluntary use, luxuries, etc.; and this gives approximately the value of all manufactures coming into the United States, and amounts in total to $334,815,956 in the nine months ending with March, 1904, against $366,107,747 in the same months of last year, a decrease of 32 millions in imports of manufactures. It is proper to add, however, that the group "articles of voluntary use, etc.," contains some articles which could not properly be classed as manufactures, especially diamonds, of which the importation has grown steadily for several years past until the present fiscal year, which shows a decided falling off compared with 1903.

ALASKA CABLE.—A Washington despatch states that Gen. Greely, Chief Signal Officer of the army, has decided to award the contract for the manufacture of about 625 miles of submarine cable to the Safety Insulated Wire and Cable Company of New York. This cable will be used to connect Sitka, Alaska, with Fort Liscum, near Valdez, on Prince William Sound. The cable will be shipped by rail from New York to Seattle and will probably be laid the coming summer. The cable ship Burnside arrived at Nagaskai, Japan, recently, on her way to Seattle. Upon arrival there she will take on board about 800 miles of cable for laying between Sitka and Seattle. When these cable connections are completed, it will be possible to telegraph from the United States to every principal town and military post in Alaska without using Canadian lines.

STERLING ELECTRIC ORDERS.—The Sterling Electric Company, of Lafayette, Ind., has just equipped one of the large department houses at Springfield, Ohio, with a complete telephone system to work in connection with the city exchange it has recently installed there. It reports also an order for a private branch exchange from a bank in Albany, N. Y.; and an order for protectors and other apparatus from the Canton, Ill., Home Telephone Company. It has also just completed a 4-position toll board for the U. S. Telephone Company for Springfield, Ohio; the installation of a 3000-line common battery switchboard at Chillicothe, Ohio, and the installation of its 4-party line system in five of the largest cities in the West.

PLANTS FOR NEW BUILDINGS.—The Thompson-Starrett Company is about to take figures for electrical equipment to be installed in various hotel and office buildings for the construction of which they have the contracts. The Zimmerman Hotel at Richmond, Va., now being built, will have a 200-hp lighting outfit. The building will be a 10-story one. Four elevators will be put in. The new Woodruff Hotel, Brooklyn, will have a 300-kw. lighting and general power equipment. The Rockfeller skyscraper office building to be constructed in Cleveland will have a 400-kw. electrical plant. Mr. Babbit, formerly associated with the Chicago Edison Company, is the electrical engineer of the Thompson-Starrett Company.

N. Y. CENTRAL POWER PLANT.—The first actual local work towards the changing of the motive local power of the trains which run through the tunnel from the Grand Central station to Ninety-sixth Street, from steam to electricity, was made last week, when foundations plans were filed in the Bronx Bureau of Buildings for power house. This power house will be located on the south side of One Hundred and Forty-ninth Street, only 95 ft. from Long Island Sound. It will be a three-story brick structure of large dimensions; being 236.6x156.4 ft. The New York Central Railroad will erect the building, and the plans have been drawn by C. Wellesley Smith, the architect of the railroad.

TO SELL SHEPHERD ENGINES.—The firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, has effected an arrangement with the Shepherd Engineering Company, of Franklin, Pa., to act as sales agent for the Shepherd vertical automatic engine in the States of New York and New Jersey. These engines are built in sizes up to 1500 hp and in single, steeple and cross compound, single valve and four-valve types. The firm will continue to represent the selling end in this territory of the Harrisburg Pennsylvania Foundry and Machine Works for the Harrisburg horizontal engines.

EQUIPMENT FOR BROOKLYN TRAINING SCHOOL.—The Brooklyn Manual Training School is to be equipped with a considerable quantity of electric machinery. Frank Dobson, 218 East Forty-second Street, New York, is the general contractor. Manning, Maxwell & Moore secured a large order for machine tools to be electrically operated. There will be upwards of 600 hp of motors. The Buffalo Forge Company has taken an order for a marine type cross compound engine to be direct-connected to a generator. This outfit will be used to drive experimental apparatus in the laboratory.

LIGHTING EQUIPMENT FOR FERRIES.—The Hoboken Ferry Company has let the contract for the equipment to light the Erie, Jersey Central and Delaware, Lackawanna & Western ferry houses, West Twenty-third Street, New York. The machinery will have a capacity of 350 kw. There will be two 190-hp Harrisburg standard side crank engines direct-connected to 125 kw, General Electric generators and one 160-hp engine direct-connected to a 100-kw generator. The contracts were awarded through Kenneth M. Muchison, Jr., 5 W. Thirty-first Street, New York.

CHRISTCHURCH N. E. POWER HOUSE.—The New England Electric Construction Company, of Christchurch, which has secured the contract, valued at $1,250,000, for the construction and equipment of a 30-mile electric traction system in that city, is ordering more power house equipment in this market. The Alberger Condenser Company has taken the order for the surface condensers and cooling towers to take care of a 1000-kw generating outfit. The boilers will be Babcock & Wilcox. Curtis turbines two units of 500-kw each will be installed.

SHAW CRANES FOR SWEDISH IRON WORKS.—Manning, Maxwell & Moore have secured a contract for an electric traveling crane of 30 tons capacity equipped with two trolleys for installation in the open hearth plant of the Sanviken Iron Works—the largest iron and steel manufacturing concern in Sweden. The crane, which will be a duplicate of an outfit shipped the same Scandinavian works eight years ago, is to be built by the Shaw Electric Crane Company.

THE NERNST IN NEW ENGLAND.—The Nernst lamp is becoming widely introduced in New England. The company has recently received two large orders, one from the Saco & Pettee Machine Shops, Biddeford, Me., for 575 three-glower lamps, and one from the Arlington Mills, Lawrence, Mass., for 600 lamps of the 44-watt type. The second order comes in the form of a testimonial, as quite a large installation of Nernst lamps had already been made in the mills.

FANS FOR INDIA.—The Fidelity Electric Company, manufacturers of electric fans, Lancaster, Pa., is in receipt of a good-sized order for its Eclipse desk fans for India, and has just filled a large order for ceiling fans for the Orient. All southern Asia is badly in need of fan motors and the Fidelity Company is doing what it can to make life pleasant there.

LIGHTING PLANT FOR TEPIC, MEX.—The municipal authorities of Tepic, a town of 15,000 population in the State of Jalisco, Mexico, are having plans drawn up for the construction of an electric lighting system which will have American equipment. General Pablo Rocha y Portee, the governor of the territory, is primarily concerned in the project.

EQUIPMENT FOR TAMPA PLANT.—The Tampa (Fla.) Electric Company is about to increase the capacity of the plant. The company is managed by Stone & Webster, of Boston, Mass. The Hooven, Owens & Renschler Company, of Hamilton, Ohio, has secured an order for a 750-hp cross compound condensing engine for direct connection to a General Electric generator.

WELLINGTON, N. Z. SYSTEM TO BE EXTENDED.—The municipal electric traction system now being built at Wellington, New Zealand, by Macartney, McElroy & Company, Limited, Havemeyer Building, is to be extended at an additional expenditure of nearly $350,000.

MORE EQUIPMENT FOR WEST AUSTRALIA.—The Perth Electric Tramways, Limited, of 3 Lawrence Poultney Hill, London, E. C., is about to extend its power plant. The present system was built and equipped by J. G. White & Co. It is somewhat over 10 miles long.

VARIOUS EQUIPMENT FOR MEXICO.—The export house of Loiza & Co., 54 Broad Street, New York, has received a contract valued at about $50,000, which calls for the shipment of various electrical equipment to Mexico.

EQUIPMENT FOR ONTARIO POWER PLANT.—The Ontario Power Company's plant at Niagara is to have a 50-ton Shaw electric traveling crane with a span of 77 feet.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary S. S. Stadtler, 39 S. 10th St., Philadelphia. Next meeting, St. Louis, Sept. 12-17, 1904.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit. Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next meeting St. Louis, Mo., Oct. 12 and 13, 1904.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., June 15, 16 and 17, 1904.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, D. Fleming, Harrisburg, Pa.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y. Next meeting, Utica, July 19, 1904.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, LaSalle, Ill.

INDIANA PUBLIC UTILITIES ASSOCIATION. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Pichardt, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, St. Louis, Sept. 13 and 14, 1904.

INTERNATIONAL ELECTRICAL CONGRESS. General secretary, Dr. A. E. Kennelly, Cambridge, Mass. Meeting, St. Louis, Sept. 12-17, 1904.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Dubuque, Ia., April, 1905.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Ia. Next meeting, second Tuesday, March, 1905.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ind.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May 24, 25 and 26, 1904. Headquarters, Hotel Vendome.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept., 1904.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Sandusky, Ohio, Aug. 16, 17 and 18, 1904.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, Canton, Ohio. Next meeting, Columbus, O., May 13, 1904.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next annual meeting June 21, 1904.

SOUTHWESTERN ELECTRICAL ASSOCIATION. Secretary, J. L. Ellis, Oklahoma City, Okla.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSOCIATION. Secretary, Frank E. Scovill, Austin, Texas.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, Sept. 21 and 22, 1904.

WESTERN SOCIETY OF ENGINEERS, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

General News.

THE TELEPHONE.

SITKA, ALASKA.—The Long Distance Telephone Company will build a line to Unalakleet from Chinik, the present terminus of the line.

MARVELL, ARK.—The Marvell Telephone Company has been incorporated with a capital stock of $20,000. The directors are E. E. McMurray and others.

LITTLE ROCK, ARK.—The New Long Distance Telephone Company has been incorporated with a capital stock of $200,000. J. B. Kin is president and general manager.

LOS ANGELES, CAL.—An ordinance is being prepared requiring the reconstruction of conduit each year by the telephone and lighting companies.

CAMPUS, CAL.—The Campus Telephone Company has been incorporated with a capital stock of $2,500, by J. D. Brophy, M. R. Walsh, N. L. Mamer and others.

TWO ROCK, CAL.—The residents of Two Rock have organized the Two Rock Valley Telephone Company. George Gaston is secretary of the company. The line will be 25 miles long.

SANTA ROSA, CAL.—Sealed bids will be received by F. L. Wright, county clerk, until May 7, for a franchise to construct and maintain a telephone system in Sonoma County, as applied for by J. M. Laughlin. Bids will also be received at the same time and place for similar privileges applied for by C. L. Patterson.

WATERBURY, CONN.—The Waterbury Automatic Telephone Company has increased its capital stock from $10,000 to $50,000.

WASHINGTON, D. C.—The Terra Telephone Company has been incorporated with a capital stock of $100,000. The directors are E. Schooley, F. C. Geiger and others.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the District Commissioners until noon, May 7, for furnishing underground signal and telephone cables for the electrical department of the District of Columbia.

BARTOW, FLA.—Mr. J. M. Oliver, of Orlando, is making arrangements to build a telephone line from Jacksonville to Tampa by way of Bartow. The enterprise is to be known as the Florida Co-operative Telegraph & Telephone Company and will be incorporated at $100,000. Building operations of this system will begin about May 15.

JACKSONVILLE, FLA.—The Southern Bell Telephone & Telegraph Company is stringing a direct copper-wire line between Jacksonville and Fernandina. There will be four wires on the new line.

PEORIA, ILL.—The Interstate Telephone Company will install a service here.

HARDIN, ILL.—The Calhoun Telephone Company has increased its capital from $15,000 to $25,000.

EDWARDSVILLE, ILL.—The Oak Grove Telephone Company has been organized in Fort Russell Township.

MATTOON, ILL.—The Gayes Mutual Telephone Company of Mattoon has increased its capital stock from $2,400 to $4,980.

CHICAGO, ILL.—The Chicago Telephone Company has secured a 20-year blanket franchise, covering all the towns in Lake County. The grant is not exclusive.

DANVILLE, ILL.—A contract for the new building of the Vermillion County Telephone Company has been awarded at $16,000. Mr. H. B. Walter will erect the building.

ATHENS, ILL.—The Menard County Telephone Company has been organized and has received a franchise. Toll lines will be built to connect with the Interstate Independent Telephone & Telegraph Company at Springfield and other points.

CHICAGO, ILL.—The directors of the Automatic Electric Company have declared the regular quarterly dividend of two per cent., payable May 2. The company is reported in a prosperous condition. It was stated that 26 cities are now using the automatic telephone system and when present contracts are filled the system will be used in 59 cities. It was stated that by May 15 the Illinois Tunnel Company will have about 8300 instruments in operation in the downtown district of Chicago.

JASPER, IND.—The Velpen, Ireland and Atwell Telephone Company has sold its plant to the Dubois County Telephone Company at Huntingburg.

INDIANAPOLIS, IND.—The American Telephone & Telegraph Company is getting the right of way for a trunk line to extend from Chicago to this city.

ST. JOSEPH, IND.—The German Township Home Telephone Company, recently organized with 65 members, is constructing an exchange at this place.

PROVIDENCE, IND.—The Providence Telephone Company is running its line to Banta and Trafalgar. The company contemplates putting in a new switchboard this summer.

HEBRON, IND.—A telephone line between this place and Macksburg has been completed and as soon as the exchange is installed, service will be given a large number of patrons.

COLFAX, IND.—The American Telephone & Telegraph Company proposes to build a trunk line from Chicago to Indianapolis and the work of securing the right of way is now proceeding.

LAWRENCE, IND.—The Lawrence Telephone Company has incorporated with a capital stock of $10,000. The directors are M. M. Hindman, L. H. Rattliff and Harry Mollenkopf.

CLEVELAND, IND.—The Cleveland Telephone Company, of Hancock County, has been incorporated with a capital stock of $160, by E. H. Thomas, Ada L. Sample, E. L. Furry and others.

CHESTERTON, IND.—The town council has granted a franchise to the

Portage Home Telephone Company. The rates are limited to $1 and $1.25 per month for residence and business telephones.

ELKHART, IND.—The Home Telephone Company, of this city, is laying 14,000 feet of new additional cable. This was necessary to the installing of the many new telephones which have been applied for.

GREEN CASTLE, IND.—A new telephone company has been organized in Madison township. The officers are Charles Kyte, president; Zimri Boswell, vice-president; J. N. Dalby, treasurer, and Thomas Heady, secretary.

FLORA, IND.—A combination of the independent telephone companies of Flora, Delphi, Frankfort, Logansport and Kokomo has been effected for mutual protection against the invasion of co-operative systems in this section.

LAFAYETTE, IND.—The Lafayette Telephone Company suffered an annoying accident on April 16. An electric light wire came in contact with one of the telephone leads and about 1200 instruments were disabled and a number damaged.

LAWRENCE, IND.—The Lawrence Telephone Company has increased its capital stock $10,000 for the purpose of extending its lines, installing a new switchboard and making other betterments. M. M. Hindman is president and L. H. Ratliff, secretary.

BATTLE GROUND, IND.—The Cairo Telephone Company, of this town, has sold its plant and property to Eldon T. Roadrick, of Brookston, one of the original stockholders. Mr. Roadrick announces that he will extend the lines and improve the plant.

ROYAL CENTER, IND.—G. S. Akers, of Ambia, Ind., has purchased the Thomas-McCombs telephone plant in this city. Mr. Akers announces that he will at once put in a new and improved switchboard. He will also make extensions and other improvements.

BICKNELL, IND.—The Bicknell Telephone Company has increased its capital stock in the sum of $12,000. The object is to extend its lines, improve the plant and increase the capacity of the switchboard. Joseph Bare is president and John S. Hoover, secretary.

INDIANAPOLIS, IND.—The Northwestern Long Distance Telephone Company, of Mohawk, Hancock County, has incorporated with a capital stock of $2,000. J. W. Murphy, Sr., Emory Pratt, G. W. Allen, J. M. Duneau and Clint Parker are the incorporators.

EVANSVILLE, IND.—It has been stated by the directors and a few stockholders of the Evansville Municipal Telephone Company that an attempt will be made to form a local independent company entirely eliminating the municipal feature and putting it on the basis of other independent companies

NEW CASTLE, IND.—The Cadiz Telephone Company, the original and largest co-operative telephone company in this county, will in the future have no affiliation with the Bell interests. At a recent meeting of the stockholders, a resolution was passed, declaring that all business in the future will be done with independent companies.

SOUTH BEND, IND.—The annual meeting of the South Bend Home Telephone Company was held recently and Theodore Thorward was elected president, M. B. Slatey, treasurer, and Elmer Stoll, secretary. C. H. Worden heads the board of directors. The company is in a flourishing condition and declared a regular semi-annual dividend of two per cent.

CORYDON, IND.—The Eureka Telephone Company will make a number of extensions of its lines at once. The company has issued a new directory which shows that it has three exchanges in the county with telephones as follows: Corydon, 170; Laconia, 166; Mauckport, 85. The following are the officers: Ed. F. Windell, president; Chas. Yeager, vice-president; H. P. Beanblossom, secretary; L. S. Flesbman, treasurer.

ELWOOD, IND.—Sixty-five more farmers on the rural lines were connected by telephone with Elwood recently. One hundred and thirty applications are also waiting to be approved by the telephone company. The Delaware and Madison Counties Telephone Company, the independent line, is working along the rural lines and five new circuits have been built to meet the demand. Over 300 farms are already connected with the local exchanges.

NAPOLEON, IND.—The citizens of Delaware and Laughery townships, Ripley County, have organized a stock company to build a telephone system from Napoleon, Laughlin township, to connect with Dr. Gibson's line which runs into Batesville. The officers are: President, John Bullman; secretary-treasurer, Granville Thackery. Work on this line will begin as soon as the officials can purchase the material and contract for its construction.

INDIANAPOLIS, IND.—The leases on the property and equipment of the New Telephone Company have been signed over to the Indianapolis Telephone Company, which was organized recently to take the property of the New company and extend and improve the service. The Indianapolis Telephone Company has also taken a mortgage from the New company for $150,000, which covers the floating indebtedness, and all future work of extending the lines, laying new cables and installing branch exchanges will be done by the Indianapolis company.

BOISE, IDA.—The Rocky Mountain Bell Telephone Company has definitely announced its decision to extend its lines as far as the famous Thunder Mountain district as soon as the state road to that point, 75 miles in length, is completed.

SCHLESWIG, IA.—The Schleswig Telephone Company has bought material for 20 miles of extensions.

WEST UNION, IA.—The Rogers Telephone Company has been formed with a capital stock of $25,000.

ELDON, IA.—Mr. C. A. Mann, of Sioux City, has bought the Eldon Telephone Company and will improve and extend the service.

CONESVILLE, IA.—The Conesville Telephone Company has been incorporated with a capital stock of $10,000. J. G. Van Lent is president.

CEDAR FALLS, IA.—A stock company has been formed to install an independent telephone system here. N. H. Harris is president and F. O. Jackson, secretary.

OLATHE, KAN.—The De Soto & Olathe Telephone Company has filed articles of incorporation, the capital being $2,000.

JUNCTION CITY, KAN.—The Union Telephone & Telegraph Company's new toll line to Topeka is now in operation. It furnishes the independent companies of central Kansas connection with Kansas City and other eastern points, and its construction cost the company $125,000.

FLEMING, KY.—The Ewing Mayslick Telephone Company, of Fleming, has been incorporated.

NEW ORLEANS, LA.—An effort is being made to have all telephone and telegraph wires placed underground on Canal Street, between Liberty and City Park Avenue.

LAUREL, LA.—The Cumberland Telephone Company has acquired possession of the Mississippi Telephone Company, of this place. Both the Laurel and Ellisville exchanges are included in the deal and half of the line between here and Hattiesburg.

ROCKLAND, ME.—The Northwestern Telephone Company is securing permission to enter Lewiston and Auburn.

SKOWHEGAN, ME.—The New England Telegraph & Telephone Company has decided to install a system here.

NEW BEDFORD, MASS.—The Automatic Telephone Company, it is stated, contemplates increasing its capital stock to extend its business to adjacent towns.

KALAMAZOO, MICH.—The Citizens' Telephone Company will spend $80,000 in improvements in this city.

LANSING, MICH.—The Citizens Telephone Company will make several extensions and improvements to its system during the coming summer. All the new work will be made with a view to the early installation of the automatic system.

TORDENSKJOLD, MINN.—The Independent Mutual Telephone Company will extend its line 35 miles.

ARLINGTON, MINN.—The Merchants' Telephone Company has been incorporated with a capital stock of $4,000.

OSSEO, MINN.—The Rural Telephone Company has been organized to build a line in Hennepin and Wright counties. The capital stock is $50,000.

JACKSON, MISS.—The Cumberland Telephone Company is changing its local exchange to the central energy system and will reconstruct a large amount of pole line.

OTTERVILLE, MO.—The Otterville-Smithton Telephone Company has increased its capital from $2000 to $5000.

DE KALB, MO.—The DeKalb Telephone Company has been incorporated with a capital stock of $10,000. The directors are W. W. Head, C. V. Davis and others.

DEWITT, NEB.—The Dewitt Telephone Company has increased its capital stock to $20,000, and will make extensive improvements in its exchange.

OMAHA, NEB.—The Farmers' Telephone Company, of Alexandria, Thayer County, has been incorporated with a capital stock of $5,000.

OMAHA, NEB.—The new central energy automatic switchboard of the Nebraska Telephone Company was recently cut into srvicve. It cost $250,000.

ENDICOTT, NEB.—The Endicott Telephone Company has filed articles of incorporation, the capital stock being $2,500. The incorporators are H. Stolz, H. E. Potter, J. A. Blausett.

SWEDESBORO, N. J.—The People's Rural Telephone Company contemplates extending its lines to reach several towns in this vicinity. Forty miles of line will be erected and 120 telephones have been subscribed for.

HOPEWELL, N. J.—The Hopewell Telephone & Construction Company has agreed to sell its local system to the Delaware & Atlantic Telephone & Telegraph Company. The system will be transferred about May 15 when the Bell interests will come in possession.

TROY, N. Y.—The Commercial Union Telegraph Company of this city has increased its capital stock from $10,000 to $800,000.

AMSTERDAM, N. Y.—The Amsterdam Automatic Telephone Company has increased its capital stock from $15,000 to $100,000.

POUGHKEEPSIE, N. Y.—The Dutchess County Telephone Company will make some important extensions to its service. Exchanges will be installed in several places.

BABYLON, L. I., N. Y.—The village board has granted permission to the New York & Long Island Telephone Company to come into Babylon by an underground circuit.

KILLAWOG, N. Y.—The Rural Telephone Company has been organized here by business men and farmers. The directors are T. R. Hitt, president; C. J. Tarble, vice-president; W. C. Ensign, secretary, and P. Hilsinger, treasurer.

SYRACUSE, N. Y.—The Central New York Telephone & Telegraph Company has let the contract for the construction of a subway under the Oswego Canal, in North Salina Street, this city. Seven 3-inch iron ducts will be laid.

RED CREEK, N. Y.—At a conference held here it was arranged to unite as one concern the Wayne-Monroe Telephone Company and the Ontario Telephone Company of Oswego. The Wayne-Monroe Company connects with the Inter-ocean Telephone Company, and by this service is enabled to reach Rochester, Buffalo, Ohio, Southern New York and Pennsylvania. In the Western New York system there are said to be 50,000 telephones.

REIDSVILLE, N. C.—The Reidsville telephone exchange has recently been remodeled and the system is now in fine working order with 150 telephone connections on the switchboard.

CHARLOTTE, N. C.—The Automatic Electric Company, of Chicago, has installed an experimental set of telephone instruments at Greensboro, N. C., which will be adopted in the proposed independent system, unless the present differences with the Bell Company are adjusted.

GREEN SPRING, OHIO.—The Green Spring Telephone & Electric Company has increased its capital stock from $20,000 to $35,000.

GREENWICH, OHIO.—The Fitchville Telephone Company is preparing to build a line into Greenwich to connect with the exchange at that place.

TOLEDO, OHIO.—The Central Telephone Company has been incorporated with a capital stock of $100,000. The directors are J. S. Brailey, H. A. Barber and others.

NORWOOD, OHIO.—The independent telephone interests that recently failed to secure a franchise in the village of Norwood are making an effort to secure the passage of their ordinance in an amended form.

JEWETT, OHIO.—Fred Patton, of this place, is building a number of farmers' lines throughout this district. He is preparing to build a new line from Jewett to Hanover and Stillwater. The lines will be connected with the exchange at Jewett.

NEWARK, OHIO.—The Central Ohio Telephone Company, of Centerburg, Knox County, has been incorporated by Charles L. Bishop, T. P. Sylvan, E. E. McGuire, J. E. Litzenburg and G. N. Jackson. Capital stock, $10,000. It will build an exchange at Centerburg with lines in Morrow, Licking and Delaware counties.

GUTHRIE, OKLA.—The Chickasaw & Choctaw Telephone Company, of Durant, has purchased the Hugo Telephone Exchange and the toll line, 25 miles in length.

TORONTO, ONT.—In discussing the fire situation at a special session of the Board of Control, action was taken with a view to placing all wires underground within the city.

DURKEE, ORE.—The Express Telephone & Telegraph Company has been incorporated by W. G. Ayre, F. S. Hub and F. L. Moore, to build a system in the Brunt River region.

WILLAMETTE, ORE.—The Willamette & Wilsonville Telephone Company has been organized and will incorporate to construct a line between Stafford and Oregon City. Mr. Charles Baker is president; G. H. Rogers, treasurer; F. C. Geery, general manager.

PHOENIXVILLE, PA.—The citizens of this place propose to organize a local mutual telephone company. Mr. William Ellis is one of the promoters.

EASTON, PA.—Mr. A. G. Dickson, of Philadelphia, special master, April 16, sold the system of the New Jersey & Pennslyvania Telephone Company to J. Davis Broadhead, of South Bethlehem, attorney for the bond holders, for $25,000.

SAN ANTONIO, TEX.—The Eureka Telephone Company is rebuilding its telephone line between this city and Fredericksburg. Its line between San Antonio and Alice has just been rebuilt.

AUSTIN, TEX.—The Texas Telegraph & Telephone Company, which owns and operates more than 600 miles of telephone lines in this part of the State will rebuild its lines between Burnst and Lampasas, a distance of about 25 miles. It will also make extensions of some of its other lines. At a recent meeting of the board of directors of the company held here, Col. C. C. Gibbs, of San Antonio, Tex., was re-elected president. He can give information in regard to contemplated improvements.

SALT LAKE CITY, UTAH.—The competitive war between the Rocky Mountain Bell Telephone Company and the Utah Independent Telephone Company commenced a few days ago when the management of the new company, which is now ready to begin business here and in Ogden, stating that it would utilize the same numbers now in use by the Bell Company. The manager of the Bell Company has protested, stating that the numbers are copyrighted and cannot therefore be lawfully used by the rival company.

RICHMOND, VA.—The Rural Retreat Mutual Telephone Company has been incorporated with a capital stock of $5000. Mr. John Killinger is president.

RICHMOND, VA.—The Patrick County Telephone Company, of Stuart, has been incorporated with a capital stock of $1,000 to $5,000. Mr. T. L. Clark is president.

KALAMA, WASH.—The Kalama Electric Light & Power Company will soon commence the installation of a telephone system.

PORT TOWNSEND, WASH.—The Citizens' Independent Telephone Company, of this place, has been incorporated with a capital stock of $10,000. The trustees are A. T. West, N. C. Strong, G. M. Parmlee, D. S. Troy and M. E. Harris.

BELLINGHAM, WASH.—The International Telephone Company is being organized here to build a connecting line between Bellingham and Victoria, B. C., through the San Juan Archipelago, a distance of 70 miles. The circuit will include 17 miles of cable costing $60,000.

ST. CROIX, WIS.—The St. Croix Mutual Telephone Company has been formed here.

MILWAUKEE, WIS.—The Milton & Milton Junction Telephone Company has increased its capital stock from $5,000 to $20,000.

ALMA, WIS.—The Tenney Telephone Company has been organized, Dr. J. S. Tenney being president and J. Accola, secretary.

MILWAUKEE, WIS.—The Great Western Telephone & Telegraph Company has decided to dissolve. Mr. Charles Webster is president and Robert C. Brown, secretary.

WILLOW SPRINGS, WIS.—The Willow Springs Farmers' Telephone Company has been incorporated with a capital stock of $4,000. The directors are Frank McCarville and others.

ELMWOOD, WIS.—The Highland Telephone Company, of Elmwood, has been organized to operate a system in Pierce and Dunn counties. The capital stock is $1000, and the incorporators are H. A. Miles, W. H. Young, Hugh Bell, Ira J. Smith and William Fensenmaier.

ELECTRIC LIGHT AND POWER.

MORENCI, ARIZ.—It is reported on apparently trustworthy authority that the Arizona Copper Company is interested in a project to establish a large electric power plant on the Blue River for the purpose of furnishing lights and power for this mining camp and town.

MALVERN, ARK.—Mr. C. W. Turner, proprietor of the electric light plant in this place, proposes to install a new dynamo and boiler.

SANTA PAULA, CAL.—The Santa Paula Electric Company proposes to extend its lines for the general distribution of light and power.

ALTURAS, CAL.—The Alturas Electric Light & Power Company has been incorporated with a capital of $20,000, by D. E. Mulkey and I. W. Gibbons.

OAKLAND, CAL.—The Oakland Electric Company will develop a second water-power station having a capacity of 15,000-hp, and will also install 750-hp steam plant during the next year. The probable cost of these improvements will be about $100,000.

MARTINEZ, CAL.—The Contra Costa Electric Light Company proposes to extend its lines to Concord, a distance of seven miles. The company purchases its current from the California Central Gas & Electric Corporation of San Francisco and has the city contract for street lighting, besides doing commercial lighting.

SAN FRANCISCO, CAL.—After a delay of many months the Mutual Electric Light Company of San Francisco, has given orders to at once construct the new electric power station at the intersection of Spear and Folsom Streets, covering a lot 137½ feet square. The machinery for the initial installation of 5,000-hp is on hand with the exception of the boilers. Additional boilers will be ordered, although the company has six Heine boilers at its present plant at Howard and New Montgomery Streets. This station will be abandoned. The equipment of the new plant will include two generating units each consisting of a 2,500-hp Pennsylvania Iron Works horizontal compound engine, direct connected to a Bullock 1,500-kw 2-phase generator. Current will be supplied at 2,200 volts. Additional boilers can be placed on the upper floors of the station, and by utilizing all of the ground available the capacity of the plant can be increased to 40,000-hp. Oil fuel will be used. A bond issue of $400,000 is to be authorized at a shareholders' meeting June 21. E. H. Rollins & Sons, of San Francisco and Boston, have agreed to purchase the bonds to the amount of $250,000.

GRAND JUNCTION, COL.—The Grand Junction Electric & Gas Company has doubled the capacity of its plant during the last three months. Mr. Charles S. Newton is manager.

GLENWOOD SPRINGS, COL.—The Colorado Power Irrigation Company, Denver, has purchased a water right about 12 miles above Glenwood Springs on the Grand River.

WATERBURY, CONN.—Bids will be received by Jas. Knox Taylor, supervising architect, Treasury Department, Washington, D. C., on May 26 for the installation of a conduit and electric wiring system for the U. S. post office at Waterbury.

BLAKELY, GA.—The water and electric light plant owned and operated by the city was destroyed by fire April 15.

THOMASVILLE, GA.—The town authorities have under consideration the construction of water works and an electric light plant.

BLUE RIDGE, GA.—The Blue Ridge Electric Light & Power Company contemplates making some extensive improvements to its system in the near future. It is proposed to utilize water power for the generation of current for electric light and power. Mr. E. B. Garwood, of Blue Ridge, is manager of the company.

LEWISTON, IDA.—Francis Jenkins, of Moscow, has purchased from John O. Bender, of Lewiston, the water right at Elk Creek Falls, about 50 miles from here. Mr. Jenkins will organize a company to develop an electric power there for running electric railways and light plants, grist and sawmills, and manufacturing plants of various kinds. A survey of the falls shows that 3,000-hp can be generated.

MOUND CITY, ILL.—Chas. Cureen is about to petition the City Council for a franchise to install and operate an electric plant here.

CHICAGO, ILL.—Mayor Harrison, in his annual message to the Council, urges the passage by the next Legislature of a law to enable the city to own gas and electric light plants.

CARTHAGE, ILL.—The Carthage Electric Light & Heating Company has changed its name to Carthage Electric Light & Power Company, and increased its capital stock from $20,000 to $50,000.

ELGIN, ILL.—The Fox River Light, Heat & Power Company has absorbed by purchase the Aurora, Elgin and Chicago Light & Power Company to avert a rate war.

FREEPORT, ILL.—The Pecatonica River Power Company has been incorporated with a capital of $5000, to operate electric lighting, railway and power plants. Incorporators: Henry B. Witte, Jos. H. Vincent and Chas. B. Courtney.

NEW HAVEN, IND.—Bids are wanted May 24 for constructing an electric light plant. John M. Jackson is Town Clerk.

GRETNA, IND.—The Jefferson Ice & Electric Light Company will enlarge the capacity of its plant in order to light the towns of Gretna and McDonoughville, if the contract can be secured in these towns.

SOUTH BEND, IND.—The South Bend Electric Company, F. A. Bryan, manager, is erecting a sub-station in South Bend from which power will be distributed from the Twin Branch Dam of the St. Joseph & Elkhart Power Company and the Buchanan dam of Mr. C. A. Chapin.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company is building a new power plant with a capacity of 800-kw., all direct connected units. The new plant will cost $150,000 and will be ready for operation July 1 next.

MARION, IND.—A bitter political fight is being waged in this city, the issue being a franchise for an electric light and heating company. The council is being charged with an intention of conspiring to sell the municipal electric light plant to the Marion Light & Heating Company which has a monopoly in commercial lighting and heating. An injunction suit has been filed to prevent the city officials from disposing of the municipal plant.

NOBLESVILLE, IND.—All bids for the contract to light this city for ten years were rejected because they were filed twenty minutes after 7 o'clock, April 19, the time advertised. It is thought that the council took advantage of this slight omission in order to enable the Noblesville Hydraulic Company, which is building a dam across White River for the purpose of furnishing electricity to Noblesville, to submit a bid. The company could not bid at present, owing to some cases pending in the Supreme Court, but will be ready to submit a bid any time after June 15. Bids will be re-advertised.

SPRINGFIELD, KY.—The Springfield Water & Electric Light Company is making large extensions to its system.

PADUCAH, KY.—The Board of Public Works has decided to improve the electric light plant.

NEW ORLEANS, LA.—Notwithstanding the acceptance of the lighting bid of the New Orleans Railroad & Power Company for furnishing electric power for illuminating in this city, it is positively stated by President Dreyfous, of the Consumers Electric Company that the building of its plant will begin at an early date.

NEW ORLEANS, LA.—Comptroller Tujague, on April 18, sold the municipal lighting franchise at public auction to the New Orleans & Carrollton R. R., Light & Power Company, the lowest bidder. The figures were $69 per lamp for the overhead lamps; $85 per lamp for the lamp fed by the underground system, and 6 cts. per kw-hour for the incandescents and other lights used in the public buildings.

LAKE CHARLES, LA.—The Lake Charles Ice, Light & Water Works Company contemplates the addition of a 300-kw generator, a 100-light station transformer and 50 alternating current series arc lamps. Mr. J. A. Landry is president and manager of the company.

SPRINGFIELD, MASS.—The United Electric Light Company will install a 100-kw steam turbine about the 1st of October next.

BALTIMORE, MD.—Bids will be received by the Board of Awards until May 11 for installing and maintaining electric lights in Druid Hill Park. W. W. Crosby is general superintendent of the Park Commissioners.

BALTIMORE, MD.—The Maryland Telephone & Telegraph Company has had introduced in the council a new ordinance for electric lighting privileges. The original bill was vetoed by the mayor. It is claimed that the Maryland Company has in the new ordinance met the objections of the mayor.

GERARD, ILL.—The Gerard Electric Light Company is in need of a larger alternating current generator. Mr. H. L. Wares is superintendent and chief engineer. The plant is operated by the municipality.

WATERVILLE, ME.—The Ft. Halifax Power Company has been organized at Waterville to construct an electric light and power plant in Benton and Winslow; capital, $250,000. Harvey P. Eaton, of Waterville, president and treasurer.

PAW PAW, MICH.—The village electric light plant will be entirely renewed in the near future.

ZEELAND, MICH.—The Zeeland Water & Light Company will probably install a 15-kw direct-current, 250-volt marine set before next winter, for use after midnight.

BREWSTER, MINN.—The Village Board has under consideration the construction of an electric plant.

CANNON FALLS, MINN.—Bids are wanted May 14 for installing a power plant on the Cannon River near this village. Approximately 10,000 cubic yards of concrete, three horizontal, direct connected water wheels, operating under 46 ft. head and generating 1575-kw at 30,000 volts, with three generators, step-up transformers, switchboards, oil switches, etc. Address G. S. Edmonstone, chief engineer, 518 Globe Bldg., St. Paul.

STARKVILLE, MISS.—The municipal electric light plant is being enlarged to about twice its former capacity.

SEDALIA, MO.—The Sedalia Water & Light Company will build an entirely new plant during the coming summer.

SANFORD, N. C.—The Sanford Electric & Power Company will extend its lines to Jonesboro, N. C., a distance of two miles and add 500 lights to the service.

CONCORD, N. C.—The municipal electric light plant will be changed over to alternating current during the next 12 months, and new equipment will be installed, including 60 arc lights and 1500 incandescents, with suitable machinery for the service.

COOPER, NEB.—The electric light plant at this place was destroyed by fire April 18. Mr. W. T. Martin, the proprietor of the plant, will rebuild at once. In the meantime the town is in darkness.

PRINCETON, N. J.—Richard Stockton has been appointed receiver for the Princeton Light & Power Company. It is stated that the assets of the company are $400,000 and the liabilities about $600,000.

ASBURY PARK, N. J.—The Atlantic Coast Electric Company is building another new circuit to Spring Lake, a distance of six miles. The circuit will be operated only by day during the months of May, June, July, August and September.

JERSEY CITY, N. J.—The Street and Water Board has granted permission to the United Electric Company, of New Jersey, which is now included in the Public Service Corporation, to construct subways for electric light, heat and power wires in certain streets of this city.

CHATEAUGAY, N. Y.—The Chasm Power Company proposes to build a line to Burke, N. Y., a distance of five miles, for the extension of its light and power service.

NIAGARA FALLS, N. Y.—It is stated that the Ontario Power Company contractors on the Canadian side of the river are experiencing considerable difficulty with land slides. Hardly a day passes that there are not one or more slides of land in the wheel pits and in the long trench of the Company. The trench now contains a large quantity of earth thus deposited, which will be removed as soon as the weather permits.

WILMINGTON, OHIO.—The Wilmington Water & Light Company is building an entirely new plant, to be completed by September next.

TOLEDO, OHIO.—Mayor Jones in his annual message advises Council to empower the Board of Public Service to advertise for bids for installing a 2000-arc light lighting system to be paid for by the city without a bond issue.

BELLAIRE, OHIO.—The Belmont Electric Light & Power Company is planning additions and improvements to the power plant that will almost double its capacity.

COLUMBUS, OHIO.—Bids will be received May 31 by the Board of Trustees of Ohio State School for the Blind for furnishing and installing one 200-hp water-tube boiler; two 100-hp tubular boilers or four 100-hp tubular boilers. H. P. Crouse is president.

MEAFORD, ONT.—Messrs. W. Moore & Sons, proprietors of the electric light plant, are developing a water power with a capacity of about 400 horsepower.

KLAMATH FALLS, ORE.—The Klamath Falls Light & Water Company will install a gasoline engine to take care of the increasing demand for its service.

SUMPTER, ORE.—The Sumpter Light Water Company will, about July 1 this year, change its power from steam to water.

CORRY, PA.—A new power house for the Corry City electric light plant is contemplated.

MECHANICSBURG, PA.—The United Electric Company is rebuilding and reconstructing its plant and installing new equipment.

EASTON, PA.—The directors of the People's Electric Light & Power Company have re-elected Dr. Evans as president; Mr. Osterstock, treasurer, and Mr. Ormsby, secretary.

CHRISTIANA, PA.—Mr. A. J. Melchen, owner of the electric light plant here, proposes to extend his system in order to take in three towns and farmer districts.

LANSDALE, PA.—The equipment of the municipal electric light plant in this place will be extended during the present year by the addition of one 120-kw alternating current machine, one 250-hp Corliss engine and one boiler.

IROQUOIS, S. D.—The electric light plant of this village is operated by the municipality. The power is furnished by a "Little Giant" turbine. The management contemplates putting in a second dynamo in order to avail of all the power of the water wheel. The chief engineer of the plant is Keefus Bartain. Mr. Charles E. Cameron is chairman of the commissioners.

ENID, IND. TER.—The Chickasha Electric & Gas Company has been incorporated with $45,000 capital. The incorporators are J. M. Dodson, H. H. Watkins and J. B. Thieme.

CALDWELL, TEX.—An electric light and power plant is to be established here. The Business Men's League can give information in regard to the project.

SAN ANTONIO, TEX.—Bids are wanted May 10 for installing a system of electric light wiring and fixtures in U. S. Court House and Post Office here. Address H. A. Taylor, Assistant Secretary Treasury Department, Washington, D. C.

BLACKSBURG, VA.—The Virginia Polytechnic Institute will increase the capacity of its electric plant to about three times the present size.

MARTINSVILLE, VA.—The town of Martinsville contemplates installing an electric light and power plant with a capacity of 1000-hp, to be operated by the town. Besides the lighting system, power will be sold for industrial purposes. The water power of Smith River, at a point one mile south of town, will be utilized. Engineers are now on the ground making surveys and estimates. Mr. A. L. Scott, representing Lockwood & Green, of Boston, Mass., is the engineer in charge.

MONROE, WASH.—The Monroe Water & Light Company recently organized will install a water system and an electric light plant.

FT. WRIGHT, WASH.—Bids are wanted May 31 for lighting the post with electricity; separate bids are wanted for the apparatus. Address Capt. W. C. Wren, Constructing Q. M., Vancouver Barracks.

MILTON, WASH.—Engineers for the Oregon & Washington Power Company are at work on a site for the power plant on the South Fork of the Walla Walla River near this place. It is expected to have the plant in operation by October 1 and to furnish light and power throughout the section of country between Walla Walla, Wash., and Pendleton, Ore. The company bought up the Walla Walla Electric Light Co. and the Pendleton Electric Light & Power Company, and is financed by Philadelphia capital.

IRON RIVER, WIS.—The Iron River Water, Light & Power Company will install a water power in the near future.

WITTENBERG, WIS.—Bids will be received May 9 by John England, village clerk, for constructing an electric light plant.

OSHKOSH, WIS.—The property of the Oshkosh Electric Light & Power Company is to be taken out of the hands of a receiver in the near future and sold on foreclosure. It is stated that the plant is now on a paying basis and the services of a receiver can be dispensed with.

THE ELECTRIC RAILWAY.

HOT SPRINGS, ARK.—The Hot Springs Street Railway will be extended and a number of improvements made to the property. President S. W. Fordyce, Chemical Building, St. Louis, has the matter in charge.

NANAIMO, B. C.—Mr. C. Brandeis has asked for a charter for an electric street railway system; also a line between Nanaimo and Bracken in the newly discovered coal fields. It is proposed to derive power from the Nanaimo River Falls. Mr. Brandeis represents a Montreal syndicate.

WALLINGFORD, CONN.—The Wallingford Tramway Company will at once begin the construction of a line from this borough to Montowese, in the town of North Haven, where connections will be made for New Haven with the Fair Haven & Westville Railroad Company. The road will be 7 miles long, and the materials for it have been ordered.

DENVER, COL.—The Chaffee County Electric Light, Power & Railway Company has filed articles of incorporation with the Secretary of State. The company, which is capitalized at $500,000, is empowered to furnish electric power and construct street railway lines in Salida and its suburbs, and also to the towns of Buena Vista, Turret and Poncha Springs. Former United States Senator William E. Mason of Chicago, Ill., and T. F. Mason of Des Moines, Ia., will be prominently identified with the concern.

HOSCHTON, GA.—John R. Hosch, W. P. Dela Perriere, R. A. Hosch, J. E. Hill, H. J. Sill, G. Brasleton and L. F. Sill will apply for a charter to build an electric railway through Stone Mountain, Logansville, Hoschton, Jefferson, Commerce and Barnesville.

TOPEKA, KAN.—The Kansas City, Olathe, Lawrence and Topeka Railway Company has been incorporated here with a capital of $1,000,000 to build an interurban line between Topeka and Kansas City.

LEXINGTON, KY.—The Lexington & Suburban Railway Company has been chartered with a capital of $250,000, to build a 25-mile line from Mayview to Henry. Gustav Haerle, of Lexington, is interested.

EMMETT, IDA.—E. H. Dewey, of Nampa, is interested in a proposed electric railway between Emmett and Pearl.

LEWISTON, IDA.—W. H. Hill, chief engineer of the Lewiston & Southeastern Electric Railway, which is planned to run between Lewiston and Grangeville, states that surveys are completed and rights of way obtained, and that the work will begin at once. The line will be 86 miles long.

SPRINGFIELD, ILL.—Articles of incorporation have been issued to the Springfield, Petersburg & Beardstown Interurban Railway Company. The home office is at Petersburg, and the stock is placed at $2500. The incorporators are John S. Hurie, James S. Miles and Robert Bone.

BEARDSTOWN, ILL.—The Springfield, Petersburg & Beardstown Interurban Railway Company, with home office at Petersburg, has been incorporated with a capital stock of $2,600,000. The incorporators are John S. Hurie, James S. Miles and Robert Bone.

GALESBURG, ILL.—The McKinley syndicate has completed all the plans for its new power house, but has not yet announced the location of the plant. It will have a capacity of 4000 horse-power. The cost of the building complete will be in the neighborhood of $200,000. Mr. Duncan, of the syndicate, states that it is more than likely no contract will be let for the construction of the building, but that the syndicate will superintend the work. Some time ago a contract was placed with the Hamilton-Corliss Engine Company for two 1500-hp engines, and the Bullock Electric Company and the General Electric Company were awarded a contract for two generators. The Sterling Boiler Company will furnish four 400-hp boilers.

WABASH, IND.—The Indiana Central Traction Company has increased its capital stock from $50,000 to $200,000. The increase of capital will enable the company to complete the construction of two lines which it is now building.

FORT WAYNE, IND.—A conductor on the Fort Wayne & Southwestern Interurban Railway was killed a few days ago in a peculiar manner. He was using a portable telephone carried on the car and, it is stated, received an electric shock which caused his death.

MUNCIE, IND.—W. H. Miller, of Bluffton; Mr. Bonham, of Hartford City, and W. H. Maxwell, of Boston, have asked for a franchise in this county for an electric railway to connect Alexandria and Hartford City by a direct route, and also a spur to run from Gaston to Stockport, and thence to Muncie. The road will be incorporated as the Oil Belt Traction Company.

COALGATE, I. T.—The Lehigh Traction Company, chartered to construct an electric railway from Atoka to Coalgate, has let the contract for building the road from Coalgate to Lehigh, a distance of 8 miles, to the Mutual Electric Company, of St. Louis. The company will also establish and operate electric lighting plants at Lehigh, Phillips and Coalgate, having already secured franchises for that purpose. The power house will be established at Phillips, which is half way between the two terminals.

OELWEIN, IA.—The Oelwein & Hazleton Construction Company has been incorporated with $10,000 capital stock to build an electric railway to Hazleton, 8 miles in length.

PITTSFIELD, MASS.—Arthur H. Rice, of this city, has been elected president of the Hoosac Valley Street Railway Company. The directors will petition for authority to increase the capital stock by $100,000, making a total of $500,000, and to issue bonds to the amount of $300,000, making a total of $400,000.

BEVERLY, MASS.—The company that will build the proposed electric railway between Beverly and Haverhill will be known as the Beverly & Haverhill Street Railway Company. The capital stock of the company will be $20,000. The directors of the company are to be Joshua Hale, John Balch Blood and Albert W. Rantoul, of Newburyport; Clifford B. Bray, A. C. Lunt, Louis L. Dodge and John H. Moore, of Beverly, Mass.

BANGOR, ME.—The contract for the construction of the Rockland, South Thomaston & Owl's Head Electric Railway has been awarded to Michael Sorretto, of Boston. Howard C. Forbes, 4 State Street, Boston, Mass., is chief engineer.

FOXCROFT, ME.—The Railroad Commissioners have approved the petition of the directors of the Dover, Foxcroft & Sebec Lake Railway Company, of Foxcroft. The capital stock is $30,000. The directors of the company are I. L. Dickinson and George W. Taylor, of Lexington, Mass.; H. L. Jones, of Boston; A. H. Stanhope, of Dover; W. E. Parsons, A. W. Gilman, Willis S. Ham, of Foxcroft.

TRENTON, N. J.—The East Jersey Street Railway Company has been incorporated at Trenton with an authorized capital of $500,000 to absorb the East Jersey Traction Company, the Raritan Traction Company and the Perth Amboy Railroad.

TRENTON, N. J.—The Chicago & Oak Park Railway Company has been incorporated here with a capital stock of $9,200,000, of which $6,000,000 is common stock and $3,200,000 preferred. This company is organized to take over the property and franchise of the Chicago & Oak Park Railroad Company. The incorporators are Charles A. Boston, West Orange; William R. Sainsbury, Brooklyn, and John G. Quincy, Bronxville.

CORTLAND, N. Y.—The Cortland & Homer Traction Company is said to be considering the advisability of extending its line from Little York to Tully.

ALBANY, N. Y.—The Cohoes Railway Company has been incorporated with a capital stock of $120,000. This is a reorganization. The directors are J. N. Wallace, New York; Thomas I. Van Antwerp and Eugene Crawford, Albany.

TOLEDO, OHIO.—A new electric railway is projected between Toledo and Jackson. Stephen A. Foster, of Toledo, is general manager of the promoting syndicate.

KANE, PA.—The Ridgway Trolley Company is stated to be interested in the building of an electric railway between St. Mary's and Sheffield.

MEDIA, PA.—Indications now point to the early building of the Philadelphia Morton and Swarthmore Street Railway from Darby to Media.

BELLEFONTE, PA.—The Phillipsburg Electric Street Railway Company has decided to extend its line from Phillipsburg to Osceola Mills.

BERWICK, PA.—C. W. Miller, of Bloomsburg, states that the early building of an electric railway between Berwick and Nanticoke is an assured fact.

JOHNSTOWN, PA.—Surveyors are at work on the final survey for the Conemaugh Valley Railway Company line, which will connect Johnstown and Ebensburg. The right of way has been secured for the entire distance.

LEBANON, PA.—G. S. W. Brubaker, of Lancaster, has the contract to build the Hummelstown & Campbellstown Electric Railway. For the present the line will extend from Palmyra to Hummelstown.

ALLENTOWN, PA.—The Hanover Central Electric Street Railway Company has asked Bethlehem Council for a franchise. The company contemplates building from Bethlehem to Catasauqua, with a spur into Allentown.

CARLISLE, PA.—The Steelton, New Cumberland and Mechanicsburg Trolley Company has closed contracts for four 200-kw generators, four 350-hp Corliss engines and four 400-hp tubular boilers. Contracts for the rest of the equipment have also been made.

DONORA, PA.—The franchise ordinance of the Donora & Carroll Street Railway Company has been passed by the Council. The company has reorganized and elected Bert W. Castner, president, and Attorney O. S. Scott, secretary and treasurer. The officials are now securing rights of way.

FAYETTE CITY, PA.—The Buena Vista power plant of the Pittsburg, McKeesport & Connellsville Electric Railway, purchased by the Webster, Monessen, Belle Vernon & Fayette City Street Railway Company, has been dismantled and shipped to Belle Vernon, near which place it will be erected.

SAYRE, PA.—The Sayre Trackless Trolley Company, capital $60,000, has been organized with these officers: I. A. Williams, president; Louis Eighmey, vice-president; H. S. Winlack, secretary, and J. T. Corbin, treasurer. The plan of the company is to build here a line of trackless trolley as developed by the American Trackless Trolley Company, of Boston.

BEAUMONT, TEX.—It is reported that the street railway system of the Beaumont Traction Company has been purchased by an Eastern syndicate which is negotiating for systems of street railway in other cities of Texas. The new owners will, it is said, make additions and improvements to the local system.

TEMPLE, TEX.—The Belton & Temple Traction Company will build eight miles of line between Belton and Temple, and lines in both cities, making about 12 miles of line in all. Plans and specifications of the road are now in the hands of J. C. Hauser, of Lewistown, Pa., secretary of the company. The officers of the company are Samuel Watt, of Belleville, Pa., president; A. F. Bentley, of Temple, first vice-president; A. C. Mayes, of Lewistown, Pa., second vice-president; J. C. Hauser, of Lewistown, Pa., secretary and attorney; Calvin Green, of Lewistown, Pa., treasurer.

RICHMOND, VA.—The Traction Development & Securities Company, of New York, has recently closed a contract with the Citizens' Rapid Transit Company, of Richmond, Va., to build 10 miles of railway in the city of Richmond. The office of the company is at 74 Broadway, New York.

FAIRMONT, W. VA.—The Fairmont-Mannington Electric Railroad Company has organized with the following officers: T. W. Fleming, of Fairmont, president; Jesse T. Koen of Mannington, vice-president; Allison Sweeney, of Fleming, secretary; Charles E. Manley, treasurer.

CONWAY, WASH.—The Conway Electric Street Railway Company has filed a petition with the Railroad Commissioners asking for the right to increase its capital from $36,000 to $116,000.

EVERETT, WASH.—A franchise to build an electric railway from Snohomish to Cherry Valley has been granted to W. M. Snyder and associates by the County Commissioners. The same persons have applied for permission to build a line from Snohomish to Lowell.

NEW INDUSTRIAL COMPANIES.

THE ANYUN FUSE & ELECTRICAL COMPANY has been incorporated in Buffalo, N. Y., with a capital stock of $25,000. The directors are Daniel Haist, J. H. Holder and G. B. Bailey, of Buffalo.

THE NORTHERN ELECTRIC COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The incorporators are T. J. Ryan, Lucien Barnes, Jr., and G. A. Schriefer, of New York.

THE MAGNETIC FLASHER ELECTRIC COMPANY, with a capital stock of $50,000, has been incorporated in Chicago to manufacture electrical devices. The incorporators are G. Discus, J. H. Minges and Frank Kramer.

THE AUTOCOIL COMPANY has been incorporated in Jersey City, N. J., to deal in electrical supplies. The capital stock is $100,000, and the incorporators are Charles T. Boyd, John J. Regan and John J. Baumann.

THE SOUTHERN ELECTRICAL COMPANY, of Nashville, Tenn., has been incorporated with a capital stock of $20,000. The incorporators are Felix Shwab, W. K. Webb, F. O. Watts, W. O. Vertrees and W. M. Bowles.

THE BREEGE MOTOR MANUFACTURING COMPANY, of Newark, N. J., has been incorporated to manufacture automobile engines. The capital stock is $10,000, and the incorporators are George A. Breege, Hugo Stummel and Joseph V. Weber.

THE WILLIAM WURDACK ELECTRIC COMPANY has been incorporated in St. Louis to do a general electrical business. The capital stock of the company is $10,000 full paid. The names of the incorporators are William Wurdack, John A. McClean and George R. Smith.

THE CENTRAL TELEPHONE CONSTRUCTION COMPANY, Toledo, Ohio, has been incorporated with a capital stock of $100,000. The company will do a general contracting business in the construction of telephone exchanges, plants and lines. The incorporators are E. L. Barber, Jas. S. Brailey, Jr., Jas. E. Brailey, Herbert A. Barber and Jas. C. King.

THE BANNER ELECTRIC COMPANY, of Youngstown, Ohio, has been incorporated with a capital stock of $100,000. The business is already established there and is one of the busiest institutions in the city. The incorporation was for the purpose of increasing the capital stock. The names of the incorporators, as given in the official document, are N. L. Norris, Thomas Carr, F. C. Kirschner, C. S. Crook and O. U. Cassidy.

LEGAL.

TELEPHONE DROP DECISION.—As we go to press, word reaches us that the Sixth Circuit U. S. Court of Appeals, sitting at Cincinnati, Judges Lurton, Severence and Richards coinciding, in the suit of the Western Electric Co. vs. the North Electric Co., in regard to the Warner drop, the opinion in favor of the North Company has been affirmed.

ELECTRIC POWER COMPANY ENJOINED.—Judge Anderson, of the Federal Court at Indianapolis, has granted a temporary injunction against the Elkhart Power Company to prevent it from disposing of any more of its bonds. The complainant is Lydia Owens who alleges that she is a large shareholder and that she has not been kept in close touch with the interests of the company, and that the merger of the several light and power companies of Elkhart was effected without her knowledge or consent.

PERSONAL.

MR. CHAS. E. WADDELL, electrical engineer, of Biltmore, N. C., recently visited New York, accompanied by his bride.

MR. H. W. POTTER, of the New York export department of the Westinghouse Electric interests, is back from a short trip to Panama.

MR. J. WATERSON, of Duban, Natal, South Africa, is now in New York, at the Murray Hill Hotel. He will place some orders for electrical machinery supplies.

MR. W. H. ST. JOHN, superintendent of the Yazoo City, Mass., light, water and sewerage plant, is preparing estimates on four miles of trolley line, with plant and equipment.

MR. RAFAEL SILVA, who is largely interested in concessions granted recently by the Mexican Government for the construction of hydraulic power plants, is now here at the Fifth Avenue Hotel.

MR. CLIFFORD WOOD, 52 William Street, New York, is about to proceed to Mexico and South America in the interests of various electrical equipment manufacturers and supply houses.

PROF. W. E. GOLDSBOROUGH recently delivered a lecture before the Pittsburg Technical Schools at the Carnegie Music Hall in that city, on the subject of "Electricity as a Factor in Expositions."

MR. C. H. HINES, recently electrical engineer for the Canadian Pacific Railroad, with headquarters at Montreal, has been visiting New York and has some special work on hand for the Erie Railroad.

MR. S. P. SHERRIN, president of the Indianapolis Telephone Company, accompanied by Mrs. Sherrin, has gone to Europe for a three-months' rest. Mr. Sherrin has done a great deal of work during the past year.

MR. R. O. WYNNE-ROBERTS, water engineer, Cape Town, South Africa, is in the market for electric stone drills and electric workers to be used for excavating rock and dressing face stones in a large dam in that part of the world.

CHARLES WHITNEY CARMAN & COMPANY, consulting electrical and mechanical engineers, have changed their address from 88 La Salle Street, Chicago, to 657 Railway Exchange. The firm is composed of C. W. Carman and M. C. Hartman.

MR. E. W. THOMAS, of Columbia, S. C., read before the meeting in Boston last week of the New England Cotton Manufacturers' Association an interesting paper on the electric transmission of power as illustrated in some of the practice in the South under his observation.

MR. EDOUARD ROTH, of Belfort, France, engineer with the Societe Alsacienne de Constructions Mecaniques, has arrived in this country on his way to St. Louis, where the corporation has an exhibit. He is also visiting some of the larger electric light and power plants.

MR. J. JENNINGS, the consulting engineer of the extensive group of South African mines controlled by Wernher Beit & Company is now on his way here from Johannesburg for the purpose of making some large purchases of electrical equipment, etc. He is expected here next week.

MR. E. W. BINKLEY, master signal electrician, U. S. Signal Corps, now at Denver, has been ordered to Seattle, Wash., to report to Lt. Col. James Allen for duty as assistant to the cable electricians on the U. S. cable ship "Burnside." Mr. F. P. Turner, of the same grade, now at Benicia Barracks, has been assigned to the same duty.

MR. S. G. McMEEN was the guest of honor at a banquet of Western Electric engineers and department heads, held at the Albion Cafe, Chicago, last week. Mr. McMeen leaves the Western Electric Company to go into consulting work, as previously announced, after nearly 20 years service of Bell telephone interests in the middle west.

MR. FRED W. WALTER has opened an office at 703 Citizens' Bank Bldg., Norfolk, Va., for the representation of leading lines of electrical apparatus and supplies. He will have in charge the interests in that region of the C. & C. Electric Company, the Stanley Electric Mfg. Company, the Bryan-Marsh Company and Pass & Seymour.

MR. C. P. STEINMETZ is the subject of the colored portrait calendar and biographical sketch issued by the Bullock Electric Mfg. Company for May in its series of "Great Men of Science and Engineering." Mr. Steinmetz was born in Breslau, Germany, in 1865, and came to America in 1889, joining the forces of the General Electric Company in 1893.

MR. JENKINS, of Jenkins & Co., Johannesburg, South Africa, will visit the United States shortly. The firm is a handler of American machine tools, electrical supplies, etc., and Mr. Jenkins will place several interesting orders while here. He may be found at the offices in the Centennial Building of the export commission house of Cadenas & Company.

MR. C. P. MARSH, of Charles Churchill & Company, Limited, the largest English handlers of American machine tools, etc., is now on a visit to this side with a view to closing some important contracts for Yankee labor saving devices to be installed in British arsenals and other Government plants. He is at the American Gas Furnace Company, 29 John Street.

MR. LYMAN C. REED has resigned from the Interstate Electric Company, of New Orleans, to enter into partnership with Mr. Wm. T. Spranley, also recently connected with the same company. The firm under the name of Spranley & Reed, will carry on business as electrical engineers and contractors with offices in Hibernia Bank Building, New Orleans.

MR. C. P. HILL.—Pittsburgh newspapers announce the engagement of Mr. Charles Phillips Hill, of the Doubleday-Hill Electric Company, to Miss Katherine M. Montague, of Baltimore, a cousin of Mrs. Alexander Brown, of that city. Mr. Hill is a great nephew of the late W. W. Corcoran, the banker who gave Washington the beautiful art gallery and collection bearing his name.

ROSENBAUM & STOCKBRIDGE announce their patent law and trade mark copartnership with offices at 140 Nassau St., New York City. Mr. W. A. Rosenbaum and W. M. Stockbridge are both well-known to the profession and need no introduction. The former has been practising in the electrical field for well nigh 20 years and has taken out hundreds of electrical patents.

C. OLLIVETTI & COMPANY, the celebrated Italian manufacturers of electrical measuring instruments, have removed from their old factories at Ivrea to new shops at 4 Via Broggi, Milan. The new plant has been built on much larger lines and equipped throughout with new machinery and apparatus. The new laboratory is specially adapted for the industrial calibration of high potential and large current instruments.

MR. S. R. INCH, electrical engineer and manager of the Missoula Light & Power Company, Missoula, Mont., was married in New York City on April 25 at the "Little Church Around the Corner," by Rev. Dr. Broughton, to Miss Margaret Bruce van den Broek, of London, England. The bride arrived from England on the "Etruria" on April 24 and Mr. Inch, who is an Englishman, came to this city to meet her and take her West.

MR. A. C. RAHE, manager of the Smith Storage Battery Company, on a recent visit to New York, stated that a few days prior he had secured two orders for installations of the Smith tray plate storage battery. One of these is for the Waverly Inn at Cheshire, Conn., and the other for the Ball & Socket Company, of the same town. The former installation replaces an isolated lighting unit, while the latter installation will be used as an auxiliary plant.

MR. OSCAR T. CROSBY, who lectured recently before a large gathering of members of the American Institute of Electrical Engineers and the New York Electrical Society on his explorations in Thibet has an interesting article in the May *North American Review*, on England and Russia in that country. He appears to regard the great, desolate table land and gigantic mountain chains as a permanent and perpetual barrier between the two leaders of European "assimilation" in Asia, and thinks China has some rights to be respected.

MR. HENRY W. POPE, of the special staff of the American Telephone & Telegraph Company, has been placed in charge of matters at the World's Fair, St. Louis, in connection with the fine Bell telephone exhibit there. Mr. Pope will hold this responsible position for the period of the existence of the Exposition. He will be glad to extend whatever courtesies are possible to members of the electrical profession, a very large number of whom he can claim as friends and acquaintances. Mr. Pope will assume his new duties at once.

MR. EUGENE ESTAVARD, a French engineer, has arrived from Paris and is now staying in New York City at the Astor House. He is studying electrical development here, and proposes also to make connections for the introduction of American specialties into France. He will be glad to hear from representative American manufacturers on the subject. Mr. Estavard has already had considerable experience in these lines in connection with one of the American firms formerly established in Paris.

BATES AND NEILSON, who have just announced their entrance into the consulting electrical engineering field, comprise Mr. Putnam A. Bates, late sales manager of one of the large electrical manufacturing companies, and Mr. John Neilson, until recently engaged in central station and railway work. These two active young engineers have some ten years' experience back of them and if perseverance, high principles and quality of work count for anything, they should make a success of their new undertaking. The offices of this new concern are at 42 Broadway, New York City. Mr. Bates has recently returned from an inspection trip to England, where he made a thorough study of manufacturing conditions and certain special subjects.

MR. A. M. HUNT, for several years connected with the engineering offices of San Francisco and up to last fall manager of the Independent Gas and Electric Company in that city, has, with Thomas Mirk, P. M. Hunt and J. M. Hunt, formed the firm of Hunt, Mirk & Co., with offices at 614 Mission St., San Francisco. Mr. Mirk was formerly chief engineer of the Independent Company's large electric station, while P. M. and J. M. Hunt have been engaged in machinery supply houses. The new firm has the Pacific Coast agency for Westinghouse steam turbines and engines, Worthington condensing apparatus, Laidlaw-Dunn-Gordon pumps, Keeler water-tube and fire-tube boilers, Patterson-Berryman heaters, etc., and in addition to the handling of this apparatus will act as contracting engineers, planning and installing complete power plant equipments. The firm starts out with excellent promise.

MR. JAMES DIETRICK, managing director of the United States & Nicaragua Company, is now here from Nicaragua in order to place large contracts which will include various electrical machinery and machine tools. The company, whose headquarters are in the Farmers Bank Building, Pittsburg, Pa., is to build some 350 miles of railroad in Nicaragua, so as to afford transportation to the vast coffee plantations in the interior of the country. Mr. Dietrick was formerly chief engineer of extensive gold mining properties in Mongolia and Manchuria for the development of which prior to the Boxer troubles he installed some three quarters of a million dollars of machinery, including electrically operated dredgers. He is expected in New York next week at the offices of H. A. Rogers, 19 John Street.

STERLING ELECTRIC AGENCIES.—C. S. Platt, 346 Broadway, New York City, is now representing the Sterling Electric Company, of Lafayette, Ind., in all eastern states. The Sterling Electric Co. would be glad to have him call on all telephone companies wishing to see a full line of telephone apparatus. D. L. Berry, of Grand Rapids, Mich., has just accepted the agency of the company in Michigan. He will handle a full line of apparatus and will be glad to show all telephone companies his samples. F. M. Ross, formerly of various supply houses, has accepted the position as a traveling representative in Indiana and Illinois. Fred E. Freers, now traveling in the western territory for the Sterling Company, carries a full line of Sterling high-grade apparatus, and would be glad to meet any prospective buyers.

MR. ALEX. HENDERSON, Master of Transportation of the Electrical Contractors' Association, sailed from Boston on April 30 for a three-weeks' trip to South America. He intends to return to Boston in time to attend the convention of the National Electric Light Association. He was accompanied by Mr. George W. Russell, the well-known electrical engineer and contractor, of New York City. Mr. Henderson says that the special train de luxe which will convey the electrical contractors to their convention at St. Louis in September will be the most handsome ever engaged and that accommodations are already being rapidly reserved. The train will be made up of combination buffet, smoking car, sleeping cars, dining car, ladies' car and library and observation car; and will have the best attendants procurable, including barbers, manicurists, hair dressers, etc. The contractors must be making money again.

PROF. A. G. BELL.—A special telegram from Washington, of April 30, says: "Alexander Graham Bell, who for the past year or two has been conducting experiments in aerial navigation at his summer home on Cape Breton Island, gave an exhibition of kite flying at Columbia, Va., this afternoon, before a number of Washington scientists. When Prof. Bell first announced his intention of testing his tetrahedral kites it was understood that he would send up a carrier that would demonstrate the feasibility of aerial navigation. Only experimental kites were used to-day, however, the biggest one being six feet high and of the same breadth. All of them sailed well in the light wind that prevailed, and the test was pronounced a complete success. After the kite flying was over, Prof. Bell received the congratulations of the scientists who had witnessed the tests and who wanted to know when the man carrier would have a trial."

MR. BION J. ARNOLD has been appointed consulting electrical and mechanical engineer for the Illinois Tunnel Company. This company has already completed some forty miles of subway tunnels underneath the streets of the business district of Chicago, and has installed an extensive automatic telephone service in the same district, carrying telephone wires in the tunnels. The problem which confronts Mr. Arnold is that of planning and installing a narrow gauge electric freight railway in these tunnels and arranging connections to the business buildings, freight depots, river docks, etc. It is proposed to perform a general freight collecting and distributing business, thus obviating a large portion of the teaming that now greatly congests the streets above. The necessary power stations, type of equipment, signalling and switching system, and method of conducting this transportation are all interesting factors in the problem. Mr. Arnold, it will be remembered, as municipal traction expert, recently made an extended study of the transportation problem in the down town district of Chicago, and his report to the city council upon that question is being followed out as the basis of a general scheme for relieving the surface congestion. He also holds the position of consulting engineer in the New York Subway enterprise.

MESSRS. CORY, MEREDITH & ALLEN.—Mr. A. M. Hunt having withdrawn from The Engineering Offices of San Francisco to form the firm of Hunt, Mirk & Co., that name has been abandoned and the remaining members, Prof. C. L. Cory, Wynn Meredith and W. H. Allen, will continue to do a general consulting engineering practice, paying especial attention to electrical, mechanical and hydraulic work. Messrs. Cory, Meredith and Allen will continue their offices at 331 Pine Street, San Francisco.

MR. MELVILLE E. STONE, general manager of the Associated Press, was given a banquet at Delmonicos, on April 30. It was attended by 300 well known people, including Messrs. H. D. Estabrook, A. B. Chandler and G. G. Ward. Ex-Postmaster General Smith said: "Mr. Stone has just returned with the brilliant laurels of the ambassador of American journalism to the Czar. He succeeded in inducing the Czar to remove the most rigorous censorship in the world, and we may regret that he did not extend his efficacious mission to the Court of the Mikado, for then we should be surer of having to-morrow morning, details of the battle fought to-day on the Yalu. One thing alone suffices to attest the great work which he did, and that is the fact recognized by every observer that the most intelligent, the most authentic, the most comprehensive dispatches which we have received have come from The Associated Press at St. Petersburg. The Associated Press is a mighty power. Under the management of Mr. Stone it has achieved a success and a breadth never before reached by it. It covers the world to-day with a breadth of sweep and a minuteness of grasp which are absolutely unparalleled. The old Associated Press presented simply the bones of the news. The Associated Press of to-day presents the life, the blood, the flesh, the color of our daily life, and in this it is doing a magnificent work. But in doing it, not alone The Associated Press, but even some of our best newspapers are not altogether free from the infection of that spirit of the new journalism which adopts somewhat sensational methods."

Trade Notes.

DALE COMPANY, Hudson & Thirteenth Streets, New York City, issues a special mail card as to its aluminum reflectors, collapsing collars, etc.

PITTSBURGH TRANSFORMER COMPANY, of Pittsburgh, Pa., issues a pretty little calendar for May and takes occasion incidentally to say a good word for its specialties in the transformer line.

FAHNESTOCK TRANSMITTER COMPANY has removed its offices to 132 Havemeyer Street, Brooklyn, near the entrance to the new Williamsburg Bridge, and with telephone call 3250 Williamsburg.

MECHANICAL APPLIANCE COMPANY, Milwaukee, Wis., issues a neat little folder of its Watson motor, shown attached direct to a ½-hp handkerchief laundry mangle machine. The motor is built in sizes from ⅛ up to 3-hp.

STANLEY & PATTERSON, INC., now announce the removal of their general offices and salesrooms to 40 Cortlandt Street, New York City. Their uptown store is at 329 Fourth Avenue, between Twenty-fourth and Twenty-fifth Streets.

CHASE SHAWMUT COMPANY.—Mr. W. S. Broue, the New York agent of this well-known New England concern has moved his local offices to the Bancroft Building, 3 West Twenty-ninth Street, which will be quarters also for the Alphaduct Mfg. Company which he represents.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that its customers are taking time by the forelock and contracting now for their next winter's supply of lamps. These contracts, the company declares, will be taken care of in A1 shape and filled with high grade Packard lamps.

THE WAGNER ELECTRIC MFG. COMPANY, of St. Louis, is issuing invitations to the electrical fraternity at home and abroad to visit it and use its offices as headquarters during the time of the World's Fair. The company will provide stenographic and other facilities for visiting friends.

THE NERNST LAMP COMPANY has established a branch office auxiliary to the Pittsburg district office at 537 Scofield Building, Cleveland, Ohio, in charge of Mr. J. C. Wright. This office will carry a stock of Nernst lamps and renewal parts, insuring prompt attention to all orders in this district.

SUMMER BREEZES is the title of a very dainty little pocket brochure issued by the Emerson Electric Mfg. Co., of St. Louis, telling all about its 1904 fans. The cover is excellent, the grass and woods all in green and a little Emerson fan supplying the breeze that ripples the foliage. Several styles of fans are illustrated.

SHEPHERD ENGINEERING COMPANY, of Franklin, Pa., has located its Boston branch office in the new Oliver Building at Oliver and Milk Sts. Mr. W. N. Clifford is in charge and prepared to handle the business of the New England territory right on the ground. In addition to the home office, it has established three branches, namely, at Chicago, Philadelphia and Boston.

AUBURN BALL BEARING COMPANY announces the removal of its main office and works from Auburn to 18 Commercial Street, Rochester, N. Y., where it will have an enlarged plant and increased facilities to produce Auburn ball thrust bearings and washers, propeller bearings, compound ball thrust and journal bearings, ball bearing hubs, power transmission specialties, steel balls, crucible steel discs, and many other well-known specialties.

STERLING ELECTRIC COMPANY, Lafayette, Ind., is receiving large orders for its various protector apparatus, especially its latest types, No. 250A and No. 250B, which a great many exchange managers have pronounced to be the finest of their kind. Its latest folder describes this protector at every point and can be had for the asking. The Sterling Company reports a very large sale of telephones of all kinds. Its new transmitter has been pronounced the best in the field.

GARVIN MACHINE COMPANY, Spring and Varick Sts., New York, has issued this month a very neat, handy and complete catalogue of its metal working machine tools. It is small 12 mo size, and contains over 200 pages and illustrates and describes fully its milling, screw, forming and tapping machines, monitor lathes, chucking lathes, drill presses, cutter grinders, hand lathes, etc., as well as a variety of special machinery. At the end are some useful tables, rules, etc., and a good index.

THE ELECTRICAL EQUIPMENT & SUPPLY COMPANY, 215½ Fourth Ave., Pittsburg, Pa., during the latter part of March secured the agency for the Yost Electric Mfg. Company. This representation covers the Western part of Pennsylvania. Since securing it, the socket business of the company has increased nearly 100%. Mr. J. H. Waugh, president and general manager of the company, believes that the business outlook is very bright for the concern, and is pushing things aggressively.

S. H. COUCH COMPANY, 156 Pearl Street, Boston, Mass., has issued a very handsome catalogue in its illustrated price list B. It is a complete and comprehensive pamphlet covering a large line of battery call single point telephones, battery call and magneto call intercommunicating telephones, magneto call telephones, and switchboard parts, telephone annunciators and instruments for hotels, apartment houses, residences, etc.; also transmitters, receivers, etc. The goods are set forth in full detail in this excellent price list.

THE F. BISSELL COMPANY, Toledo, Ohio, builder of switchboards for lighting and power reports that its trade on these boards has increased so largely that it has become necessary to extend its facilities and that it has recently placed large orders for additional stocks of marble and slate. It has found such a large demand for information and for ready prices on switchboards that at a cost of considerable money and labor it has prepared a new handbook on switchboards. This handbook will be sent free of expense to anyone interested in switchobards.

ELECTRIC CONTROLLER & SUPPLY COMPANY, of Cleveland, claims to be one of the first concerns ready in Electricity Building at St. Louis. Two of the specimens of the company's products are entirely new to an exposition. One of these is the direct action electric planer. The model at the fair is the first electric planer ever exhibited, permitting of the frequent reversals and changes of speed required in heavy steel work. Another novelty will be the lifting magnets perfected by the Electric Controller & Supply Company. These have been in successful use for some time, but have never before been exhibited.

GAS ENGINE SPECIALTIES.—Emil Grossman, of 298 Broadway, New York, is importing and manufacturing a number of gas engine and automobile specialties, chief among them being the Continental spark coil for gas engine ignition. This spark coil is the result of the long experience of a leading French manufacturer with devices of this kind and it has been pronounced most satisfactory by American manufacturers of gas engines, by whom it is widely used. In this coil both the primary and secondary windings are silk covered and the core is made from Swedish iron which possesses high magnetic qualities. The coil is made in all sizes and with case in any finish.

THE I. C. S. BUILDING AT ST. LOUIS.—The International Correspondence Schools, of Scranton, Pa., is represented at the Louisiana Purchase Exposition by a handsome building. The structure faces the plaza in the Model Village, which is one of the most interesting features of the Exposition. The lower floor of the building is devoted to a public exhibition of the plans and methods of the Schools, with specimens of the work of students. The second floor, furnished with all conveniences and comforts, is used as a post office, reading room, writing room, and, in fact, a rendezvous for I. C. S. students and their friends. The accounts of the rise of some of the I. C. S. students read like romance. Many of these experiences have been published in book form, and are exceedingly interesting. The book is entitled "1001 Stories of Success," and can be had for the asking.

THE METROPOLITAN ELECTRIC SUPPLY COMPANY, of Chicago, of which Mr. William McKinlock is president, has just moved to the Kelly Building at 184 Lake Street. The new building is directly across the street from the old and well-known location, and is equipped with electrical power, including fans, pumps and elevators complete. By means of the prism windows at front and rear, the salesroom, office and shipping room are a revelation of good light, even the basement stairs with the door shut being a great deal lighter than the corridor of many office buildings. Mr. Kinlock now has the exclusive agency for the Eureka flexible conduit, the Toerring arc lamp, and the Submerged motor. This latter consists of motor, propeller and rudder complete at the lower end of a metal post, which is used as the rudder post and is clamped by an adjustable device to the stern of a rowboat. Mr. McKinlock reports that the business doubled on the first day in the new quarters.

STEAM ENGINE CATALOGUE.—The latest example of the edition de luxe printing engraving which in recent years has been characteristic of certain lines of trade literature, is a catalogue of steam engines built by McIntosh, Seymour & Company, of Auburn, N. Y. The catalogue contains 68 oblong pages 9"x12" in size, about a third of which are given up to half-tone engravings of a kind, both in execution and printing, rarely seen outside of works of art and machinery catalogues. The engravings in the front part of the book illustrate details of the several types of McIntosh, Seymour engines, including some excellently executed line engravings. The second half of the book is given up to half-tone illustrations of large installations of steam engines supplied by the McIntosh & Seymour Company. To those interested directly in steam engineering this catalogue will have a high intrinsic value; while those interested in fine engraving and printing will find pleasure in looking through its pages.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has at the St. Louis Exposition the most extensive and comprehensive exhibit that has ever been made of storage batteries and auxiliaries. It is located in Block 20, Electricity Building. A conspicuous feature is a map about thirty feet in height by forty-five feet in length, which, by an ingenious arrangement, shows the distribution of chloride accumulator installations throughout the United States. Illuminated glass jewels designate the locations and characters of the installations, whether for railway, central station, isolated lighting and power service, yacht plants, telephone installations, etc. There is set up in a model battery house a complete operating installation of chloride accumulators for railway service. Specimens of chloride accumulators ranging in size from a 61H type of cell to the smallest laboratory cells, are also shown, together with a complete exhibit of the Exide battery used for electric automobile work. In another section of the exhibit there are five types of switchboards, together with end cell switches, storage battery recording instruments, etc.

APPLICATION OF ELECTRICITY TO MACHINE DRIVING.—That the advantages of electrical operation of works and factories are becoming practically self-evident is demonstrated in the presidential addresses in engineering societies. Recently the president of the Sheffield Society of Engineers and Metallurgists said: "The engineer of ordinary ability found in electricity a simple means for remedying extravagances in works more readily than by any other method, and consequently welcomed its introduction. In large works the introduction of a central power station had been a means of doing away with miles of steam pipes connected with the various outlying engines, which caused great loss of economy from condensation. Boilers of high pressure were put down close to the central power station. These, with the electric distribution plant, gave an efficiency of, in many cases, more than 50 per cent. ahead of the old conditions of outlying steam engines. The wages of engine tenders were to a great extent saved, as the various motors throughout the works merely required periodical visiting at much less cost than the engine tenders wages added up to." Messrs. Johnson & Phillips, of Old Charlton, Kent, have sent us a handbook entitled "The Application of Electric Motors to Machine Driving," and a copy will be forwarded to those contemplating the introduction of electric driving in works, especially in the iron and metal, textile and printing trades.

NEW VEEDER TACHOMETER.—The Veeder Mfg. Company, Hartford, Conn., has just brought out in Form C a portable instrument for indicating revolutions per minute of dynamos, motors, shafting, etc. The readings are plainly shown by the height of the colored liquid in the indicator tube, in connection with the graduated scale. There is but one moving part in this instrument, viz., the paddle wheel in the centrifugal pump. The latter constitutes the lower part of the instrument. When the paddle wheel is revolved, the centrifugal force draws down the liquid in the reservoir and forces it up in the indicator. The bottom of the reservoir communicates with the center of the pump, and from the periphery of the pump there is a passage to the indicator tube. The vertical height between the surface of the liquid in the indicator tube and of that in the reservoir will be approximately proportional to the square of the speed of revolution. The reservoir is concentric with the indicator tube, so that a slight inclination does not vary the level of the liquid in the tube. The small handle at the front of the instrument is for throttling the passage from the pump to the indicator, to prevent the dancing or vibration of the column of liquid due to sudden fluctuation in the speed. Thus, if desired, the readings may be made "dead beat." A displacement plunger is provided for adjusting the zero level of the liquid. Pure alcohol, colored with aniline dye, is used. The standard length of scale is twelve inches. For laboratory work instruments can be furnished with scale 3½ feet high, or scales can be supplied with special graduations. The tachometer for general use has a ball thrust bearing on the end of the shaft.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 26, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

758,057. GROUND CONNECTION FOR ELECTRIC CONDUCTORS; Frederick P. Fuller, New York and John J. Walsh, Yonkers, N. Y. App. filed Oct. 16, 1902. A strap adapted to surround a pipe and carrying a clamp for the end of the wire to be grounded, is held in intimate contact with the pipe by means of a screw that bears against the pipe and exercises a tension upon the strap.

758,094. ELECTRIC, STEAM AND VAPOR GENERATOR; Thomas W. Neely, Marshall, Ill. App. filed April 23, 1901. Electrodes are placed in a body of water contained in a suitable boiler; the arc passing between them converts the liquid into vapor.

758,095. PROCESS OF GENERATING STEAM; Thomas W. Neely, Marshall, Ill. App. filed May 2, 1901. A process carried out by the apparatus above described.

758,106. TRANSMISSION OF ELECTRICAL IMPULSES; John S. Richmond, New York, N. Y. App. filed April 27, 1901. Two equal conductors forming the sides of a metallic circuit, combined with a ground connection for maintaining zero potential at the meeting point of the two conductors.

758,117. STEREOSCOPIC APPARATUS; Homer C. Snook, Philadelphia, Pa. App. filed June 22, 1903. An X-ray apparatus in which are employed a set of non-permeable stops so arranged between a fluorescent screen and the sources of radiation that two sets of images are formed, which are viewed by a similar set of non-permeable stops, whereby each eye sees a set of images formed by a single source of radiation, such images blending to produce the stereoscopic effect.

758,120. SWITCH; Henry Trumbull, Plainville, Conn. App. filed July 18, 1903. Details.

758,157. MEANS FOR PREVENTING ARCING BETWEEN COMMUTATOR BRUSHES; Elihu Thomson, Swampscott, Mass. App. filed May 29, 1903. A barrier of non-conducting material is placed in the space between the brushes.

758,164. RHEOSTAT; William C. Yates, Schenectady, N. Y. App. filed Aug. 16, 1901. A rheostat provided with two ranges of contact studs continuously connected in series relation and means for operating the one having the larger resistance units intermittently during the operation of the other.

758,165. INSULATION; Edmund E. Bechtold, Chicago, Ill. App. filed June

22, 1903. An insulating band attached to the edge of canopies to separate them from the wall.

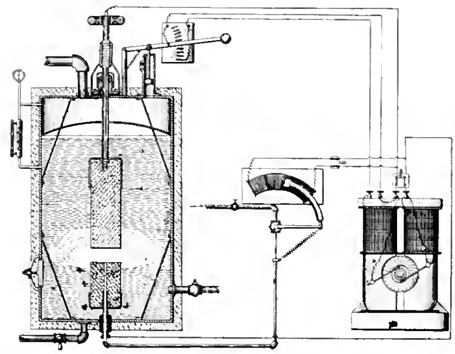
758,172. BLOW OUT FUSE; Fred B. Corey, Schenectady, N. Y. App. filed Sept. 2, 1902. The current carried by the fuse itself develops a magnetic field, the lines of force being carried by iron plates to intensify the field at the point where it acts on the fuse.

758,175. INSULATOR; Scott C. Cutter, Oswego, Ill. App. filed Dec. 11, 1902. A porcelain body having peculiarly shaped slots and openings to receive the wire.

758,116. SUPERVISORY SIGNAL APPARATUS FOR TELEPHONE SWITCHBOARDS; Edwin H. Smythe, Freeport, Ill. App. filed Sept. 14, 1903. (See page 875.)

758,179. SUPPORTING PIN FOR LINE INSULATORS; John D. Hilliard, Jr., Glens Falls, N. Y. App. filed June 16, 1903. To prevent the pin from breaking off, it is sustained by a conical sleeve resting upon the cross arm and bearing against a shoulder on the pin.

758,202. TELEGRAPH RECEIVER; Luigi Cerebotani, Munich, Germany. App. filed May 2, 1900. Electromagnets operate a shutter to allow a ray of light to strike a sensitized strip at intervals to photograph the signals thereon.



758,094. Electric, Steam and Vapor Generator.

758,205. MASSAGE MACHINE; John Graves, Milwaukee, Wis. App. filed Aug. 10, 1903. A massage machine consisting of a hollow handle, battery, conducting cap, a spiral wire roller and means for making a circuit from the cap through the roller.

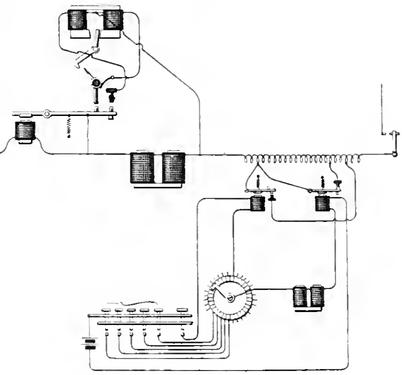
758,225. ELECTRIC MOTOR; Alexis Vanderbeck, Roseland, Kan. App. filed Oct. 10, 1903. A reciprocating motor in which the pole pieces are arranged so that unlike poles will attract and like poles repel at the same time.

758,230. TRAIN CONTROL SYSTEM; Harold E. White, Schenectady, N. Y. App. filed Nov. 20, 1902. The motors throughout the train are connected in pairs in such manner that the armature of each motor of a pair is in series with the field of the other motor of a pair; the armature and field combinations are then treated as if they were series motors by connecting them in series and parallel in the customary manner.

758,232. TELEGRAPH TRANSMITTER; Charles Adams-Rabdall, New York, N. Y. App. filed Aug. 25, 1902. Details.

758,236. ELECTROMAGNET; Harold W. Chamberlain, Brunswick, Me. App. filed Aug. 27, 1903. A two-limbed electro-magnet having an armature fulcrumed thereon in direct polar and magnetic contact therewith, and guiding means for the armature permitting it to be so fulcrumed during its entire movement, the magnet having one pole extending inward toward the other and situated under the inner side of the armature.

758,250. PRINTING TELEGRAPH; Clarence L. Healy, Newark, N. Y. App. filed June 16, 1903. Two stops are provided for an armature lever, one



758,250.—Printing Telegraph.

of which moves in proportion to the type carrier, and a detent for the type-carrier is set or not by the fact of the lever colliding with one or the other of said stops.

758,293. ELECTROMAGNETIC GEARING; Edward M. Bentley, Lawrence, N. Y. App. filed Dec. 2, 1903. A regulator for a dynamo electric machine acting to vary the effective rate of relative movement of field magnet poles and armature, comprising a pole shifter for the field magnet, giving the pole a rotation adjustable for regulation and supplementary to the relative mechanical movement of field magnet and armature.

758,297. RAILWAY SIGNAL APPARATUS; Clarence W. Coleman, Westfield, N. J. App. filed April 4, 1902. The signal is operated by fluid pressure from a tank arranged near the signal, from which the pressure is released to a pressure applying chamber in operative connection with the signals, by electrically operated valves.

758,303. ELECTRIC HEATER; Ernst Eckmann, Berlin, Germany. App. filed Aug. 15, 1902. Electric heater wires are stretched across the outlet conduit of a blower.

758,304. OFFICE DESK TELEPHONE; Alan Robb Fergusson, New York, N. Y. App. filed Nov. 16, 1901. (See page 875.)

758,306. ELECTRIC SWITCH; Alan R. Fergusson, New York, N. Y. App. filed Dec. 16, 1902. An automatic switch mounted on a pivoted arm which carries telephone instruments, is arranged to cut the instruments into and out of circuit with the changes in position of the arm.

758,324. SUPPORT FOR ELECTRIC CONDUCTORS; Fred C. Locke, Boston, Mass. App. filed Jan. 24, 1903. Details of a supporting clip.

758,328. DEVICE FOR SECURING INCANDESCENT LAMP FILAMENTS TO LEADING-IN WIRES; Albert W. W. Miller, South Orange, N. J., and Geo. P. McDonnell, St. Louis, Mo. App. filed July 3, 1903. Adjustable clamping devices mounted on a movable carrier, for holding the filament and leading-in wires in position while they are being connected.

758,342. SWITCH MECHANISM FOR ELECTRIC SIGNS; Frank S. Wahl, Buffalo, N. Y. App. filed July 14 1902. Details.

758,352. APPARATUS FOR ELECTROPLATING SOUND RECORDS; George K. Cheney, New York, N. Y. App. filed June 6, 1903.

758,355. TROLLEY WHEEL; James S. Fletcher and Donald H. Waters, Chicago, Ill. App. filed Sept. 3, 1903. Details of the mounting and contact devices of the wheel.

758,363. TELEPHONE RECEIVER; Miller Reese Hutchison, Norwood, N. J. App. filed Nov. 25, 1902. (See page 875.)

758,378. ALTERNATING CURRENT MOTOR; Ralph McNeill, New York, N. Y. App. filed Dec. 4, 1902. The armature circuits are each adapted to successively make contact with each of a number of energizing circuits, without being at any time short circuited upon themselves, and to always be in contact with at least one of the energizing circuits.

758,398. SIGNAL OPERATED BY CAR BRAKE BEAMS; Samuel N. Wilcoxon, Collingwood, Ohio. App. filed Jan. 13, 1904. When the brake is applied, the circuit to a special signal lamp on the car is closed, to notify a following car, in the dark, that the car ahead is being stopped.

758,415. TELEPHONE INSTRUMENT; Albert C. Christopher, Chicago, Ill. App. filed Feb. 3, 1904. (See page 875.)

758,430. APPARATUS FOR CIRCULATING LIQUIDS IN TANKS; George E. Dunton, New York, N. Y. App. filed Sept. 15, 1903.

758,445. TROLLEY HEAD; Peter D. Hean and John J. Eagan, Media, Pa. App. filed Dec. 26, 1903. Details of a construction to prevent the wheel from jumping from the wire.

758,468. ALTERNATING CURRENT SIGNAL RECEIVING APPARATUS; Greenleaf W. Pickard, Amesbury, Mass. App. filed Feb. 29, 1904. A relay consisting of two iron pole pieces with adjacent ends and an armature space, a pivoted armature having its free end held at the middle of the space and adapted to swing toward either pole, a coil surrounding one of the pole pieces, a magnet adapted to revolve around or past the other ends of said pole pieces and to induce opposite and cyclically changing magnetizations in the respective pole pieces.

758,478. ELECTRIC SWITCH; Joseph H. Resby, Nutley, N. J. App. filed June 25, 1903. Details.

758,485. RAILROAD SIGNAL OR ALARM; Robert F. Stuart, Logansport, Ind. App. filed Oct. 14, 1903. Details.

758,503. PROCESS OF FORMING VESSELS FROM SHEET METAL; Hermann G. Blevins and James E. Whittaker, Newcastle, Pa. App. filed July 1, 1903. The seams are electrically welded.

758,513. APPARATUS FOR CIRCULATING LIQUIDS IN TANKS; George E. Dunton, New York, N. Y. App. filed April 26, 1904.

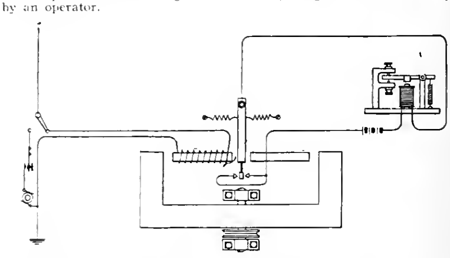
758,517. ART OF WIRELESS TELEGRAPHY; Lee De Forest, New York, N. Y. App. filed Sept. 21, 1903. The method of determining the distance to a sending station consisting in employing a choking influence of regulable amount in the receiving apparatus to thereby reduce the intensity of the signals received to a standard of comparison and in comparing the amount of such influence required with results obtained under known conditions.

758,527. SIGNALING AND OPERATING SYSTEM; Hedley C. W. Graham, Rochester, N. Y. App. filed July 9, 1903. A wireless transmission system is used to stop a train following too close upon another.

758,528. CURRENT COLLECTOR; John E. Greenwood, Utica, N. Y. App. filed May 16, 1903. Details of a double wheel trolley.

758,541. BLOCK SIGNALING APPARATUS; John A. Lehr, North York, Pa. App. filed Feb. 18, 1903. The signals received through a third rail arrangement are made to act successively on three different signaling devices, so that in case one should be out of order, the others will still respond.

758,589. LIGHT CONTROLLING SYSTEM; Harry Faltermayer, Philadelphia, Pa. App. filed Oct. 2, 1903. An apparatus wherein the lighting of the lamps of a sign to form various combinations is done automatically after a plate or card having in it certain openings, is once inserted properly by an operator.



758,468.—Alternating Current Signal Receiving Apparatus.

758,592. SAFETY TROLLEY; William M. Gruner and William C. Fink, Springdale, Pa. App. filed Nov. 5, 1903. Details.

758,594. ELECTRIC RAILWAY SIGNAL; William S. Jackson, Hoboken, N. J. App. filed June 30, 1902. Details.

758,598. TRANSMISSION OF ELECTRICAL IMPULSES; John S. Richmond, New York, N. Y. App. filed April 27, 1901. The art of electrical transmission consisting in producing in adjacent conductors electrical impulses simultaneously equal at contiguous points, but differing in that the potential of the one is above and that of the other below the maintained zero potential.

12,214. PROCESS OF OBTAINING TIN BY ELECTROLYSIS; Ernest Quintaine, Argenteuil, France. App. filed April 26, 1904.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

Vol. XLIII. NEW YORK, SATURDAY, MAY 14, 1904. No. 20.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

Telephone Call: 7605 Cortlandt. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office - - - - - - 1139 Monadnock Block.
Philadelphia Office - - - - - - 929 Chestnut Street.
European Office, Hastings House, Norfolk St., Strand, London, Eng.

NEW YORK, SATURDAY, MAY 14, 1904.

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Visitors from Abroad.

It is interesting to note that provision is being made betimes by the American Institute of Electrical Engineers for the reception of the visitors from abroad who will attend the Electrical Congress in September. It is true that the Institute has its annual meeting in this city next week, but interest is concentrated more particularly on the important work to be done later in the year; and we are encouraged to note that a number of European engineers and others may be expected. In fact, according to cable advices received from President Gray, of the British Institution of Electrical Engineers, its contingent is already one hundred strong, and other large delegations are known to be preparing for the voyage. All this promises great success for the Congress, and is also to be hailed as a sign of a desire to become better acquainted with this country and its development. American engineers are far better acquainted with Europe than European engineers are with America, and it is for the benefit of all that the inequality should be redressed. There cannot come too many from abroad this year, and the heartiest welcome awaits every one. In fact, it promises to be so hearty we may have to mitigate its rigors a bit for those who are not accustomed to jump around 500 miles a night in sleeping cars.

Street Railway Municipal Ownership.

The recent balloting in Chicago on the subject of municipal street railway ownership and operation will doubtless lead to a general agitation of that issue, at least where politicians think that it may be to their advantage to bring it into the field of practical politics. We have some sympathy with the general feeling of irritation that can be aroused by a prolonged wrangle with transportation companies punctuated by strikes and riots, but the merits of the controversy which led to the action in Chicago are neither here nor there; they are utterly inconsequential in the present issue. Nor do we consider the failure or success of municipal tramway enterprises abroad of any particular consequence. If they have uniformly failed, so much the worse for them; if they now and then succeed it is to the personal credit of the administrators rather than to the glorification of the principle. We are not so deeply rooted in pessimism as to hold that nowhere upon the orb of the earth can a municipal transportation enterprise be operated with honesty and economy, but we do submit that the past record and present character of municipal administration in Chicago and in the cities of this country apt to follow in the footsteps of that city, are such as to foredoom the result of any experiment made.

The current demand upon tramway companies is in its essence a demand for reduced fares. The several propositions brought to the front may bear either directly or indirectly upon that purpose, but they all come ultimately to the same issue. Adequacy of the accommodations is sometimes a subject of discussion, but upon this matter the tramway companies and the citizens soon meet upon common ground and work together. Attempts to lower the customary five-cent uniform fare meet, however, with determined opposition. The difference between four cents and five cents is on its face trivial, but it aggregates twenty per cent. of the gross receipts of a tramway company, and a three-cent fare would cut the gross receipts forty per cent. In theory some allowance would have to be made for increased traffic at the lower fares, but it has yet to be shown that the gain would be material. On the relatively long hauls there is small reason to expect much increase of patronage, and even on the short hauls the gains would be small unless a complete zone system with graded fares were adopted, and this in an American city would be unpopular. There are few commercial enterprises that can stand a cut of even twenty per cent. in their gross income unaccompanied by any reduction of expenses. Even granting that some urban roads are grossly overcapitalized and that their earnings upon the actual cash invested are very large, yet a loss of twenty to forty per cent. in gross earnings would be disastrous. The zone system will probably have to be tried sooner or later as a means of cutting fares, but we think a very short experience with it will be sufficient for the American public.

As to municipal ownership itself, its only excuse for being is a desire to obtain for the public in one form or another the profits of the enterprise. Practically it stands for reduced fares with all the financial difficulties thereby implied. Its real reason for existence, however, is far less innocuous than its nominal excuse. Graft is written large all over any municipal tramway scheme. As a source of jobs and miscellaneous swindling, a municipal tramway in an American city would be in a class quite by itself. The number of employees involved is large, the annual supply bills are large, and the pickings and stealings would be upon a scale of magnificence difficult to equal. And does any sane man suppose that such opportunities would be neglected even for a single season? All that dishonest officials now get from the bland almoners of corporate bounty would be only as a drop in the bucket compared with the results of municipal ownership in any American city. If Chicago really desires to inaugurate a carnival of graft the preliminary steps now taken are emphatically in a suitable direction. Fortunately for Chicago and the country at large, further steps will be more difficult, and there will be time for the sane second thought of honest citizens to come to the rescue. We cannot seriously believe that the metropolis of the West will place itself definitely upon a platform of which "Millions for Graft" is the one conspicuous plank.

Electric Automobiles.

It has not escaped general notice that in the large automobile parade held in this city recently, a considerable proportion of the industrial vehicles were of the electric character. In other words, nearly all of the 80 or 90 commercial vehicles in line were of the electric type, and it is matter of common observation that very few of the industrial automobiles seen hereabouts are other than electric. In this category we do not include the cabs and hansoms of the electric type, which are also so numerous, and which apparently have very little competition from gas or steam automobiles of the same type. Whatever may be the status of electricity in regard to pleasure automobiles, it certainly seems to be holding its own in doing the work of the world, and in the long run we think that after some of the craze for fancy automobiling has died out this condition will not be altogether to the disadvantage of electricity.

Meantime we believe that the central stations in this country can do a great deal to foster and encourage the use of electric vehicles, not only in supplying current, but in operating vehicles of this character themselves. We are glad to call attention to the fact, for example, that the New York Edison Company has in its own service just about a score of these vehicles, not all but mostly of the industrial type, and all of them employed in facilitating the service of the company; some in transporting the officials and inspectors from point to point; some in handling lamps and supplies; some in conveying heavy material, and some in such work as hauling in underground cable. In fact, a case came to our notice recently where 4,400 ft. of high-tension cable was safely hauled in in a ten-hour day and 500 ft. in 18 minutes. It is by applications of this kind that central station companies not only give an admirable example to the public, but tend to build up their own business in a department which should afford a field of very large consumption of current. The Boston Edison Company has also done admirable work in this field, and we believe the convention in that city this month could well devote, and profitably, an hour or two to the general subject.

Harnessing the Hudson.

We are now glad to be able to give our readers, supplementing data given last year, a rather detailed account of the immensely interesting power developments in the region around Albany. The generating plants for this important network, distributing power to all the electric systems in an area of more than 600 square miles, have already been fully described in our columns, and the present article relates merely to the utilization of that power at various points in the territory reached. This work, involving the displacement of steam in stations doing all sorts of work and long established, required no small amount of engineering ability, for it is always easier to lay out a great system *de novo* than to adapt a new transmission plant to the various exigencies of a heterogeneous electric service already long in business. In such a task there are likely to be required a wide variety of compromises, and the warring demands of various customers are apt to stimulate the ingenuity of the engineer. The details of a group of sub-stations make instructive reading, but they seldom pulsate with the vital interest that inspires editorial comment. In the mass, however, one can find occasional bits that rise above the plane of constructive common-place and illustrate methods or tendencies which have more than a local importance. In the present instance there are three salient features of the system which separate it from many recent plants which we have described. In the first place the frequency is 40 periods, as in the original Mechanicville station, a periodicity which is unusual in this section of our country. Second, there is a considerable use of high-voltage, three-phase cables not only underground, but for crossing the bed of the Hudson. And finally there is in the sub-stations a very wide use of synchronous motors, in utter contravention of the practice in some plants of the past few years.

As regards the question of frequency, the three-phase system started out both here and abroad at a periodicity of 40 periods to 50 periods, in the days when ordinary alternating plants ran at 120 periods to 130 periods. The lower frequency enabled one to run incandescent lamps admirably and gave also good motor service. At 50 periods, certainly, alternating arc lamps could be used with good results and the frequency was well suited to mixed service. But a new line of transformers was required, and presently in a rather rash attempt to make the old transformers answer for the new apparatus everybody had a try at a frequency of 60 periods to 70 periods. This process of putting new wine into new bottles led to the customary result, but by the time a new line of transformers had replaced the misused ones which had burned out, many polyphase plants had gone in at the increased frequency. By this time, too, the rotary converter was in full swing, and a sharp demand had sprung up for low-speed motors. Under the pressure thus created, inasmuch as rotaries and low-speed motors are not easy to build at 60 periods or so, a new line of apparatus at 25 periods came into use. Just why this frequency which is just too low for the advantageous working of incandescent lamps was chosen it is hard to say—possibly because some engineers thought that in the rotary converter they saw the finish of alternating distribution circuits. Now, the plant under consideration has come back to first principles at 40 periods, and apparently without inconvenience, save in the matter of frequency-changing for some of the arc service; and merely as a matter of saving changes, it would appear, for part of the incandescent circuits. Rotary converters up to 600 kw output are operated at 40 cycles and we do not imagine that the slightest trouble will be experienced with them. It is difficult to predict the trend of frequency, especially since alternating-current motors for railway service are beginning to be introduced, but it certainly has been demonstrated that it is unnecessary to go to extra low frequency merely on account of rotaries.

The cable feature in this plant is of particular interest. It was necessary to use underground lines in going into Albany. This was a comparatively straightforward job, and cables at the pressure used, about 10,800 volts, had already been made; but, still, the performance of these paper-insulated, lead-covered cables at so high a pressure will be exceedingly well worth watching. We are inclined to the opinion that they will answer the purpose well. In entering Troy it was necessary to cross the Hudson, and a choice had to be made between a high span from steel towers and an underwater cable. Just what determined the choice of the latter we are unable to state definitely, but we are glad that the cables were chosen, if merely for their value in experience. Like the underground cables, these are paper-insulated, lead-covered cables, but armored with galvanized iron laid over jute. Barring danger from lightning, lessened by careful local protection by lightning arresters, the cables run no especially severe risks, and their performance in steady use will be immensely instructive. So little is known about the working of high-tension cables under water that every instance of their use is of direct importance to the art.

Finally, we must note the regular use of synchronous motors in the various sub-stations. Two or three years ago the trouble from "hunting" in these machines had the bulk of the engineering profession pretty well scared, and many enormously big induction motors were being installed to avert the difficulty. The big induction motor is a beautifully simple machine, but it is not altogether a good thing to encourage in a large transmission system, and we are glad to see that the synchronous motor has been mastered sufficiently to allow its free use in situations where it can be of value. One other point in this system awakens a lively interest—the use of automatic three-phase regulators in one of the sub-stations. It is only recently that such apparatus has been put out, although it has been greatly needed. If thoroughly successful, and there is no good reason why it should not be, one of the standing difficulties in long-distance power transmission will have been obviated. Hand regulation is effective enough, but good automatic regulation is greatly to be desired for all classes of service.

THE MAGNETIC OBSERVATORIES OF THE UNITED STATES.

The United States Treasury Department, controlling the United States Coast and Geodetic Survey, has recently issued a very entertaining buff book marked "Appendix No. 5 of the Report for 1902," reciting the conditions of the United States magnetic observatories in operation July 1, 1902. Careful records of terrestrial magnetic elements have been compiled during the last three centuries. The results acquired are of great scientific value, and indicate the possibility of important utilitarian application in the future, when they shall be better understood and interpreted. A few years ago the capitals of nearly every important country had a magnetic observatory in full operation, recording from moment to moment the direction and intensity of the earth's magnetism. Thus, London had Kew Observatory, the United States had the Washington Naval Observatory, Canada had the Toronto Observatory, etc.

Alas for the mutability of magnetic forces! The all-invading trolley car has been more fell than hunger, anguish or the sea. The magnetic observatories have been put out of business by the central stations. Kew, Washington, Toronto and Paris have all banished their observatories to fresh fields and pastures new. Kew fought hard against the deadly trolley and invoked Parliament and City Council, but finally packed up her instruments. Numerous other observatories have followed a similar flight. The magneticians all ask the same question: "Where can we erect our altars and set up our instruments out of the ruthless reach of the desecrating trolley?" The Emperor William of Germany, reposing upon the divine right of kings and kaisers, uttered a royal decree forbidding trolley cars to come within 16 km. of his Potsdam observatory. This solved the difficulty for the two observers and the six suspended magnets at Potsdam. But the various thousands of disinterested German citizens in the neighborhood protested, in favor of rapid transit. According to the report, there has been some talk of taking back the decree and taking away the observatory. The United States has joined in the exodus. The Washington Observatory gave up the struggle. There are now four United States magnetic observatories that the experts consider safe for the time being from the trolley cars. One is in Sitka, Alaska, "near the new Russian cemetery," a quiet, remote place. The second is "on an immense coral plain" 20 km. west of Honolulu in the Island of Hawaii. The third is in Baldwin, Kan., 21 km, in an air line, south of Lawrence, Kan. This, however, is but a temporary site, and, if trolleys should come the equipment can be shipped quickly. The fourth is at Cheltenham, Md., on the grounds of the Maryland Reform School. Two local passenger steam trains pass Cheltenham daily. The report states that the land in this region, while in a flourishing condition before the civil war, when slaves were available for tilling the soil, is now so undesirable that so far as can be seen at present, there will be little inducement to run electric car lines into this region. The civil war was thus evidently not in vain from one special viewpoint.

Great pains have evidently been taken with the construction of the buildings for these observatories, so as to maintain a nearly uniform internal temperature at the magnetographs. This thermal insulation has been provided by using multiple walls and large thicknesses of dry sawdust. Three thousand sacks of sawdust are stated to have been used in the Sitka Observatory alone. The thermograph records for Cheltenham Observatory inside and outside the building during a week show that while the external range of temperature during that time was about 50°, the internal range was about 1°. It is interesting to observe that the apparatus employed for making and recording the observations differs but little from that employed thirty years ago. Of course, it is only reasonable to expect that observations and apparatus may crystalize after three centuries of use. Moreover, there is one advantage of uniformity of type, in that all observations may have a greater degree of approximation. On the other hand, it seems strange that portable magnetometers, on electromagnetic lines, have not come into general use for rapid work in traveling. The absence of a proper scientific terminology in the magnetic c.g.s. units reveals itself in the work of the department, which has created a unit and name of its own. The earth's horizontal intensity, if interpreted as $\mathcal{H}$, a magnetic force, would be expressible in gilberts-per-centimeter; or, if interpreted as flux density $\mathcal{B}$, would be expressible in gausses. Not having the gilbert-per-centimeter, the tabular results are "expressed in gammas." The gamma, a unit of magnetic intensity, invented and christened by the department, is 1/100,000 of one gilbert per centimeter. The results are expressed, as a rule, to five significant digits, and are probably conveniently written in terms of a unit of that particular magnitude. A more conformable method, with respect to other branches of magnetic science, would be to shift the decimal point, and express the result in milligilberts, or microgilberts-per-centimeter as $\mathcal{H}$, or if the values may be interpreted as $\mathcal{B}$, to write them in milligausses or microgausses. The adoption at the 1900 International Electrical Congress of the name gauss to designate the c.g.s. unit of flux density, renders particularly inappropriate the invention and use by a government bureau of a new unit and new name. That it will survive in view of the international action above noted is improbable, and in the meantime it will give rise to confusion.

National Electric Light Association.

Mr. Charles L. Edgar, president of the National Electric Light Association, spent two or three days in New York last week making final arrangements for the convention to be held in Boston May 24-27. Owing to President Edgar's energetic methods 25 papers and reports are now in type, and it is expected that copies will be distributed to those members who have announced their intention of attending the meeting, reaching them before they leave home, and thus enabling them to prepare themselves to discuss the papers intelligently.

Mr. Hodskinson, chairman of the committee on hotel accommodations, has succeeded in getting replies from every member company, stating whether or not a representative would be in attendance, and from these replies it is estimated that the representation will be far in excess of that at any previous meeting. Most systematic arrangements have been made for the reception and registering of delegates, and a plan of distributing and looking after the papers has been formulated which promises to make that part of the convention routine run very smoothly.

Heavy Travel in Greater New York.

A report of the New York State Railroad Commission covering the year ending February 29 shows the number of cash passengers and also the number of transfer passengers carried by the local traction systems as follows:

Interborough, 273,133,242, increase 37,318,852; car mileage 60,730,337, increase 12,870,859.

New York City Railway (Interurban), 397,644,829, increase 144,311. On transfers there were 166,310,453 passengers carried, an increase of 11,435,049; car mileage 62,412,527, increase 954,666. The number of passengers carried in the first three quarters of the year increased 5,129,287, but the loss in the winter months practically offset this.

Brooklyn Rapid Transit, 285,725,986, increase 23,280,423. On transfers 55,146,001 passengers were carried, an increase of 3,772,959; car mileage 54,394,315, increase 3,025,769.

Coney Island & Brooklyn, 33,129,812, increase 967,765. On transfers 6,016,455, increase 88,063; car mileage 6,212,762, increase 43,854.

Union Railway, 21,273,870, increase 1,998,543.

The chief item of interest is the rapid gain on the Interborough elevated system as compared with stationary conditions on the Interurban surface system in New York. Probably the latter will improve when the fearful mess and obstruction of the underground railway work is cleared out of the way.

Annual A. I. E. E. Meeting.

A departure will be made this year from past practice in relation to the annual or business meeting of the American Institute of Electrical Engineers, which will have somewhat the character of a general meeting. The meeting will extend over two days, with a programme covering the morning, afternoon and evening of the first day and the morning and afternoon of the second day.

The first session will be called to order at 10.30 A.M. Tuesday, May 17. During the morning the following papers will be presented: "Predetermination of Sparking in Direct-Current Machines," by W. L. Waters; "Effect of Self-Induction on Railway Motor Commutation," by E. H. Anderson; "On the Calculation of Line Batteries," by W. E. Winship.

At 1 P.M. there will be a luncheon, followed by a visit to the Rapid Transit Subway. At 8.15 P.M. a meeting will convene at which the annual reports will be read, announcement made of the results of the annual election, to be concluded by a paper by Mr. B. G. Lamme on "Data and Tests on a 10,000-Cycle Alternator."

At a morning meeting on Wednesday the following papers will be presented: "Notes on Fly-Wheels," by H. H. Barnes, Jr.; "The Single-Phase Induction Motor," by Prof. W. S. Franklin; "Wave Form Variations of a Long-Distance Line," by Prof. Geo. H. Rowe. At 1 P.M. there will be luncheon, after which the library and technical laboratories of Columbia University will be visited.

It is announced that the general meeting of the Institute will be held at the St. Louis Exposition during the week ending September 17, 1904, at which no unsolicited Institute papers will be presented or discussed.

Convention of Texas Electrical Associations.

The Southwestern Gas, Electric & Street Railway Association and the Southwestern Electrical Association held a joint annual convention at Dallas April 25, 26 and 27, at which it was decided to unite the two organizations under the name of Southwestern Electrical & Gas Association. Those eligible for active membership in the new association are companies, firms or individuals engaged in the manufacture of gas, generation of electricity, operation of electric railways, telephone exchanges and telegraph lines. The officers-elect of the new association are as follows: President, J. F. Strickland, of Waxahachie; secretary, F. E. Scovill, of Austin, and treasurer, A. E. Judge, of Tyler, Tex.

Most of the first day's session was occupied with discussions as to the benefits and evils of telephone competition. This discussion grew out of a paper read by Mr. J. E. Farnsworth, general manager of the Southwestern Telegraph & Telephone Company. Mr. James Moroney, of Dallas, favored independent companies and pointed out the benefits to be derived through their service. At the conclusion of the afternoon session the members were tendered a trolley excursion around the city. In the evening various entertainments were provided for the visitors. Forty candidates were put through the initiation of the "Sons of Jove," after which a smoker was held.

Among the papers announced on the programme were "Municipal Franchises," by John W. Shartell, president of the Metropolitan Railway Company, of Oklahoma City, and "Advantages of Combination of Gas & Electric Plants," by R. R. Stitcher, of the Cleburne Gas & Electric Company, of Cleburne, Tex. Mr. H. F. MacGregor, vice-president of the Houston Electric Company, read a paper entitled "Accidents and the Damage Suit Industry." Mr. MacGregor referred to the growing evil of damage claims based on the slightest pretext and frequently on fraud, and gave some advice as to the management of this department of companies. He stated that the increase in the amount of damages paid for the work of damage suit bureaus in magnifying slight injuries and prompted fraudulent claims until finally the matter has attracted the attention of the Railroad Commission of the State of Texas to the injustice. Every member of the Association, he said, should enlist in the campaign of exposure of fraudulent claims. Corporations have suffered from the administration of justice in Texas, not so much from the intent of juries not to reach the justice of the case, but from perjured testimony that creates confusion; and the inaction of the judges.

Western Union and the Poolrooms.

The relations of the Western Union Telegraph Company to the pool rooms which are carried on contrary to law in New York, but which it furnishes a special service, continue to attract considerable attention and excite comment. President Clowry, of the company, in a public statement, says: "In view of recent occurrences I have to say that I do not believe any fair-minded person will suppose that the Western Union Telegraph Company would willingly become party to any criminal undertaking. While we cannot put ourselves in the attitude of passing upon the morals of the people for whom we transmit messages, or to whom we lease wires, we are quite ready to co-operate with the constituted authorities in their efforts to suppress crime, and we will go just as far in the direction as, under the advice of our counsel, we are permitted by law to go. Surely, no one will expect us to enforce one law by breaking another law. If the authorities will give us evidence upon which we can prudently act, they need have no fear that we will not aid them. Whenever those charged with the enforcement of the law will furnish this company in writing with the names of persons who are engaged in keeping unlawful pool rooms, and specify the places where the pool rooms are located, and state that they have decided to take action to close them up, if they request the telegraph company to cease the transmission of intelligence to such places we will promptly comply with such request, even though the public authorities should prove to be mistaken and the telegraph company be thereby involved in litigation and liability."

The attack is now being leveled at the New York Telephone Company as well, on the ground that it also gives service in the pool rooms; and the accusation is made that the attitude of Col. Clowry is hypocritical. Several of the papers print in "caps" the names of the directors of both companies, as men willing to make a special profit out of business with gambling hells.

Hudson River Power in Albany, Troy and Schenectady.

ELECTRICAL supply in Albany and Troy, N. Y., is now drawn from Spier Falls on the Hudson 40 miles up stream, and from the falls at Mechanicville, 15 miles away. This transmitted energy is supplied to the local companies in Albany and Troy by the Hudson River Water Power Company, and the contracts call for the immediate delivery of a maximum of 6,000 hp in each city.

The water power plants at Spier Falls and Mechanicville, and the transmission lines, switch houses and sub-stations of the Hudson River Water Power Company have already been described in previous issues of the ELECTRICAL WORLD AND ENGINEER, dated June 27, October 24 and 31, and November 7, 1903.

Two three-phase transmission lines from Spier Falls, and one three-phase line from Mechanicville, run to the Watervliet sub-station of the Hudson River Water Power Company, which is just across the Hudson from the city of Troy. Each of these three circuits is made up of three bare solid copper wires, size 3/0 B. & S. gauge. Energy delivered to the line at Spier Falls at about 30,000 volts reaches the Watervliet sub-station 35 miles away at about 26,500 volts, and the current from Mechanicville comes into the same sub-station at approximately 10,800 volts. Transformers at the Watervliet sub-station reduce the 26,500-volt current from Spier Falls to the 10,800-volt pressure, and the energy from both Spier Falls and Mechanicville is then transmitted from Watervliet at this latter voltage to the local sub-stations of the lighting and traction systems in Albany and Troy. The energy from Spier Falls is reduced in pressure from 26,500 volts to 10,800 volts at Watervliet because it is necessary to cross the Hudson River with a cable in order to reach Troy, and to run underground in entering Albany. It was not thought desirable to use as high a pressure as 26,500 volts in the submarine and underground cables necessary for these purposes. At Mechanicville the current is developed at a little above 10,800 volts, and the reduction of the 26,500-volt current to this lower voltage at Watervliet brings both sources of energy there to the same pressure.

At the Watervliet sub-station the equipment includes nine transformers rated at 1,000 kw each, which are arranged in three groups for the transmission circuits above mentioned, and reduce the voltage from 26,500 to 10,800. From Watervliet two 10,800-volt, three-phase overhead circuits run to another sub-station of the Hudson River Water Power Company about four miles distant near the city limits of Albany and called the Albany sub-station. The object of this sub-station is to regulate the pressure of the two 10,800-volt circuits, connect their overhead wires with underground cables, and to reduce the voltage of a part of the energy for local distribution. This sub-station is 55 ft. 9 in. by 31 ft. 6 in. on the ground, partly one and partly two stories in height, and has a basement underneath its entire area. In structure the walls of this building are brick, the floor of the basement concrete, the upper floors concrete on steel I-beams, and the roof tile, also supported by I-beams.

The central portion of the basement forms an air pressure chamber over which the transformers on the first floor are located. On this first or main floor there are also located two so-called I. R. T. automatic regulators of General Electric make rated at 300 kw each. Each of these regulators is connected to one of the 10,800-volt, three-phase circuits, has capacity to raise or lower the voltage thereon by 7.5 per cent., and is designed to maintain a constant voltage to within one-half of one per cent. Room is provided over the air pressure chamber for nine transformers of 500-kw each, these transformers to be arranged in three groups and reduce the voltage from 10,800 to 2,300 for local distribution. From these transformers the 2,300-volt circuits lead to a switchboard on the same floor that controls the local lines. Two motor-driven blower sets occupy a part of the floor space over the air pressure chamber, and maintain the pressure that forces air through the transformers and the I. R. T. regulators.

In front the sub-station is two stories high above the basement, and the two-story portion is 10.5 ft. wide between 12-in. brick walls and its length occupies the entire width of the building. Into this front end of the sub-station, which is thus separated by a brick wall from the remainder of the building, come the bare overhead transmission lines. For the entry of these lines nine circular openings,

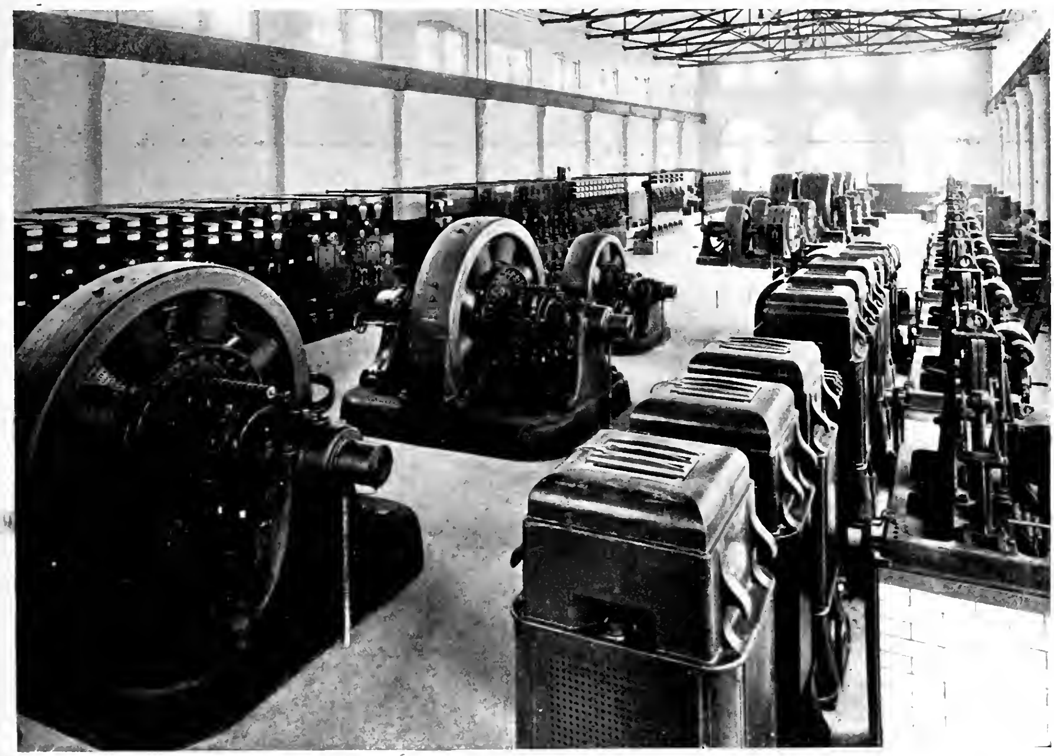


FIG. 1.—VIEW OF INTERIOR OF SUB-STATION OF SCHENECTADY RAILWAY, SCHENECTADY, N. Y.

each 15 in. in diameter, were made in the brick wall along the same horizontal line and with centers $21\frac{1}{2}$ in. apart. These openings in the brick wall are protected from storms by an extension of the roof, which is about 2 ft. above the openings, and by a cement wall 2 in. thick and 2 ft. outside of the brick wall that drops from the extended roof of the front part of the building to the lower roof of the rear part.

In this cement partition or wall there is a row of circular holes opposite to the holes in the brick wall, but each hole in the cement wall is only 10 in. in diameter. After passing through these two sets of openings the nine wires of the three transmission circuits enter single-pole, double-blade knife switches that connect each wire with a bank of lightning arresters and with a 10,000-volt type H oil switch

FIG. 2.—DOCK STREET SUB-STATION, SCHENECTADY.

of General Electric make. From these oil switches two of the three circuits go through other knife switches to the two I. R. T. regulators; thence through still other knife switches to 15,000-volt, type K oil switches of General Electric make, and from these K switches to more single-pole, double-blade knife switches that connect with static discharges and underground cables. The third 10,800-volt circuit, after passing through an H oil switch with knife switches on each side, goes to the transformers that lower the pressure to 2,300 volts for local distribution.

All three of the 10,800-volt circuits, after leaving the H oil switches, connect with duplicate sets of bus-bars by means of which any one of these circuits can be joined to either I. R. T. regulator, or to the transformers. The lightning arrester cells, the static dischargers

of the Albany company the distance is about two miles, and twelve standard clay ducts, each 4 in. in diameter, have been laid in Portland cement concrete between these two stations. For present purposes two three-phase cables have been laid in these conduits in order to deliver the 10,800-volt current at the Trinity Place station. Each of these cables contains three 3/0 stranded copper conductors, is insulated with paper, and covered with a lead sheath $\frac{1}{8}$ in. thick. At the station of the Albany company a new fire-proof addition has been built to receive the 10,800-volt underground cables and contain the high-tension switching and transforming apparatus. This addition adjoins the brick wall that forms one side of the main steam power station, has brick walls one story high, measures 32 ft. 4 in. by 37 ft. 4 in. outside, and has a concrete floor and a concrete cemented roof, this latter being supported on steel I-beams. A 15-ton traveling crane sweeps the entire space included within the addition save what is devoted to the switching apparatus and bus-bar compartments.

On the distribution system of the Albany company the load consists of open direct current and of enclosed alternating arc lamps, incandescent lamps on two-phase circuits, and of direct-current motors. The entire load has previously been carried by steam power at the Trinity Place station, and the plan in the application of transmitted water power in the system was to abandon the regular use of steam and yet make no changes in the character of the connected loads. To avoid any such change it was necessary to continue the operation of the 9.6-amp., direct-current arc dynamos and of two-phase, 60-cycle alternators, also to substitute rotary converters for the abandoned direct-current, 500-volt generators that had been used to carry the motor load.

On entering the new addition of the Trinity Place station the two underground cables connect with oil switches and high-tension bus-bars of Westinghouse make. From these switches and bus-bars connection is made with four banks of transformers all located in the fire-proof addition to the old station. Each of two of these groups of transformers consists of three units rated at 200 kw, making 600 for the group. These three transformers reduce the 10,800-volt, three-phase current to 375 volts for a 500-kw, 550-volt rotary converter that is located in the main station. There are thus two of these converters with a combined capacity of 1,000 kw for the load of direct-current motors. Each of the other two groups of transformers consists of two units rated at 400 kw each and connected Scott fashion so as to change the current from three-phase to two-phase, while reducing its pressure from 10,800 to 2,300 volts. This 2,300-

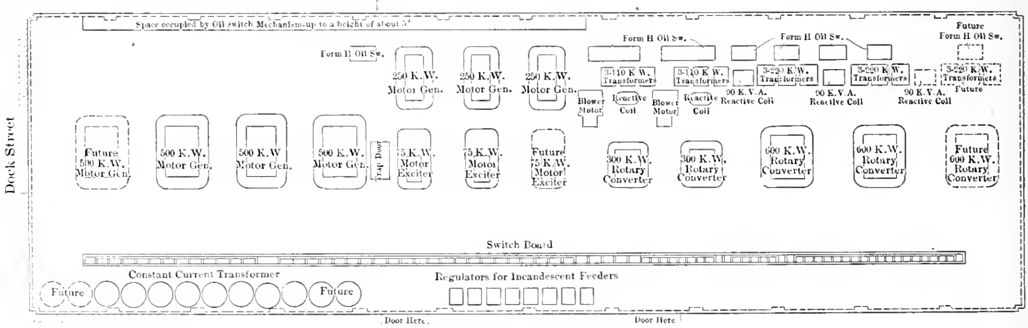


FIG. 3.—PLAN OF DOCK STREET SUB-STATION.

and both the types of oil switches are all located in the front end of the sub-station on two floors, and are separated from the remainder of the sub-station by the brick wall already mentioned. The conductors between these several switches and bus-bars are bare copper, and like the knife switches are supported at the tops of large porcelain insulators like those used outside on the line. Each of these insulators is mounted on a wooden pin that is 9 in. long above the shoulder, and that is cemented into the brick wall of the building. The clips of each knife switch are attached to a cast-iron cap that is cemented to the top of one of the insulators just named. This method of insulation is highly effective.

After leaving the K oil switches the 10,800-volt circuits connect with underground cables that run to the station of the Albany Electric Illuminating Company on Trinity Place. From the above sub-station of the Hudson River Water Power Company to the station

volt current passes to the switchboard for distribution lines in the main part of the station, which is separated from the transformers by a brick wall. With the 2,300-volt, 40-cycle current thus obtained the distribution circuits for incandescent lamps and induction motors are supplied.

The old station contains a long main shaft to which the arc dynamos and 60-cycle, 2,300-volt alternators have been connected by belts in the past, the shaft itself being driven by steam power. The steam engines have been uncoupled from this shaft, though the connection can be quickly remade if it becomes desirable, but the arc dynamos and one 225-kw alternator remain belted to it. Near each end of this line of shafting and directly coupled therewith are synchronous motors, each rated at 550 kw, 10,800 volts and 343 r.p.m. These motors draw their current from the high-tension switches and bus-bars in the new addition to the station, and the same is true of a third motor of like voltage and capacity that is direct-connected to a 225-kw alternator at each end of its shaft. This third motor and the two alternators to which it is coupled operate at 480 r.p.m., and the alternators develop two-phase, 2,300-volt, 60-cycle current. These alternators are devoted to the circuits that operate commercial, enclosed arc lamps. The transformers, rotary converters and synchronous motors just mentioned were all furnished by the Stanley Company.

Public street lighting in Albany is done entirely with open arc, direct-current, 9.6-amp. Brush lamps, and about 680 of these lamps are in use and connected to the station of the Albany Electric Illuminating Company. To the circuits of the company there are also connected direct-current motors of about 1,500 hp total capacity at 550 volts and arc and incandescent lamps of about 2,000 kw combined capacity on 2,300-volt, two-phase lines.

In order to reach the electric lighting station in Troy from the Watervliet sub-station of the Hudson River Water Power Company it is necessary that the 10,800-volt lines cross the Hudson River. A point about one mile down stream from the sub-station and nearly opposite to the lighting station in Troy was selected for this crossing, and a cable was laid in the bed of the river. Bare overhead conductors run from the Watervliet sub-station to the cable landing on the west bank of the Hudson, and there enter a small brick terminal house where they join the cables and have lightning arresters attached.

After crossing the river the cables enter a large manhole close to its east bank and are there connected to underground cables that run to the lighting station, a few hundred feet away. Two cables were used to cross the river, which was covered with a thick coating of ice at the time they were laid, in December, 1903. By means of horses the two heavy cables were dragged across the river on the ice so that they lay side by side over the location on its bed, where they were to rest, which had been previously determined, and then the ice was sawed through on each side of the cables so that they sank into position by their own weight.

Each of these two cables contains three No. 3/0 stranded copper conductors, is insulated with paper, enclosed within a lead sheath, and protected on the outside by a layer of galvanized steel wires that are laid in spiral form on a bed of jute that rests on the lead sheath. Between the 3/0 wires the thickness of paper is ½ to 9/16 in. and between each wire and the lead sheath the paper measures about ⅜ in. This insulation was tested with 25,000 and 50,000 volts applied for one hour. The lead sheath outside of the paper has a radial thickness of 3/16 in., and then comes the layer of jute or other fibrous material, which is 1/16 in. thick, and supports the armor of No. 4 Birmingham gauge steel wires. Outside of this armor the cable has a diameter of 3⅜ in. Both of the cables were made by the National Conduit & Cable Company.

At Troy the connected load on the electrical supply system includes about 15,000 incandescent lamps of nominal 16-cp rating, 290 enclosed arc lamps in commercial use, 427 direct-current, open-arc lamps for street lighting that are rated at 2,000 cp each, 40 open arcs for stores, and 125-kw capacity in direct-current motors. Dynamos for the operation of these several loads have been previously driven by steam power through a long main shaft at the Troy lighting station. In the application of the transmitted water power to these loads the steam engines were disconnected from the main shaft, and synchronous motors were installed to drive it and the several types of dynamos. These dynamos include direct-current arc machines of 9.6 amp., 2,300-volt alternators, and 500-volt, direct-current generators for the motor load. The underground cables bringing the 10,800-volt, three-phase current from the Watervliet sub-station enter the old lighting station at Troy, and this current, after passing through oil switches, goes to the 10,800-volt synchronous motors without transformation. In this way the old generating equipment at Troy is retained, and is driven by synchronous motors and water power instead of by steam engines.

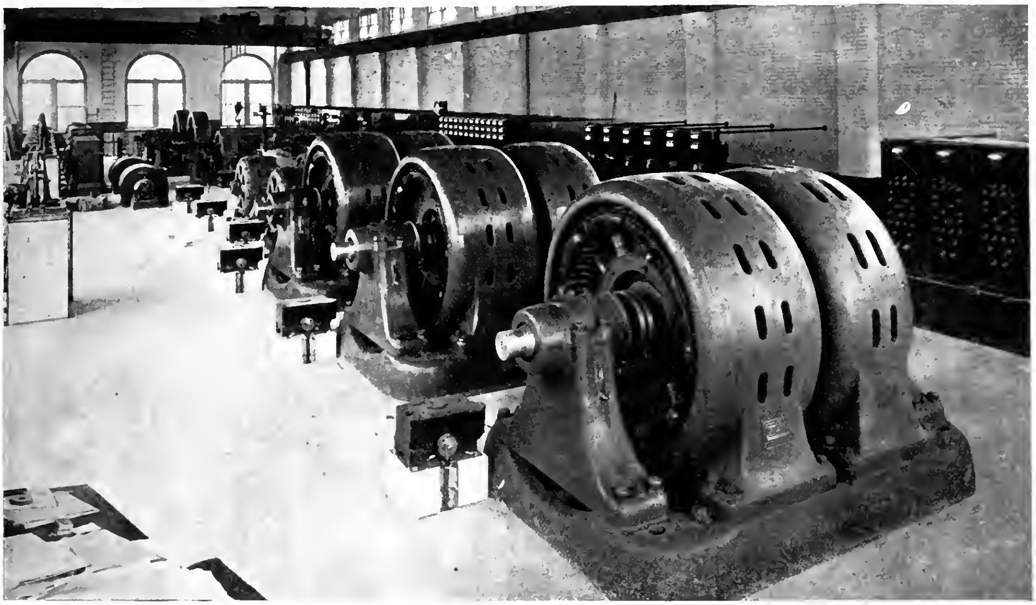


FIG. 4.—ANOTHER VIEW OF INTERIOR OF DOCK STREET SUB-STATION, SCHENECTADY.

Besides the supply of transmitted energy to the local lighting systems of Albany and Troy, as above outlined, the Hudson River Water Power Company also furnish a large part of the power used to operate the electric car lines of the United Traction Company in and between these two cities. Power for this electric railway system is delivered in the form of 10,800-volt, three-phase, 40-cycle current at two sub-stations of the United Traction Company, one located near the Watervliet sub-station of the Hudson River Water Power Company, and the other at North Albany some four miles away. At each of these railway sub-stations the 10,800-volt current from the water power plants is transformed to about 375 volts and delivered to rotary converters that supply direct current at about 550 volts. The contracts between the Hudson River Water Power Company and the Albany lighting company, the Troy lighting company and the United Traction Company look to the complete substitution of transmitted water power for steam in the entire public lighting and street railway systems in these two cities as soon as sufficient generator capacity has been installed in the great plant at Spier Falls to meet the maximum requirements at these and other points, when operated in conjunction with the water power station at Mechanicville.

The transfer of electric lighting and railway loads in Albany and

Troy to the water power system completes the substitution of energy drawn from the Hudson River for steam power in electric systems over a territory some 15 miles wide east and west, and 45 miles long north and south. This territory includes Glens Falls on the north, Troy on the east, Albany on the south and Schenectady, Ballston and Saratoga on the west. Probably no other single electric system in the United States serves an equal population over an equal area with an equal amount of power.

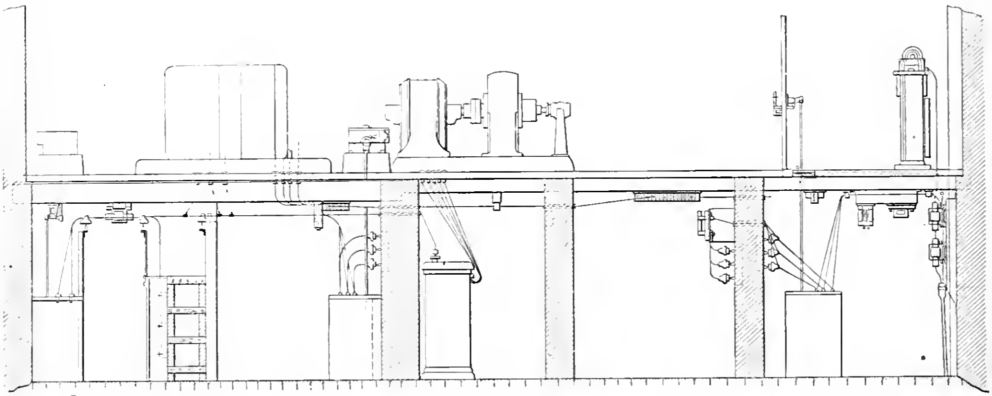
Transmitted water power from Spier Falls and Mechanicville also operates the electric railway and lighting systems of Schenectady, N. Y. Both of these systems are owned by the Schenectady Railway Company, and the energy for their operation is delivered through the main switchboard in the power station at the General Electric Works. Energy from steam as well as from water power is available at the General Electric switchboard, so that certainty of continuous service on the railway and lighting systems is secured without auxiliary steam equipments in its sub-stations.

As at present operated, the railway and lighting systems have three sub-stations, one on Dock Street close to the General Electric Works in Schenectady, one at Colone on the branch of the railway that connects Schenectady and Albany, and one at Latham's Corner on the railway between Schenectady and Troy. The Dock Street sub-station distributes light and power in Schenectady, besides delivering current to the railway, but the other two sub-stations carry only railway loads. When the branch of the Schenectady railway that connects that city with Ballston Spa is in operation a fourth sub-station located at the latter place will supply power to that branch.

Between the power station at the General Electric Works and the new sub-station on Dock Street there are three underground cables each containing three 3/0 stranded copper conductors. Each of these cables carries 10,000-volt, 40-cycle, three-phase current drawn from step-down transformers in the General Electric plant, and the current delivered by two of the cables is devoted to railway work, while the third supplies energy to the lighting system. From the Dock Street sub-station to that at Colone there are two circuits of three No. 1 B. & S. gauge wires each, and between the Colone and the Latham's Corner sub-stations there is one circuit of three No. 2 B. & S. gauge wires. Between the Dock Street sub-station and the city limits of Schenectady the two circuits of No. 1 wire are made up of two paper-insulated lead-covered underground cables, with three conductors each, but the remainder of these circuits, and that of No. 2 wire are bare overhead conductors. These circuits running to the Colone and Latham's Corner sub-stations transmit the 10,000-volt, three-phase current delivered to the Dock Street sub-station from the General Electric Works.

When the sub-station at Ballston Spa is in operation its energy will be drawn directly from one of the two transmission circuits between Spier Falls and Schenectady, before they reach the General Electric Works. At the sub-station just named the electric railway equipment will include two 300-kw, 550-volt, 40-cycle rotary converters to operate at 800 r.p.m. three 220-kw air-blast transformers with double secondary windings, and two 45-kw air-blast reactive coils, all made by the General Electric Company. A 2-hp, three-phase induction motor will drive a direct-connected, 35-in. blower, and a 20-hp motor of the same type will operate a Magan air compressor. At the Colone and also at the Latham's Corner sub-station, both of which have been in regular operation for some time, there are three 300-kw rotary converters supplied with energy from the 10,000-volt line through transformers and delivering direct current of about 550 volts.

The new sub-station on Dock Street has recently been put into service to replace an old power house and sub-station nearby and carries all of the lighting and stationary motor service at Schenectady as well as a large share of the street railway load. The ground area of the sub-station is 165 ft. 8 in. by 45 ft. 2 in., and its elevation includes a high basement and main operating room or first floor above. The basement floor of this sub-station is slightly above the ground level outside because the Hudson River and Erie Canal near which it is located are liable to overflow. From ground to coping the height of the sub-station is 40 ft. 4 in., from basement floor to main floor the distance is 10 ft., and main floor to the lower cord of the steel roof trusses the distance is 24 ft. In structure the sub-station is of



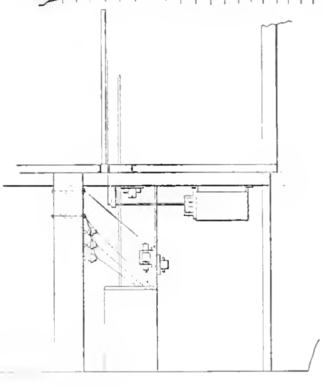


Fig. 5.—Cross-Section of Lighting End Dock Street Sub-Station, Showing Wiring.

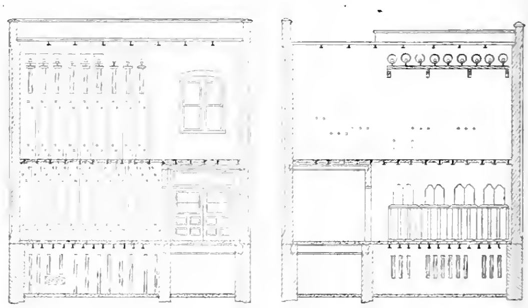


Fig. 6.—Cross-Sectional Elevations of Cell Rooms.

stone, brick, concrete and steel, save for the three-inch plank that supports the slag covering of the roof.

Up to the level of the main floor the outer walls are of brown stone, and above this they are brick. In thickness the stone wall is 20 in., increasing to 27½ in. at buttresses, and the brick wall above is 12 in. thick, increasing to 24 in. at buttresses. The basement floor is formed by a one-inch layer of cement on 4 in. of concrete, and the main floor is composed of concrete arches resting on steel I-beams and all supported by the outer and by interior walls. The sub-station is lighted by large windows along three sides and smaller, high windows on the fourth and along the center line of the roof are ranged four 36-in. globe ventilators.

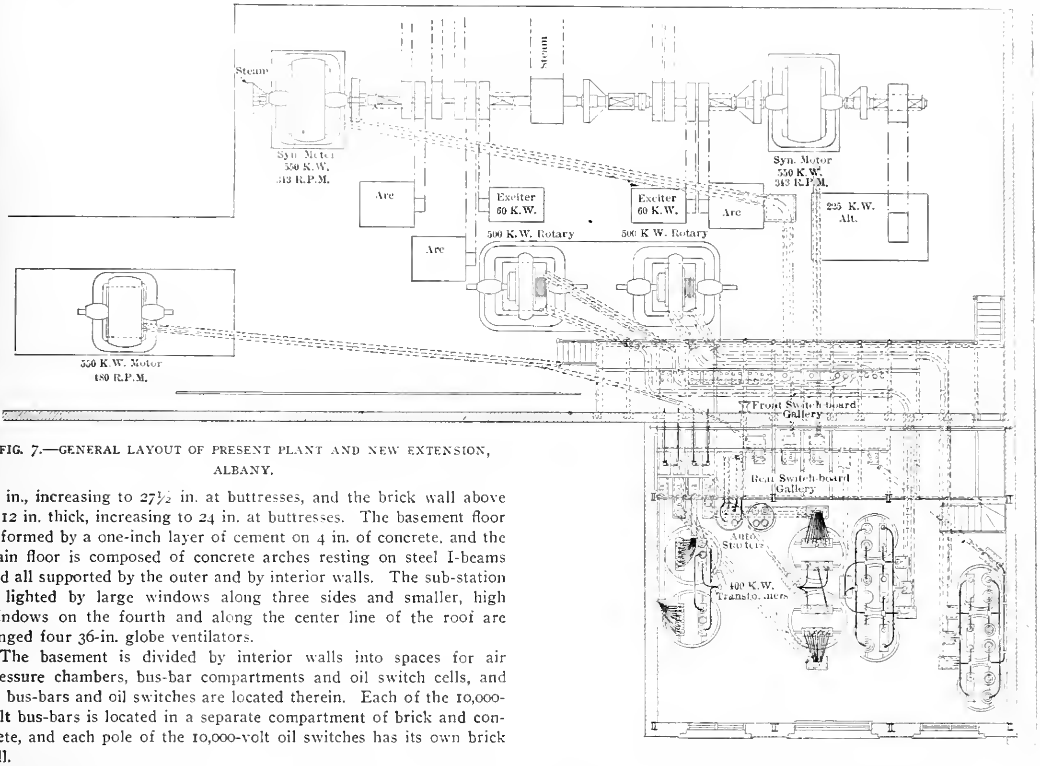


FIG. 7.—GENERAL LAYOUT OF PRESENT PLANT AND NEW EXTENSION, ALBANY.

The basement is divided by interior walls into spaces for air pressure chambers, bus-bar compartments and oil switch cells, and all bus-bars and oil switches are located therein. Each of the 10,000-volt bus-bars is located in a separate compartment of brick and concrete, and each pole of the 10,000-volt oil switches has its own brick cell.

The entire main floor of the sub-station is swept by a 15-ton traveling crane, and this crane runs over an archway at one end of the building, where teams can drive in at the basement level. The 18-in. I-beams on the side walls of the sub-station on which the crane travels are supported by the brick abutments, and these abutments are not reinforced by steel columns. On the main floor of the sub-station are located transformers, the operating gear of oil switches, rotary converters, exciters, synchronous motor-generators and the switchboard panels. Along one-half of the main floor the railway apparatus and along the other half the lighting apparatus is located. Current is supplied to this apparatus in part by six transformers, each rated at 10,000 to 375 volts, and 110 kw, and of the air-blast type. These six transformers are connected in two groups with two rotary converters, each rated at 300 kw, 40 cycles and 600 volts. Two other banks of transformers are made up of six units with a rating of 10,000 to 375 volts and 220 kw each, and each of these banks feeds a 600-kw, 600-volt, six-phase, 40-cycle rotary converter. With each of the 300-kw rotary converters there is a 45-kilovolt-amp. reactive coil of the air-blast type, and with each 600-kw rotary there is a 90-kilovolt-amp. reactive coil of the same type. Space has also been provided for three more 220-kw transformers and one 600-kw rotary converter with its reactive coil. Each group of three transformers

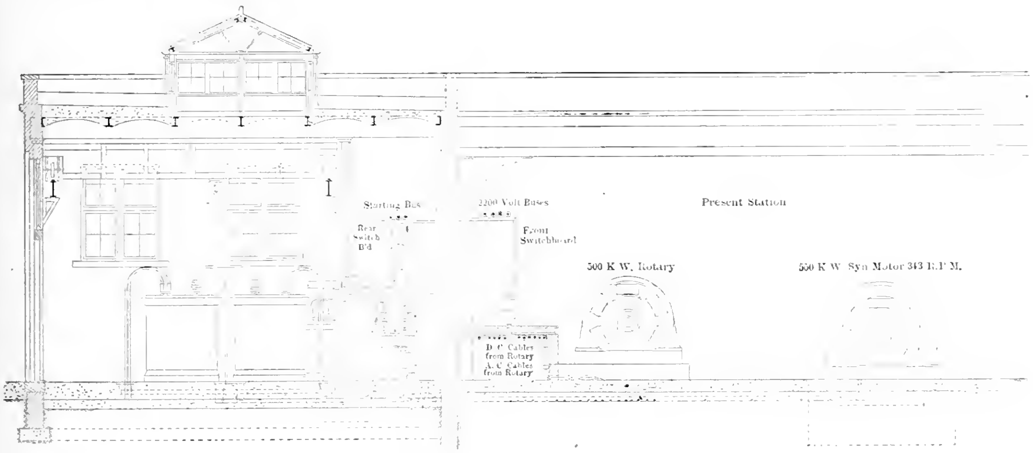


FIG. 8.—CROSS-SECTION THROUGH PRESENT STATION AND NEW EXTENSION, ALBANY.

is connected to the 10,000 bus-bars through a type H General Electric oil switch, electrically operated by current from a battery of 55 type E storage cells made by the Electric Storage Battery Company. The panels that carry the controlling switches for all the apparatus at the sub-station are of black enameled slate, and the maximum pressure to which they are exposed is 15 volts. Of these panels three carry instruments for three incoming lines of 10,000 volts and 4,000-kw capacity each. On each of these three panels there is one horizontal edgewise ammeter, one voltmeter of the same type, one double-pole

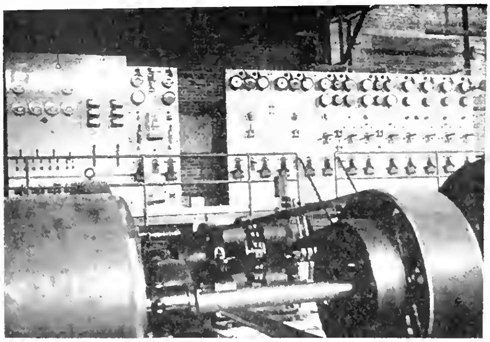


FIG. 9.—SWITCHBOARD, ALBANY.

overload relay that indicates by lamps whether the oil switches are open or closed, one controlling switch for the type H oil switch, and a current and potential transformer and static dischargers. The two panels for outgoing lines are of 10,000 volts and 1,500-kw capacity each, and equipped like the incoming panels with the addition of polyphase induction recording wattmeters. For each rotary converter the panel includes a recording wattmeter, power factor indicator and overload relay, besides volt and amperemeters, controlling

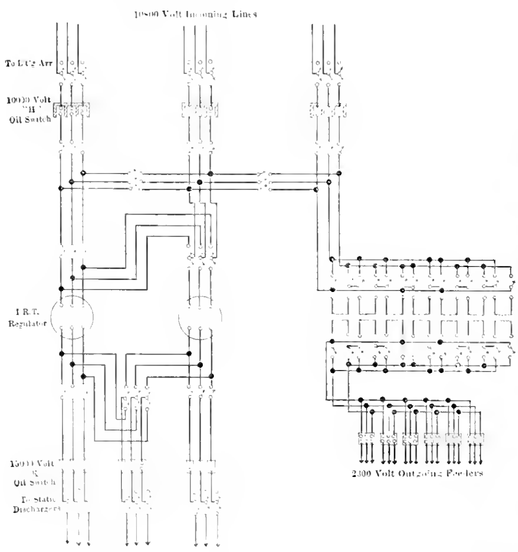


FIG. 10.—DIAGRAM OF MAIN CONNECTIONS, ALBANY SUB-STATION.

switches for the type H oil switch, indicating lamps and secondary transformers. Lamps in the sub-station may be operated from either the regular lighting circuits, the railway circuit or from the storage battery above mentioned.

Two 75-kw motor-driven exciters are already in use at the sub-station, and space has been provided for a third set when required. The lighting equipment at this sub-station includes synchronous motor-generators and constant-current transformers. Each of three of the motor generators is made up of a 550-kw, 10,000-volt, 40-cycle, three-phase motor, and a 500-kw, 2,300-volt, 60-cycle, three-phase generator. Space for a fourth motor generator of this capacity is also provided. Each of the other three motor-generators is of 250-kw output capacity, and converts the 10,000-volt, 40-cycle, three-phase current to 2,300 volts and 60 cycles. Each synchronous motor of these motor-generators is connected with the 10,000-volt, three-phase bus-bars through one of the electrically-operated type H oil switches. Series arc lighting is provided for by eight constant-current transformers of 4,000 volts and 6.6-amp. capacity each. These

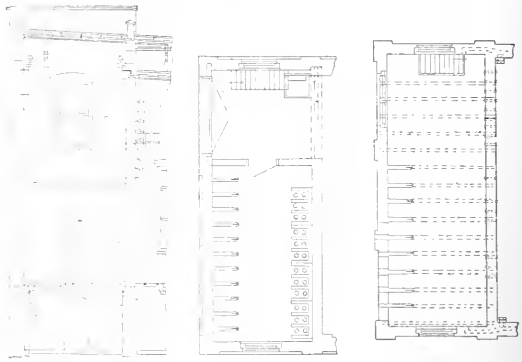


FIG. 11.—SECTION AND PLANS, ALBANY SUB-STATION.

transformers are supplied with 2,300-volt, 60-cycle current from the motor-generators. Current of 40 cycles was tried for arc lighting from the old sub-station, but its use has been abandoned. As may be seen from this list of equipment, the sub-station sends out only two sorts of current for the general supply of light and power; that is, current of 60 cycles at 2,300 volts and constant-current of 6.6 amp. and the same number of cycles as the other. Two automatic regulators are provided at the sub-station for the two most important 2,300-volt circuits that leave it for lighting service, and hand regulators are connected in the other 2,300-volt lighting feeders.

Between the Dock Street sub-station and the main business parts of Schenectady the lighting and power circuits are composed of underground cables in Camp tile ducts. Feeder cables for the 2,300-volt circuits have three conductors each, and these conductors in

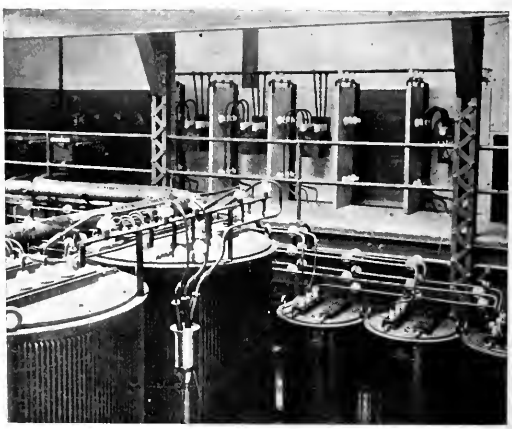


FIG. 12.—TRANSFORMERS, ALBANY.

most cases are each of 500,000 cm. cross-section. For the constant-current arc circuits single-conductor cables are used. The general distribution system for light and power at constant pressure includes 2,300-volt, 60-cycle, single-phase primary mains, subway transformers in manholes and three-wire secondary mains at about 250 volts. In the outlying parts of the city the 2,300-volt underground feeder cables connect with overhead feeders, and these feeders supply banked transformers and secondary three-wire mains as far as is practicable. Separate transformers for single customers are used only in isolated locations. The connected load of the Schenectady electrical supply system includes constant, alternating-current arc lamps, constant-pressure alternating arc lamps, incandescent lamps on constant-pressure circuits, and induction motors at 550 or lower voltages. All arc lamps are of the enclosed type. Substantially all of the commercial service is supplied through meters of which there are 5,306 in use with 5,309 customers. The number of arc lamps used for street lighting is 440 of the 6.6-amp. type on series circuits, with an estimated equivalent capacity of 4,400 incandescent lamps of 16 cp each. Commercial arc lamps on constant-pressure circuits number 519, with individual ratings of 4 to 25 amp., there being 10 of the largest size, and the number rated at 6 amp. each is 482. Estimated on the basis of 16-cp incandescent lamps, the equivalent capacity of these commercial arcs is 10,030 in number. Commercial incandescent lamps number 84,572, and their equivalent capacity in lamps of 16 cp is 79,-

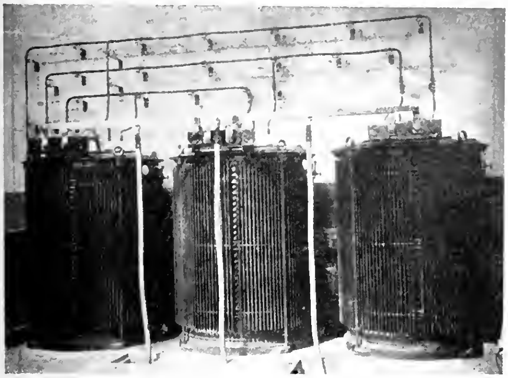


FIG. 13.—A GROUP OF TRANSFORMERS, ALBANY.

180. In candle-power these incandescent lamps range from 4 to 100, and the number of 10-cp lamps is 16,820, of 16-cp 63,769, and of 100-cp 6.

All motors are of the induction type, and their total number is 173, with a combined rating of 671 hp, and an equivalent capacity of 11,140 incandescent lamps of 16 cp each. These motors range from 1/16 to 50-hp capacity, and there are five of the 20-hp, five of the 30-hp, and two of the 50-hp size. The equivalent rating of all the lamps and motors above named is 100,350 incandescent lamps of 16 candle-power.

Besides the above connected load the Schenectady Railway Company has secured a twenty-year contract, subject to confirmation at the end of each three-year period, to pump all of the public water supply for the city. This water is pumped into standpipes under a head of 110 pounds and with a suction of 6 pounds. For the work of pumping there have been provided two vertical turbine centrifugal pumps with a daily capacity of 12,000,000 gallons. To each of these pumps there is direct-connected an 800-hp, 40-cycle, 550-volt induction motor. Each motor is supplied with current from the 2,300-volt, 40-cycle, three-phase line through three transformers rated at 250 kw each. Two pole lines and circuits extend from the Dock Street sub-station to the pumping station, and the supply of power is assured by the fact that not only the water-driven stations at Spier Falls and Mechanicville, but also the steam plants at the General Electric Works can be drawn on. The entire electrical equipment at the Dock Street sub-station, and most of the lamps and motors on the supply system are of General Electric make. The facts as to this notable application of water power have been obtained through the kindness of Mr. A. L. Rohrer, of the General Electric Company, and Mr. F. G. Sykes, of the Schenectady Railway Company. The Schenectady system is shown in Figs. 1 to 6. The Albany system is illustrated in Figs. 7 to 13.

New Rapid Transit Tunnel for New York.

Governor Odell has signed the two New York City rapid transit bills passed by the New York Legislature. The bills were introduced at the request of the Rapid Transit Commission, which is now enabled to proceed with the arrangements for the construction of another independent rapid transit tunnel up and down Manhattan Island.

Lamme Single-Phase Railway System.

Two patents were issued May 3 to Mr. Benjamin G. Lamme on applications filed December 26, 1901, covering his single-phase alternating-current electric railway system, one being a so-called "system" and the other a "method" patent. The specifications cover in an abridged form the specifications of the English patent, which were printed in full in our issue of February 13 of this year. As against the four claims in the English patent, the American "system" patent contains seventeen claims and the American "method" patent eight claims. The illustrations are the same as those in the English patent, with one exception in the "system" patent, which illustrates a method of voltage regulation.

Referring to Fig. 1, the car transformer has two secondary circuits, one of which is closed on itself and the active length made variable by means of a switching device. The variable voltage in this circuit may be impressed upon the motor circuit through the series transformer diagrammatically indicated. By reversing the connections this variable impressed voltage may be employed either to subtract from or add to the voltage of the motor circuit through all of its varying values, thereby providing the necessary variation of

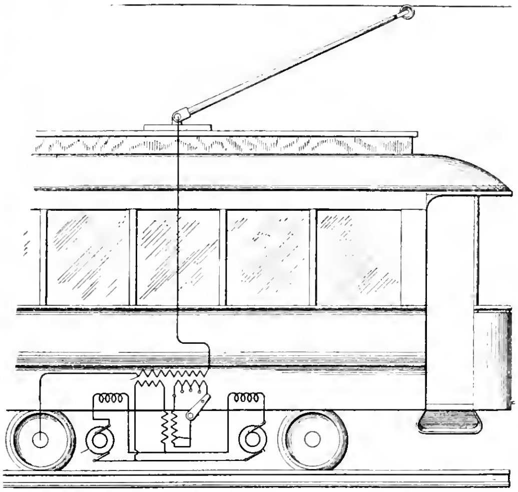


FIG. 1.—DIAGRAM OF CAR TRANSFORMER.

motor speed from zero to the desired maximum. It is stated that with this combined arrangement the motors may be designed for such voltage and such current as are best adapted for their operation, and the controller designed for some other voltage and current best adapted for its operation. Instead of varying the active length of a portion of the main transformer winding, the magnetic relations of the primaries and secondaries may be varied by adjusting one of the parts with reference to the other in a well-known manner; or such adjustment may be combined with means for varying the active length of a portion of a transformer winding.

A third patent issued on the same date to Mr. Lamme, on an application filed October 31, 1902, relates to details of his single-phase alternating-current motor. The object of the invention is stated in the patent to be to provide a single-phase motor with high-resistance conductors between the armature coils and the commutator bars, which shall be advantageously disposed with reference to the other parts of the motor.

In motors of this type the armature winding is of the closed-coil, parallel-circuit type and is closed upon itself, and as the magnetic field of the motor is alternating, any short-circuited turn through which the magnetic flux from a field pole passes will have a secondary current set up in it. By the well-known laws of the transformer, the ampere-turns in such short-circuited secondary will approximate the ampere-turns in the primary winding, which is in this case the field magnet winding. By reason of the character of the armature winding certain of its coils are short-circuited through the brushes when the adjacent commutator bars, to which the ends of the coils are connected, are bridged thereby, and when the brushes are located in neutral positions or without lead the short-circuited turns surround the paths of the magnetic flux and are, therefore, good secondary circuits in which under ordinary conditions relatively large secondary currents are set up by induction. This is the principal cause of the excessive sparking in series motors of ordinary construction when it is attempted to operate them upon an alternating-current circuit.

In order to obviate destructive sparking, the current in the short-circuited turns of the armature coils should be limited to an amount materially less than what would normally flow. This may be effected by inserting a definite amount of resistance in each of the leads between the closed winding and the commutator bars. The working currents in the armature winding will not pass through these resistances except at the bars in contact with the brushes, because the armature winding is closed upon itself inside or beyond the resistance leads. Consequently, the loss in the winding due to the introduction of the resistance may be relatively small, and when the armature is rotating this loss is distributed successively through all the resistances, thus making the average loss per resistance lead very small. Various ways of introducing such a resistance may be employed; but to provide the desired amount of resistance and at the same time so dispose it that it will be securely supported under the comparatively rapid rotation of the armature is a somewhat difficult problem.

In motors of large power employed for operating railway vehicles the space allowable for the motors is extremely restricted, and hence it is a matter of material importance to so dispose the several elements of the motor as to secure the desired ventilation and general efficiency without occupying more than the allowable amount

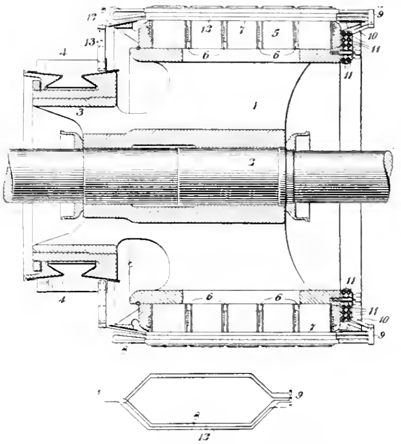


FIG. 2.—SECTION OF ARMATURE AND COMMUTATOR.

of space. Fig. 2 shows a longitudinal section through an armature and commutator of such a section, and a diagram of one of the armature coils.

The skeleton frame or spider, 1, of the armature is mounted upon and keyed to the shaft, 2, in the usual manner and is provided with an extension, 3, on which is mounted the commutator, 4. The laminated core, 5, is mounted and suitably fastened upon the frame or spider, 1, and is provided with ventilating ducts, 6, and with slots, 7, in which are mounted the coils, 8, these coils being connected at the end remote from the commutator by means of suitable connectors, 9, so as to form a closed parallel circuit winding, the winding being also joined by means of conductors, 10, to balancing rings, 11, in order to properly balance the magnetic circuit.

Each coil, 8, is connected to its appropriate commutator bar by means of a conductor, 12, of relatively high resistance and a connector, 13, one end of which is fastened to the corresponding commutator bar and the other end of which is fastened to the corresponding end of the resistance conductor, 12. This conductor, 12, may be formed of German silver or other suitable high-resistance material and is located in the bottom of the slot, 7, it being provided with a suitable insulating sheath in the same manner as are the corresponding portions of the coils, 8. There is, obviously, one of these resistance conductors, 12, in each slot, and since it is located in the bottom of the slot it is advantageously disposed both as regards the security of its position and also because it does not interfere in any way with the proper disposition of the other parts of the machine.

The claims cover the combination with a commutator of an armature core provided with slots, a parallel closed circuit winding and high-resistance leads connecting the winding with the commutator bars, the coils and leads being located in the slots and connected together at the end of the armature remote from the commutator.

On the same date a patent was issued to Mr. Charles F. Scott on a system of alternating-current distribution particularly adapted to

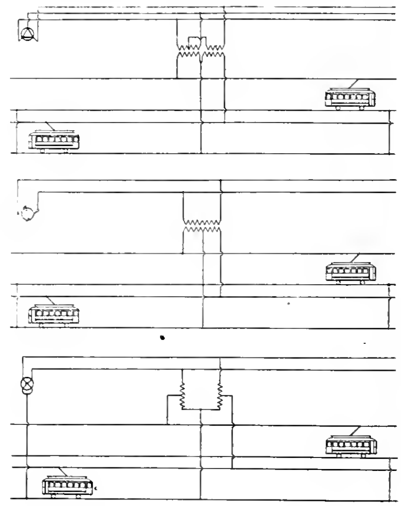


FIG. 3.—DIAGRAMS OF DISTRIBUTION SYSTEMS.

systems employed for operating single-phase alternating-current motors, the armature and field magnets of which are in series relation. The object of the invention is stated to be to provide a system of distribution and transformation which shall insure economy in the use of electrical energy by the use of a single-phase transmission system for the operation of electric vehicles upon two parallel tracks. In the accompanying illustration, Fig. 3, the upper diagram refers to a three-phase transmission circuit, a double-track railway and transformers for supplying single-phase currents to the motors on their respective tracks. The middle portion is a corresponding diagram of a single-phase transmission system, and the lower diagram that of a two-phase, three-wire transmission system.

In the first-mentioned method three-phase currents are transformed to two-phase currents, one side of the two-phase circuit being connected with the track. It is stated that by this arrangement a saving in conductors for the transmission circuit is effected by employing the three-phase system, and that a further saving is effected by using the rails of the two roads as a common return for both circuits. In the single-phase arrangement the line voltage is transmitted at double the voltage of the trolley circuit, the rails being connected to the middle point of the secondary of the line transformer. The third method relates to a two-phase system employed with a ground return. It is stated that with this system there are the advantages of a polyphase transmission system and a saving in conductors by the use of the rails as return circuits for both phases of the high-voltage circuits and also for the two trolley circuits.

Western Union and Erie.

It was reported last week that the Postal Telegraph-Cable Company would displace the Western Union Telegraph Company's service along the line of the Erie Railroad. It was also reported that a like change would take place about July 1 on the Pennsylvania lines west of Pittsburg. As to the former report both President Underwood, of the Erie, and President Clowry, of the Western Union, deny any knowledge whatever.

Recent Electrochemical Developments.

ELECTROLYTIC PROCESSES.

The consumption of tin has increased enormously in recent years, notably on account of the very large amounts of tin used for tinned iron for canning. The production of tin from the ores has also increased, but not to the same degree. Under these circumstances, the electrolytic winning of tin from tinned iron scraps or from the cans after the preserves have been eaten has become a well-paying business. It is estimated that in Germany alone at present about 35,000 tons of tin scraps are treated per year electrolytically, from which 2 to 2.5 per cent., i. e., about 800 tons of tin are won, amounting to about $500,000. These processes are used on a large scale, notably in two German plants, but have been introduced later into Holland, and also recently to this country. The processes used are kept secret, especially the electrolyte, although it is generally understood that the commercially successful companies use an alkaline electrolyte.

A patent granted on April 26 to Mr. E. Quintaine, of Argenteuil, France, relates to a new process of this kind, the feature of which is the electrolyte which consists of a solution of acid nitrate of tin, to which a certain quantity of sulphate of ammonia is added in order to neutralize the bath. The inventor prepares a bath of a solution of acid nitrate of tin, to which is added gradually a certain amount of sulphate of ammonia and a tin chloride. This gradual addition to the solution is continued until precipitation ceases.

A patent granted on May 8 to Mr. H. Spence, of Manchester, England, refers to the production of a "new titanous sodium-sulphate compound" for use as a reducing agent in various manufacturing processes, in the discharge of coloring matters from textile fabrics, etc. The compound is produced by means of electrolytic reduction of titanium sulphate in the presence of sulphuric acid, with an addition of sodium-sulphate, and by means of evaporating the solution afterwards.

The importance of thorough stirring of the electrolyte for certain electrolytic processes is well known. Some means of stirring becomes necessary whenever the object to be obtained by electrolysis requires the solution to be kept as much as possible in its original condition. For instance, if a metal is to be deposited from a solution of one of its salts, the tendency of electrolysis is to render the solution near the cathode poor in the ions of the metal to be deposited. This results then in a new reaction which is mostly generation of hydrogen, and represents a waste of energy. Various apparatus have been suggested by which it is possible to obtain a thorough agitation of the electrolyte. Two patents granted on April 26 to Mr. G. E. Dunton, of New York City, refer to mechanical details of such devices. The author makes use of pumps and pipes provided with nozzles.

A patent granted on April 26 to Mr. G. K. Jenney. of New York City, refers to mechanical details of an apparatus for electroplating sound records. The inventor describes a case or holder by which the sound record discs may be supported through peripheral contact only and the record surface thereby fully exposed to the electrolytic action and protected at the same time from accidental blows or mutilation.

ELECTRIC DISCHARGES THROUGH AIR.

A further contribution to this subject which has been investigated by various experimenters in recent years—mainly with two objects in view, viz.: the fixation of nitrogen and the production of ozone—is given in two patents granted to Mr. J. N. Alsop, of Owensboro, Ky., on May 3. He does not state exactly the chemical compound which he wants to get, but says that the air after treatment contains nitrogen peroxide and traces of ozone and "is in a state of ionization." He states, however, explicitly for which purpose he wants to use his modified air. The object is to whiten and purify cereals and otherwise improve their quality. For instance, flour is very noticeably bleached, the dough then formed is drier and more elastic and sections of the loaves of bread made from such dough have a fine white color.

In his apparatus he uses essentially two sets of electrodes which in turn are separated to form an arc. When the arc between the first set of electrodes is formed by separating these electrodes, the electrodes of the second set are being brought together and when they make contact a short-circuit is produced and the arc of the first set is extinguished. The second set is then separated, etc.

STORAGE BATTERY INVENTION.

The well-known process of Mr. A. G. Betts for electrolytic lead refining has led the same inventor to a storage battery of the following construction described in two patents, granted on May 3. He places two graphite electrodes in a strong solution of lead fluosilicate containing some free acid or a somewhat acid solution of fluosilicates of lead, and another metal, such as copper, capable of being deposited by electrolysis practically free from lead from such a solution. On passing an electric current of moderate strength through the cell, peroxide of lead is deposited on the anode in a dense, adherent and well conducting form, while metallic lead or the other metal (copper) is deposited on the cathode. Free fluosilicic acid remains in solution. This represents the charging of the cell. During discharge the reactions are reversed.

A patent granted on May 3 to Mr. J. T. Niblett, of Greenwich, England, refers to the type of battery in which the cell is filled with granules or pellets forming the active elements. As active material the inventor uses a mixture of granulated lead or granules of lead oxide incorporated with kieselguhr.

A patent granted to Mr. V. G. Apfel, of Dayton, Ohio, refers to the following construction of a storage battery. The whole case is divided into two compartments, the inside surface of each compartment being electrochemically active. Each compartment contains a series of liquid-tight conducting cases, one within the other and insulated one from the other. Their respective interior and exterior surfaces are electrochemically active. Within the inner case of each compartment a central element is provided which constitutes one electrode.

A patent granted to Mr. W. J. Redmond, of Cleveland, Ohio, refers to the construction of a storage battery plate in which the surface is provided with a great many hair-like projections for holding the active material.

New Telephone Patents.

NEW RECEIVERS.

A three-pole receiver is undoubtedly unusual, but such is one recently patented by Mr. E. H. Strauss, of Chicago. The design of this may be best understood by a reference to Fig. 1 wherein, in the upper part of the figure, is shown a section of it. As will be noted, a metal cup supporting both diaphragm and magnetic system, is clamped within the casing by the cap piece. The single oblong coil surrounds

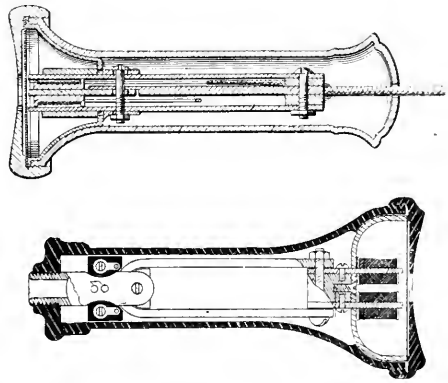


FIG. 1.—STRAUSS RECEIVER.

a flat rectangular pole piece, which is an extension of a central bar magnet. At the other extremity of this bar magnet are iron spacing pieces, outside of which are bolted two other bar magnets in such a manner that each forms a return pole piece extending nearly to the diaphragm. This magnetic system is adjustably supported from the metal cup, the clamping bolt securing it thereto running in slots in the base of the cup. A still further means of adjustment is obtained, by using this same clamping bolt to secure the pole piece to the central magnet and providing this pole piece with a slot. This enables an adjustment of the air-gap of the central leg of the magnet entirely independent of that of the side poles.

Still another receiver having the magnetic system supported from a metallic cup is that patented by J. S. Gemmill, of Cleveland, Ohio. A sectional view of this receiver is shown in the lower part of Fig. 1. The most novel feature is undoubtedly a clevis screwed into the tail of the receiver casing and spanning the closed end of the U magnet.

This serves to take up side strains and at the same time to form a guide for the receiver cords and a mounting for the hard rubber terminal block.

TRANSMITTER.

Mr. Gemmill has also patented a transmitter of a design to prevent moisture penetrating the granular button. This result is accomplished by supporting the front electrode upon a disc clamped between two annuli of sponge rubber. One of these is the insulating medium within the metallic granule box, and the front electrode supporting disc is held tightly against it. This pressure has, however, little effect upon the susceptibility of the electrode to motion, as it is caused by pressure exerted by an exactly similar ring, the net result being a supporting of the electrode between two balanced springs.

AN EXTENSION STATION WIRING.

Another circuit patent is that of Messrs. Charles E. Scribner and J. L. McQuarrie, of Chicago, which describes a method of so wiring a main and extension instrument upon a single line that these may be used independently of the central office and yet may receive their entire current supply therefrom. The circuit hinges upon the removal of the line relay from the ungrounded side of the line as usually arranged in the Bell Company's switchboards and the placing of it in the grounded side of the line. Thus, the battery may be fed

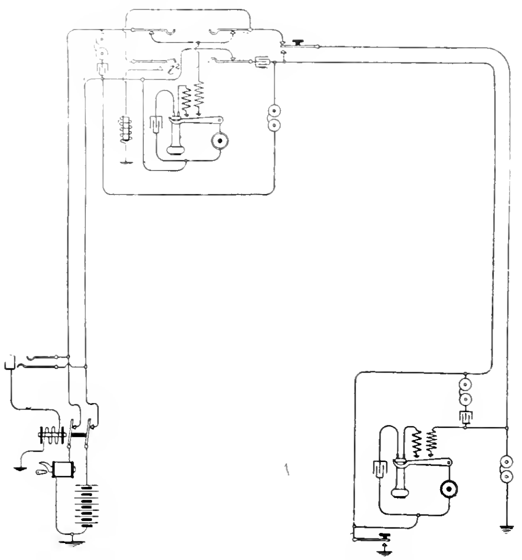


FIG. 2.—SCRIBNER & M'QUARRIE TELEPHONE SYSTEM.

out from the central office over one side of the line and return through the ground, without effecting the display of a line signal. Signalling between the main and extension stations is by single-stroke bells working by direct current under the control of contact keys located at the two stations. Provision is made that either station may call or be called by the central office; that either may call the other without signalling the central office; that that the main station may cut the extension from the circuit at will. With this explanation, the operation of the circuit, shown in Fig. 2, may be readily traced by those familiar with this line of work and to whom alone it is of interest. The Western Electric Company has obtained the patent by assignment.

TWO-WIRE SWITCHBOARD CIRCUIT.

A patent for a two-wire common battery switchboard circuit has just been issued to Mr. W. W. Dean, which differs considerably from the two-wire circuits now used by the Kellogg Company, to whom it has been assigned. In this system a line relay and a cut-off relay are provided, the cut-off relay leaving the talking lines undisturbed, and instead cutting off the line signal apparatus. In such an arrangement, but two wires being available, the cut-off relay must be included in series with the line relay, and to warrant its remaining unoperated during the display of the line signal, its resistance must be made low in comparison with that of the line signal. On the other hand, as during a conversation, the cut-off relay is virtually bridged across the line, a high resistance, therefore, is desirable. To meet both requirements, Mr. Dean has double-wound his relay, the windings being of unequal resistance and in series. The higher winding is normally shunted out by the back contacts of the relay. Now, when a calling signal is sent, the small line relay current passes without effect through the low-resistance cut-off relay coil. When the operator responds a large current traverses the cut-off relay until the relay can respond. Then the line relay being cut off, the shunt on the high resistance part of the cut-off relay is removed, and the relay now of high resistance remains in the operated condition until disconnection is made.

Copyright in Telephone List.

The Rocky Mountain Bell Telephone Company has issued a letter to the public of Salt Lake City asserting copyright in its telephone list. The notice is as follows:

Our attention has been called to a letter sent to our subscribers by the Utah Independent Telephone Company, signed by H. B. Brown, Manager Contract Department, offering to retain in the new company the same numbers now held in ours. For several years we have endeavored to convince the people of Salt Lake that two telephones would be a burden upon them, and that the Rocky Mountain Bell Telephone Company is able to give them all the service they need, and more than can be furnished by any other company for years to come. The letter referred to shows that the Independent Company expects you to subscribe to two telephones, with an added cost and inconvenience, which we claim is unnecessary. With our over 5,500 subscribers in Salt Lake, and our long lines connecting every city, town and village in the inter-mountain region, we feel justified in saying that we can give you a service that no other company can give.

This letter is called forth by a constant demand from our patrons to know what they should do. This is our answer: We have tried to serve you in the past and feel that we can do better in the future. Two telephones are a nuisance and will cost you more money than one; our advice is to wait and see whether the "pig in the poke" is worth buying. We most decidedly object to the use of our telephone numbers by the Utah Independent Telephone Company, or by any other company. Our telephone numbers are all copyrighted, and the property of this company, and will be protected.

CURRENT NEWS AND NOTES.

VOLUNTEER RUSSIAN TELEGRAPHERS.—The Czar of Russia has accepted the offer of the senior class of the Electro-Technical School at Odessa to serve as volunteer telegraphers in Manchuria. These volunteers will have charge of the wires along the Manchurian line.

INDEPENDENT TELEPHONES IN POST-OFFICES.—Some weeks ago the Postmaster-General ordered the removal from post-offices of all telephones that did not have long-distance connection with Washington. This cut out the independent service. The independent telephone interests protested against this action and sent representatives to Washington to secure a modification of the ruling. Their efforts, it seems, have been rewarded with success and a bill has passed through Congress providing for such an ample appropriation for telephone service that the independent companies will not be compelled to remove their instruments from post-offices. One of the principal claims for the independents has been that they have brought the people in touch with the public utilities.

THE EDISON MEDAL.—President Bion J. Arnold, of the American Institute of Electrical Engineers, has addressed to the educational institutions of the United States and Canada a statement with regard to the Edison Medal founded this year and calling their attention to the fact that it is open for competition by students for the best thesis or record of research on theoretical or applied electricity and magnetism. Mr. Arnold announces that the medal committee of the Institute is being formed and requests the authorities of institutions qualified and desirous to compete to send in their names to the medal committee, at 95 Liberty Street, New York City, on or before June 1, when further information will be given. It is hoped and expected that there will be a large competition from among the graduating students in electricity.

EVANESCENT RADIUM.—According to statements made by Prof. Sir William Ramsay, as reported in a recent special newspaper dispatch, there will be no more radium 1,150 years from now. It will all have disintegrated and vanished in the meantime. Radium, Sir Ramsay is reported to have said, instead of being a primeval substance which has been slowly disintegrating since the world began, is merely a temporary phase of matter, an unstable resting point in a series of transmutations, of which nobody knows the beginning, or end, or meaning. The rate of disintegration does not depend upon the quantity existent. It would all vanish, whether it measured a cubic inch or a cubic mile, forming in the process other substances, the only one at present known being helium. It is obvious, therefore, that radium must now be in the course of production. If it had been an original deposit it would have disappeared long ago. It was the merest speculation to discuss how it was produced. Nobody knew, but possibly it came from uranium.

TELEPHONES IN A CONVENTION.—It was decided recently at the St. Louis meeting of the Committee on Arrangements for the convention of the Democratic National Committee to introduce an innovation in the form of telephonic communications between the platform and each of the State delegations at the National Convention in July. The proposal to connect the chairman with all parts of the hall, in order that his attention may be secured promptly by the person first entitled to receive recognition, was accepted after a very brief discussion. In addition to being connected with the State, the chairman will be able to communicate by telephone with the officers of the convention at the doors or any other part of the hall. The importance of the innovation will be appreciated by all who have attended a national convention. Outside of the main hall, the telephone service will be extended to the lobbies, where many additional instruments will be installed, affording long-distance connections.

Letters to the Editors.

Reciprocating vs. Turbine Engines.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to Mr. Seymour's communication in your issue of April 30, I have as much aversion to entering into anything of the nature of a controversy as Mr. Seymour, and would not ask you for space to reply to his communication were it not for some of his statements regarding the steam turbine, which I feel, if left unchallenged, would leave but a poor impression of the adaptability of the steam turbine for general power purposes. Mr. Seymour says:

"According to his figures (that is, mine), if the vacuum should fall to, say, 21 in. instead of 25 in., which, however, does not seem unreasonable, the capacity of the turbine would be cut down 30 per cent., with a corresponding increase in steam consumption, and under such conditions, with a drop in the steam pressure of 10 per cent., the turbine would not pull its rated load, with by-pass full open."

This, in the face of my statement that all Westinghouse-Parsons turbines are capable of carrying full load without any vacuum at all. The 10 per cent. drop in steam pressure would affect the capacity to about a similar extent, but the falling off of economy would be only 3 per cent.

The figures Mr. Seymour referred to were a mere statement on my part, that for each inch of vacuum above 25 in. the economy of the turbine was affected 3 per cent. to 4 per cent.

With reference to an attendant having to be on the spot to open a hand-operated by-pass arrangement for carrying overloads, would say that where the exigencies of the station demand such a thing, this valve is made automatic and is operated by the governor, in which case the turbine is capable of meeting the most exacting demands of fluctuating loads. I fail to see how this feature is any more "a drag upon both boiler and condenser" than in the case of a reciprocating engine carrying overload by means of an extended cut-off.

At the conclusion of Mr. Seymour's letter, he makes some remarks from which inference might be drawn that the economy of a turbine is likely to fall off with age. Experience of five years in this country shows absolutely no deterioration of the working parts, on which condition the economy depends. European experience has been similar in this respect, tests having demonstrated that there has been no falling off in economy.

PITTSBURG, PA. FRANCIS HODGKINSON.

Electric Conductors in Pipe Galleries.

To the Editors of Electrical World and Engineer:

SIRS:—The report of the Plans Committee of the Rapid Transit Commission having again brought the question of pipe galleries prominently to the front, I ask permission to comment briefly on the editorial remarks in your issue of April 16, suggested by the fire in the subway at Broadway and Fulton Street, which temporarily threw out of service so many telephone and telegraph circuits. Your editorial conclusion appears to be that this accident, instead of furnishing an argument for pipe galleries, supplies one against them. Obviously, if the subway had not been built the wires would not have been disturbed, and what happened would not have happened. It may also be true, as you say, that "in most of the pipe gallery schemes which have been discussed from time to time, the plan has been broadly that of carrying the cables in masses through an open tunnel, thus exposing them throughout their entire length to the danger of just such an accident as that which has occurred, and which will inevitably occur again unless greater care is taken."

The prospect of following foreign practice which, in several cities, has given excellent results, does not alarm me as much as it probably would if I had been at less pains to learn what results have followed the crude methods of pipe gallery design which were originally proposed for New York. Permit me to quote further from your editorial comment as follows: "At first glance, the pipe gallery idea has many recommendations, particularly in the ready accessibility of the various services and the facility with which new services can be installed, thus, for example, rendering new competition feasible, which to-day does not appear easy to effect. On the other hand, it does seem as though in working out a pipe gallery scheme, the first consideration should be given to dividing up the services rather than bunching them, so that as in a sectional water tube boiler, the danger would be lessened rather than increased." In the pipe galleries designed for lower Broadway by direction of President Cantor, of Manhattan, at least average intelligence was displayed in planning to accomplish exactly what you deem necessary. Not only did every conductor have its own vitreous conduit encased in cement, but the systems were so divided that the light and power wires were wholly separated from the signal wires, and access to them was had through separate manholes. There was absolutely no connection between the ducts for electric conductors of either class and the chambers containing gas or water pipes. In these respects the system was beyond intelligent criticism, unless based on the ground that it embodied refinements which nothing in foreign experience shown to be necessary for the protection of the public or of private interests. To the engineer responsible for this design it seemed wise to err on the side of safety, and in submitting his plans to President Cantor to say: "Foreign experience in safely grouping high-tension and low-tension electrical conductors, gas mains and water mains in common chambers would seem to indicate that in designing the pipe galleries for lower Broadway excessive regard for safety has been shown in giving the electrical systems ducts in which not only are the high and low-tension wires completely separated, but are wholly removed from even proximity to gas mains. This seemed desirable, if not necessary, in the present instance, but I am of the opinion that in future work of like character the foreign practice may be more closely followed with economy and safety."

The foreign practice here referred to may be learned from the typical example of the pipe galleries built and building by the London County Council, under such of the thoroughfares of that city as are improved in a large way. A sectional drawing given me by Mr. Maurice Fitzmaurice, chief engineer of the County Council, shows the pipe gallery of the Victoria Embankment. It is an arched tunnel without divisions or partitions. Besides the water mains, it contains two 30-in. and one 36-in. gas mains, and a smaller gas pipe of probably four or six inches. The electric wires are disposed of by stringing them on racks dependent from the crown of the arch or on trough-like shelves against one of the side walls. Nothing cruder in design could be imagined, but the system works very well and gives no trouble. The water mains do not break or leak, and an occasional low place where any water which gets on the floor of the gallery may run and be removed by the attendants in pails, is all that is found necessary. There is no gas leakage. Mr. Fitzmaurice, who visits the tunnels daily, assures me he has never noticed even the odor of gas. Permits are freely issued to plumbers to take torch lamps into the galleries, and to maintain naked flames for soldering purposes. I was myself invited to walk through the system with the chief engineer, and was told that I might smoke cigarettes the whole distance. The only persons not permitted to smoke in the galleries are the workmen, and the prohibition applies to them only during working hours.

I make no pretension to being a practical electrician, but the piling of cables one on another in troughs and on hangers suggested an inquiry as to what happened when crosses and short-circuits were established. I was told this rarely occurred, and that when it did nothing happened.

The fact of the matter in few words is that gas and water mains in tunnels do not leak, and that very crude appliances for keeping electrical conductors out of the way appear to serve their purpose very well. The dangers to be apprehended from pipe galleries are wholly imaginary; their advantages are almost incalculable, and without them New York can never hope to attain the character of a city of the first class.

NEW YORK CITY. JAMES C. BAYLES.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Variable-Speed Motors.—PUNGA.—An article on the design of direct-current motors for variable speed. The commutation is by far the most important factor and to get good commutation it is necessary that the number of armature turns per segment is kept small; that the number of lines of force entering the armature is large; and that the effective length of one turn as well as the free length are small. He gives some rules how to alter the design of a constant-speed motor, so as to obtain a good commutation for variable speeds. If the commutator cannot be decreased in diameter and the width of a segment cannot be decreased, then the most effective way to obtain the end in view is to increase the diameter of the armature, keeping the length constant. These deductions are valid only if mechanical difficulties do not prevent an increase of the armature diameter; if the corresponding speed motor has sparking for its limit of output, and if the number of turns per segment is larger than one. These provisions are discussed in detail. The general conclusions arrived at by the author are discussed for the example of a 7-hp, 125-volt semi-enclosed motor. Special devices for the prevention of sparking may be profitably used in variable-speed motors of a wide range. It is thought that a smooth-core motor fits admirably the requirements of the variable-speed motor, because the amount of copper employed is very small, causing only a slight increase of the air-gap. This motor should be designed with small diameter and large length of armature, since this affords the greatest advantage to the use of the smooth-core winding.—Lond. *Elec. Rev.*, April 22.

Predetermining the Regulation of Alternators.—TORDA-HEYMANN.—A paper illustrated by diagrams in which he develops a theoretical basis for the experimental predetermination of the regulation of alternators with reference to a former paper of Behrend (ELECTRICAL WORLD AND ENGINEER, 1903, Vol. XLII, p. 802). The regulation is defined as the drop in voltage which occurs when full load is put on the machine, excitation and speed remaining constant. His method is a graphical one and is based on the knowledge of the following three curves: First, the no-load saturation curve; second, the short-circuit curve, and third the apparent magnetic resistance curve. The abscissæ are in all cases the excitation in field ampere terms while the ordinates in the first curve represent the e.m.f. at the armature terminals, in the second curve the current in the short-circuit armature and in the third curve the apparent magnetic resistance of the alternator which is the ratio of field ampere terms to the e.m.f. of the generator. By means of these three characteristic curves the voltage drop on inductive load with power factor zero may most accurately be obtained by a simple geometrical construction. For other power factors, then, the regulation is easily determined by well-known methods. The method is described in detail and applied to various examples.—Lond. *Elec.*, April 22.

LIGHTS AND LIGHTING.

Gas Versus Electric Lighting.—BOOTH.—An article on the advantages of modern gas lighting over electric light. The author says that for 100 years little or no improvement has been made in the methods of using gas. Nor was it looked upon as good policy to encourage systems of gas burning which made for economy. The standard of gas light was a paltry 16 cp from a flame burning at the rate of 5 cu. ft. of gas per hour. Now, the Welsbach burner using 3 to 8 cu. ft. of gas per hour, gives 18 candles per cu. ft. The present condition of gas lighting is such that the mantle bars the way to any further improvement, but with better mantles there can be better efficiency. "At present with one of the current systems a thousand feet of gas, at three shillings per thousand feet, will produce 36,000 to 40,000 candle-hours, or 1,000 to 1,100 candle-hours for one penny; that is to say, fully 20 hours of 50 cp for one penny. Users of electricity may compare their bills on the basis of three lamps of 16 cp each, run for 24 hours, and they will perceive how exceedingly extravagant a light is that from electricity." Gas lighting with modern methods is claimed to be at present far ahead of electricity in all respects, save convenience, and, under ordinary circumstances, health. Electricity lends itself to situations for which gas is out of question; but it is thought that for plain, straightforward lighting of rooms, workshops and public buildings, it is very doubtful whether electricity will hold first place in any sense of the term. It is pointed out that the "machinery of electric light" has become more complicated instead of simpler as time has moved on. "In coal consumption the incandescent electric light probably demands three times as much as modern gas lighting." It is thought that the hope for electric lighting at present lies in the direction of the arc light.—*Cassier's Mag.*, May.

POWER.

Steam Turbines.—An illustrated description of the power plant of the Yale & Towne Manufacturing Company, of Stamford, Conn., which is the first factory plant which has adopted the steam turbine in comparatively large units. The Westinghouse-Parsons turbine units are of 400-kw capacity each, giving a total capacity of 1,072 electric hp. The equivalent, at the 85 per cent. over-all efficiency claimed for the units, of about 1,260 indicated hp. The space occupied by the turbines and the surface condenser is roughly one square foot for three indicated horse-power, but this does not include the space occupied by the circulating and hot-well pumps which are in the basement nor the dry vacuum pump which is in another part of the engine room. The turbines with their attached generators weigh 33,200 pounds apiece and are set upon concrete foundations which cost less than $400 for the two machines. The cost of installation erected and ready to run was about 65 per cent. of that of a unit of the same capacity and efficiency operated by a reciprocating engine. The first unit was guaranteed to produce an electric hp-hour on 16.5 pounds of steam at 155 pounds gauge pressure, superheated 40°, and with 28 in. of vacuum. With an over-all efficiency of 85 per cent., this would be 14.025 pounds of the superheated steam per indicated hp-hour. On test with the rated load, 150.92 pounds pressure, 19.66° of superheat and 26.95 in. vacuum, the turbine used 22.156 pounds per kw-hour, or 16.53 pounds per electric hp, or 14.05 per indicated hp. As neither the pressure, superheat nor vacuum were what they should have been, the guarantee is recorded as more than fulfilled. In the same issue a description with detailed drawings is given by Levin of a multiple impact steam turbine.—*Power*, May.

Degree of Uniformity of Prime-Movers.—BERKITZ.—A description of a new method for rendering visible the degree of uniformity of the rotation of prime-movers during one revolution. A disc is loosely connected to the machine axle, but is made to revolve with uniform speed. The movements of the machine in relation to the uniform rotation of this disc are used for displacing the position of a mirror which also revolves. This mirror reflects the rays of a stationary series of light upon a surface, so that curves are described on this surface. The form and area of these curves depend upon the degree of uniformity of speed. From the curves it can, therefore, be determined whether the machine runs with the required degree of uniformity of rotation. A practical method of carrying out this principle is described and illustrated.—*Zeit. f. Elek.* (Vienna), April 17.

Electric Cableway.—An illustrated description of the cableway which has been installed for carrying 4,000 tons of railway construction plant over the Zambesi River in Africa. A special arrangement of steel towers for the cable has been adopted, with a special self-contained electric conveyor, which only requires a copper trolley wire to convey the current to it from the generating station on the bank. The conveyor is suspended on two traveler wheels running on the rope. On a frame which hangs down from the wheels are carried an electric motor, a chair for the driver, and two drums, which latter are actuated by the motor on which the hoisting ropes are wound. The conveyor is capable of lifting and carrying a maximum load of 10 tons, and it is estimated that no less than 800 tons of material can be transported across the river in one day.—Lond. *Eng'ing*, April 22.

REFERENCES.

Coal Mining.—FOWLER.—A long illustrated article on coals and coal mining methods of the Pocahontas field. The article deals mainly with general mining methods and the use of electric power is only occasionally mentioned. For ventilation fans are used from 25 to 40 ft. diameter, with a capacity of 300,000 to 500,000 cu. ft. of air per minute, and are driven either by an individual steam engine or an electric motor, dependent upon the location. If they are near the central power house, and within easy reach of steam, engines are used; but if they are over a distant opening in the outcrop, they are driven by an electric motor. The miners' cars are hauled out by either electric or steam locomotives, though the latter are used in the majority of cases.—*Eng'ing Mag.*, May.

Quayside Cargo Appliances.—CUNNINGHAM.—A fully illustrated description of some modern quayside cargo appliances and especially of electric quay cranes.—*Cassier's Mag.*, May.

TRACTION.

Voltage Drop in the Rails with Alternating-Current Traction.—BEHN-ESCHENBURG.—A paper in which the author first discusses the difficulties which arise from the use of the rails as one conductor in an alternating-current traction system, on account of the disturbances set up in telegraph and telephone lines in the neighborhood, using the earth as return conductor. The Oerlikon Company has made a series of tests on the action of sinusoidal alternating currents of various frequencies on a telegraph relay, a telephone bell and a telephone receiver. The disturbances of telegraph relays and of the frequency from 15 to 50 for a given voltage at the terminals; on the other hand, the vibrations of the telephone membrane will rapidly increase for higher frequencies from 25 to 50 periods. The author concludes that disturbances in telegraph and telephone lines using the earth as return, can only be avoided if the loss of voltage in the railway rails is compensated for. He gives some actual data on measurements of voltage drop in the rails on an experimental road of 400 meters length. He then describes a system of the Oerlikon Company in which the voltage loss in the earthed rails is avoided by diminishing the current in the rails. For this purpose an auxiliary line is provided which is connected to the rails at regular intervals. Only on that section of the road on which a train is just running, the rails carry current, while in all other sections the return current does not flow through the rails, but through the auxiliary wire. The advantages of this auxiliary wire, compared with a second insulated return conductor may be questioned, but the enormous simplification of the collection of the current by means of the wheels of the train is of decisive importance. The scheme is shown in Fig. 1, which shows two sections of the road. *L* represents the auxiliary conductor, while *S* represents the rails. Each section contains a transformer, the primary being in the overhead conductor and the secondary in the auxiliary conductor. By properly designing these transformers it is possible to accomplish that the return current flows nearly throughout through the auxiliary line, and that it flows through the rails only in that section on which the car runs. When they applied this method on their experimental lines it was possible to reduce the voltage loss in the rails 25 times. The transformer must be so designed that its self-induction is very large compared with the ohmic resistance of the section of the artificial conductor and that with this transformer an e.m.f. is produced which is equal to the voltage drop in the section of the auxiliary conductor.—*Elek. Zeit.*, April 21.

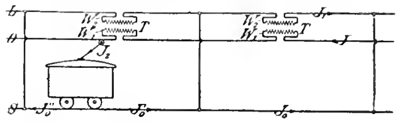


FIG. 1.—ALTERNATING-CURRENT TRACTION.

Petrol Electric Cars.—An illustrated description of the equipment of the petrol electric motor cars, which have recently been installed on the North-Eastern Railway in England. They have a capacity for 52 passengers. The driving power consists of a four-cylinder petrol engine, rated at 80 brake hp at 420 r.p.m. This drives a compound-wound and separately-excited dynamo rated at 55 kw, which supplies current to two 55-hp tramway motors mounted on the front bogie of the car. The exciter is driven by belting from the generator. The exciter is shunt-wound and is also used for running the 30 incandescent lamps of 16 cp and 72 volts, with which the car is lighted, and can further be used to furnish current at 95 volts for charging a secondary battery of 38 cells, each rated at 120 amp.-hours, which is fixed beneath the floor of the car. In starting up, the engine is driven for a turn or two by the generator acting as a motor and taking current from the secondary battery. Once the engine is up to speed and the voltage has been adjusted to 400 volts, the car is started by the controller in the usual way. For slow speeds the car is run with the motors in series, and for high speeds with them in parallel. The voltage of the generator is gradually increased to 530 volts by cutting resistances out of the exciter circuit and the car accelerated until a speed of 36 miles per hour is attained. In stopping the car the controller handle is moved back to the off position, and then over in the reverse direction to supply the magnetic track brakes.—Lond. *Eng'ing*, April 22.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Small Electric Station.—The first part of a description of small electric plants for little rural towns and summer resorts. The first plant described is that of Mitterfels in Southern Germany, a town of 700 inhabitants. Water power is utilized with a minimum capacity of 12 hp. The two-wire, direct-current system is used with a voltage of 220. A storage battery of 125 cells with a capacity of 10 kw for a three-hour discharge is provided. The price charged for the current is 25 cents per candle-year and, if a meter is used, 12½ cents per kw-hour for lighting and 5 cents for power. The only attendant at the plant is the seventeen-year-old daughter of the proprietor of the mill, which was changed into the station.—*Elek. Anz.*, April 14.

WIRES, WIRING AND CONDUITS.

Eddy Currents in Cable Sheaths.—FIELD.—The conclusion of his paper. The author remarks that in dealing with the sheath losses in multiple-core cables one should form a mental picture of the approximate distribution of the external magnetic field produced at different periods of the cycle by all the currents within. He gives several diagrams and especially one showing the successive distributions of magnetic field around a three-phase cable at six moments within half a cycle. He calculates the possible losses for a three-core, three-phase cable of certain dimensions with an effective current of 200 amp. per core for a frequency of 60. The sheath loss per mile is found to be 0.67 kw. The copper-earthed sheath directly under the lead, now advocated by the British Board of Trade, increases this loss and may bring it up to 2 kw per mile. If the cable is then let in an iron trough or is steel-armored, the total external field will again be largely increased, perhaps two or three times. The author recommends first to wind on the copper strips with a lay as different from that of the cores as possible, and then to apply a thin coat of paint before applying the lead sheath.

This coat of paint will be amply sufficient to prevent eddy currents leaving the copper, but should leakage occur from one of the high potential conductors, this insulation would be either instantly broken down or, failing this, would be sufficiently low to form a thoroughly good earth. He finally considers the case of centric cables. If, on account of faulty manufacture, some eccentricity exists, a cable carrying 200 amp. having an eccentricity of 1/8 in., would produce an e.m.f. in a parallel pilot wire, situated 4 in. away, from 3 to 4 volts a mile.—Lond. *Elec.*, April 22.

Calculating Distribution Networks.—MÜLLENDORF.—The conclusion of his long mathematical article in which he describes a method for calculating a distribution network. Without going into mathematical details, this method is essentially as follows: Feeding points are chosen and the "natural districts of action" are determined for the same. It is then investigated whether one of these districts is relatively too large or too small and whether the feeding points are situated in the centers of gravity of the natural districts of action. For each district the central station is to be taken into account. If this investigation does not lead to any changes in the number or position of the feeding points, the cross-section of the conductors in each district of action is calculated by the simple method of moments of current, and the possible minimum of conductor copper is determined. The network is thus calculated if one does not want to simplify further the cross-section. In the latter case one substitutes the definite cross-section for the former ones and calculates the resulting distribution of the current. The amount of copper thus found is compared with the predetermined minimum. He thinks the value of his method lies in a constant control of the consumption of copper and in the simplicity of the method of controlling it.—*Elek. Zeit.*, April 21.

Testing Networks.—A long editorial on regular tests of electricity supply networks. It is pointed out that they are often neglected, although periodical tests of the insulation—actual quantitative measurements—can be carried out with instruments no more delicate than those which are erected on the switchboard of every modern station, and by men possessing only a very limited knowledge of electrical engineering. It requires a little more to be able to appreciate the exact nature and principle of the tests and the suitability of the instruments used, but a station engineer should have this knowledge. The same applies to fault localization. By carrying out simple instructions there is no reason why even the shiftiest shift engineer should not be able to localize a fault within a network within a yard or two and eliminate it with far less disturbance to the continuity of supply than by means of the cut-and-try method. Of course, there is room for refinements and faults should be discovered and removed before they have become bad enough to do any damage.—Lond. *Elec.*, April 15.

Electro-Physics and Magnetism.

Vacuum Tubes.—TAYLOR.—When electrical energy passes between the electrodes of a vacuum tube, the discharge may be either direct or alternating, continuous or disruptive; but not much is known, except in the case of the continuous discharge, concerning the variations in potential which occur in any of these cases. The author has made a series of experiments in this direction, using first calorimetric methods. Afterwards it was found that better results could be obtained by means of the Braun tube, with which he could determine not only the potential difference with considerable accuracy, but could also observe the variations of potential and the frequencies of discharge. It was found that the potential rises to a certain maximum height and then suddenly falls off to a minimum value, but never to zero, although the maximum and minimum values for any tube depend upon the particular conditions under which the tube is tested. He describes a method by which the Braun tube can be conveniently used to measure high potentials, of say, 1,000 or 1,200 volts, where the fluctuations are not too great. When the limits of variations are great, say 500 volts or more, the problem is more difficult, but the author describes a method for such cases. The measurements of the author show that the manner in which the potential develops and falls off is very largely effected by the capacity of the circuit.—*Phys. Rev.*, May.

Hall Effect in the Electric Arc.—CHILD.—An American Physical Society paper on the phenomenon that if two carbon pencils are so placed in an arc that there is little or no potential difference between them, a potential difference is produced by creating a magnetic field about the arc. This may be as high as 1.5 volt. It appears to be similar to the Hall effect in metals, and if it is this effect it would show that the negative ions have a velocity enormously greater than that of the positive. He describes several observations made concerning this effect, but says that no definite explanation can at present be given.—*Phys. Rev.*, May.

Conductivity and Electrostatics.—VON NICOLAJEW.—A paper in which the author points out that conductivity should enter into electrostatic formulæ as often as the specific inductive capacity, and that the neglect of the factor makes modern electrostatics too much of a fiction. He quotes some experiments in electrostatics, in which the conductivity plays a more important part than the inductive capacity, and yet is usually left out of account. A piece of paraffin suspended in air beside a charged conductor is attracted by the latter owing to its higher dielectric constant. If the conductivity of the air were very much higher than that of the paraffin, the latter would be repelled instead. If the medium and the suspended body have nearly the same dielectric constant, the effect of the conductivity may very well mask that of the dielectric constant.—*Phys. Zeit.*, April 1; Lond. *Elec.*, April 22.

REFERENCE.

Radioactivity.—MARCKWALD.—A paper read before the Berlin Electrical Society in which he gives a review of the researches of various investigators on radioactive substances.—*Elek. Zeit.*, April 21.

Electro-Chemistry and Batteries.

Storage Batteries.—A review of new developments in the storage battery line during the last year or so. It is based mainly on patent specifications, but it is pointed out that most of the patents in this field would not have been taken out if the inventors had not been quite inexperienced. It is stated that the large manufacturers now care less and less for inventions which may be theoretically pretty but are practically worthless, and they try to make accumulators of the most simple construction. For this reason the makes of different firms have become so similar that the accumulator business has nearly become "trading in lead." Concerning electrolytic methods of formation, it is stated that all methods which have been found practically effective, are based on the use of an anion which is able to form a lead salt, soluble in water. Under suitable conditions lead peroxide is formed at once, without a previous production of lead sulphate. It is said that this is an interesting reaction which appears to be related to the passivity of iron, chromium and nickel electrodes and which should be studied more thoroughly not only for technical but also for scientific reasons.—*Zeit. f. Elektrochemie*, April 15.

Glass Furnace.—A note stating that electric furnaces are giving good results at the large glass factories at Matrey in Tyrol and at Plattenburg, in Westphalia. In the latest type of furnace the raw material, before it is exposed to the heat of the arc, is made into a paste with water. It is then pressed and dried and finally it passes in the shape of a ribbon through the arcs between a number of electrodes, out of which it emerges completely fused. The heating is chiefly done by radiation and care is taken to prevent impurities from carbon entering the molten glass.—Lond. *Elec. Eng.*, April 15.

Chemical Engineers.—HERRESHOFF.—A long abstract of an American Chemical Society paper on the training of the chemical engineer. What is needed now in chemical industries is not a chemist, pure and simple, but one who has, besides chemical training, a full knowledge of physics and mathematics and a thorough training in engineering. There was a long and animated discussion in which chemical engineers and professors equally participated. There was unanimity concerning the desirability of such a training, but it was doubted that this could be accomplished with the present system of university instruction.—*Electrochem. Ind.*, May.

REFERENCES.

Laboratory.—BURGESS.—An illustrated description of the electrochemical equipment of the University of Wisconsin, with an account of the research work which has been done there in recent years.—*Electrochem. Ind.*, May.

Electric Furnace.—WRIGHT.—A long illustrated description of various electric furnace processes either in actual operation or proposed in patent specifications.—*Cassier's Mag.*, May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Practical System of Units.—ROBERTSON.—A communication in which he remarks that four fundamental quantities are really necessary for a system of electrical units, length, mass and time usually being three of them. In the electromagnetic system, magnetic permeability is taken as the fourth, that of air being the arbitrary unit. The writer recommends to take as the four fundamental or arbitrary units the meter, kilogram, second and ohm (defined from a mercury or wire standard). We thus get a complete system which includes all the established practical electrical units and gives units which have a convenient magnitude for most purposes. Instead of resistance we may take electric quantity, with a coulomb defined from the electrolysis of silver, as the fundamental unit. One advantage of this would be that the dimensions in terms of the fundamentals would have no fractional indices, but the material standard is not quite so direct. He recommends to define the permeability and the specific inductive capacity in such a way that the well-known 4π disappears in most formulas; under these conditions the permeability of air is $4\pi \times 10^{-7}$ henrys per meter, and its specific inductive capacity $(1/36\pi) \times 10^{-9}$ farads per meter. Instead of kilogram he recommends to write k'gram or kram. The name newton is suggested for the unit of force (10^5 dynes), but new names should not be given to other units. Compound names should be used like volt-second for the unit or flux and volt-second per square meter for the unit of flux density, etc. The giving of new names only results in confusion. It is also undesirable to have too many prefixes for sub-units. Only those representing powers of 1,000 have been found really useful and the others should be abandoned.—Lond. *Elec.*, April 22.

Electrical Notation.—EMDE.—A communication discussing the use of various types of letters for notation in electrical engineering and in physics in general. His suggestions cannot be shortly abstracted, but it may be mentioned that the author does not propose to try and get an international system of notation. He thinks it would be valuable only on paper, but not in practice. "German books are mostly read by Germans. If they are translated the symbols may also be changed. If a foreigner overcomes the difficulties of the German language, German symbols will not disturb him." He does not think that *W* for resistance and *A* for work (derived from the German words Widerstand and Arbeit) would be unsuitable for international use.—*Elek. Zeit.*, April 21.

Direct-Reading Instruments.—EDGCUMBE AND PUNGA.—The conclusion of their paper read before the British Institute of Electrical Engineers, on direct-reading measuring instruments for switchboard use. They describe methods of connecting wattmeters for the measurement of power.—Lond. *Elec.*, April 8. The extended discussion which followed the paper is abstracted in Lond. *Elec.*, April 8 and 22. In an editorial it is said that instrument users rather than instrument makers should derive most profits from the discussion and from the paper. They can learn what accuracy to expect from the instruments and one source of serious errors which is too often disregarded has been pointed out, viz.: parallax. Nignoles stated this is especially troublesome with the "edgewise" instruments, in which the angle between the direction of the observer's vision and the instrument scale differs enormously for different readings. It is only on account of the parallax error that "set up" or "open scale" instruments are more accurate than those with equally divided scales, for the percentage accuracy of the instrument itself if the same in the two cases, if the instruments are otherwise similar. Ayrton called attention to the stray field due to the bus-bars. Some switchboards are designed in such a way that the instruments could not possibly be accurate unless they were calibrated in position, and even on the best-designed direct-current switchboard there are magnetic fields, dependent on the current through the bus-bars, which may be troublesome if the instruments are not sufficiently well sheathed. Nalder pointed to an error that could arise from the screening iron case itself.—Lond. *Elec.*, April 22.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—BRAUN.—An illustrated article on methods for increasing the transmitter energy of wireless telegraph systems. In so-called closed circuit ("coupled") systems the open circuit of the transmitter is not directly excited, as was the case with the first Marconi arrangement, but is connected with an oscillatory circuit containing condensers and self-induction and serving as an energy reservoir. There are two theoretical possibilities of increasing the energy; first by increasing the capacity, and second by raising the charging voltage. The author shows, however, that both methods have their limitations. He has, therefore, searched for methods which—without altering the frequency of oscillations—would allow the energy disposable for radiation to be decreased in such a manner that the economy of a single jar circuit is retained. Various arrangements of this kind are described. One is shown in Fig. 2 in which the condensers, *C*, are charged in parallel and are connected for

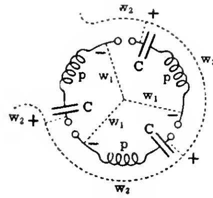
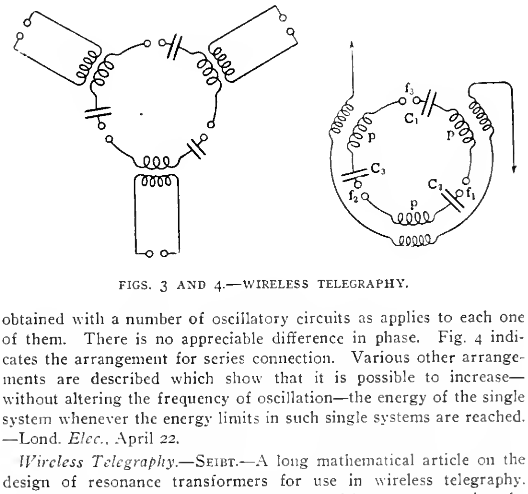


FIG. 2.—WIRELESS TELEGRAPHY.

this purpose with non-inductive or inductive resistances, *w*. As soon as one spark occurs, the whole circuit closes within itself. The large charging resistances are then practically inactive. If wholly unforeseen peculiarities of the spark do not exist, then the spark will also act in the same manner as in a single system. It is possible to obtain, as in Fig. 3, the same effects (final voltages, heating effects, etc.) simultaneously on each of three artificial transmitters which are tuned to one another. The same efficiency is, therefore,



FIGS. 3 AND 4.—WIRELESS TELEGRAPHY.

obtained with a number of oscillatory circuits as applies to each one of them. There is no appreciable difference in phase. Fig. 4 indicates the arrangement for series connection. Various other arrangements are described which show that it is possible to increase—without altering the frequency of oscillation—the energy of the single system whenever the energy limits in such single systems are reached. —Lond. *Elec.*, April 22.

Wireless Telegraphy.—SEIBT.—A long mathematical article on the design of resonance transformers for use in wireless telegraphy. The author remarks that the hopes that had been set on tuning the transmitting and receiving stations to the same frequency have been fulfilled in practice only to a very small degree. In order to protect one's self against disturbances from other stations, the only means is at present to diminish artificially the receiver intensity and to increase the transmitter intensity. This means the necessity of radiating larger and larger quantities of energy. This is now possible. The author finally asks whether Marconi utilizes the resonance of the slow oscillations in his large stations. He says that, according to his calculations, this would be possible only if he had provided his transformers with an air-gap of several centimeters.—*Elek. Zeit.*, April 17.

Nickel in the Core of the Marconi Magnetic Detector.—An account of experiments on the changes of sensibility of a magnetic detector as a function of the varying distances between the moving magnet and core. Since nickel is more susceptible than iron in weak magnetic fields and less susceptible in strong fields the author thought that a more uniform sensibility for varying distances might be obtained by making the core of nickel. He found that the sensitiveness of the detector with a nickel core was not very different from the sensitiveness when an iron core was used. Contrary to expectations, however, the sensitiveness with the nickel core appeared to be greater in stronger fields and with the iron core in weak fields. Both show a maximum of sensitiveness at a short distance from the magnet, the maximum for nickel being the farther removed. A mixed core consisting of annealed piano wire and hard-drawn nickel wire produces a more sensitive detector than using a core of piano wire alone.—*Phys. Rev.*, May.

REFERENCES.

Munich.—A profusely-illustrated description of the new telegraph station in Munich.—*Elek. Zeit.*, April 21.

Municipal Telephony.—BENNETT.—An abstract of a paper on the history and equipment of various British corporation telephone exchanges.—Lond. *Elec.*, April 22.

Wireless Telegraphy.—BRAUN.—A communication discussing at some length the question of priority between Marconi and himself in the employment of the oscillatory circuit in the transmitting system of wireless telegraphy installations.—Lond. *Elec.*, April 15.

New Books.

WHITTAKER'S ELECTRICAL ENGINEER'S POCKET BOOK. By Kenelm Edgcumbe. London: Whittaker & Co. 444 pages, 149 illustrations. Price, 3 shillings, 6 pence.

While this book belongs in the familiar class of engineers' reference books, it differs in plan from most of those which have previously appeared in that the compiler does not content himself with assembling all the formulæ and empirical data that may be available on given subjects, without any indication to the reader as to which of conflicting rules or formulæ are most generally used or accepted; a clear-cut synopsis of each subject is given. The first 47 pages are devoted to mathematics and physics and contain the usual logarithmic and trigonometrical tables, tables of weights and measures, circular functions, etc., as well as brief discussions of the elementary principles of mathematics and physics. Next, practical mechanics are treated briefly, and then the electrical part proper is reached. There are imperfections, of course; whoever saw a first edition free of them? In the table of units, for example, the practical English unit of acceleration is said to be feet per minute per minute and that of angular velocity to be revolutions per minute. On page 98 we are told that "the C. G. S. unit of inductance is, therefore, the unit of length, i. e., the centimeter," which is news, to say the least. On the whole, however, the subject matter is accurate. The sections on measuring instruments, direct-current and alternating-current dynamos and motors and testing generators and motors are particularly good. The methods of dynamo and motor design outlined in the dynamo and motor sections are thoroughly practical, although somewhat too condensed to be useful without the aid of the more detailed treatment to be found in books devoted exclusively to that subject. The section (if two pages may be so termed) on storage batteries is about as unsatisfactory as those just mentioned are praiseworthy; the paltry amount of information that is given is accurate, but the scope is so limited as to make the discussion negligible. This is also true of arc and incandescent lighting, which has been accorded the space of four pages. With the proper balancing, which the book will doubtless receive in the course of future revisions, Mr. Edgcumbe's work will be of much value to his fellow engineers.

DIE ELEKTROMETALLURGIE DER ALKALIMETALLE. By H. Becker. Halle: Wilhelm Knapp. 128 pages, 83 illustrations. Price, 6 marks.

This work on the electrometallurgie of the alkali metals, containing 135 pages and 83 figures, forms the ninth volume of the "Monographien über angewandte Chemie," but in itself forms an independent work. The first few pages are devoted to the methods of obtaining the alkali metals by chemical means, and as this lays practically outside the scope of this work, little stress is laid on this chapter. The author's object in introducing this chapter is evidently only to show in how far the chemical and electrochemical processes are identical, and then to demonstrate how much easier and more economically the processes can be performed with the aid of the electric current. The rest of the work is a careful and full description of the existing patents for the manufacture of the alkali metals, to which Becker has added his remarks.

The greatest stress has been laid on those processes which are in actual operation to-day; in other words, those which proved commercially successful. Among the successful ones belongs also a process of the author's, and the remarks he adds to some of his competitor's processes, are somewhat bitter and sometimes misleading. In more than one case his information is erroneous and lacks accuracy. He thus states that he does not know whether Castner's process in England is operated by the Castner-Kellner Company or by the Aluminum Company, and it certainly would not have cost him much trouble to ascertain, that the process is operated by the Castner-Kellner Alkali Company, Limited, in Runcorn. The information and illustrations about the Darling process are very interesting, but instead of stating that the same did not prove a commercial success and never passed its experimental stage, he states that it is in operation at the Harrison Bros'. works, in Philadelphia, which is entirely erroneous, although the experiments were carried out in their factory. He also hints that possibly the Darling process is of more commercial value than Castner's process, which is operated at Niagara Falls. Castner's process seems to be a thorn in the author's side; but this is explicable, as his (Becker's) process is operated at the Usines de Rioupéroux works in Isère, France, and Castner's at the Cie de Electro-Chimie, also in Isère. The author tries to minimize the value of Castner's process at all points, but we must consider that this process is possibly the best, as it is the only one which is operated in the United States, England, Germany and France; whilst Becker's process is only working in France and perhaps now in Germany, but apparently not with equal success to Castner's.

In his chapter on the uses of sodium, his information on its application for the production of cyanide is entirely wrong. He states that most of the cyanide produced at present is made by the older method with potassium ferrocyanide and sodium, and that the newer method of making the same, with sodium, charcoal and ammonia gas, is not in operation; this hardly coincides with the fact that both in the United States and Germany certain cyanide factories dispensed with the first method and are, since at least four years, successfully operating the second process, even at the low prices they have to meet to-day. One can, however, easily reckon out that the latter process would still be the cheapest process for the manufacture of cyanide, even if the results were not of the highest efficiency. Becker ends his work with three very complete tables, giving the numbers of the patents described, their inventor and other interesting information in regard to the same.

FREE-HAND LETTERING. By Victor T. Wilson. New York: John Wiley & Sons. 95 pages, 13 illustrations. Price, $1.00.

Much of the draughtsman's success depends upon the appearance of the finished drawing, and no part of it contributes so forcibly to the production of a pleasing impression as correctly designed and neatly executed lettering. In the past draughtsmen's alphabets galore have been published, but these have usually been merely pictures of various styles of lettering which the draughtsman was left to copy either enlarged or reduced, as might suit his purpose.

The present volume departs distinctly from previous precedents in that it attempts to be a scientific treatise upon the principles of lettering, and endeavors to convey the methods by which titles should be designed and executed, rather than to furnish examples purely for copying.

The work consists of seven chapters, the first of which deals with the history of alphabetic characters and the principles which enter into the construction of roman and gothic letters. Chapter II takes up the question of spacing and shows that there is no mathematical rule governing proportioning but that spacing must be altered with the type of letter and with the effect which the draughtsman desires to produce. Then come instructions in the use of the pen and in that off-hand lettering which is becoming more and more popular in all classes of drawings. Chapters IV and VI deal respectively with the designing of titles and the design of letters. Chapter V introduces instructions for special technical lettering such as that required for photographic reproduction, while finally Chapter VII takes up the various mechanical aids to good lettering.

The underlying thought in the volume is that lettering like other forms of art is a method of expression that cannot be done purely mechanically, and that unless the draughtsman is able to design free hand it is impossible for him to become a perfect letterer.

ELETTROCHIMICA. Soda Caustica, Cloro e Clorati Alcalini per Elettrolisi. Ing. F. Villani. Milan: Ulrico Hoepli. Price, 3.50 lire.

This is one of the manuals of Hoepli's well-known series. Three hundred pages deal with electrolysis of aqueous solutions and 15 with electrolysis of fused salts, but of the great number of industrial processes, in use on a large scale, those best known in this country, like the Castner-Kellner and the Acker processes receive no attention. On the other hand, the author's own process is described at length and a large amount of interesting information is given concerning it. The chapters on volumetric analysis and on the continual supervision of an electrolytic caustic soda and bleaching plant also contain much useful information for the specialist in this field.

National Association of Manufacturers.

This Association will hold its ninth annual convention on May 17, 18 and 19 at Carnegie Hall, Pittsburg. The headquarters are at the Hotel Schenley, nearby, in a pleasant part of the city. A good convention is expected by Mr. Marshall Cushing, the secretary.

Electrical Exhibits at the Opening of the St. Louis Exposition.

THE large number of completed and operating exhibits, and the condition of the Electricity Building on the opening day, April 30, received favorable comment from all visitors. While there is considerable installation work to be done in many spaces, on that Saturday exhibits were attractively arranged, aisles were cleared, and the building as a whole made a neat appearance. The accompanying photographs were taken of the several exhibits as they appeared at that time.

The handsome booth of the Bristol Company is located in Section 36, and contains a large variety of recording instruments, for pressure,

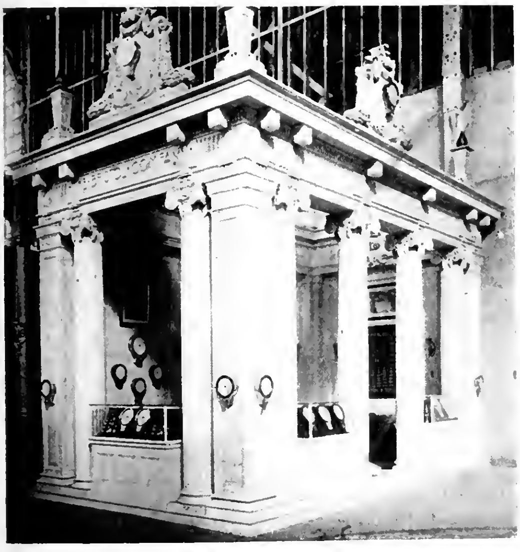


FIG. 1.—BRISTOL COMPANY'S BOOTH.

temperature and electricity. These instruments record continuously and automatically with ink, upon graduated revolving charts, all changes that occur in pressure, temperature or electricity, so that the record after a period of twenty-four hours or more may be observed at a glance. Many of these instruments are in actual operation, and demonstrations will be made for visitors, showing the manner of construction, the scientific principles upon which the operations depend, and the extreme sensitiveness and accuracy that it is possible to attain in instruments of this character without rendering them too delicate for commercial application. Recording pressure gauges are shown for all ranges from full vacuum to 10,000 pounds per square inch. Also recording thermometers and pyrometers for ranges from 60° below zero to 1,000° F. The recording thermometers are made in many varieties of form to make them applicable to all industrial requirements, especially where it is desired to record tem-

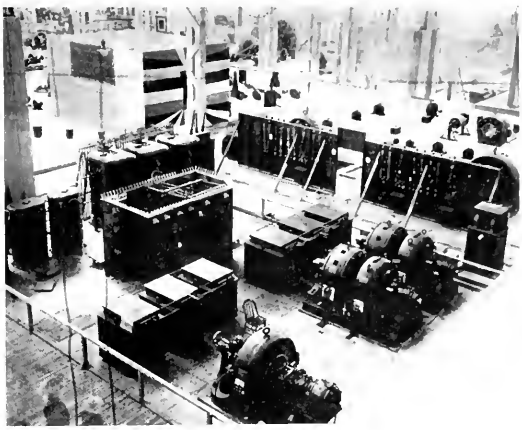


FIG. 2.—SUB-STATION.

peratures at a distance from the source of heat. Recording volt, ampere and wattmeters, for both alternating and direct current, are shown, including a great variety of ranges suited to commercial demands for different voltages and currents in electric light, power and railroad plants. Recording water gauges in operation and a new instrument designated as a thermometer-thermostat will be shown.

The exhibit of the Baldwin Locomotive Works in the northwest corner of the building comprises electric locomotives and electric

FIG. 3.—BALDWIN LOCOMOTIVE.

railway trucks for various conditions of service. The locomotives shown in the photograph include the following: A ten-ton machine equipped with two 50-hp Westinghouse railway motors constructed for the Berwind-White Coal Mining Company, adapted for heavy and frequent service in the coal mines of Western Pennsylvania: a fifteen-ton locomotive constructed for the Norfolk Coal & Coke Company, for use in the mines of West Virginia, where coal has to be handled on the surface in all kinds of weather and conditions of track; an electric locomotive built for surface work, of special design, permitting powerful motors of standard construction to be mounted, adapted to run on track of extremely narrow gauge. The machine exhibited is for operation on a track gauge of 24 in., and at the same time carries two Westinghouse railway motors of 35 hp each. The electric railway trucks consist of one constructed for the Interborough Rapid Transit Company, of New York, and designed for heavy elevated passenger service; one for the Illinois Central Traction Company, designed for high-speed interurban service; and also one for light work. All trucks shown are of M. C. B. design and equipped with Westinghouse Electric & Manufacturing Company's railway motors.

The operating exhibit of the Bullock Electric Manufacturing Company represents the high development of this company as a manufacturer of electrical apparatus of all kinds. The space includes all of Section 15, and is 54 by 104 ft. In the center is erected an ornamental pavilion, handsomely finished and comfortably furnished. Motors direct-connected to machine tools, requiring variable speeds and operating on the multiple-voltage system, in practical operation, are shown in the Bullock exhibit. The main generator furnishes current at 250 volts, and a balancer splits the voltage into 60 and 160 volts for distribution. An engine lathe, a milling machine, a boring mill and a shaper, all direct driven by Bullock motors, will be operated by this set. This gives three fundamental speeds, but by the proper insertion of shunt field resistance twelve speeds in the forward direction are obtained, and nine in the reverse. The controller used in connection with this system is so constructed that a careless operator cannot stop the handle between the voltages. The motors when enclosed are supplied with spun metal covers, particularly adaptable for dirty, damp or dusty places.

The five alternating-current generators on exhibition range in size from 50 to 350 kw in size. An interesting feature in the design of these alternators is that the magnetizing coils of the field are

FIG. 4.—BULLOCK ELECTRIC AND MANUFACTURING COMPANY'S EXHIBIT.

made of strip copper wound on edge. This permits as high peripheral speeds as are possible for steel wheels without windings.

The exhibit includes two heavy street car trucks, on each of which are mounted two 50-hp Bullock street car motors. These are duplicates of the 300 motors now being supplied to the Boston, Haverhill & Manchester Electric Railway Company. The motors will be turning over with current at 500 volts furnished by the 500-kw Bullock railway rotary converter. Alternating current is obtained from the Bullock 3,500-kw, 6,600-volt generator installed in the Allis-Chalmers Company's exhibit in Machinery Hall, reduced in a Bullock 150-kw, oil-filled, self-cooled transformer. There are three of these transformers to be seen in the exhibit. The case of the transformer is made of corrugated sheet steel, which makes it considerable lighter than if it were made of cast iron, as is usually the custom.

The Western Electric Company's space occupies 5,764 sq. ft., having frontage on two main aisles of 88 ft. 5 in., and a width of 65 ft. 2 in. In the center is a motor-generator equipment, consisting of two 100-kw frames, the motor side taking current at 500 volts, and the generator side delivering current at 220 volts. This unit operates in conjunction with a 15-kw compensator, permitting the use of 110-volt current. The center space also contains two switchboards, one for controlling the operation of the apparatus receiving current from the motor-generator, and having all the necessary switches, circuit-breakers, ammeters, etc. The other board is for display purposes only, and on it are circuit-breakers, knife switches, voltmeter switches and kindred apparatus.

In the extreme northeast corner of the space a small machine shop is installed showing the actual operation of modern machine tools driven by Western Electric motors on the three-wire multi-voltage system. West of the machine shop are several direct-connected and belt-driven generators, and a number of Cornish cycle engines direct-connected to generators; these sets being especially for marine use. In the northwest corner of the space are a line of power motors arranged in the form of a pyramid, the smallest ones at the top. In the southwest corner is a series alternating arc light

FIG. 5.—WESTERN ELECTRIC COMPANY'S EXHIBIT.

equipment, consisting of a full line of transformers, regulators and switchboards. Opposite this are ornamental arc lamp stands from which are suspended various types of arc lamps. There are also a number of sewing machine motors in operation. Fan motors and ceiling fans will be distributed throughout the space, suspended from overhead, and a number of boards containing supplies manufactured by the leading companies throughout the country.

Above the space of the Electric Storage Battery Company is a large map of the United States, approximately 40 ft. by 25 ft., which indicates the location of each of the 1,700 electric battery installations made by this company. These are shown by different colored spots of isinglass about one inch in diameter, which will be illuminated by incandescent lamps mounted behind the map, the different colors being as follows: Red lamps for railway plants; blue lamps for Edison plants; white lamps for telephone and telegraph plants, and green lamps for isolated plants. Beneath the map is a model battery house, constructed on exactly the same lines as one forming part of a power house or sub-station equipment. The battery house is of fire-proof and acid-proof construction, properly ventilated and with acid-proof brick floor. A small booster is operated in connection with this battery, and a complete switchboard installed with recording instruments to show what work the battery is doing on a fluctuating load, and also how constant the load is maintained on the generator or bus-bar circuit. The fluctuating load is provided either by switching on or off banks of lamps, or starting up a motor load with brake attached. A railway booster of about 100 kw complete with switchboard and regulator is shown, the motor being connected so that the machine can be run light. A complete line of switchboards for Edison lighting work, isolated plants, railway booster equipment and line batteries; a set of three motor-driven end cell switches connected up complete with motor control and indicator apparatus; complete cells for railway work, such as are installed for the St. Louis Transit Company, and cells of smaller type are set up to show the various types and capacities. A complete exhibit of vehicle batteries for automobile and locomotive work is shown, as well as a collection of photographs and curves as to existing plants and results obtained in them.

The exhibit space of James Clark, Jr., & Co. contains a group of electrically-driven machine tools, small motors and generators and

FIG. 6.—EXHIBIT OF THE WESTON ELECTRICAL INSTRUMENT COMPANY.

FIG. 9.—NATIONAL CARBON COMPANY'S BOOTH.

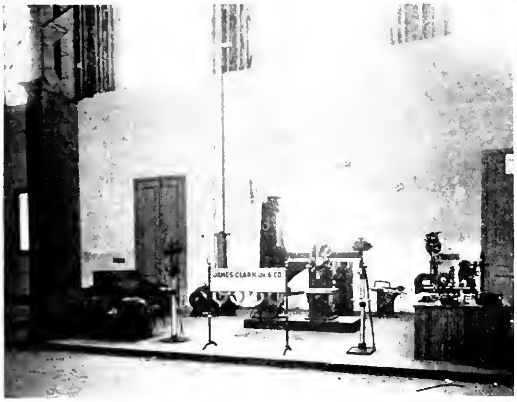


FIG. 7.—JAS. CLARK, JR., & CO.'S EXHIBIT.

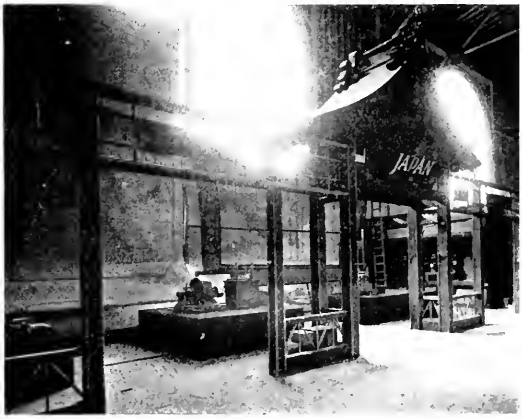


FIG. 10.—JAPANESE EXHIBIT.

FIG. 8.—ELECTRIC STORAGE BATTERY COMPANY'S EXHIBIT.

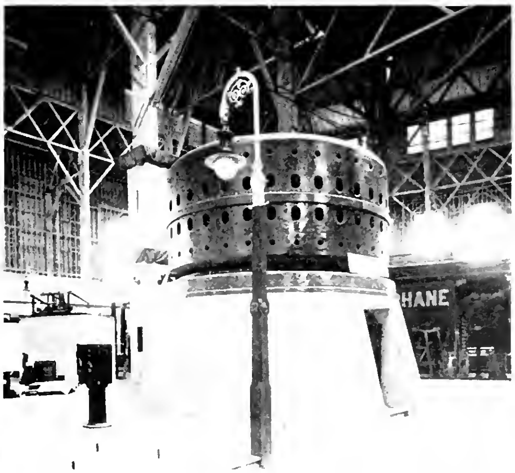


FIG. 11.—PART OF GENERAL ELECTRIC COMPANY'S EXHIBIT.

SOME OF THE ELECTRICAL AND KINDRED EXHIBITS AT THE ST LOUIS EXPOSITION a new variable-speed motor. These electrically-driven tools all have their driving motors built into the machines forming integral parts of them. The exhibit includes a five-foot radial drill, 22½-in. upright drill, automatic armature disc notching machine, a machine for winding magnet coils for electrical machinery, a 14-in. water tool grinder, bench grinder, shop saw, sensitive drills and several sizes of portable drills and center grinders. The radial drill has the driving motor built into the head of the machine, and drives the spindle through the least possible number of gears. The motor is of their variable-speed type, with nine speeds, which, in connection with the lock gears, gives eighteen speeds for the spindle, any of which are instantly available. The lock gears can be thrown in without stopping and the spindle can be instantly reversed for tapping. The spindle has a quick return, eight positive feeds, depth gauge and automatic stop. The arm is raised and lowered by a plain series vertical motor in the top of the column controlled by the small handle on the side of the column. The column swings on ball bearings and can be clamped in position by a lever. The 22½-in. drill has the same features of control as the radial. A 12-in. sensitive drill with motor directly on the spindle demonstrates the adaptability of the electric motor for machine tool driving. The notching machine and magnet winder are machines which will be of special interest to electrical manufacturers, the magnet winder especially being a new development in this class of machinery. The small electrically-driven breast drills are shown in several sizes. There is in operation a 9-kw motor-generator taking current from the 500-volt mains, and supplying the exhibit with 220-volt current, all of the machines being connected so that they can be shown in operation. Several standard small motors are shown, and a new variable-speed motor, designed especially for direct connection to machinery. It has two commutators and two armature windings, having a ratio of five to three, giving three primary speeds, three variations of each of these being made by field resistance giving a total of twelve speeds at high efficiency.

Japan for the first time has made an electrical exhibit, and, to the engineer, it will appear strange to see Japanese characters upon the name plate of a motor. The material and workmanship of the electrical apparatus are of high order, and it will be interesting to ascertain if the operating characteristics are equal to American and European makes. A small steam-driven generator set is exhibited by the Shibaura Engineering Works of Tokio, also a 150,000-volt testing transformer. The Oki Company, of Tokio, exhibits a fine assortment of telegraph and telephone instruments and switchboards. Several models and photographs of hydraulic electric power stations are shown, as well as charts indicating the advance of electrical industry in the empire. The exhibit is enclosed in a handsome booth of Japanese design and erected by native workmen.

FIG. 12.—AUTOMATIC FIRE ALARM COMPANY'S EXHIBIT.

In the French section the exhibit of the Compagnie Francaise des Cables Telegraphiques consists of samples of cables installed in various parts of the Atlantic Ocean and Gulf of Mexico. The damaged cable shown in the foreground of the exhibit was one removed during the repair of Porto Plata, Martinique, cable after the eruption of Mount Péleé in Martinique, May, 1902.

The full-sized model of the latest type of 10,000-kw generator for the Niagara Falls power plant may be seen in one of the engravings. This occupies the southwest corner of the General Electric Company's space. Its great size makes it a conspicuous object in the building.

The Brazilian space is taken up by a display of telegraph, telephone and fire alarm apparatus, porcelain insulators and maps and charts showing the extent of telephone and telegraph lines in the great republic.

One illustration shows the traveling crane over the main aisle along the west side of the building. The craneway has a span of 57 ft. 5½ in. Upon this is a four-motor, 30-ton electric crane furnished by Pawling & Harnischfeger. A 20-hp, 220-volt motor gives a horizontal speed of 250 ft. per minute, an 8-hp motor gives a trolley transverse speed of 150 ft. The main hoist is equipped with a 30-hp motor, having a speed of 25 ft., and the auxiliary hoist with a 15-hp motor, and has a travel from 30 to 90 ft. per minute. The crane proved very serviceable in the installation of exhibits.

FIG. 13.—PAWLING & HARNISCHFEGER CRANE.

The De Forest wireless telegraph station in the Electricity Building consists of three 75-ft. towers, the bases of which may be seen in the illustration. The sending and receiving instruments are placed near the center of the triangle formed by the towers. The ability of wireless telegraphy to maintain simultaneous communications between a number of stations without interference will here be determined. It is largely with this in view that the De Forest Company decided to equip so large a number of stations upon the World's Fair grounds. With eight stations, all in operation simultaneously, some sending messages only a few hundred yards and others to Chicago and Springfield, conclusive tests can be made under adverse conditions. The interference to which the stations in the Electricity Building are subjected from high-tension machinery of all descrip-

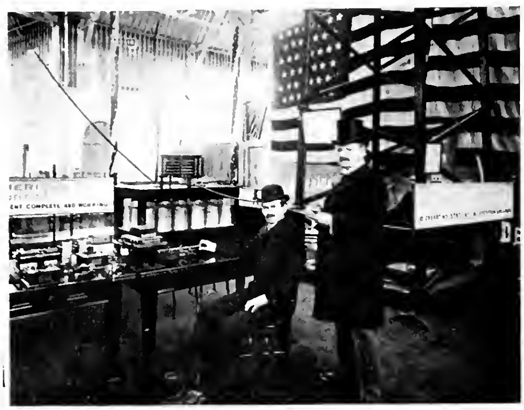


FIG. 14.—DE FOREST WIRELESS TELEGRAPH EXHIBIT.

The governor and pilot valve are operated by a worm gearing on the main shaft, shown in Fig. 5. The pilot valve has no "inertia of rest," and does not stick. On the larger machines a speed limit governor is arranged to instantly shut off the steam supply whenever a predetermined limit of speed above normal is reached.

Oil for the turbine and generator bearings is raised by a small plunger pump, Fig. 7, from a main reservoir in the bed plate and

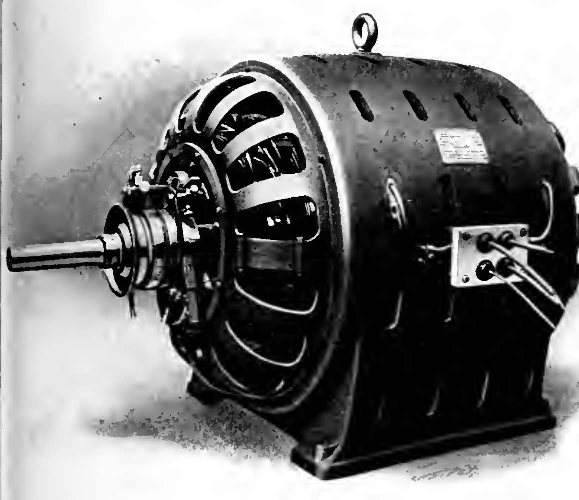


FIG. 8.—400-KW ALTERNATING-CURRENT TURBO-GENERATOR.

circulates by gravity, being cooled by water coils. No oil under high pressure is used in this type of turbine.

For the generators, two frequencies are now standard: 25 cycles per second for railway and power work and 60 cycles per second for lighting. The generator characteristics determine the speed of the turbine units; for instance, the 25-cycle generator which at 1,500 r.p.m. has two poles, has four poles at 750 r.p.m. Fig. 8 shows a generator of 400-kw capacity.

The turbine generator has a revolving field, small in diameter and finished smooth to minimize windage. Ventilation is secured by ducts cut in the solid steel. The standard construction of laminated armature is employed and the structure is well ventilated by air ducts between the laminations, communicating with the exterior through openings in the frame. Bar, strap or wire windings are used according to the voltage and capacity of the machine, and through protection afforded by embedding them in closed slots in the laminations.

The Frost Storage Battery Grid.

On April 12 last there was granted to Mr. George W. Frost, of Columbus, Ohio, a patent on a storage battery grid which merits special attention on account of the unusual design. The accompanying illustration, Fig. 1, will serve in a way to convey the idea embodied in the construction. The cut shows a section of the plate with one side sawed away, in order that the cross-section may be made clear. It would seem that it is practically impossible for the paste or active material to wear away or be forced out of a grid of a type similar to that in the illustration, as the T-shaped cross-section securely holds the paste in place. The paste is forced in while in a plastic condition and afterwards properly hardened and formed.

The grid is cast all in one piece in a two-part metal mould. The retaining strips are cast as thin as practicable, the usual thickness being .06 of an inch. This thickness is greater than is required to give the grid the necessary rigidity, and the cast grids are, therefore, passed under a broad milling cutter, which removes .03 of an inch from each side of the plate. The thickness of the cast grid, which is usually .32 of an inch for heavy stationary cells, is thereby re-

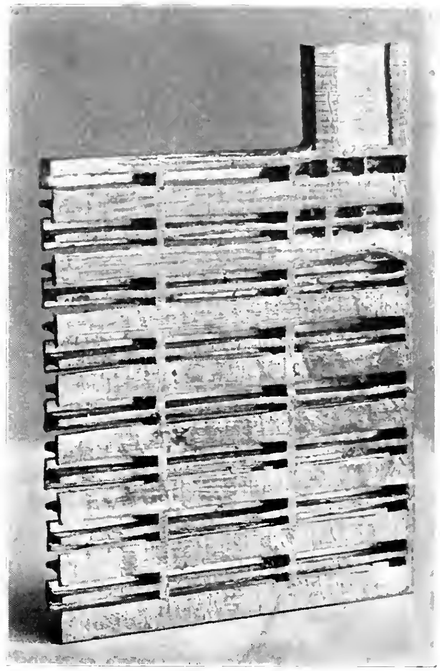


FIG. 1.—BATTERY GRID.

duced to .26 of an inch, the weight of the grid being decreased about one-third. For automobile batteries the grids are cast .25 of an inch thick and milled down to .19 of an inch. As the milling cutter passes over the surface of the plate it leaves narrow burrs or flanges at the edges of the retaining strips and webs. These flanges are of service in retaining the active material in the grid.

All grids are stiffened by several vertical ribs extending from the top to the bottom of the plate. The distribution of the metal of the grid is such as to give it great rigidity, with the least possible weight. The space available for active material amounts to from 50 to 70 per cent. of the total volume of the electrode, and the weight of active material, in portable batteries, may be 50 per cent. of the total weight of the electrode. The exposed surface of the active material is reduced to a minimum of about 40 per cent. of the total surface of the electrode, and the lead surface of the grid increases greatly the capacity of the plate as it becomes oxidized during use.

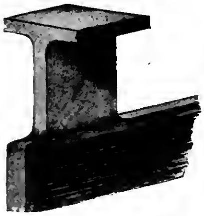


FIG. 2.—PLATE HEAD.

Careful tests have shown that the exposed surface of the active material is sufficient to give ready access to the electrolyte. For example, two cells were placed in series; one of them of 120 amp.-hours capacity of an approved standard design, the other of a similar capacity, but having plates of the design illustrated. A charging current was passed through them so that they received a total of 100 amp.-hours, or, in other words, they were purposely not quite completely charged. The standard type of cell was allowed to discharge its current through a fixed resistance, the output being 86 amp.-hours. Immediately thereafter the new type cell was made to discharge its current through the same resistance, the output being 87 amp.-hours, thus proving that the construction is such that the current is readily absorbed and given out.

The retaining strips and webs not only prevent the plate from buckling, but give a large contact surface, so that current is readily carried to or taken from the active material. The design of the grid is also such that it expands very evenly as the active material increases in volume. The grid can be cast in a simple and inexpensive mould and a workman can cast several hundred medium-sized grids in a day.

Fig. 2 illustrates a T-shaped head, which is cast integral with the plates, and Fig. 3 shows how the plates are lined up ready to

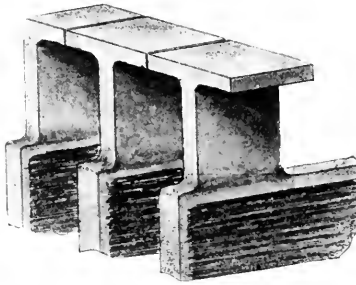


FIG. 3.—PLATES LINED UP.

be burned together with an oxyhydrogen flame; a mould being placed around the joint and the lead melted all the way through so as to produce an absolutely perfect joint.

The Frost grid has been adopted by the Columbus, O., Storage Battery Company as their standard for plate construction, and they have already installed several large lighting plant batteries, with plates of the new design.

Indiana State Independent Telephone Convention.

The annual meeting of the Indiana Independent Mutual Telephone Association will be held in the City of Lafayette, Ind., June 28 and 29. There will be able papers prepared and discussions upon topics of vital interest to all independent telephone people. The leading manufacturers and supply men will make creditable displays of all lines of goods. The headquarters will be at the Hotel Lahr. There will be a programme of entertainment such as trolley rides, vaudeville shows, music, an inspection of the electrical and mechanical department of Purdue University, banquet and a dance, all of which will be free gratis to the members attending the telephone association. The Sterling Electric Company, of Lafayette, have also sent out a warm open-handed welcome.

Theatre Dimmers.

It is a far cry from the earliest theatre dimmer consisting of incandescent lamps or iron wire mounted on a wood frame with crude circuit arrangements, to the thoroughly organized apparatus of today with their refinement of electrical design and excellence of me-

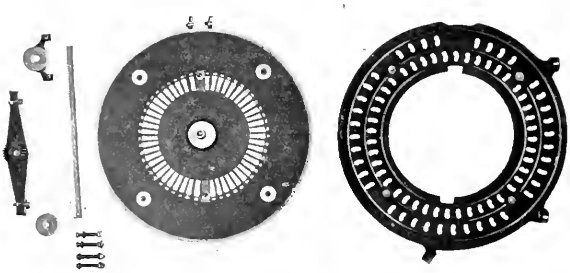


FIG. 1.—DETAILS OF DIMMER.

chanical execution. This is well illustrated in a new type of dimmer being placed upon the market by the Cutler-Hammer Manufacturing Company, several illustrations of which are given herewith. This new type is designed to meet the best requirements of stage lighting, which involve subdividing the lamps into a comparatively large number of circuits, thereby assuring more perfect control of the lighting and enabling special effects to be better obtained. In the dimmer illustrated, known as the "Simplicity" type, each unit or plate has a maximum capacity for 50 16-cp lamps, which number most nearly meets the average conditions for good stage lighting effects. As will be noted from the illustration, the dimmer units consist of circular plates mounted on an open frame, to which they are fastened by screws passing through three lugs into wrought-iron connecting bars. One of the features of this new type is the ease

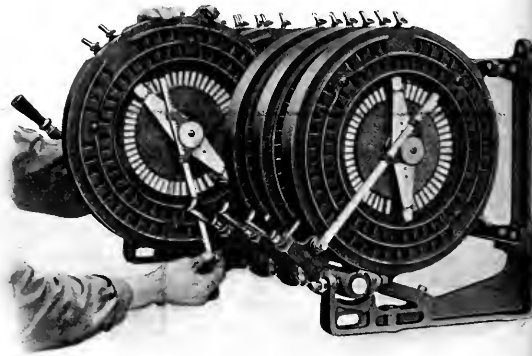


FIG 2.—THEATRE DIMMER.

with which a section may be removed, which operation is indicated in Fig. 2. It is merely necessary to remove a pin from the operating lever and the three screws above mentioned, when the plate can be lifted out. The several plates consist of a base of insulating material carrying the contact parts, as shown in Fig. 2, and all current-carrying parts essential to the operation of the dimmer, including lever contacts, resistance and binding posts, are mounted on this one insulating base and form a complete rheostat in themselves. The plate is enclosed by the gridiron casting shown in the illustration, this simply forming a cover and finish and carrying the lugs whereby the plate is secured to the frame. The several levers connected with the rheostat rack arm are loose on an interlocking shaft and may be moved without reference to the position of the master lever. A slotted cam, Fig. 3, is placed at the side of the lever and fixed to the shaft with set screws so as to be moved when the shaft is moved. This cam is provided with a slot into which the interlocking bolt drops, and is so arranged that if dropped when the slot is not directly below, the bolt will rest on the curved surface of the cam and drop into the slot when the cam is moved into the proper posi-

FIG. 3.—DETAILS OF LEVER.

tion. By this arrangement a dimmer plate may be set at any desired point independent of the master lever, and may be picked up by the master lever when it reaches the corresponding position. The dimmers may have the operating handles mounted on the frame, as in Fig. 1, or mounted on a board in front, the dimmer being provided with rack extensions sufficiently long to pass through the board and be attached to the operating levers.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Exceeding dullness prevailed in the market, which was entirely professional, the interest shown by the public being confined to the purchase of bonds. The United States Steel stocks were weak on the dissolution of the conversion syndicate and adverse trade reports, but their decline was checked on short covering. There also seemed to be nervousness on the part of the bears in the standard railroad stocks, owing to easy conditions in money and the attending lack of liquidation. Among the industrials, apart from the decline in Steel common and preferred and in the 5 per cent. bonds, there was little worthy of note. United States Rubber attracted some attention on account of the firmness of both the common and the preferred, following the resumption of dividends on the latter. A heavy tone prevailed in General Electric, due to threatened competition in the electrical manufacturing business. This stock closed at 158. Allis-Chalmers common was steady throughout the week, closing at 6½, which is unchanged from the previous quotation. Preferred stock closed at 41, which is a net gain of 2 points. Westinghouse common lost 3 points net, closing at 155, and preferred closed at 175, which is the same as the previous quotation. Bell Telephone remains practically unchanged, closing at 126; and the same applies to Western Union, which closed at 88⅞. Commercial Cable closed at 175. Among the tractions Brooklyn Rapid Transit was quite steady, closing at 45½, while Metropolitan Street Railway was somewhat weaker, closing at 108⅝, being a net loss of 1 point. Following are the closing quotations of March 10.

NEW YORK.

	May 3	May 10		May 3	May 10
Allis-Chalmers Co.	6⅞	6¼	Electric Vehicle	5¾	5⅜
Allis-Chalmers Co. pfd.	39	41	Electric Vehicle pfd.	9	9
American Tel. & Cable	86	86	General Electric	157½	157
American Tel. & Tel.	126	126	Hudson River Tel.	.	.
American Dist. Tel	23	22	Metropolitan St. Ry.	109¾	109
Brooklyn Rapid Transit	45⅝	45⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	175	180	Marconi Tel	.	..
Electric Boat	25	26	Western Union Tel.	88¼	89
Electric Boat pfd	60	60	Westinghouse com	153¼	155
Electric Lead Reduction	½	⅝	Westinghouse pfd	175	175

BOSTON.

	May 3	May 10		May 3	May 10
American Tel. & Tel	126¼	126¼	Western Tel. & Tel. pfd.	77	77
Cumberland Telephone	113½	113¼	Mexican Telephone	1⅜	1¼
Edison Elec. Illum.	236	*235	New England Telephone	*122½	*122½
General Electric	156½	157	Mass. Elec. Ry.	19¾	18½
Western Tel. & Tel.	8	8	Mass. Elec. Ry. pfd	72¾	71½

PHILADELPHIA.

	May 3	May 10		May 3	May 10
American Railways	44	44	Phila. Traction	96	96
Elec. Storage Battery	57	56	Phila. Electric	5¼	5¼
Elec. Storage Battery pfd.	57	56	Phila. Rapid Trans.	13¼	13¼
Elec. Co. of America	7¾	8			

CHICAGO

	May 3	May 10		May 3	May 10
Central Union Tel.	..	..	National Carbon pfd.	103	101¾
Chicago Edison	..		Metropolitan Elev. com.	15	15
Chicago City Ry.	158	155	Union Traction	5½	5¼
Chicago Tel. Co	..		Union Traction pfd.	30¼	30
National Carbon	30	28			

*Asked

CONSOLIDATION OF ROCHESTER ELECTRICAL INTERESTS.—Official announcement of the plans of the merger of the Rochester Gas & Electric Company, the Rochester Railway Company and the Rochester Light & Power Company has been made. The name of the consolidated company is to be the Rochester Railway & Light Company and its capital stock will be $3,000,000 of preferred stock and $6,500,000 of common. The issue of the first consolidated mortgage 5 per cent. bonds not to exceed $16,000,000 will be authorized and used to retire the present funded debt of the Rochester Gas & Electric Company. Provision has been made for the sale of $500,000 of these bonds at par, an accrued interest balance to be reserved for the requirements of the consolidated company. Under the provision of the consolidation a balance of about $1,200,000 in cash will be immediately available for the company's purposes, and from further assessments on the common stock and from surplus earnings it is estimated that another $1,000,000 will be forthcoming for betterments, extensions and improvements during the years 1904, 1905 and 1906. In addition to this amount, there will be in the hands of the trustee $4,073,000 of bonds reserved for future requirements.

THE MACKAY COMPANIES.—A director of the Mackay Companies makes the following statement to the *Wall Street Journal* of the amount of the stocks of the companies now held in Canada: "While five years ago fully one-half of the stock of the present Mackay Companies was held in Canada, at the present time not more than one-third of the stock at the very most is held here. It is held by between 400 and 500 people living in different parts of Canada, all the way from the Atlantic to the Pacific. Unlike most stocks, it is nearly all held for investment and I do not think there are 500 shares held by Canadians that could be secured in the open market. We are all satisfied with the plan that is being carried out by President Mackay."

SAN FRANCISCO TROLLEYS.—The United Railroads of San Francisco reports as follows for the year ended December 31:

	1903.	1902.	1901.
Gross	$6,243,219	$5,533,904	$5,125,883
Expenses and taxes	3,910,835	3,274,129	3,059,958
Net	$2,332,384	$2,259,775	$2,065,925
Other income	24,754	28,906	17,230
Total income	$2,357,138	$2,288,681	$2,083,155
Charges	1,536,438	1,324,050	723,200
Balance	$820,700	$964,631	$1,359,955
Sinking funds	123,999	114,000	84,000
Balance	$696,701	$850,631	$1,275,955
Dividends	480,000		
Surplus for year	$216,701		

An allowance of $157,500 for depreciation leaves $59,201 for profit and loss surplus.

CINCINNATI GAS AND ELECTRIC.—The earnings of the Cincinnati Gas & Electric Company for the year were $1,397,000 net, or 4.80 per cent. on the total capital, slightly over $29,000,000. It is expected that during the current year the earnings will aggregate $1,605,000, that for 1906 they will be $1,845,000, in 1907 $2,120,000, and in 1908 $2,436,000. The company now has 4,789 stockholders, against 4,300 last year. After deducting dividends of 4 per cent. for the year there is a surplus of $43,000.

INCREASE IN GENERAL ELECTRIC'S CAPITAL.—The stockholders of the General Electric Company, at a special meeting in Schenectady, on May 10, voted favorably on the proposition to increase the company's capital $3,325,500, making the total capital $48,325,500. Immediately after this meeting the annual meeting of the company was held, at which the present board of directors was re-elected.

Commercial Intelligence.

THE WEEK IN TRADE.—It is a pleasure to note the change in tone of trade reports as compared with the discouraging records of the past few weeks. The long-looked-for good weather has at last materialized, and agriculture and trade have taken on a seasonable aspect in consequence. Farmers are helped by it and crop preparations and planting have made good progress. Retail and wholesale trades, while improved, are not so strong as they should be, and the results are rather under the earlier expectations. Reorder trade with jobbers, as noted by one of the mercantile agencies, is slow and fall orders are backward. Other conditions, it is pointed out, partake of irregularity. Iron is quieter, and prices are weaker. On the other hand, the labor situation is more settled and favorable as compared with that of last year at this season. Pig iron is easy in price in all markets, with limited sales, aside from the placing of contracts for castings for new railway construction work. Finished products are dull and unsettled. Copper also tends downward on enlarged production and less eager demand. Business was on a very limited scale, and the export movement was much below the level of earlier months. The market closed steady but dull at the following prices: Lake, ⅜c. to 13⅝c.; electrolytic, 13⅛c. to 13¼c.; casting stock, 12⅞c. to 13⅛c. The exports of copper for April aggregated 13,567 tons, this being a heavy falling off as compared with previous months of the year. Railway earnings continue to decline. Failures, *Bradstreet's* states, are slightly above the normal in number, but, swelled by suspensions of financial institutions and a few large manufacturers, liabilities are heavy for this season of the year. The number of failures reported by the same authority, for the week ending May 5, was 176, against 188 the previous week and 175 the corresponding week last year.

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty Street, New York, has secured a contract for a 150-kw generator, together with six motors aggregating 200 hp for installation in large saw mills operated by A. A. Low, of Brooklyn, brother of Seth Low, in St. Lawrence County, Adirondacks. The plant will be operated by water. The Aetna (Ind.) Powder Company, whose plant is already equipped with 220 kw of C. & C. generators, has just ordered 75 hp of motors. The Arkelyan Press, Boston, Mass., has ordered a 30-hp series-parallel equipment to be utilized to operate a Hoe magazine press and a 35-hp outfit is to be shipped to the Seattle (Wash.) *Post-Intelligencer* for driving a Hoe quadruple press. The latter order is a duplicate of one secured three years ago. Another repeat order comes from the Ohio Quarries Company for two 50-hp motors to be used for operating grindstone lathes at the North Amherst quarries of the company. The St. Paul Roofing & Cornice Company, of Baltimore, is to be shipped four small motors for driving machine tools. Two 50-kw generators have been ordered by John R. Sheehan & Co., the building contractors, for the Gouverneur Hospital, to be used for lighting purposes. The engineering firm of Reis & O'Donovan, 15 Cortlandt Street, has ordered a 20-kw direct-connected generator and five motors aggregating 50 hp for operating equipment in the Manual Training High School. The St. Charles (Ill.) Home for Boys is to have two C. & C. direct-connected generators of 50-kw capacity each. This equipment will be used for both light and power. The C. & C. people also report receipt of a fair number of small orders for motors and generators for export to Canada, Cuba and Mexico.

GERMAN TELEPHONE SYSTEM.—Mr. Richard Guenther, United States Consul-General at Frankfort, Germany, states that the total cost of the German federal telephone system, operated in connection with the German federal telegraph system, is $60,000,000 up to date. The kingdoms of Bavaria and Württemberg are not included, these having their own independent telephone systems. The longest telephone connection in Germany is the one between Berlin and Paris, 742 miles. Next is Berlin and Budapest, 612 miles; Berlin and Memel, 593 miles; Berlin and Basel, 577 miles. The following connections are all more than 300 miles long: Berlin with Dortmund, Düsseldorf, Essen, Frankfort, Gleiwitz, Cologne, Königsberg, Munich and Vienna; Hamburg with Copenhagen; Frankfort with Paris and Hamburg. The line between Berlin and Frankfort is the most used—485 communications daily. The number between Berlin and Cologne is 243; Berlin and Vienna, 118, and Berlin and Düsseldorf, 116. In spite of the high fee not less than 65 communications daily take place between Berlin and Paris.

MANUFACTURING IN IOWA.—The Black Hawk Electric Company is the latest addition to the business concerns incorporated at Davenport, Iowa. The articles of incorporation show the new company to be composed of W. A. Fuller, James E. Bayliss and John H. Eagal. Mr. Fuller is the well-known electrician at the Rock Island arsenal and Messrs. Bayliss and Eagal have been in partnership for some time in Davenport in the automobile business. Mr. Fuller was originally with the General Electric Company for many years. The capital stock of the new company is $10,000 and the general nature of its business is to manufacture, contract and install electrical power and lighting plants, the sale, manufacture and installation of all electrical appliances, apparatus and sundries, mechanical, electrical and hydraulic engineering, and the selling, repairing and renting of automobiles. The officers and directors of the company are as follows: President, W. A. Fuller; vice-president, James E. Bayliss; secretary and treasurer, John H. Eagal.

THE GREGORY ELECTRIC COMPANY, of Chicago, reports among recent orders the sale of a direct-connected, 75-kw, two-phase, 60-cycle Westinghouse alternating generator to W. A. McKay & Co., Sydney, C. B., Canada; two 120-kw Westinghouse alternators to the Fulton Electric Light & Power Company, Fulton, Ky.; a 120-kw General Electric alternator to the Stanberry Electric Light & Power Company, Stanberry, Mo.; a 37½-kw Fort Wayne alternator to the Madeline Electric Company, Madeline, Cal., besides a large number of direct-current generators and motors. Their spring business is exceptionally good, sales being slightly in advance for the corresponding time of last year. The Gregory Company reports an unusual amount of repair work on hand at the present time in its repair department. The force in this department is now larger than ever before in the history of this company.

TURBINES FOR BRIDGEPORT FACTORY.—The Eaton, Cole & Burnham Works at Bridgeport, Conn., are to be operated by an electric plant, which will be one of the most elaborate and extensive equipments ever installed by an Eastern manufacturing concern. The electrical machinery will ultimately be capable of generating 2,400 kw. Westinghouse turbines will be put in while both the Westinghouse and General Electric Companies have secured orders for motors. The turbines, two of which have already been contracted for, will be 400 kw each. The motors, aggregating over 600 hp and ranging from 3½ hp to 30 hp, will be built by the General Electric and Westinghouse people—about 300 hp each. The switchboard, consisting of a combined generator, exciter and thirteen feeder panels, will be of Westinghouse build. G. K. Hooper, Bowling Green Building, is consulting engineer in the matter.

ELECTRICITY FOR COTTON SEED OIL PLANT.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, has secured a contract for the first electrical equipment to be used in this country for operating a cotton seed oil mill. The mill will be built at Sinclair, La., for George H. Laws, of Cincinnati, Ohio, and will have a capacity of 60 tons per day. It will be driven by six motors aggregating 305 hp and varying from 5 hp to 75 hp. There will be two of 75 hp, three of 50 hp and one of 5 hp. The motors will be General Electric alternating-current, three-phase, 60-cycle, 550-volt type.

EQUIPMENT FOR NEW TIFFANY STORE.—The new $1,000,000 Tiffany Building, at Thirty-seventh Street and Fifth Avenue, New York City, is to be equipped with a 275-kw electric plant. There will be three units. The engines will be built by the Ames Iron Works, of Oswego, N. Y. The generators will be Westinghouse. The wiring will be done by Livingston Johnston, Jr., & Co., 113 East Twenty-second Street. The H. Krantz Manufacturing Company, of Brooklyn, took the order for the switchboard. C. O. Mailloux, 76 William Street, is the consulting engineer on the electrical work.

MOTORS FOR COAST FORTIFICATIONS.—The U. S. war department has placed a contract with the Holtzer-Cabot Electric Company, of Brookline, Mass., for a large lot of special motors to be used for the manipulation of disappearing gun carriages in the various fortifications along the Atlantic coast. The machines will be multipolar motors. Sixty motors have already been ordered of 4 hp. capacity, each operating at 400 r.p.m.

EQUIPMENT FOR ABRAHAM & STRAUSS.—Additional lighting equipment is to be installed in the Abraham & Strauss department store, Brooklyn. The outfit will comprise a 400 kw direct-current generator to be direct connected to a 600 hp Corliss engine. Mr. C. O. Mailloux, 76 William Street, is the consulting engineer in the matter. The existing equipment is of 800 hp capacity and has been installed for several years.

ALBERGER CONDENSERS FOR PHILA. R. T. PLANT.—The Alberger Condenser Company, White Building, has secured the contract for the condensing equipment for the Philadelphia Rapid Transit Company's plant. Jet condensers of dry vacuum system with centrifugal circulating pumps and Corliss two-stage dry vacuum pumps capable to taking care of four 1500-kw Westinghouse turbo-generators, will be installed.

TWENTY-THIRD REGIMENT ARMORY CONTRACT.—The lowest bidders on the lighting equipment to be installed in the Twenty-third Regiment Armory, Brooklyn, are Peet, McAnerney & Powers, 225 Fourth Avenue, New York. The capacity will he 185 kw., two 75 kw., and one 35 kw. generators have been requisitioned for. Mackenzie, Quarrier & Ferguson are the consulting engineers.

EQUIPMENT FOR WANAMAKER PLANT.—The John A. Roebling's Sons Company, 117 Liberty Street, has obtained the contract for the wire to be installed in the huge new Wanamaker store, New York, whose electric plant, as stated in our last issue, will have a capacity of 1800 kw. and will have Westinghouse generators and Buckeye engines—six units. The Thompson-Starrett Company is letting the contract.

EQUIPMENT FOR MEXICAN MINES.—An American syndicate in which William M. McCord and Lucien M. Fairbanks, of Chicago, are largely concerned, will very shortly be in the market for electrical equipment intended to operate large mills on its Peregrino mines in the Guadalajara district, Mexico. The properties have been recently acquired by the syndicate from the Gonzales family.

CUTTER CIRCUIT-BREAKERS FOR BRITISH NAVY.—The Cutter Company, of Philadelphia, whose Mr. Scott is now on the other side regarding the matter, has just secured a substantial contract from the British Admiralty for circuit-breakers for navy use. The company has also been allotted a contract for large circuit-breakers by the Philadelphia Rapid Transit Company.

TELEGRAPH WIRE FOR NICARAGUA.—The American Steel & Wire Company has received a contract for wire to be used in the construction of several hundred miles of telegraph lines in Nicaragua. These lines will be built by the United States & Nicaragua Company, a $10,000,000 concern in which prominent Pittsburgers are chiefly interested.

ALLIS-CHALMERS-BULLOCK.—The Canadian businese of the Allis-Chalmers Company, which recently acquired the Bullock Electric Manufacturing Company, of Cincinnati, will herafter be conducted by a new organization bearing the name Allis-Chalmers-Bullock, Ltd. The works and principal offies of this important new Canadian company are in Montreal.

BIG EQUIPMENT FOR GRAPHIC ARTS BUILDING.—Considerable electrical equipment is to be installed in the Graphic Arts Building, to be built by the *Town Topics*. Walter Tubby, the architect, of 80 Fulton Street, has the matter in hand.

General News.

THE TELEPHONE.

FLORENCE, ALA.—The Bell Telephone Company will build a line from Florence to Bailey Springs. Five thousand dollars will be expended in improvements.

DUNCAN, ARIZ.—A new telephone line is to be constructed from this place to Guthrie. The line will connect at Guthrie with the Gila Valley Telephone Company's line which will give Duncan direct communication with the towns of Clifton and Morenci.

TEXARKANA, ARK.—The New Long Distance Telephone Company, of this city, has opened its line from this city to Honey Grove, Tex., a distance of 100 miles. It is stated that a line will be built from Texarkana to Little Rock.

SANTA ROSA, CAL.—The Mark West & Santa Rosa Telephone Company has been organized here with R. Peterson as president and J. M. Laughlin, as secretary.

MONROVIA, CAL.—The Monrovia Telephone & Telegraph Company's system has been sold to Boaz Duncan, W. W. Wollwine and Dr. West Hughes, of Los Angeles.

LOS ANGELES, CAL.—Sealed bids will be received until May 23 by C. G. Keyes, county clerk, for a franchise to construct and maintain for a period of 30 years telephone lines throughout the streets and highways of the County of Los Angeles. Conduits and pole line will be used.

SAN BERNARDINO, CAL.—The United States Long Distance Telephone Company has filed articles of incorporation with the county clerk. The principal place of business is Los Angeles and the capital stock is $3,000,000. The directors are C. A. Gates, A. F. Morlan, D. J. Maguire, et al.

TAYLORVILLE, ILL.—The Interstate Telephone Company has decided to establish an exchange here.

HARDIN, ILL.—The Calhoun Telephone Company has increased its capital stock from $15,000 to $25,000.

MILLSTADT, ILL.—Permission has been granted to the Millstadt Telephone Company to build and operate a telephone line in this village.

EVANSVILLE, ILL.—The Evansville Telephone Company has been incorporated with a capital stock of $2500. The incorporators are William Wolff, John V. Tummel and William R. Mathews.

CHICAGO, ILL.—The charter of the United Telegraph & Telephone Company has been filed with the county recorder. The capital stock of the company is $2500, and the names of the incorporators are Henry E. Weaver, G. Watson French, Henry L. Turner, Harry D. Critchfield and Harry Rubens.

ALEXANDRIA, IND.—The Central Union Telephone Company is arranging to install an entirely new system in this city.

LEISURE, IND.—The Leisure Telephone Company has been incorporated with a capital stock of $10,500. The directors are Arthur L. Hiatt, David T. Hutcherson, David S. Wasdwell, Frank Smith and William Steel.

MECHANICSVILLE, MD.—The Southern Maryland Telephone Company which was incorporated by the last legislature has been organized with the following officers: J. F. Coad, president; L. J. Canter, vice-president; J. B. Ballenger, secretary-treasurer; J. L. Sothoron, recording secretary. A line has already been built by the company between Mechanicsville and Charlotte.

CEDAR FALLS, IA.—The Ced r Falls Mutual Telephone Company has been incorporated.

PLYMOUTH, IA.—The Plymouth Telephone Company has been incorporated with a capital stock of $10,000.

CONESVILLE, IA.—The Conesville Telephone Company has been incorporated with a capital stock of $10,000.

SANBORN, IA.—The Floyd Valley Rural Telephone Company, of Sanborn, has been incorporated with a capital stock of $1000. The incorporators are N. S. Miller, P. H. Miller, Wm. Clarksen, George Dummett, J. H. Greet and J. J. Getting.

OLATHE, KAN.—The Olathe Citizens Telephone Company has been sold to Oscar Ayers, of Gardner, for $20,000. Mr. Ayers is also proprietor of the Gardner Telephone Company. The connections are to be made with the Home Telephone Company of Kansas City within the next 30 days.

FLEMINGSBURG, KY.—The Flemingsburg Telephone Company has increased its capital stock from $25,000 to $35,000.

BOSTON, MASS.—A bill before the Legislature to put telephone and telegraph corporations under the supervision of the Gas and Electric Light Commission of this state was defeated by a tie vote a few days ago, on the third reading.

QUINCY, MICH.—The Michigan State Telephone Company has ordered material for the construction of 115 miles of lines in Branch County.

BEAVER CREEK, MINN.—A local telephone company is projected in this place. Mr. O. M. Page is president.

WHITE BEAR, MINN.—The Twin City Telephone Company has been granted a franchise for an exchange in this place.

SHAKOPEE, MINN.—C. Kopp, C. T. Buchanon and G. H. Reis have been granted a franchise to construct and operate a telephone exchange here.

HOLUM, MINN.—The Sunberg & Brooten Telephone Company will build a two-wire line between the two points named, the distance being 25 miles.

CHAPMAN, NEB.—The Chapman Telephone Association of Chapman has been incorporated with a capital stock of $50,000. This will be an independent system.

TROY, N. Y.—The Cooperstown, Cherry Valley & Sharon Springs Telephone Company has increased its capital stock from $5000 to $10,000.

SYRACUSE, N. Y.—Mr. Frank M. Potter, Jr., general superintendent of the Syracuse Telephone Company, is inspecting the automatic telephone systems in use in some Western cities, and if he believes such a system is feasible for Syracuse it will be installed here.

MIDDLETOWN, N. Y.—The Hudson River Telephone Company has purchased a lot in this city on which it will erect an office building. The new exchange will be fire-proof and will be used exclusively by the company. It is the intention of the company to lay conduit throughout the principal streets and remove its overhead wires.

RAVENA, N. Y.—The Ravena & Medway Telephone Company has been incorporated with a capital stock of $5000. The directors are William C. Harden and Ernest Bilz, of Stanton Hill; Harry Thorne, New Baltimore; Clifton Bedell, Aquetuck; E. L. Haight, Arthur Hartt, Frederick C. Bush and Clarence E. Whitney, of Ravena; Harric McK. Curtis, Coxackie.

FLUSHING, N. Y.—The New York & New Jersey Telephone Company announces that hereafter its local subscribers will have an unlimited local service and that the toll rates for calls to New York, Brooklyn and Long Island City will probably be considerably reduced in the near future. This action on the part of the company is claimed to be the result of the agitation by the Flushing Association for lower rates.

SYRACUSE, N. Y.—One million dollars will be expended in the extension and improvement of the systems of the Central New York and the Empire State Telephone & Telegraph Companies. The bulk of the appropriation will be expended in the city of Syracuse and vicinity. A new five-story exchange building will be erected in this city at a cost of $200,000. The new switchboard which will cost $150,000 will have a capacity for 20,000 lines.

RALEIGH, N. C.—The Ivey Telephone & Telegraph Company, of Mars Hill and Marshall, Madison County, has been incorporated with a capital stock of $125,000.

MIDDLEBURG, PA.—The Snyder County Rural Telephone Company has been organized by the election of Alfred Schloch as president and J. M. Baker, secretary. This company has been organized to take the place of the United Telegraph & Telephone Company.

PORT ROYAL, TENN.—The Cumberland Telephone Company has established an exchange at Port Royal, Tenn.

CUERO, TEX.—A telephone line is being constructed between this place and Cheapside.

PRINCETON, TEX.—The Princeton Telephone Company has increased its capital from $25,000 to $240,000.

TAYLOR, TEX.—The Williamson County Telephone Company will enlarge its system and make other improvements.

ROCKFORD, WASH.—The Rockford Telephone Company has been organized by C. S. Shepard as president; G. Saunders, vice-president, and O. Sullivan, secretary. The company will build a line from Mt. Hope to Rockford.

GLIDDEN, WIS.—The Glidden Telephone Company will build several farm lines during the summer.

ELECTRIC LIGHT AND POWER.

SEWARD, ALASKA.—The Seward Electric Company has been incorporated by George E. Dickinson and George Sohus.

MENDOCINO, CAL.—The Mendocino Electric Light & Power Company has taken possession of the Mendocino Lighting Company's plant. Ths price paid for the old company's property was $15,000. The business has been re-organized, Mr. J. A. Grindle being elected president and Albert Brown, secretary.

SILVERTON, COL.—The town of Silverton contemplates building about two miles of new line for its electric light service and installing 25 series arc lamps.

WASHINGTON, D. C.—Bids will be received May 24 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yards at Mare Island, Cal., and Puget Sound, Wash., a quantity of arc lamps, carbons, incandescent lamps, electric fans and exhausters, conduit and fittings, transformer, etc. Address H. T. B. Harris, Paymaster General, U. S. N.

WOOD RIVER, IDA.—The Idaho Electric Light Company is contemplating the installation of new machinery at this place and will greatly increase its plant.

GREER, IDA.—High water washed away the dam and flume of the Lolo Creek Power Company recently, entailing a loss of $10,000. The dam and flume were built on Lolo Creek at a cost of $25,000. The plant furnished electricity for a lighting plant and mills at Nez Perce. The damage will be repaired as early as possible.

LITCHFIELD, ILL.—The United Gas & Electric Company has been incorporated with a capital stock of $100,000. The incorporators are David David, William F. La Force and Jacob J. Frey.

OTTAWA, ILL.—The property of the Marseilles Water & Light Company has passed into the control of W. D. Boyce. The new board of directors chose the following-named officers: W. D. Boyce president; Benjamin Boyce vice-president; Dwight Cook, treasurer, and L. H. Strawn, secretary.

INDIANAPOLIS, IND.—The Union Trust Company, of this city, has been appointed receiver for the Home Heating & Light Company on the petition of Knight & Jellison Company. The complaint charges that Home Company is wholly insolvent. The plant will be operated by the receivers.

FT. THOMAS, KY.—Bids are wanted May 31 for wiring buildings, furnishing and installing watt and voltmeters, transformers, arc lamps, and other electric fixtures; erecting necessary pole lines on the reservation, and furnishing necessary current for electric lighting at this post. Address Lieut.-Col. W. H. Miller, Ch. Q. M., Pullman Bldg., Chicago, Ill.

BATON ROUGE, LA.—The Capital Light & Power Company has been incorporated with a capital stock of $25,000. The names of the incorporators are C. H. Kretz, E. F. Wieck and Turner Buynum.

ANNAPOLIS, MD.—Bids will be received at the Navy Department, Washington, D. C., until May 21 for boilers, engines and dynamos at the U. S. Naval Academy, Annapolis. Address Chas. H. Darling, Assistant Secretary.

KALKASKA, MICH.—The Kalkaska Electric Light Plant, Saw & Planing Mill contemplates building a dam and installing a plant for the utilization of water power. It intends to change its present direct current system to alternating current.

ANN ARBOR, MICH.—The Michigan Milling Company has two water powers within five miles of Ann Arbor, which are likely to be utilized for electrical work in addition to the present water power plant of the company. Mr. N. J. Kyer is manager.

JANESVILLE, MINN.—The Council is considering plans for a system of water works and electric lighting, to cost $22,000.

MONTEVIDEO, MINN.—The Montevideo Electric Light & Power Company, of Montevideo, has been incorporated; capital, $60,000. Incorporators: E. H. Sorlien and Olaus Lende, Granite Falls; E. A. Aspines and Lyndon A. Smith, Montevideo.

GREENWOOD, MISS.—The citizens of Greenwood have voted to issue $125,000 worth of bonds in order to purchase the electric light plant, water works and sewerage plant.

WOODVILLE, MISS.—Bids will be received by the Mayor and the Board of Aldermen until June 7 for building a system of water works and an electric light plant. W. C. Miller is mayor; C. N. Jenks, Fayette, Miss., is the engineer.

ST. LOUIS, MO.—A $1,000,000 mortgage on the property of the West St. Louis Water, Light & Power Company in favor of the St. Louis Union Trust Company, trustee, was filed in the Recorder's office in Clayton, St. Louis County, April 20. One thousand $1000 20-year gold bonds are to be issued, 600 of which are to be placed on the market immediately.

JOPLIN, MO.—W. G. Sergeant, of Joplin, has begun the work of building a dam across Spring River, at Lowell, Kan. It is estimated that a 7200-hp will be available. An electric plant will be erected on the banks of the river, and power will be transmitted to all sections of the mining district. It will probably be a year before the plant is in operation.

ST. LOUIS, MO.—Plans for a municipal plant to light by electricity that portion of the city south of Keokuk Street are still being considered by the Board of Public Improvements. It was first planned to locate a plant on the river near Elwood Street, but the latest idea is to have it situated at the House of Refuge, Osage Street and Virginia Avenue. The board has not yet progressed far enough to state what the plant will cost. At present the city pays $59,000 per year for lighting the city south of Keokuk Street with gas.

LINCOLN, NEB.—The North Platte Electric Light & Power Company, of Colorado, has decided to do business in Nebraska. Articles of incorporation have been filed with the Secretary of State of Nebraska. The principal place of business is in Denver, and the capital stock is $20,000. The company operates its plants by power obtained from North Platte River.

MUNNSVILLE, N. Y.—The Stanley Electric Company and the Cramp's have completed estimates for the construction of a power plant of 1000-hp at Limekiln Falls, near Munnsville, at a total estimated cost of $45,000.

NEW YORK, N. Y.—The following are the bids opened April 23 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for a turbo alternator, five induction motors, a generator and two switchboards and accessories: General Electric Co., $47,447 (with certain modifications); Westinghouse, Church, Kerr & Co., New York, N. Y., $54,000.

SALISBURY, N. C.—All the stock and securities, amounting to $50,000, belonging to the Salisbury Gas & Electric Light Company, have been transferred at par value to the Salisbury & Spencer Street Railway Company. H. B. McCanless is president, and H. Vanderford, secretary.

ANTELOPE, ORE.—The citizens are considering the question of constructing an electric light plant.

PORTLAND, ORE.—It is reported that the Portland General Electric Company will expend about $250,000 on an extension to its power plant.

BRADFORD, OHIO.—The Bradford Electric Light Company has been incorporated with a capital of $10,000 by A. W. McCune, G. Z. Arnold and others.

NEWTON FALLS, OHIO.—Bids will be received May 20 by the City Council for an electric light plant. The successful bidder will be given a contract for 10 years for lighting the village and a 20-year franchise for commercial lighting and furnishing power.

SHENANDOAH, PA.—Bids are wanted by the Borough Council for furnishing 60 or more street arc lights of 2000-cp.

CARBONDALE, PA.—The Hendrick Light & Power Company, of Carbondale, has been incorporated with a capital of $5000.

SPANGLER, PA.—The Spangler Electric Light, Heat & Power Company, of Spangler, has been incorporated, with a capital of $5000.

DANVILLE, PA.—The Council has voted to establish a municipal light plant and the Committee on Light has been instructed to procure estimates prior to asking for bids. H. B. Patton is borough secretary.

ANDERSON, S. C.—A company has been organized at Anderson, S. C., to develop the Hatton Shoals on the Tugaloo River. A large electric power plant will be built.

CALDWELL, TEX.—Cypher Bros., of Austin, propose constructing an electric light and ice plant here to cost about $10,000. D. A. Cypher is the engineer.

LEONARD, TEX.—The Leonard Electric Light & Ice Company has been organized to construct an electric light and ice plant. Y. T. Manning is president, L. H. Saunders, secretary.

CLARENDON, TEX.—The City Council has granted two franchises for the operation of electric light plants in Clarendon—one to Chase & Co., who have been for some time operating a plant in this city, while the other was granted to Jas. Trent, who will immediately install a plant.

HOUSTON, TEX.—The Houston Light & Power Company has been increasing the capacity of its plant and it is now ready for the installation of the machinery. The equipment includes three 450-hp Babcock & Wilcox boilers, General Electric generators and turbine engines. The distribution plant will also be extended.

WEST POINT, VA.—Broaddus & Byers, of West Point, are the engineers for an electric light plant for West Point.

WOODSTOCK, VA.—The Woodstock Electric Light & Power Company has been incorporated with a capital of $2000 to $10,000.

MARTINSVILLE, VA.—The Town Trustees have secured an option on the water power of Smith River, about 1½ miles south of Martinsville, and have employed A. L. Scott, representing Lockwood & Green, of Boston, Mass., to make a survey and estimate the cost of bringing this power to the town by electric transmission. The probable cost of the plant is $70,000.

WALLA WALLA, WASH.—A $250,000 mortgage has been filed by the Baker Loan & Investment Company of this city against the electric light plants, water rights, rights of way and other property of the Washington & Oregon Power Company, which is building a large plant on the South Fork of the Walla Walla River to supply power, etc., to Walla Walla, Wash. and Pendleton, Ore. The Washington & Oregon Company has also purchased the local plant at both Walla Walla and Pendleton.

MENOMONEE FALLS, WIS.—This city is reported interested in the construction of an electric light plant.

BURLINGTON, WIS.—An election will probably soon be held to vote on issuing $27,000 bonds for an electric light plant.

ANTIGO, WIS.—The station of the Antigo Electric Light & Power Company was destroyed by a fire of unknown origin on May 5. The loss on machinery is estimated at $20,000, but the indirect loss will be large, as the city is without light, and many small factories are compelled to shut down for lack of power All the local newspapers were also put out of business temporarily for the same reason.

OTTAWA, ONT.—It is reported that the Consumers' Electric Company will expend $30,000 in laying conduits from Chaudiere to its power station on Maria Street.

ST. CATHERINES, ONT.—The Lincoln Electric Light & Power Company of this place will install a 300-kw generator and will build a three-phase line to the power house of the Hamilton Cataract Power, Light & Traction Company for the lighting of the new Welland Canal.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The survey of the proposed electric railway from Bessemer to Blue Creek is finished. As soon as the report of the engineers has been accepted a company will be formally organized by the subscribers and work begun.

SAN FRANCISCO, CAL.—The Ione & Eastern Railroad Company (Electric) has been incorporated. The directors and stockholders are Jackson Dennis, of Amador County, and J. J. Fagan, William Pardy, R. E. Wallace, H. H. Ferns and S. C. Sheeline, of San Francisco. The capital stock is $1,000,000.

DENVER, COL.—The Northern Colorado Electric Railway Company has filed its articles of incorporation with the Secretary of State at Denver. The principal offices will be located at Fort Collins. The main line will run from Fort Collins to Denver. Branch lines are planned between Fort Collins, Eaton and Greeley and Fort Collings, Chambers' Lake, Walden and thence to the Grand River in Grand County. The capitalization is $1,000,000. The directorate is composed of P. J. McHugh, L. C. Moore, R. L. McCullogh, H. A. Edmonds and W. A. Mosman.

MERIDEN, CONN.—The transformer plant which the Meriden Electric Railroad Company has been erecting at Hanover Park has been completed. Under the new arrangement the power to operate the local electric railway will be transmitted from the New York, New Haven & Hartford Railroad Company's station at Berlin, a distance of 9 miles. The old power plant on Pratt Street will be kept in readiness for use in cases of emergency.

MT. VERNON, ILL.—The Southern Illinois Electric Railway Company, which has in contemplation the construction of an extensive system of electric railways in this territory, has voted to increase its capital stock from $50,000 to $2,000,000.

ALTON, ILL.—The Alton Light & Traction Company has awarded the contract for building an embankment for its electric railway from Alton to East Alton, and may continue to build the line into St. Louis, independent of the St. Louis syndicate.

MT. VERNON, ILL.—The Traction, Engineering and Construction Company has been incorporated, with a capital stock of $2500, by John R. Piercy, Isaac A. Smith, Fred. L. Webster, E. C. Parker and William C. Blair. The same interests are connected with the Southern Illinois Electric Railway, and the inference is that the Traction, Engineering & Construction Company will build the Southern Illinois Company's lines.

JEFFERSONVILLE, IND.—The Jeffersonville City Railway Company has been purchased by Peter Arundel, representing Louisville capital, and is now being equipped with electricity. The road extends from Jeffersonville to Port Fulton.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company is building a new power plant with a capacity of 800-kw, all units being direct-connected. The cost of the plant will be $50,000 and the new equipment will be ready for operation July 1 next.

MUNCIE, IND.—A franchise has been granted the Oil Belt Traction Company through the northern portion of Delaware County. It is proposed to build from Alexandria through the northern part of the country to Celina, Ohio. A branch will be extended from Gaston to Muncie.

BOSTON, MASS.—The Railroad Commissioners have authorized the Boston & Worcester Street Railway Company to issue $100,000 additional capital stock at $100 per share; also $200,000 twenty-year 4½ per cent. bonds, the proceeds to be used to pay off floating debt incurred in constructing and equipping the road.

JACKSON, MICH.—Articles of incorporation of the Consolidated Traction Company, of Jackson, have been filed with the Secretary of State. The new company is one formed by W. A. Bowland to take over the property of the Jackson & Suburban Traction Company, now operating the Jackson City lines and a road to Grass Lake, and also a spur line connecting Wolf Lake resort and casino, 10 miles east of Jackson, with the Roland system. The new company is at present independent of the Jackson & Battle Creek Traction Company, and also of the Jackson & Ann Arbor Company. The capital stock of the new company is $1,000,000.

ST. LOUIS, MO.—The St. Louis Elevated & Subway Railroad Company has applied to the City Council for the second time for a franchise to build and operate an elevated and underground railroad subway and tunnel for passenger service from Third Street and Washington Avenue to the city limits. H. K. Gilman, S. L. Langsdale, Harry S. Doyle and J. E. Longworth are interested.

ST. LOUIS, MO.—Further changes in the management of the St. Louis Transit Company, looking to a general reduction of operating expenses, are about to take place. General Manager Robert McCulloch has announced the resignations of W. O. Mundy, chief engineer, and Superintendent Dunne, of overhead construction, both to take effect on or about May 1. Their duties will be merged into those performed by other officers.

JERSEY CITY, N. J.—The North Jersey Street Railway Company has purchased a large tract of land on the Hackensack river front on which it will erect a large power plant. Power for the entire trolley system east of the Hackensack River will be supplied from this station. Architects are now at work on the plans and it is stated that the cost of the buildings and machinery will be at least $400,000.

CUBA, N. Y.—W. F. Mayo, of Cuba, and others, have recently been in conference here regarding the building of an electric railway from Cuba to Weston's Mills, a distance of about 16 miles.

NEW YORK, N. Y.—The proposal of the New York & Jersey Railroad Company to continue its Hudson River tunnel from the terminus of West Tenth and Hudson Streets, originally proposed, under Sixth Avenue and to Thirty-third Street, has been reported adversely by the committee that had the matter in charge.

ROCHESTER, N. Y.—At the annual meeting of the stockholders of the Albion Electric Railway Company the following directors were chosen: Charles B. Hill, E. C. Lufkin, C. L. Ingham, George H. Sickles and Frederick B. Griffith, Jr., of Buffalo; Alvah K. Potter and George E. Greene, of Lockport; Lorenzo Burrows and George B. Church, of Albion. The directors elected these officers: Charles B. Hill, of Buffalo, president; Frederick B. Griffith, Jr., of Buffalo, secretary and treasurer.

ROCHESTER, N. Y.—Senator Merten E. Lewis, attorney for the promoters, says the electric railway from Rochester to Caledonia is assured. The company will be incorporated in about two weeks. Plans and surveys have been completed. The road is to be known as the Rochester, Scottsville & Caledonia Railroad. The subscribers to the new company are: Henry C. Brewster, John F. Alden, Charles T. Chapin and Le Grand Brown, of Rochester; D. C. Becker, of Fairport; Andrew H. Brown, of Penfield; Charles H. Palmer, Eugene Brown, Selden S. Brown and Isaac W. Salyerds, of Scottsville. The company is to be capitalized at $250,000. Henry C. Brewster is to be president of the corporation.

COHOES, N. Y.—The Cohoes Railway Company has filed papers of incorporation with the Secretary of State. The capital is $120,000. The new company is a reorganization of the Cohoes City Railway, which was sold at auction recently. The directors are P. C. Dugan, John W. McNamara, president of the United Traction Company, of Albany; James McCredie, Edgar S. Fassett, Reuben C. Calkins, Eugene Crawford and Thomas Van Antwerp, of Albany; James N. Wallace, of New York, and John E. MacLean, of Cohoes. The stockholders have authorized the issue of the mortgage which is a part of the plan of reorganization. The United Traction Company interests are the controlling factor in the company.

NEW YORK, N. Y.—The Central Crosstown Railroad, which is controlled by the Metropolitan Street Railway Company, has sold to Kuhn, Loeb & Company $2,250,000 of two-year 5 per cent notes, secured by deposit of $2,250,000 guaranteed bonds of the Crosstown Company. The proceeds reimbursed the Metropolitan Securities Company for the money advanced in electrifying the crosstown system. Kuhn, Loeb & Company have also purchased $2,300,000 of the Metropolitan Street Railway refunding 4 per cent. bonds, the proceeds from which will be used in part to pay off the $1,500,000 Broadway & Seventh Avenue first 5s, maturing June 1, and the balance for other refunding operations. This increases the outstanding refunding 4s to $15,080,000. In addition, Kuhn, Loeb & Company have bought $2,000,000 of Third Avenue first consolidated 4s, increasing the outstanding issue to $37,000,000. The new bonds are issued to pay for improvements and other purposes.

CHARLOTTE, N. C.—The route has been surveyed for a trolley line connecting Roanoke, Va., and Mount Airy, N. C.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway Company is securing right of way for a line up the Muskingum River Valley to Devol.

DEFIANCE, OHIO.—The Ohio Northern Traction Company is making surveys for its line which is to extend from Defiance to Wauseon, O., and Adrian, Mich.

CAMBRIDGE, OHIO.—The Consolidated Company has filed an amendment to its charter changing its name to the Cambridge Power, Light & Traction Company.

COLUMBUS, OHIO.—The Chillicothe, Bainbridge & Aberdeen Electric Railway Company has been incorporated, with $50,000 capital stock. The incorporators are G. F. Horn, A. A. Luther, O. R. Eyler and Floyd E. Furneau.

INDIANA, PA.—The Indiana Street Railway Company and the Indiana & Blairsville Intersection Street Railway Company have been merged.

WASHINGTON, PA.—The Washington County Street Railway Company has been granted a franchise here. The plan of the company is to build an electric railway from Washington to Pittsburg.

BRADFORD, PA.—It is said that the Bradford Street Railway Company's property and franchise have been purchased by a party of Philadelphia capitalists, and that the Olean, Rock City & Bradford Company is included in the deal.

EASTON, PA.—The Easton Transit system and its allied roads in Easton and Phillipsburg, and the Easton, Palmer & Bethlehem road, now controlled by the Lehigh Valley Traction Company, are to revert to the Easton Consolidated Electric Company. H. R. Fehr is to assume control for the old company. The Lehigh Valley Traction Company has defaulted in the payment of the rentals of its leased lines, and the receivers have been unable to better conditions to any great extent.

CHATTANOOGA, TENN.—The Rapid Transit Company of Chattanooga will issue $250,000 in bonds for improvements and extensions of its consolidated lines.

BEAUMONT, TEX.—It is reported that a large part of the stock and bonds of the Beaumont Traction Company has passed into the hands of a Boston syndicate.

SALT LAKE CITY, UTAH.—Work on the Salt Lake Southern electric railway, which will traverse several miles of the suburbs of the city, has been resumed. The company has filed with the county clerk amended articles of incorporation, increasing the capital stock from $500,000 to $2,000,000, and the Knickerbocker Trust Company, of New York, has been designated as trustee. It was stated recently that $1,500,000 will be expended this year in construction work. A power plant with a capacity of 3500 horse-power is to be established by the company a few miles south of the city.

DANVILLE, VA.—The Danville Street Railway & Electric Company has asked the permission of the County Circuit Court to extend its line to Stokesland, 5 miles south of this city. The line will be extended this spring to the Country Club, beyond the suburbs.

WEST SEATTLE, WASH.—It has been voted to issue $18,000 worth of bonds by the city to build an electric street car line. The city is to own and operate the road.

EAU CLAIRE, WIS.—The Chippewa Valley Electric Railroad Company, of which Arthur E. Appleyard is president, has taken over all of the property of the Eau Claire Light & Power Company, including its franchise.

FOND DU LAC, WIS.—The Fond du Lac Northwestern Railway Company has increased its capital stock from $100,000 to $750,000. Work has been started on the Fond du Lac end of the road, and it is thought a branch will be built to this city, connecting with the Green Bay-Kaukauna interurban.

NEW WESTMINSTER, B. C.—W. Blackmore & Son, architects, have prepared plans for a sub-station to be built by the British Columbia Electric Railway Company.

NEW INDUSTRIAL COMPANIES.

THE CENTURY GAS & ELECTRIC FIXTURE COMPANY, of New York, has been incorporated with a capital stock of $3000. The directors are S. M. Israel, E. M. Pine and S. H. Shinnisky, New York.

THE WOOD CHANGING SIGN COMPANY, of New York, has been incorporated with a capital stock of $100,000. The directors are N. B. Wood and W. A. Kroyer, New York, and B. B. Austin, Brooklyn.

THE JOHNSON ELECTRICAL MANUFACTURING COMPANY, of Phoenix, Ariz., has been incorporated with a capital stock of $200,000. The incorporators are W. Frederick Nutt and Charles H. Johnston.

THE H. R. & K. MANUFACTURING COMPANY has been incorporated in New York to deal in electrical appliances. The capital stock is $75,000 and the directors are W. E. Knight, Fanwood, N. J., and H. C. Workman and M. A. Ryan, New York.

THE HUTCHISON WIRELESS TELEPHONE COMPANY has been incorporated at St. Louis with a capital stock of $3000. The incorporators are M. R. Hutchison, Hallon C. Spaulding, Edward C. Husted, L. Z. Harrison and Joseph A. Wright.

THE TAPE TRANSMITTER MANUFACTURING COMPANY has been incorporated in Jersey City, N. J., with a capital stock of $100,000. The incorporators are Edward T. Clarke, Jersey City, and Elihu Beach and Loyal Ward Reynolds, New York City.

THE ALLENTOWN ELECTRIC CONSTRUCTION & SUPPLY COMPANY has been incorporated at Allentown, Pa., with a capital stock of $30,000. The incorporators are U. H. and W. E. Wieand, W. H. Gangawere, R. E. Wright, J. R. Druckenmiller and W. H. Miller.

THE NEEL ARMSTRONG COMPANY has been organized at Portland, Me., for the purpose of manufacturing and dealing in electrical apparatus. The capital stock of the new concern is $200,000, of which nothing has been paid in. The officers are: President, Willard C. Baldwin; treasurer, Geo. C. Knight.

LEGAL.

WESTERN UNION VS. PENNSYLVANIA.—Judge Gray on May 2 handed down an opinion in the United States Court of Appeals at Philadelphia remanding the case of the Western Union Telegraph Company against the Pennsylvania Railroad Company to the Circuit Court for further proceedings. The litigation involves the right of way of the telegraph company along the lines of the Pennsylvania Railroad Company, and the United States courts in that district have always sustained the position of the railroad. The last decision, however, reverses the Circuit Court on a demurrer raised by the telegraph company and the case is sent back to the lower court for a hearing on its merits.

TO OUST CUMBERLAND TELEPHONE.—At Nashville, Tenn., on May 2, Chancellor Allison handed down a decision to-day ordering that the Cumberland Telephone & Telegraph Company, a Kentucky corporation, be ousted from the State. An appeal to the Tennessee Supreme Court was taken. The grounds for the decision are discrimination and conspiracy to stifle competition. A receiver was also asked for, but the court declined to appoint one, "for satisfactory reasons." One specific charge is that the leasing of the Maury County or Columbia Exchange to Leland Hume, an officer of the Cumberland Company, was an evasion of the law, and designed to permit rates to be illegally cut. It was also charged that the defendants had broken down independent concerns elsewhere by methods which they had no right to practice. Officials of the Cumberland Telephone and Telegraph Company decline to make any statement further than to assert that their business will continue to be transacted as usual. The company has an authorized capital of $20,000,000 and about $12,000,000 is outstanding.

OBITUARY.

MRS. MARY PECK, mother-in-law of Prof. Elihu Thomson, and Mr. E. F. Peck, manager of the Schenectady, N. Y., electric railway system, died last month at Lakewood, N. J. She was the daughter of the Rev. Dr. Emerson Davis, of Westfield, Mass., and widow of Mr. Charles Peck, of New Britain, Conn. She was a woman of strong religious convictions, active social sympathies and prominent in all kinds of philanthropic work. Her death at the Laurel House, Lakewood, was due to a slip and falling down a flight of stairs.

EDUCATIONAL.

HEBREW TECHNICAL INSTITUTE, New York City, will hold its commencement exercises on Wednesday evening, May 18, in the large hall of Cooper Union, preceded by an exhibit of work of the graduating class at the Institute, Stuyvesant Street.

ELECTRO-RADIO THERAPY.—The importance that radio-activity is assuming as an agent in the treatment of disease is emphasized in the establishment by the trustees and medical faculty of the New York Polyclinic Medical School and Hospital of a special department of electro-radio therapy.

PRATT INSTITUTE, Brooklyn, N. Y., in its March *Monthly* gives the annual report of the department of science and technology, including a very interesting illustrated description of the electrical laboratory and the methods adopted there of instruction in testing apparatus, cables, etc. The report is signed by Mr. S. Sumner Edwards, who is to be congratulated upon this useful report of good work done.

PERSONAL.

MR CLARENCE GEORGE has been appointed city electrician of Houston, Tex., by Mayor Jackson.

MR. WALTER H. GRAEFF, of G. & O. Braniff, Mexico City, which concern represents the Westinghouse interests in the Southern Republic, is now on a visit to the States.

CAPT. C. F. GOODRICH, U. S. N., has an interesting article in the latest (March) issue of the *Proc. U. S. Naval Institute* on "Cable Cutting." It is full of data with reference to this important topic.

MR. L. W. MILLER, secretary of the Goudey-McLean Company, 120 Liberty Street, New York, is expected back very shortly from Europe, where he has been for some two years past in connection with the company's business.

MR. J. J. O'BRIEN, who has been for some years past cashier of the Chicago Edison Company has resigned and has become general auditor for the H. M. Byllesby & Company, the consulting and contracting electrical engineers of Chicago and New York.

MR. J. L. LYLE, manager of the New York City offices of the Buffalo Forge Company, has been appointed secretary of the Engine Builders' Association, vice Mr. D. L. Fleming, of the Harrisburg (Pa.) Foundry & Machine Works, who has resigned from the position under pressure of business.

MR. J. W. STEED, of the International Steam Pump Company, will have charge of the installing of the electrical equipment, machine tools, etc., at the huge Worthington works now being hastened to completion at Harrison, N. J. Practically all the electrical equipment will be of General Electric manufacture.

MR. CHARLES H. LEDLIE, Rialto Building, St. Louis, was the consulting engineer of the Kansas City Telephone Company's plant described recently in these pages, the entire system including switchboards, desk equipment and telephones, as well as the outside construction work, having been built under specifications prepared by him, and the work done under his immediate supervision.

MR. H. V. CROLL, who has been in charge of the Salt Lake City, Utah, office of the Allis-Chalmers Company for several years, and who was before that the representative of the E. P. Allis Company at Spokane, Wash., has been appointed to the charge of the Allis-Chalmers office in San Francisco, as the successor of Mr. Geo. Ames, who has resigned. Mr. Croll's San Francisco office is 623 Hayward Bldg.

PROF. S. P. THOMPSON, F. R. S., is now busily engaged on the second volume of his new edition of "Dynamo Electrical Machinery," in which he is giving special care and attention to the subject of alternators. When it is off his hand, he intends making a final effort to complete the rewriting of that valuable work, "The Electro Magnet," now seven years in process of execution, to embrace a large amount of original matter.

CHARLES HENRY DAVIS & PARTNERS, of New York City, have issued an announcement of the dissolution of this firm from May 1, and the formation of Charles Henry Davis & Company, at 25 Broad Street, by that gentleman and Mr. Nat Tyler, Jr. As to the other old members, Mr. T. W. Sprague will practice at 4 State Street, Boston, Mr. John S. Griggs, Jr., 25 Broad Street, and Mr. J. Byers Holbrook, at the same address.

MR. C. P. BRUCH, assistant general manager of the Postal Telegraph Cable Company, is also president of the Canton Society of New York, composed of men who came from President McKinley's city. The society gave a dinner on May 7 to their fellow townsman, Justice Day of the U. S. Supreme Court, at which a number of distinguished public men were present. Mr. Bruch presided and also discharged the duties of toastmaster in a very felicitous manner.

MR. PAUL G. BURTON, formerly chief inspector of the Western Electric Telephone installation department, has been appointed superintendent of maintenance of the Chesapeake and Potomac Telephone Company, the territory of which includes Baltimore and Washington. Before his departure from New York Mr. Burton was the guest of honor at a dinner given at the Arena by the Western Electric Foremen's Club, of which he had been president for several years.

DR. LEE DE FOREST, whose wireless telegraph system is being used so effectively in the Russo-Japanese war by the *New York Times* and *London Times*, is the subject of an interesting biographical sketch in the former paper. It is accompanied by an engraving which shows him mounted as a bugler of the Yale battery in the Spanish war of 1898, when he was one of the first of the New Haven men to enlist. The following year Yale made him a Doctor of Philosophy for his thesis on Hertzian waves.

MR. IRVING A. TAYLOR, who has for many years been connected with the electrical industry both on the manufacturing side and as consulting engineer associated with A. B. Herrick, has joined the staff of the Engineering Company of America. Mr. Taylor has had a very broad experience in central station work, not only with Edison systems but also with high tension transmission plants, one of his recent tasks being the installation of the 12,000-volt generators at the power house of the Niagara Falls Hydraulic Power Company.

MR. T. A. EDISON.—A dispatch from Washington, May 10, states that President Roosevelt recently overruled a decision of Patent Commissioner Allen in a case in which Mr. Edison is interested, and directed that a hearing be given to Mr. Edison, which had been denied. It appears, from the dispatch, that Mr. Edison applied for a patent in connection with his storage battery, and that another inventor working along the same lines, it is alleged, was permitted to withdraw his application and insert in it the substance of Mr. Edison's claims. Mr. Edison protested and asked for a hearing, which the Commissioner refused to grant. President Roosevelt was appealed to with the above result.

MR. S. STERN, vice-president and managing director in Europe of the American Electrical & Novelty Company, returned recently from a trip abroad. The company now has factories and selling agencies in Paris, Berlin and London. "The Germans take most kindly to our ideas and to our goods," Mr. Stern said, "but they are also the best imitators. In July, 1900, I established our first factory in Berlin for the manufacture of portable electric lights. The Germans had never heard of such a thing, then, but inside of a year I had seventy-five competitors. We created a new industry in Germany, and to-day there are at least 150 factories there making electrical devices. The Germans take to all our novelties and are our best customers." Mr. F. J. Alvin, president of the company, has also recently made a quite successful trip through Canada.

MR. G. MARCONI left England last Saturday by the Campania for New York. The ship has been equipped with long distance wireless apparatus, and during the entire voyage Mr. Marconi expects to be able to keep in communication with both shores. He is accompanied by Mr. W. W. Bradfield, engineer of the American Marconi Company, who has been with him for several months past studying the new apparatus designed for the operation of the trans-Atlantic system. The first station to be equipped will be that at Glace Bay, Nova Scotia, following which the station at South Wellfleet will be put in shape. When the stations on this side of the Atlantic have been opened for business there will be stations abroad, to which communications may be directed, at Poldhu, Cornwell and Pisa, Italy. By means of relay from these stations wireless communication may also be had with Amsterdam, Holland; LaHague, France; Gibraltar; Rosslare, Ireland, and other points.

MR. HERMAN A. STRAUSS was appointed general manager of the Sheboygan Light, Power & Railway Company, of Sheboygan, Wis., early this year. This company operates about 30 miles of city and interurban trackage and all the lighting systems of the city of Sheboygan. This appointment of Mr. Strauss comes after one year's service as engineer of the Construction Company of America in the design and construction of ten miles of interurban railway and a large, modern, fire-proof power station for the Sheboygan Light, Power and Railway Company. Mr. Strauss has had a large and varied experience. He was attached to the engineering staff of the Westinghouse Electric and Manufacturing Company for several years; he has acted for two years as an assistant electrical engineer for the Manhattan Elevated Railway Company of New York City, throughout the period of electrification of this system, and has done considerable independent consulting engineering work.

MR. W. E. SHELDON, formerly treasurer of the Fitchburg Steam Engine Company, who was afterwards connected with the Providence Steam Engine

Company and with the Providence Engineering Works, has become connected with the "Manufacturers Agency," Milk & Oliver Streets, Boston, Mass., which has rented an entire floor of 35 rooms in the Oliver Building there. The agency will act as selling agent and purchasing agent for manufacturers, furnishing capital, loans and everything convenient for manufacturers having dealings with it. The proposition is to finance companies and represent them through New England, reaching out for business in a manner which a moderate manufacturer cannot do. A large staff of traveling salesmen has been engaged who know the companies in that territory thoroughly, and who are experts in respective lines. To Mr. Sheldon has been given the engineering department, of which he will have full charge. Mr. J. F. Preston is the president of the organization.

Trade Notes.

THE TOLEDO ELECTRIC STORAGE BATTERY COMPANY, Toledo, Ohio, capitalized at $100,000, has been re-organized with Mr. J. Grasser as president.

ELECTRIC POWER FOR BREWERY.—F. C. Werk, Cleveland, Ohio, has secured a contract for equipping the plant of the Isaac Leisy Brewing Company, of Cleveland, with electric power. A number of motors will be installed.

SPRAGUE ELECTRIC COMPANY has issued a bulletin devoted to its M. C. type motors, direct current, open form and enclosed form, intended for very general application. It is No. 216 and is well illustrated as well as full of detail data.

CUTLER-HAMMER IN WEST AUSTRALIA.—The Cutler-Hammer Manufacturing Company has appointed the West Australian engineering and contracting firm of Splatt, Wall & Co., Perth, as agents for the Cutler-Hammer specialties in that part of the world.

THE F. BISSELL COMPANY, Toledo, Ohio, has just issued a very neat little "Handbook of Switchboards." It is devoted to boards of 2500 amp. or less, complete or in parts, and is profusely illustrated by diagram as well as being carefully explicit as to details of every kind.

H. T. PAISTE COMPANY, Philadelphia, has issued some new calendar blotting pads for May, illustrating and describing its P. K. show window "fieldings," the P. K. Pushin attachment plug, etc. These specialties are thus attractively brought to notice.

THE PROVIDENCE ENGINEERING WORKS, of Providence, R. I., has established a New York office at 42 Broadway, N. Y., in charge of Mr. Wm. E. Hussey, who is well known in engine circles. The New York office will also cover the Philadelphia territory.

COLUMBIA INCANDESCENT LAMP COMPANY, of St. Louis, Mr. A. Garrison, president, has found it necessary to open an office in Minneapolis, and to carry a complete stock of lamps at that point in order to care properly for its large and growing number of customers in Minnesota and the Northwest. The business there has shown a remarkable increase. Mr. J. B. Coale, who formerly represented the company in the district named, will be in charge of the Minneapolis office.

INCREASE OF CAPITAL.—The directors of the Monarch Electric Manufacturing Company, of Warren, Ohio, have decided to increase the capital stock of the company from $10,000 to $50,000. The increasing business of the company requires larger capitalization in order that it may be more properly carried on. The outlook for the fall trade is stated to be very good and the plant will be operated throughout the summer so as to be able to meet the demand for the company's products.

MULTIPLE TAP CABLE SYSTEM.—Mr. L. W. Stanton, telephone engineer, Electric Building, Cleveland, has issued an interesting illustrated bulletin as to the merits of the "multiple tap" system for telephone services, as compared with older methods. This open-wireless or all-cable telephone method has been introduced with excellent results and is highly spoken of by experts and authorities. One view shows a single cable on pole at Austin, Minn., equal to a lead of five crossarms and 50 bare wires.

WARD-LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has just issued a new catalogue, No. 19,038, covering its enameled resistance units. On account of the increasing demand for new sizes of this resistance unit, it has catalogued three new sizes; one a tube 2 inches long and 7-16 inches diameter, upon which in extreme cases can be placed 5000 ohms resistance. Another is a tube four inches long by 7-16 inches diameter upon which can be placed 11,000 ohms. The SS type covers a tube suitable for small rheostats, as it is divided into eight steps. Copies of the bulletin can be had on application by any one interested.

GENERAL ELECTRIC COMPANY, through its power and mining department at Schenectady, N. Y., has just issued a very handsome and complete report dealing with the subject of electric mine haulage. It is a handsome, small quarto of 70 pages, profusely illustrated and gives also a great variety of interesting details and information, including several quoted articles, and considerable original data. It is the more valuable also because of the historical record presented; but probably its chief value lies in the impressive demonstration that it makes of the remarkable rapidity and extent of the adoption of electricity in mining operations all over the country.

THE MICA INSULATOR COMPANY, of 218 Water St., New York City, has incorporated the exhibit of its well-known specialty "Micanite," with that of the State of North Carolina, in the Mines and Metallurgy Building, St. Louis. The exhibit is an interesting object lesson showing to what utility and extent mica can be put in the ever-expanding field of electrical insulation. Micanite in all kinds of shapes and forms is shown, including flat sheets of various thicknesses, generator and motor commutator segments, and rings of many of the standard types; and Micanite tubes from one-eighth of an inch in diameter to the large tubes entering into the construction of induction coils for X-ray purposes.

ROSSITER, MACGOVERN & COMPANY, 71 Battery Place, New York City, have issued for May an elaborate bulletin of all the second-hand material which they now have ready for the market. The phrase "second-hand" is used advisedly as almost all of the material is of modern design and of standard manufacture; has been thoroughly overhauled in the Jersey City and St. Louis factories of the company, and is ready to go on any circuit to which it is adapted. In fact, Rossiter, MacGovern & Company are ready to equip complete plans for lighting or street railway work, and it would seem as though almost any want could be met from this complete and exhaustive catalogue covering every branch of the light and power industry.

NEW LEFFEL CATALOGUE.—The new catalogue of engines and boilers made by James Leffel & Company, of Springfield, Ohio, is a book that will interest many of our readers. It should interest any one who has to do with steam power. This book goes into the matter of the making of Leffel engines and boilers and shows on what their merit is based. It is well gotten up, printed on heavy enameled paper, has numerous full-page and many smaller illustrations, and is filled with just such detailed information about engines and boilers as to make it truly valuable to those using or contemplating using an engine or boiler. The book will be mailed free to prospective buyers of an engine or boiler, stating wants and addressing the company as above.

A FIREPROOF DREAMLAND.—The H. W. Johns-Manville Co., 100 William St., New York, is supplying the Dreamland Company, Coney Island, with several thousand squares of "Asbestoside" to be used for siding the buildings in "Dreamland," which will be the largest pleasure resort on Coney Island, and the summer attraction of several million people. "Asbestoside" was specified by the architects, Messrs. Kirby, Pettit & Green, of New York, and formally approved by the Building Department, which classified it as a "high grade, slow burning or fire retardent material." The distinctive features of "Asbestoside" are, that it is cut into sheets of 7 feet and crated; is easily applied being finished with large head galvanized nails which are covered with a half round wooden beading or moulding, and does not require painting of any description with the exception that the wooden strips may be tinted any desired color in contrast to the siding which is white. "Asbestoside" is superior to metal siding, along the sea coast, as it will not rust or decay and the first cost is cheaper, besides doing away with the annual coating.

THE STANDARD UNDERGROUND CABLE COMPANY, in conjunction with the McRoy Clay Works, has a joint exhibit in Section 3 immediately adjoining the northwest entrance of the Electricity Building, St. Louis. The exhibit shows a cross-section of an actual conduit consisting of 72 ducts, with a manhole at either end, one manhole being complete with a cover, the other being open. A trench 7 feet deep and 5 feet wide extends the entire length of this conduit, enabling close inspection of the method of laying conduits, including the wrapping, concrete base and top, and the general construction of the manholes, showing hangers, pipes to poles, etc. At one end in the manhole is shown a capstan rigged up for drawing in cables and connected to a cable which is mounted on a reel at the other manhole; the cable being drawn through the ducts and part of the ducts being split so as to show the method of fastening cables to rope, etc. From the manholes, cables go to distributing poles, showing the method of distribution to aerial cables for telephone, electric light and street railway work with various terminals used to protect the ends of the cable in such work. The McRoy Clay Works show piles of clay as it is dug from the ground and the various processes through which the material goes to produce the finished duct. The Standard Underground Cable Company shows samples in handsome cases of all the various cables and appliances made by it. An examination of this system will show, in very complete detail, the method of installing conduits and drawing cables into completed conduits.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 3, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

758,610. CONTROLLER FOR ELECTRIC MOTORS; Thomas E. Barnum, Milwaukee, Wis. App. filed Feb. 7, 1902. A number of switches connected in series and situated at a distance from the rheostat, for stopping and starting the motor independent of the rheostat.

758,621. HIGH TENSION CIRCUIT BREAKER; Harry P. Davis, Pittsburg, Pa. App. filed Sept. 13, 1902. A construction to prevent danger to neighboring objects from the arc and a means for indicating when the circuit breaker is automatically opened and another means for positively indicating at all times whether the breaker is open or closed.

758,623. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed May 11, 1904. (See page 913.)

758,631. COLLECTOR RINGS AND BRUSH HOLDERS; Karl F. Ehlers, Pittsburg, Pa. App. filed Sept. 26, 1903. The object is to provide brush-holder collecting rings for machines having a relatively large number of brushes which shall occupy the smallest amount of space.

758,635. DIRECT CURRENT GENERATOR; William H. Foot, Wilkinsburg, Pa. App. filed Sept. 16, 1903. Relates to the mounting of cross-connecting rings and their connections to the bars of the commutator.

758,638. LIGHTNING ARRESTER; Louis R. Gaw, Asbury Park, N. J. App. filed June 3, 1903. Details.

758,644. ELECTRIC ARC LAMP; Thomas Hamilton-Adams, London, England. App. filed Aug. 29, 1903. Two coils with tubular iron linings and connected in series are substituted for the usual solenoid, the said coils being wound in the same direction and placed one above the other some distance apart and mounted on a tube of non-magnetic material through which the upper electrode passes.

758,646. FUSE BLOCK; John A. Heany, York, Pa. App. filed Oct. 12, 1903. Details.

758,647. ELECTRIC SAFETY FUSE OR CUT-OUT; John A. Heany, York, Pa. App. filed Oct. 12, 1903. A non-conducting plug having an eccentric passage for the fuse with metal end caps having perforations corresponding in position to the bore of the tube, so that by twisting the caps, the fuse can be cut off at a definite length and then held in position by the cap.

758,648. ELECTRIC SAFETY FUSE OR CUT OUT; John A. Heany, York, Pa. App. filed Oct. 13, 1903. Special clamps adapted to engage the caps referred to in the preceding patent, to place them in circuit.

758,649. ELECTRIC SAFETY FUSE OR CUT OUT; John A. Heany, York, Pa. App. filed Oct. 14, 1903. A tube lined with a protective layer and having two metallic plugs arranged therein in which the fuse is centered.

758,650. ELECTRODE FOR VAPOR ELECTRIC APPARATUS; Peter Cooper Hewitt, New York, N. Y. App. filed Jan. 13, 1904. To prevent the spark where the current enters the negative electrode from wandering over its surface, a platinum point is projected from the surface of the mercury electrode, upon which the current enters.

758,655. MAGNETIC ORE SEPARATOR; William L. Imlay, Philadelphia, Pa. App. filed Oct. 2, 1899. Details.

758,669. BRUSH HOLDER FOR ELECTRICAL MACHINES; Benjamin G. Lamme, Pittsburg, Pa. App. filed Sept. 16, 1903. Details.

758,683. SYSTEM OF ELECTRICAL DISTRIBUTION; John S. Peck, Pittsburg, Pa. App. filed Aug. 8, 1903. A system for so distributing the self induction included in the alternating current side of systems of distribution employing rotary converters, that equal differences of potential may be obtained between slip rings belonging to the different phases.

758,684. MOISTURE PROOF CASE OR RECEPTACLE; John S. Peck, Pittsburg, and Albin L. Zwarnik, Braddock, Pa. App. filed Sept. 16, 1903. A corrugated metal casing with specially constructed joints for transformers.

758,692. STORAGE BATTERY; William J. Redmond, Cleveland, Ohio. App. filed Sept. 29, 1902. (See page 913.)

758,701. ELECTRIC BURGLAR AND FIRE ALARM; Solomon Schwarzschild, Rochester, N. Y. App. filed Feb. 24, 1902. A local circuit including an induction coil and vibrator is placed at the premises to be protected and is adapted to send a characteristic signal over a telephone circuit running to the premises.

758,703. APPARATUS FOR TELEPHONE LINES; Charles E. Scribner and James L. McQuarrie, Chicago, Ill. App. filed April 2, 1900. (See page 913.)

758,710. TITANOUS COMPOUND AND PROCESS OF MAKING SAME; Howard Spence, Manchester, Eng. App. filed Sept. 11, 1902. (See page 913.)

758,713. LEACHING APPARATUS; Geo. W. Stead, Philadelphia, Pa. App. filed July 26, 1902. The scrapers projecting into the pan have hinged lips that yield in one direction, but are stiff in the other, so that as the pan is reciprocated, the solid material is moved along the bottom of the pan step by step.

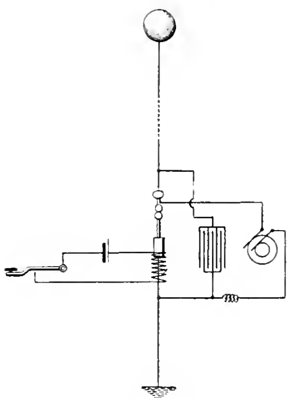
758,722. CONTROLLER REGULATOR; Vandiver J. Von Horn, Keokuk, Ia. App. filed Sept. 10, 1900. Details of a governing device which will enforce a gradual operation of the controller.

758,724. SIGNALING SYSTEM; Joseph Weatherby, Jr., New Cumberland, Pa. App. filed June 1, 1903. Details.

758,730. ELECTRIC LAMP; Alexander J. Wurts and Edward Bennett, Pittsburg, Pa. App. filed Jan. 10, 1901. The insulating frame upon which the parts of a glow lamp are mounted, is covered with a readily removable coat which receives the particles given off when the lamp is burning and by a timely removal of which short circuits may be prevented.

758,732. PRINTING TELEGRAPH; John C. Barclay, New York, N. Y. App. filed July 24, 1903. An arrangement of selecting relays and associated devices whereby the operation of a single relay in a single main line circuit controlling the selective action of the selecting relays, any one of a plurality of type-bars may be actuated at will.

758,650.—Electrode for Vapor Electric Apparatus.



758,842.—Wireless Telegraphy.

758,736. AUTOMATIC FIRE AND BURGLAR ALARM TELEGRAPH; Robert G. Callum, Washington, D. C. App. filed March 1, 1902. Details of construction of a transmitter.

758,775. APPARATUS FOR THE TREATMENT OF GASES; Harry Pauling, Gelsenkirchen, Germany. App. filed Nov. 20, 1903. Apparatus for the continuous treatment of gases by means of spark discharges in such a manner that every particle of the gas is brought into contact with the spark.

758,795. TELEPHONE RECEIVER; Ernest Hugo Strauss, Chicago, Ill. App. filed July 25, 1902. (See page 913.)

758,842. WIRELESS TELEGRAPHY; James F. King, Washington, D. C. App. filed Dec. 17, 1902. The improvement consists in creating a flaming arc in a normally closed generator circuit and simultaneously connecting around the arc a capacity in a vibratory circuit.

758,855. RAILWAY SIGNAL; Edward F. Ryman and Edward W. Stevenson, Wilkesbarre, Pa. App. filed Oct. 19, 1903. Details.

758,860. SELF PLAYING MUSICAL INSTRUMENT AND NOTE SHEET THEREFOR; Chas. A. Shaffer, Philadelphia, Pa. App. filed July 21, 1903. The several movements of the note sheet and the actuation of the notes are obtained by means of a metallic sheet having both surfaces covered with insulating material which is removed in spots where contact fingers are to close the circuit.

758,883. METHOD OF GENERATING GASEOUS MEDIUMS FROM AIR; James N. Alsop, Owensboro, Ky. App. filed May 29, 1903. (See page 913.)

758,884. APPARATUS FOR GENERATING GASEOUS MEDIUMS FROM AIR; James N. Alsop, Owensboro, Ky. App. filed May 29, 1903. (See page 913.)

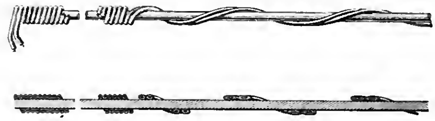
758,922. SIGNALING ON ELECTRIC TRACTION SYSTEMS; T. H. Jones, Portsmouth, England. App. filed July 7, 1902. Details.

758,938. AUTOMATIC MAGNETO CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed July 31, 1903. Improvements in the tripping mechanism.

758,946. ELECTROHEATER; Edwin R. Waterman, San Francisco, Cal. App. filed July 13, 1903. A liquid heater consisting of a number of concentric interspaced cylinders each containing electric heating devices.

758,954. AUTOMATIC CUT OFF IN TIME OF STORM; Frank P. Bell, Fairfield, Washington. App. filed April 24, 1903. Details.

758,977. GUARD COVERING FOR THIRD RAILS OF ELECTRIC RAILWAYS; John Kress, New Rochelle, N. Y. App. filed Dec. 30, 1903. A housing for the third rail in which the roof is divided into two laterally sliding parts, which are moved aside by the plow as it progresses and afterwards automatically closed.



759,120.—Electric Inductive Conductor.

758,986. TUBULAR INSULATOR; Fred M. Locke, Victor, N. Y. App. filed Nov. 11, 1901. A plurality of shelves one arranged within the other and having a double conical shape around the center of which the line wire is secured.

759,004. ALTERNATING CURRENT MOTOR; Burton McCollum, Lawrence, Kan. App. filed April 4, 1903. Means for producing in the field of the motor, a special component of magnetism in phase with the main component in space, but differing therefrom in time, preferably by 90°.

759,007. STORAGE BATTERY; Job Thomas Niblett, Greenwich, Eng. App. filed Feb. 5, 1903. (See page 913.)

759,026. ELECTRIC CLOCK; Herbert Scott, Bradford, and Alfred Loebl, London, England. App. filed June 10, 1903. A ratchet wheel and the oscillating means are obliquely arranged to each other, the driving pawl for the ratchet wheel being carried by the oscillating means with the parts so arranged that the power applied by the pawl to the wheel is in a substantially direct line with the movement of the actuated tooth.

759,047. ELECTRIC SIGNAL SYSTEM; George L. Vannais, Hartford, Conn. App. filed June 20, 1903. Details.

759,058. STORAGE BATTERY; Vincent G. Apple, Dayton, Ohio. App. filed June 5, 1901. (See page 913.)

759,060. ELECTRIC RAILWAY SWITCH-POINT AND OPERATING MEANS THEREFOR; Arthur J. Backer, Spracuse, N. Y. App. filed July 8, 1903. The magnet which throws the switch tongue is located in a chamber inside of the tongue itself.

759,062. DEVICE FOR DISTRIBUTING NOXIOUS FUMES; Lyman M. Beckes, Vincennes, Ind. App. filed June 26, 1903. The closure of an electric circuit by a burglar will release noxious fumes intended to overcome him.

759,065. METHOD OF ACCUMULATING AND USING ELECTRICAL ENERGY; Anson Gardner Betts, Troy, N. Y. App. filed Aug. 17, 1903. (See page 913.)

759,066. ELECTRIC STORAGE BATTERY; Anson Gardner Betts, Troy, N. Y. App. filed Aug. 17, 1903. (See page 913.)

759,094. TELEPHONE TRANSMITTER; James I. Gemmill, Cleveland, Ohio. App. filed Aug. 28, 1901. (See page 913.)

759,095. TELEPHONE RECEIVER; James I. Gemmill, Cleveland, Ohio. App. filed Dec. 22, 1902. (See page 913.)

759,096. FRICTIONAL ELECTRIC GENERATOR; Garabet Germakian, Paterson, N. J. App. filed Aug. 22, 1903. The generation of static electricity is aided by providing a heating device other than that due to friction, the heat of which is applied to the plate.

759,098. SAFETY DEVICE FOR ELECTRIC RAILWAYS; George Gibbs, New York, N. Y. App. filed Dec. 24, 1903. The invention is concerned with providing means for cutting off the current in classes of accidents where the working conductor is not interfered with, or in an emergency at the will of an authorized person.

759,119. ELECTRICAL CONDUCTOR; Percy A. McGeorge, West Hoboken, N. J. App. filed Sept. 10, 1902. Two conductors are placed in parallelism with a magnetic strip arranged between them, but electrically insulated, the object being to provide a magnetic as well as an electric conductor.

759,120. ELECTRIC INDUCTIVE CONDUCTOR; Percy A. McGeorge, West Hoboken, N. J. App. filed March 17, 1904. A modification of the preceding invention in which the magnetic conductor is spirally wound by the two electric conductors.

759,121. POLE CHANGER; Roger M. Newbold, Birmingham, Ala. App. filed Aug. 19, 1903. Details.

759,122. ELECTRIC DYNAMO; Roger M. Newbold, Birmingham, Ala. App. filed Nov. 3, 1903. A casing especially adapted to axle-driven railway car dynamos, permitting ready access to the parts.

759,148. ELECTRIC ATTACHMENT FOR ROCKING CHAIRS; Gaines M. Allen and Samuel M. Cawker, Denver, Colo. App. filed Nov. 3, 1903. The movements of the chair are utilized to generate a small current to electrify metal plates placed at various points on the chair, so that a person occupying the chair will receive the current.

759,150. MOTOR STARTER; William Baxter, Jr., Jersey City, N. J. App. filed Feb. 9, 1904. A motor starter provided with a main switch and a rheostat switch, both of which are controlled independently by a magnet that is energized by two coils, one being connected in series with the armature, and the other in shunt relation thereto.

759,166. POWER TRANSMITTER; George M. Eames, Bridgeport, Conn. App. filed Sept. 25, 1903. A device for driving sewing machines comprising a power transmitter which can be operated independently of the motor to stop and start the machine while the motor is continuously in operation.

759,210. SUPPORT FOR FIELD WINDINGS; Bernard A. Behrend, Norwood, Ohio. App. filed Dec. 7, 1903. The winding is supported upon the core by a supporting frame that sustains it interiorly and exteriorly.

759,216. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed March 14, 1903. The receiving apparatus comprises a syntonic and non-syntonic receiving system, each containing a wave-responsive device; also an indicating device connected with both wave-responsive devices and oppositely effected thereby.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, MAY 21, 1904. No. 21.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

Remittances for foreign subscriptions may be made through our European office.

In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, MAY 21, 1904.

CONTENTS.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

All the signs indicate that the convention of the National Electric Light Association in Boston next week will be one of the largest and most important ever held by that body. The engagement of rooms in advance—far exceeding any precedent—shows that the attendance will be very good, while the programme, which we present on another page, is evidence that there will be an abundance of live material for discussion. We give also a little sketch, which, we believe, will be of interest in a retrospective way, of the last convention held by the Association in Boston seventeen years ago. The programme then was indeed meagre as compared with the imposing list of papers, subjects and authors submitted by President Edgar for the coming week. But the same continuing spirit and policy have run through the history of the Association, and its evolution has been marked by steady good work. A few years ago it looked as though the Association had outlived its earlier usefulness, or at least had fallen upon days of restricted opportunity; but it is now easily to be seen by everybody that the responsibilities and duties of the Association to the electric light and power industry are larger than they ever were, and are being met in a manner to command respect and to ensure its growth.

MEETING OF THE INSTITUTE.

During the current week the American Institute of Electrical Engineers has held its annual meeting in New York City. The statement of the directors as to the affairs of the Institute is a highly creditable one, and to all who take interest in the Institute and in the advance of the profession, it must be encouraging to note that with the present month the membership has reached the remarkable figure of 3,000 with an immediately prospective total of 3,300. This rate of growth, of 800 or 900 new members a year, speaks volumes for the expansion of the profession and its allied arts, and shows that the Institute, on thoroughly equal terms, can hold its own with the other great national engineering societies, among which it is the latest comer. The financial affairs of the Institute are also in excellent condition in spite of heavy expenses assumed during the past year or two, while it is also a splendid proof of public spirit to find that the building fund for the Institute's share in the Union Engineering Building project has already been lifted over $60,000 by the contribution of members. The officers who have been elected to the Council are in themselves a pledge that the good work will go on. The new President, Mr. John W. Lieb, is representative of the highest type of electrical engineer and of all the noblest aims and aspirations of the Institute. He is a hard worker and a man of affairs and of culture, and one whose occupancy of the chair coincides happily with the year of the Congress and the visit of so many electrical friends from abroad.

NEW RESOURCES OF ILLUMINATION.

Whatever may be their final outcome, it is interesting to note that in our present issue, three of the newer electrical illuminants are treated under aspects which warrant a very hopeful feeling in regard to them as permanent and valuable additions to the resources of the electric lighting art. In fact, the details given with regard to the adoption of the Nernst lamp for the art galleries at the St. Louis Exposition; and concerning the successful employment of mercury vapor lamps in the largest automobile garage in the country, indicate that both of these forms of lamp are finding quickly spheres of utility and fitting into them. We must all welcome heartily such additions to the means belonging to the art, especially as the whole work and utility of illumination is thereby enlarged. As a general thing we have of late been slower or more timid than European engineers in taking up and fostering these new developments, so that even to-day some varieties of illuminants are in use across the Atlantic which have virtually never been seen here. Even if they are no good, our famous American curiosity and inquisitiveness ought at least to have brought them forward, so that judgment could be formed in regard to them from actual observation.

The third novelty, if we may so describe it, though it has less present actuality than the other two lamps to which our pages draw special attention, is the magnetite lamp. Mr. Charles P. Steinmetz describes this in a characteristic article, which we know will be read with great eagerness. Rumors and reports in regard to this new illuminant have been in circulation for some time past, and Mr. Steinmetz now to some extent gratifies the general desire for information of the subject, supplementing his text with some illustrations of the lamp and its arc. It is to be hoped that the new lamp will be on view in Boston next week, and if so, it will certainly constitute one of the leading novelties of the convention.

The Electrical Hub.

From the standpoint of the central station man the electrical situation in Boston is a most instructive one in many respects. If one were to pick out the features which seem most important to the engineer, the two most conspicuous would be the respective policies of the Boston Edison Company and the Boston Elevated Railway Company in the building up of their distribution systems. The former is an admirable evidence of the progressive instincts of the talented engineer who is the head of the system. The problem which he had to solve was the welding into a coherent whole not only of two diverse urban systems of distribution, but of a group of suburban stations of most heterogeneous character. The task with all its inherent difficulties has been accomplished in a most workmanlike fashion. From the great alternating central station energy is being transmitted more than thirty miles to suburban customers, while the direct-current urban service has been preserved in its integrity, and the improvement in service all over the territory served has been very marked. It is a remarkable example of deft adaptation in a rather trying combination of conditions. The other is the very striking and successful policy of segregated stations of the Elevated Company. The feeding of so great a network from a skillfully planned group of allied stations stands alone in American central station working. In almost every instance this condition has been met elsewhere by generation of power at a single central station and distribution at high tension to sub-stations. We should much like to see a disclosure on the matter of cost of power as between the Boston system and those operated with converter substations. From what data is available on the subject, we are inclined to the opinion that the Boston stations would not come out second best. The sub-stations certainly produce power within a very small percentage of the figure reached by the large new station, and the latter will compare favorably with the best figures reached elsewhere.

Measurement of the Insulation Resistance of an Electric Wiring System.

There is very little trouble in measuring the insulation of an electric plant or wiring system when the plant has been shut down. The system is then an inert network of conductors. But when the plant is at work, or in popular language "alive," the measurement is neither so easy nor so convenient. The difference brings to mind the relative degrees of convenience in measuring the span of an eagle's wings dead and alive. The article of Mr. E. F. Northrup on page 966 relates to the methods of insulation measurement in a working system. These methods are not entirely new, but they are well presented and are set in very practical form. Two methods are described. In the first the source of testing e.m.f. is the generator or set of generators working in the system. A reading of potential to ground from each side of the system through a voltmeter of known resistance, together with the magnitude of the working voltage, suffices to determine the apparent insulation of the system on each side. In the second method, which is better adapted to relatively high insulations, a separate testing e.m.f. is used independently of the working e.m.f. in the system, and the testing e.m.f. is applied to the system at a point such that no appreciable disturbance is effected. The latter method is capable of being employed with a three-wire system, or with a system of any number of wires; but the former method requires some modification to meet the requirements of a working three-wire system.

The Protection of Telephone or Telegraph Lines When in Hazardous Proximity to High Tension Lines.

The article on this subject, by Mr. R. E. Chetwood, Jr., appearing on page 968 of this issue, is of much interest as representing the most modern practice of the Bell Telephone system. The engineering department of that company has faced the problem under consideration for a number of years, and has had a very wide experience in the nature and conditions of the hazards to which overhead telephone wires are exposed by crossing the route of high-pressure wires. The importance of adequate protection from high-tension crosses is manifest after a moment's consideration. If a high-tension line carrying power electrically at a pressure of many kilovolts crosses the route of a telephone pole line, the high-pressure wires must cross either above or below. It is desirable that they should cross above the telephone lines, because the high-pressure wires, being usually much the stouter, are less likely to break accidentally. Nevertheless, there is always the remote possibility of an insulator breaking on one of the poles of the cross-over, thereby bringing much electric pressure on the cross arm, which might burn off and let the high-pressure wire fall upon the telephone wires below. If, on the other hand, the telephone wires cross above, their number may be considerable, say, 30 or 40, and at some time one of these wires may break in the cross-over span, thereby falling on the high-pressure wires below.

In either case the contact between high-pressure wire and telephone wire may be fraught with disastrous consequences. The best result that can be looked for is the rupture of the small telephone wire, at or near the point of contact, whereby the high-pressure connection immediately ceases. If the telephone wires does not break, the high pressure of the transmission wire is led into the telephone central station at one end, and into the telephone subscriber's premises at the other. In each of these places it is the unvarying custom to install protective devices, which are designed either to open or ground the circuit, and to remove the pressure from the terminal apparatus. There is, however, always the remote possibility of something going wrong at a protective device, whereby it may fail to operate. In such a case the high pressure on the telephone line might destroy apparatus at either end, and, under particular conditions, might initiate a fire. It is physically possible for a cross between a telegraph or telephone line and a high-tension line to initiate a fire in a building a hundred miles away from the cross, the high-pressure being capable of carrying a dangerously strong current to similar distances.

Moreover, every year sees more wires strung across the country, more telephone and telegraph wires, and more high-pressure transmission wires. This is only another way of saying that civilization and material wealth are advancing. Nevertheless, there is no cause for undue apprehension merely because the network of line crossings is increasing in complexity. We all know that the staunchest steamer ever built may founder if she collides in midocean with another vessel. The chance for collision undoubtedly increases with the number of ships along the course, and more ships are sent to sea from year to year. The greater the speed of a vessel, other things being equal, the greater the chance of a collision, yet although ocean speeds are increasing, we do not hesitate to embark on a voyage to Europe whenever opportunity smiles upon occasion. The correct course, therefore, is neither to ignore the dangers of high-tension crosses on the one hand, nor to take unreasonable alarm on the other; but to provide against accidents by engineering methods. Since engineering brings about the danger, engineering is able to minimize it. Every step taken from barbarism towards civilization entails some penalty of danger. Tall buildings may totter and fall in an earthquake. Railway trains may be wrecked. Illuminating gas supply may give rise to explosions in buildings. Yet none of these things cause us dismay. We face them confidently with engineering methods.

Mr. Chetwood's article sets forth methods of cross-over construction which are designed to reduce the possibility of accidental crosses to a minimum. The preferred construction is a short cross-over span, with the high-pressure wires above, on double insulators, but not dead-ended. The insulators have steel pins which are grounded. If this plan is impracticable, the telephone wires go over on a short span. Where short spans cannot be used, guard wire spans are introduced. The interesting feature of the high-tension guard wires is that when grounded they must be capable of carrying three times the normal high-tension line current. The real difficulty in many cases is to make an effective ground. The method described is probably the most satisfactory known under the conditions of practical line construction. It consists in employing a galvanized-iron rope and burying a coil of half a dozen turns, not less than eighteen inches in diameter, at the depth of permanently moist earth, in three bushels of fine coke. The general features of the cross-over construction described seem to be well worthy of imitation, which in such cases is known to be the sincerest form of flattery.

Electric Fire Risks.

The last quarterly report from the electrical bureau of the National Board of Fire Underwriters is just at hand, and like its predecessors it contains much that is instructive. The good old times when every fire of unknown origin was charged up to electric circuits have gone by, but the habit of years is hard to break, and we are not surprised to see the report of 181 fires "supposed to be due to electricity." To do the board credit, these fires are not included in its report as electrical, but the average fire chief or inspector greatly dislikes having to report a fire as of unknown origin and evidently soothes his soul by accusing the almost omnipresent electric wire. Fifty other fires charged to electricity proved to be due to quite prosaic causes like overheated stoves, matches and cigar stubs. However, the accredited list shows 135 fires definitely traced to electrical causes; and while this is not a large number considering the almost universal presence of electrical circuits in American cities, it is great enough to bear considerable reduction. From the standpoint of the electrician it is gratifying to note the comparatively small proportion of the total fires due to actual bad construction on the part of the electric light circuits. By far the largest proportion of the fires were caused by the hopeless and irremediable foolishness on the part of the users of electric current. A smaller but still conspicuous proportion was caused by crossing of telegraph or telephone wires with electric light wires. We would much like to know what number of these, if any, came from the fault of the latter. It almost seems as if bad construction were at a premium on these slightly constructed circuits, for their wires seem to break and fall upon the heavier wires beneath on the smallest provocation.

But the plain everyday fool seems to have been the active agency in most of the cases adduced. We should have supposed, for instance, that at this date people of the most ordinary intelligence would have awakened to the fact that incandescent lamps if placed in a confined space in contact with inflamable material are unsafe. But each report brings the same old tale of woe. Even the incandescent lamp as a foot warmer on cold nights comes to the front with each succeeding winter, and each holiday season brings back the fine old sure-fire combination of lamp-bulb and cotton waste. One would suppose, too, that people would have learned to be careful about driving nails through electrical conduits, mixing up electric wires and gas pipes, replacing fuses by copper wire, and all that sort of thing, but they seem to go on in the same old way. Misused flexible cords seem to be responsible for frequent difficulties. But there are still left, after eliminating the fool, a moderate proportion of fires due to bad or stupid house wiring. The old open link cut-out scores quite too frequently. In these days it surely should be replaced by something better, or at least placed where it can do no harm. Even relatively poor material can do good service if it is used discreetly, while the very best can be made dangerous by misuse. When one couples poor material and bad judgment, the combination is invincible. We often wish that the Board of Fire Underwriters would use its power less in general recommendations than in seeing that specific ones are honestly carried out. The modern American frame house is more or less of a fire trap at best, and when built on speculation by an avaricious and unscrupulous contractor, it becomes a menace to public safety.

Every insurance inspector can enumerate a long list of atrocious violations of all rules of decent construction by thievish wiring contractors, and denounces them with hearty indignation in which we earnestly join. There is in these days absolutely no excuse for dangerously bad interior wiring such as is continually being discovered, often, alas, too late. The Board of Fire Underwriters can do more to prevent this than any other power, and in a campaign for good work it will have the cordial support of the electrical public at large, and the support, too, of every honest electrical contractor. For the honest man who insists on doing only good and thorough work is continually robbed of business by the chap who scamps his materials and leaves his work half done. We have personally seen scores of houses being wired in a way that simply courts danger from fire, both as regards material and method of installation. Some of the jobs met the letter of the law; none of them would have passed an honest inspector with any discretionary powers. The bad work of last year and the year before insures fire risks this year and next, and we would like to see opened a campaign of education and rigid inspection for the enforcement of safe installation. The stake is a large one; even though electrical fires have been greatly reduced in number of late years the aggregate annual loss to the insurance companies from this cause would pay for the services of a tremendous force of competent inspectors. Each contractor rigorously brought to book is less dangerous for the future, and by the same token the public is safer. We think the board has erred in the past in trying to do too much in general and too little in detail; in making sometimes hypercritical distinctions in its approved materials of construction, and paying too little attention to the manner of their use in concrete cases. It is quite possible to do a "cheap and nasty" job of wiring with approved material and still follow the letter of the code, and the fellow who does this generally is able to work off poor material to boot.

Programme of the National Electric Light Convention.

The following is the detailed programme of the proceedings of the National Electric Light Association meeting to be held at the Hotel Vendome, Boston, next week. It will be the twenty-seventh convention:

Tuesday, May 24, First Session, 10 o'clock A.M., Convention Hall, Hotel Vendome.—President's address, Mr. Charles L. Edgar, Boston; report of Committee on Progress, Editor Mr. T. Commerford Martin, New York; "A Three-Wire, 500-Volt Lighting System," Walter I. Barnes, Providence; "Luminous or Flaming Arc," Mr. Welles E. Holmes, Newton; Committee on Standard Candle-Power Incandescent Lamps, Dr. Louis Bell, Boston, chairman; Committee on Legislative Policy, Mr. Samuel Insull, Chicago, chairman; Committee on Photometric Values of Arc Lamps, Mr. Henry L. Doherty, Denver, chairman; Committee on Uniform Accounting, Mr. Guy L. Tripp, Boston, chairman.

Tuesday, Second Session, 2 o'clock P.M.—"A One-Hundred-Mile Transmission Line," Mr. Robert Howes, Spokane, Wash.; "Grounding the Neutral of High-Voltage Generators," Mr. George H. Eastman, Chicago; "Remote Control of Electrical Apparatus," Mr. William H. Cole, Newton; "The Organization and Equipment of an Arc Lamp Department," Samuel G. Rhodes, New York; "Electric Heating," Mr. James I. Ayer, Cambridge; report: Lost and Unaccounted-for Current, Mr. C. W. Humphrey, Denver.

Wednesday, May 25, Third Session, 10 o'clock A.M.—"Economy in Minor Station Supplies," Mr. Edgar B. Greene, Altoona, Pa.; "Notes on the Internal Combustion Engine as Applied to Central Station Service," Mr. E. E. Arnold, Pittsburg, Pa.; "Economy Test of a 5,500-hp Three-Cylinder, Compound Engine and Generator.," Messrs. J. D. Andrew and W. F. Wells, New York; "The Mechanical Stoker and Human Operator," Mr. Edwin Yawger, Pittsburg; Committee on Award of Doherty Gold Medal, Dr. Schuyler S. Wheeler, Ampere, N. J., chairman; report: Investigation of Steam Turbines, Mr. W. C. L. Eglin, Philadelphia, chairman; "Practical Notes on Steam Turbine," Mr. Francis Hodgkinson, Pittsburg, Pa.

Thursday, May 26, Fourth Session, 10 o'clock A.M.—"Electric Light and Power Plants in Connection with Ice Plants," C. L. Wakefield, Dallas, Tex.; report on Sign and Decorative Lighting, Arthur Williams, New York; report on Advertising, La Rue Vredenburgh, Boston; report on Purchased Electric Power in Factories, W. H. Atkins, Boston, chairman; report of Committee on District Heating, E. F. McCabe, Lewistown, Pa., chairman; report on Office Methods and Accounting, Frank W. Frueauff, Denver.

Thursday, Fifth Session, 2 o'clock P.M.—"A Proposed System of Standard Instruments for Operating Companies," H. P. Davis, Pittsburg, Pa.; "Single-Phase Power Motors for Electric Lighting Stations," W. A. Layman; report on Analysis of Flue Gases, Henry L. Doherty, Denver, chairman; "Wrinkles," Editor Charles H. Williams, Madison, Wis.; "Question Box," Editor H. T. Hartman, Philadelphia, Pa.

Thursday, Sixth Session, 8 o'clock P.M.—"Types of Large Water Power Installations," with stereopticon, Dr. F. A. C. Perrine, Pittsfield. Executive Session.

An excellent programme of trips and entertainments has been provided, note of which has already been made and which will be carefully arranged in detail. The chairman of this committee is Mr. J. I. Ayer, and the members are: Prof. C. A. Adams, Albert Anderson, William H. Atkins, F. E. Barker, F. P. Barnes, R. N. C. Barnes, George H. Berg, H. Bottomley, Capt. William Brophy, F. E. Cabot, C. W. Cartwright, A. E. Childs, A. T. Clark, Prof. H. E. Clifford, S. B. Condit, Jr., Charles B. Davis, R. B. Edes, George C. Ewing, H. H. Fairbanks, H. C. Farnsworth, George H. Finn, Almon Foster, W. C. Fish, H. A. Hale, Charles J. Hatch, Percy Hodges, W. E. Holmes, C. W. Holtzer, Sydney Hosmer, P. J. Kennedy, A. H. Kimball, George B. Lauder, F. W. Lord, Emil O. Lundin, Norman Marshall, E. H. Mather, Everett Morss, H. W. Moses, W. L. Mulligan, J. H. Parker, H. S. Potter, C. B. Price, C. F. Prichard, Andrew Raeburn, F. H. Raymond, F. S. Richardson, Frank Ridlon, D. P. Robinson, F. P. Royce, G. L. Sadler, F. S. V. Sias, F. E. Smith, Prof. H. B. Smith, J. A. Smith, J. Brodie Smith, George B. Stetson, F. J. Stone, G. M. Stuart, La Rue Vredenburgh, Thomas C. Wales, R. L. Warner, N. T. Wilcox, S. B. Wetherbee, F. S. Wilson, Paul Winsor, W. C. Woodward.

The Executive Committee of the Association will hold a meeting on Monday evening. The members are: Louis A. Ferguson, Harry Bottomley, Alex. Dow, A. C. Dunham, J. H. Perkins, C. F. Hewitt, D. P. Robinson, P. G. Gossler, H. T. Hartman. The officers of the Association are: C. L. Edgar, president; S. B. Livermore, first vice-president; J. W. Lieb, Jr., second vice-president; E. H. Davis, secretary and treasurer; Harriet Billings, assistant secretary; George F. Porter, master of transportation. The usual fare and a third applies on all trips to the convention. The Southwestern Excursion Bureau has granted a rate of a fare and one-third on the certificate plan from all points in its territory to Boston and return to delegates and friends attending the twenty-seventh convention. This is the first time the concession has been made in this territory, and is additional evidence of the geographical as well as numerical growth in membershhip. The reduced rate has now been granted by all the passenger associations, and if the applications already received for rooms at the Boston hotels are any indication, the rate will be very generally taken advantage of.

Tesla on the Patent Office.

The New York *Sun* of Wednesday contained a letter from Mr. Nikola Tesla in which, referring apparently to recent publications concerning difficulties between Edison and the Patent Office, he takes up the cudgels for the office and is particularly complimentary in references to its technical staff. In a long personal experience he said he has found the examiners to be far more satisfactory than he had thought possible, and many times he has noted with astonishment the thorough grasp of ideas, the keenness of the criticisms and the exhaustiveness of the search for anticipations, while invariably he has obtained valuable information through the references cited and the suggestions made. He considers any criticism capable of creating a doubt in the minds of people as to the faithful performance of duties and competency of its staff must be deemed unfortunate, since such doubt may destroy confidence in the value of patent property. Mr. Tesla advocates more liberal appropriations and more suitable quarters for the Patent Office, and refers to the fact that owing to low salaries difficulty is found in retaining the services of competent men.

While examiners, he says, can never keep quite abreast with inventors, they are men well educated and trained, recruited from colleges, and to obtain appointment have to pass a severe examination covering the several branches of applied and cognate sciences. Serious dissatisfaction then is not likely to arise from the examiners' insufficient knowledge or lack of comprehension, nor is it apt to come from an inherent defect of adopted procedures, although some of these might be omitted to advantage. For example, the suggestion of claims by the examiner in a case of conflicting applications is, in my opinion, always in favor of the inventor possessed of better knowledge and stronger imagination. The introduction of greater rigidity in the withdrawal and amendment of specifications might also be helpful. But, after all, what difference does it make how the original documents are modified? The successive changes are all recorded and can be examined at any time. If new matter is injected in an amended application it will not be permitted to remain, and, ultimately, the testimony in the interference will bring out the exact facts which will settle the question of priority. The advantages which might be secured by such or similar changes would be slight. Of late years the demand on certain departments has been increasing so fast that more expeditious methods had to be adopted; and this has naturally detracted from the quality of the work. The remedy for this is a liberal appropriation.

Mr. Tesla considers that one of the greatest problems confronting the world is to devise methods and means for protecting intellectual property. "As we develop, this need asserts itself more and more. The ultimate aim should be to arrive at laws and regulations at least as precise as those which define the ownership of tangible things. A new principle is still to be discovered which will make this possible. Perhaps in the distant future photographic records of the retina of the eye may furnish a foundation for a new and more perfect system of protection and just valuation of the creations of the mind. As far as I am able to understand the working of the human mechanism, such records offer the only chance of doing away with the present imperfect ideas of possession and use of crude equivalents. But let us bear in mind that for the time being the United States Patent Office is the farthest advance toward that ultimate aim. Taking this broader view of the institution we shall better appreciate its immense influence on the welfare and morals of the country."

Fig. 1.—View of Boston Edison Station from the Harbor.

Expansion of the Boston Edison System.

SIXTY thousand kilowatts is to be the ultimate generator capacity of a steam turbine station that is being constructed by the Edison Electric Illuminating Company in Boston. The site of this new station is a plot of land 810 ft. by 1,300 ft., bounded on three of its sides by L Street and East First Street, South Boston, and by the Harbor Commissioners' line. A portion of this plot, perhaps one-third, is now under tide water, and is occupied in part by the coal wharf and the docks of the company. On the dry portion of this area, and not far from its center, is the old Fourth or L Street generating station of the Edison Company, which was built by the Boston Electric Light Company in 1898, and passed to the Edison Company with the purchase of the entire Boston electric system in 1901. An elaborate 26-page article on the then existing Boston system, by Mr. E. S. Mansfield appeared in Electrical World and Engineer in May of that year.

The new turbine station adjoins the generator room of the original plant, fronts Boston Harbor at a distance of about 128 ft. from the water line at the present bulkhead, and is designed to extend back, ultimately to the East First Street line of the property. In plan the new station is, with small exceptions, at its front end, a rectangle of about 252 ft. parallel with East First Street, and about 638 ft. parallel with L, and with the longer side of the old plant.

The ground area represented by these figures is that of the proposed station when fully completed, but at present only the front or harbor end of the station is being built. The length of this portion parallel with L Street is about 230 ft. in its largest part. On the ground where parts of the propsed station will set there are now located several old buildings that will in the future be removed. In general elevation the new station has one high story, but this is varied by a basement under the boiler room, and by dividing the switch house into three low stories with a basement underneath. In general structure the new station is built entirely of concrete, brick, stone, tile and steel from foundation to roof. The main walls of the station, both exterior and interior, are of brick, and the exterior walls, especially on the harbor front, have heavy stone trimmings that give a decidedly ornamental effect. At the harbor end of the turbine room, which juts out a little beyond the boiler room, there is a great arched window whose keystone bears a figure of Mercury, and just above this figure comes the word Edison beneath the letters MCMIII. At either side of this window is a great metal globe in which an arc lamp will be mounted.

As to its interior the new station is divided into the boiler house, the turbine house and the switch house by heavy brick walls that run parallel with the greater dimension of the building. The boiler house thus formed will have interior floor dimensions of about 146 by 630 ft. In the steam turbine house the width is about 65 ft. and the length 642 ft. The front or harbor end of the section of the station called the switch house is devoted to offices, and back of these offices the space on each floor available for switching purposes measures approximately 28 by 562 ft. This switch house adjoins the generator room of the original L Street station on one side and the new turbine room on the other, and communicates by doors with both.

In the design of the new station the controlling idea has been the division of all apparatus into isolated groups in order to reduce as much as possible the damage and delay that might result from any disaster. The unit of division selected for this grouping is the combined steam turbine and electric generator, and the apparatus connected to this unit is distinct, starting with its boilers and ending with its switches. More than this the elements of each group of switching apparatus are separated, the terminals of the generator cables being located in the basement of the switch house, the bus-bar compartments on the floor above, the high-voltage oil switches on the second floor and the controlling switches on the third floor.

The turbine house when completed is designed to contain twelve generating units each rated at 5,000 kw. These turbo-generators will be arranged in a single row from end to end of the turbine house, so that the center of each is about 11 ft. from the wall that separates the turbine house from the boiler house. In line with each turbine unit, but located on the other side of the wall just mentioned, is the row of eight boilers that supply it with steam, each of which has a nominal rating of 500 hp, or 4,000 hp for the group. Each row of eight boilers is set in four batteries and runs across the smaller floor dimension of the boiler house, so that when completely equipped this house will contain twelve parallel rows of boilers. Each group of eight boilers supplies steam to only a single turbine and its pumps. The rows of boilers are arranged in six pairs, the two rows of each pair being back to back with a chimney between them for their common use.

This chimney sets midway between the ends of the two rows of boilers, and has two flue openings in its opposite sides. The eight boilers forming the opposite halves of each pair of rows at one end connect with their chimney through a common flue, and the eight boilers that form the opposite halves at the other ends of the same rows connect with the other side of the chimney through another common flue. Tile arches between steel beams form the floor of the boiler room, and this floor is supported by the brick walls and by steel columns that rise from the basement foundations to the steel beams that carry the roof. These steel columns are so spaced that each boiler sets between and is supported by two of them at both its back and front ends. In this way six of the steel columns carry each battery of two boilers. Beneath the entire boiler room there is a basement whose concrete floor is just on a level with that of the turbine room, but is 18 ft. below the floor of the boiler room.

Down into this basement beneath each boiler projects a brick, concrete and steel ash chamber, which receives the ashes as they fall from the grate above. The bottom of each ash chamber, which is about 8½ ft. above the basement floor, opens by mechanical means so that the ashes may drop by their own weight into either a cart or conveyor underneath. In the basement beneath the rear part of each row of boilers there is a space where the steam and water mains for the boilers of that row are located. The steam pipe from each of the eight boilers in any one row drops at once to this steam main, and this main passes directly through the brick wall that separates the turbine and boiler houses, and to the particular turbine that is in line with this row of boilers.

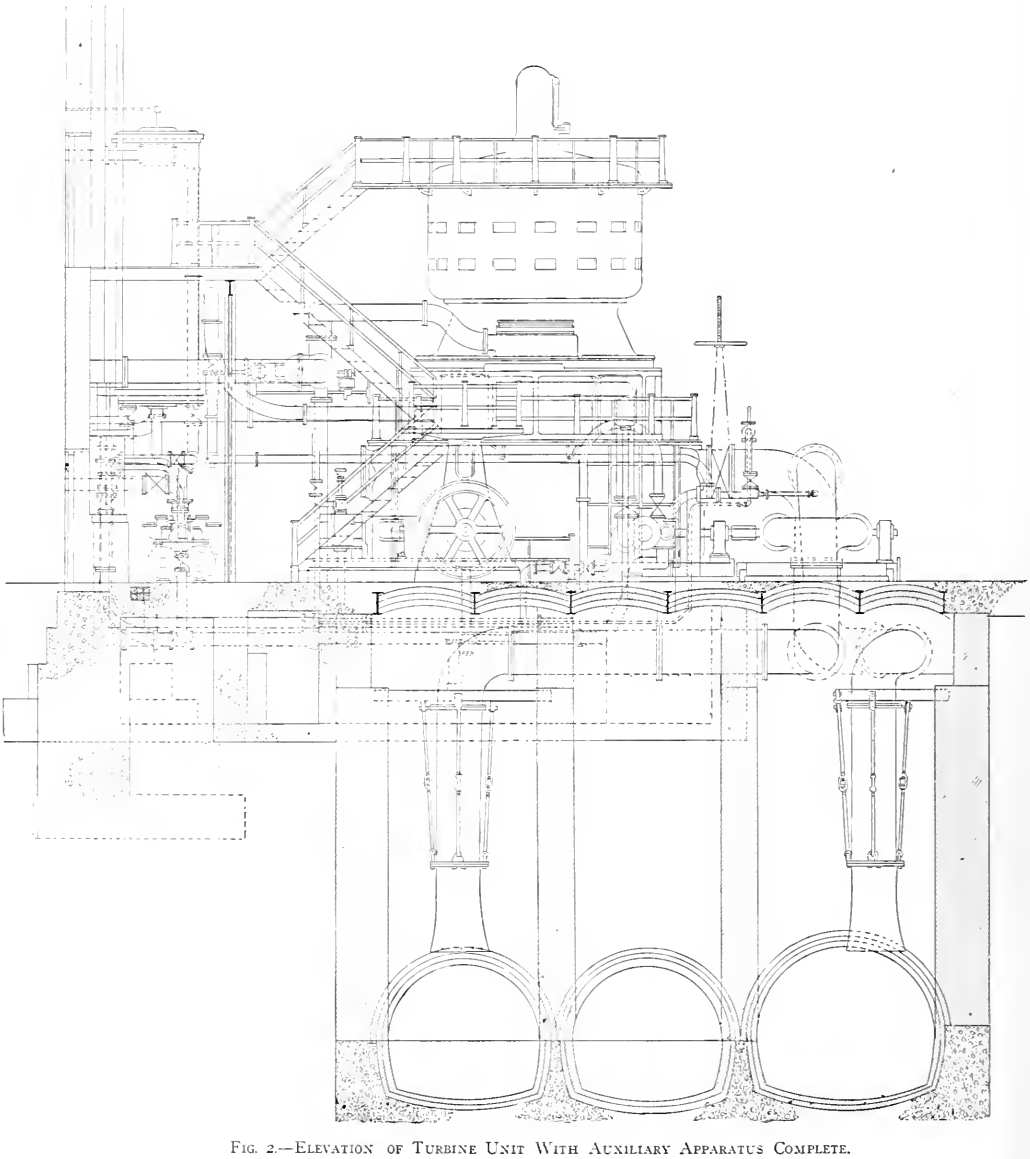


FIG. 2.—ELEVATION OF TURBINE UNIT WITH AUXILIARY APPARATUS COMPLETE.

Above the front side of each row of boilers and extending in part above the roof of the boiler house there is a coal conveyor and bunker of steel, tile and concrete construction, supported on the steel roof beams. The top of this coal bunker is 79 ft. 5 in. above mean low tide water. From this bunker the coal feeds by gravity down to the mechanical stokers in front of the boilers. At the harbor front of the boiler room light is supplied through a row of large windows in the wall, and beneath each large window there are two small windows and also a door leading onto an iron balcony to enable firemen to get readily to the outside air. Windows and large doors admit air to the basement, and all the air for the boiler furnaces enters in this way and passes up to the fires through openings in the sides of the ash pits. In the long outside wall of the boiler house parallel with L Street there is a large window and there are also two small windows and a door opening onto an iron balcony opposite each aisle between the fronts of rows of boilers. On the roof above each of these aisles there is a monitor skylight.

The concrete floor of the turbine house on a level with that of the boiler house basement, and 16 ft. above mean low tide water, rests on the concrete foundations of the station and has no basement under it. The entire turbine house when completed will be divided by cross brick walls into three rooms of nearly equal length, and each of these rooms will contain four of the turbine units. In each of the brick walls between turbine rooms there will be a great window like that at the outside end on the harbor front, and the end on East First Street will also contain a similar window. Besides these windows there will be a skylight along nearly the entire length of the roof. In the brick walls of the turbine room on its longer sides there are steel columns that run up from the basement foundations and support crane beams and also the steel roof trusses. The lower chords of these trusses are 56.5 ft. above the floor of the turbine room.

Beneath the floor of the turbine room are three sluiceways that carry sea water for condensing to and from the turbine units. Two of these sluice ways are equal in size and each of these carries the cold sea water to six turbines. The third sluiceway is larger and carries the heated water from the entire row of twelve turbines back to the harbor. Each of the sluiceways is of horseshoe shape, and the discharge sluice is 10 ft. wide and 9 ft. 3 in. high. In width each of the smaller sluices is 8 ft. 3 in., and in height 7 ft. 9 in. All three sluices have the same bottom level and the top level of each of the suction sluices is 21 ft. 9 in. below the floor of the turbine

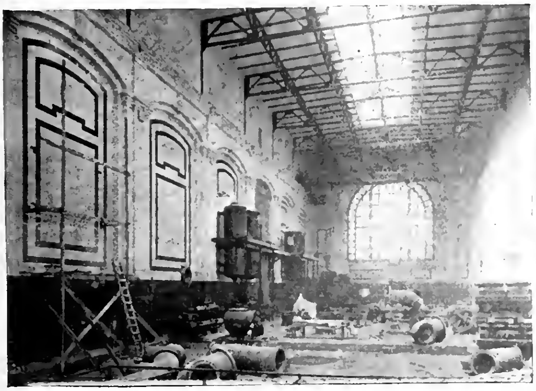


FIG. 3.—INTERIOR OF NEW PORTION, BOSTON EDISON PLANT.

room and 3 ft. 9 in. below the water level at mean low tide in the harbor. Directly in front of the turbine house and about 108 ft. therefrom are the gates for the suction sluices and beyond these but just inside of the face of the bulkhead is the large entrance chamber where the two suction sluices terminate. A channel has been dredged from the mouth of this chamber out into deep water, and over its mouth a screen is located to keep floating objects out of the suction sluices. The discharge sluice goes clear to the face of the bulkhead and a deflecting wall gives the hot discharged water a direction away from the entrance chamber.

Near each turbine unit there are grouped a centrifugal pump with direct-connected engine to handle the condensing water, a wet vacuum pump direct-connected to its driving engine, a steam-driven boiler feed pump, a steam-driven oil feed pump for the step bearing of the turbine, an accumulator to store oil under pressure for the turbine bearing, a separator between the condenser and the dry air pump to prevent the passage of water to the latter and a feed water heater and a hot well for the storage of water arranged side by side on the wall. Feed water for the boilers is drawn from the city mains and this water after condensation is used over and over, so that the loss is very small. Much of the piping between the various pieces of apparatus just named is carried in conduits beneath the concrete floor of the turbine room. Other conduits beneath this floor receive the electric cables from the turbines, and these cables then pass to the basement of the switch house where the floor is 2 ft. 3 in. below that of the turbine. After emerging from the cable terminals in this basement the high-voltage cables run to motor-operated oil switches on the second floor of the

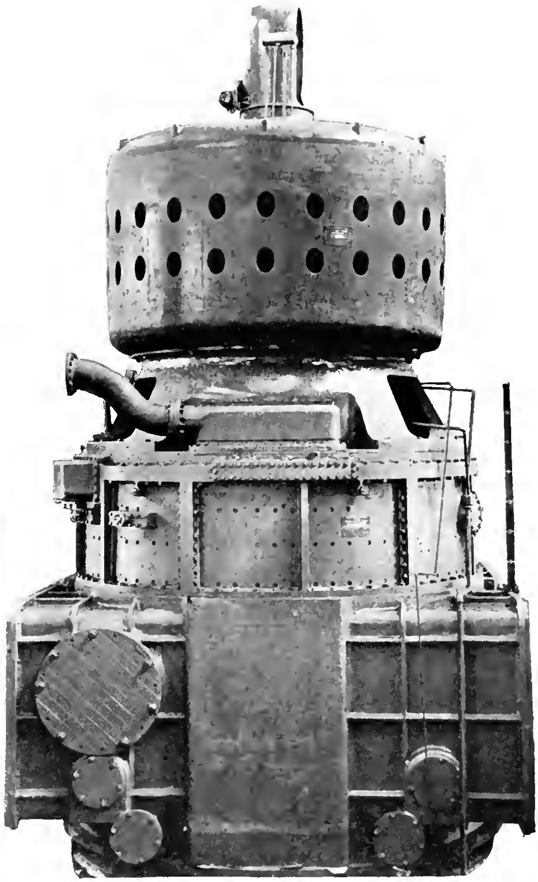


FIG. 4.—FOUR-STAGE CURTIS 5000 KW TURBINE FOR BOSTON PLANT.

switch house, and these switches complete the connections with the four sets of bus-bars on the first floor. On this first floor there are also located the knife switches for opening lines that are not in use, the lightning arresters and the instrument transformers.

The operating room of the switch house is on the third floor and here are located control switches for the oil switches below that make connections between the bus-bars and the generators and the outgoing cables. On this floor there are also control switches for the transformers that raise the voltage of the current from the generators in the old station, and also exciter panels for all of the generators in both the old station and the turbine station. The Corey signal system for both stations is also on this floor. As already pointed out, the switch house lies between the generator room of the old station and the turbine room of the new. From the operating room of the switch house one may pass through a door on one side to the switchboard gallery of the old station, or through a door on the opposite side to an observation gallery that projects out into the new turbine room.

In that part of the old station on the opposite side from the switch house is the coal pocket, and directly in line with this pocket is the coal wharf of the company which extends out into the dock a distance of about 368 ft. On this wharf there are now two coal derricks and a third is to be added. One of the present derricks has a one-ton bucket and works on only one side; the other derrick has a 1½-ton bucket and works on either side. The third derrick will have an equal capacity with the second. Running almost the entire length of the coal wharf and into the coal pocket there is a Robins 36-in. belt conveyor with a maximum capacity of 700 tons of coal per hour. A Hunt conveyor in the coal pocket distributes the coal. At the front end of this pocket there is a crusher that reduces the run-of-mine coal to 4-in. cubes.

Before entering the crusher the coal passes over a sort of screen or grating that allows the finer parts to fall through. Adjoining the coal pocket side of the old station and approximately 288 ft. by 516 ft. in area there is an open air yard for the storage of coal. The storage of coal on this large scale is thought to be desirable to avoid any possible shortage and because the cost per ton of the transportation of coal by water to Boston is the best part of a dollar higher in winter than in summer. In order to distribute coal over this large open storage area, belts numbered 2 and 4 are located across the end of No. 1 belt, that runs along the wharf as already mentioned, and No. 3 belt that is located in the open yard parallel with No. 1. The belts of conveyors Nos. 2, 3 and 4, like No. 1, are each 36 in. wide. After the coal has been dumped in a narrow pile extending the length of the yard under belt No. 3, it must be moved and piled in other parts of the yard, and for this purpose a Brown traveling bridge is employed.

This bridge is a steel truss 248 ft. long mounted on steel towers that move on tracks which extend the entire length of the yard. One of these tracks has a single and the other has two rails, and the distance of these tracks between centers is about 156 ft. One of its supporting towers is under that end of the bridge which is the more distant from the coal pocket in the old station, and the other end of the bridge overhangs the No. 3 belt conveyor that runs nearly the length of the yard. Beneath the bridge there is a motor-driven carriage that carries an attendant and also a 2-ton coal bucket. This carriage travels the entire length of the bridge, and this motion, together with that of the entire bridge up and down the yard, enables coal to be picked up at any point therein and dropped either on the belt conveyor or at any other point in the yard.

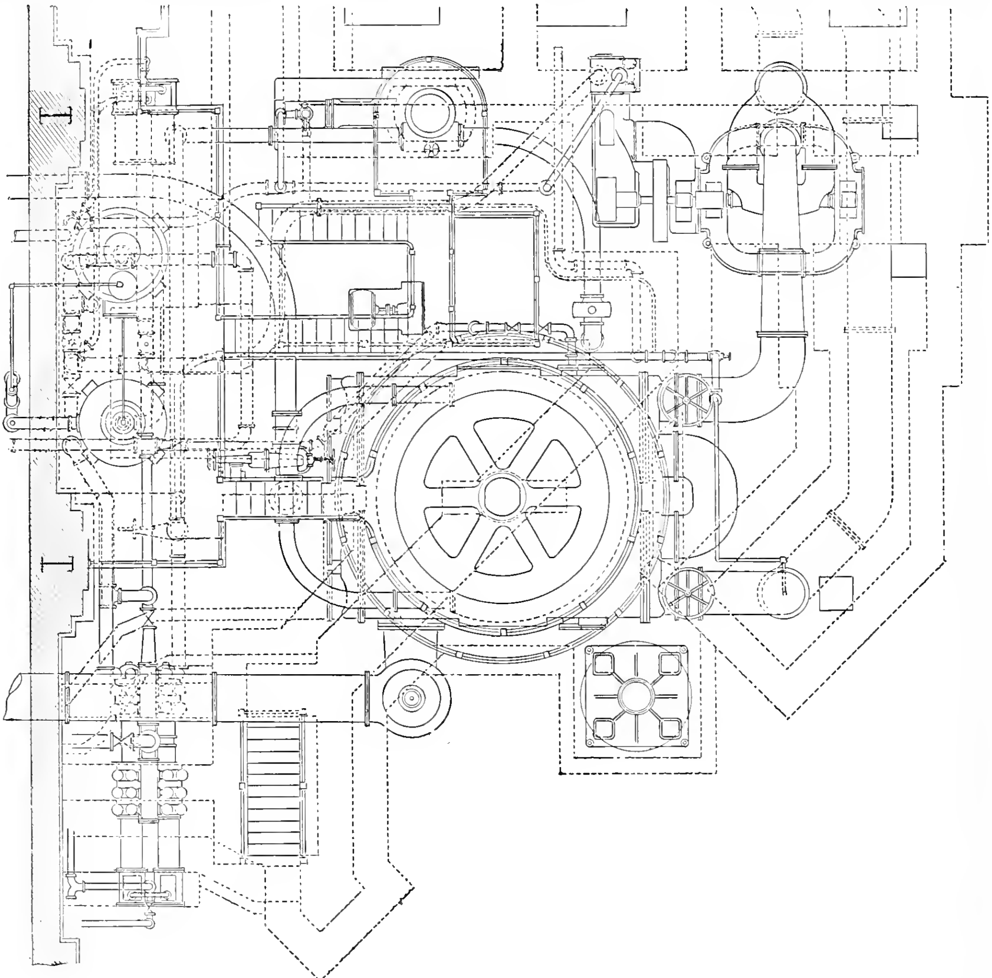


FIG. 5.—PLAN VIEW OF TURBINE UNIT AND AUXILIARY APPARATUS.

From the coal pocket at the side of the old station a belt conveyor is intended to run over the roofs of the turbine and boiler houses for each row of eight boilers that supplies a single turbine unit. Each of the conveyors for this purpose has a belt 20 in. wide, and there will be twelve such conveyors when the proposed turbine station is completed. In front of and above each row of eight boilers the coal bunker into which the conveyor belt empties has a capacity of 44 tons of coal, good for 1½ days' operation at full capacity. From the bunkers this coal passes to Roney stokers with 110 sq. ft. of grate surface per 500-hp boiler. These stokers are driven by induction motors.

All the boilers are of the Babcock & Wilcox water tube type, and each has 152 tubes arranged 14 tubes wide and 18 high. Each tube is 4 in. in outside diameter and 18 ft. long. The tubes of each boiler connect with two 42-in. diameter steam and water drums and the superheater coils occupy a space between the tubes and the under sides of these drums. The tubes and the lower halves of the steam and water drums in each boiler give 5,120 sq. ft. of heating surface, or a little more than 10 sq. ft. of surface per horse-power at a nominal rating of 500 hp per boiler. The hot well for each row of eight boilers is normally nearly empty, and is connected by an automatic valve with the city mains.

The feed water heater for each row of boilers contains 1,600 sq. ft. of coil, is of the National type, and is mounted beside the hot well on the wall of the turbine room near each turbine. Each heater is expected to add 118° to the temperature of the boiler water when it has all of the steam that it can utilize. It is not quite certain at what temperature the water of condensation from the turbines will reach the feed water heaters, but the expectation is that the water will be returned to the boilers with a temperature somewhere between 170° and 200° F. The normal pressure of boiler steam is to be 175 pounds with 150° of superheat. As already pointed out, the circulating pump for condensing water, the boiler feed pumps, the dry vacuum pumps and the oil pumps are all steam-driven, feed water from the 17 by 12 by 15-in. duplex back plunger pump that sits near the turbine. In the dry air pump the 10 by 18-in. steam cylinder is horizontal and the 24 by 18-in. air cylinder is vertical, as this arrangement permits the use of a small fly-wheel. Steam entering this pump is controlled by a throttling governor. To keep water out of this pump, a 10-in. separator is connected between it and the condenser. For handling the condensing water the centrifugal pump at each turbine is of the Worthington volute type, 24-in. size, and is driven by a direct-connected Fleming Harrisburg side crank engine with 15 by 15-in. cylinder, at 200 r.p.m. This engine has a throttling governor.

The circuit of the condensing water through its pump and the condenser forms a syphon, so that the pump is only obliged to give the water a velocity head and to overcome the friction. Though the floor of the turbine room is 16 ft. above mean low tide water, it is estimated that the maximum lift of the pump that handles the condensing water will be less than 10 ft. Each turbine may draw its condensing water from either of the two suction sluices above considered, and this makes it possible to discontinue the use of either of these sluices for the purpose of cleaning or any other reason. The Worthington volute wet vacuum pump is driven by a direct-connected 10-hp motor of the induction type.

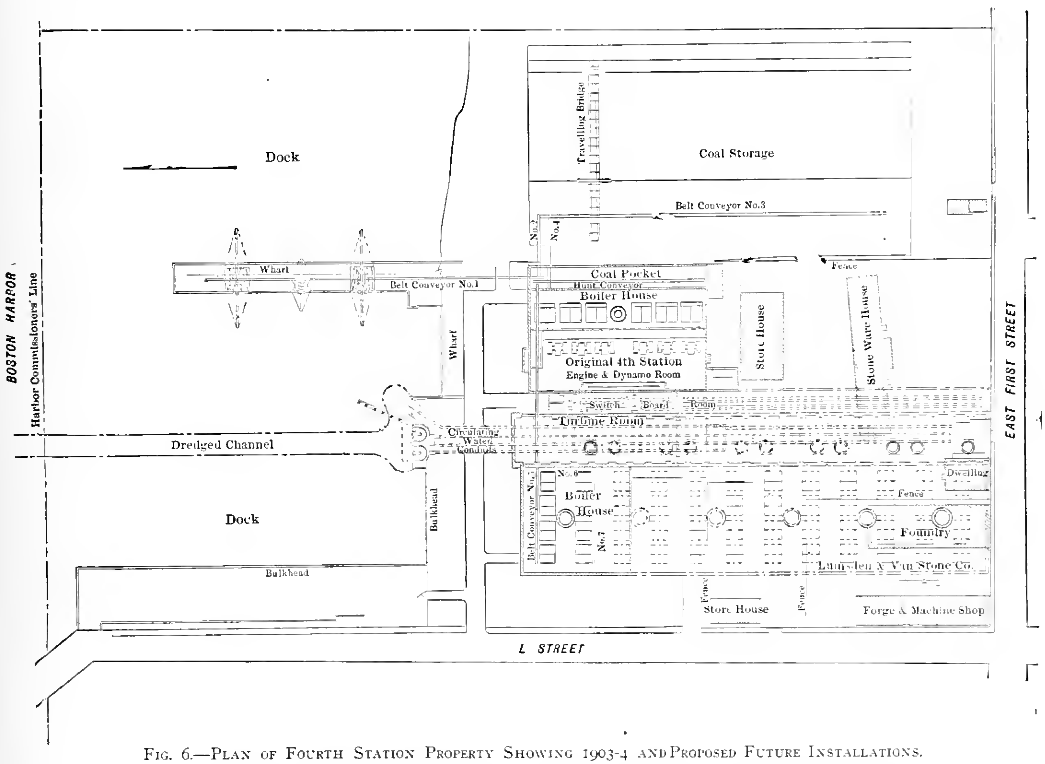


FIG. 6.—PLAN OF FOURTH STATION PROPERTY SHOWING 1903-4 AND PROPOSED FUTURE INSTALLATIONS.

and steam instead of electric drive is used for these pumps because there is not as much exhaust steam available as could be used in the feed water heaters.

No economizers are to be used in this plant, but the gases of combustion from each end group of eight boilers go directly to their chimney through a short iron flue of 8 by 20 ft. cross-section. Each chimney thus receives the gases from 16 boilers through two flues of this size on opposite sides. The number of chimneys for the completed station is thus six, there being one chimney for every two turbine units. Gases from boilers of 8,000 hp nominal rating thus pass to each chimney, which is round in plan with a height of 250 ft. above the foundation, and interior diameters of 18 ft. at the bottom and 16 ft. at the top. These chimneys are constructed by the Alphons Custodis Chimney Construction Company.

The eight boilers that supply steam to each turbine receive their

The steam-driven oil pump that supplies oil for the step bearing of each turbine has cylinders 10 by 2½ by 10 in., and can maintain an oil pressure of 11,000 pounds per sq. in. The oil cylinder of this pump connects with an accumulator that has a 12-in. ram with a 10-ft., 3-in. stroke, and stores 60 gallons of oil, enough to run the step bearing for 10 minutes after the pump stops. At the turbine step the oil pressure is 800 pounds per sq. in.

Each of the 5,000-kw turbo-electric units is of the vertical type, General Electric make, has a weight of 260 tons and stands 29.5 ft. high above the floor. A system of iron stairway and platforms gives ready access to all sides of the turbine. The electric generator of the turbine weighs 82 tons, and the armature alone 42 tons. It has 14 poles and operates at 514 r.p.m., so that the current developed has 60 cycles per second. The Y-connected armature yields 6,900 volts, three-phase. The outside diameter of the generator is 12 ft.

3 in. For maximum exciting current in the magnet coils the required power is 28 kw. or 0.56 of one per cent. of the rated armature output. The exciting current for the turbine generators is supplied at 125 volts, and for the present will be drawn from dynamos in the old station by way of the operating room in the switch house. In each turbine room the great Niles crane that sweeps over all of the equipment is entirely motor-driven and has a lifting capacity of fifty tons.

From each turbine generator the 6,900-volt, three-phase current passes to a pair of 800-amp., 15,000-volt oil switches on the second floor of the switch house, and through these switches to double sets

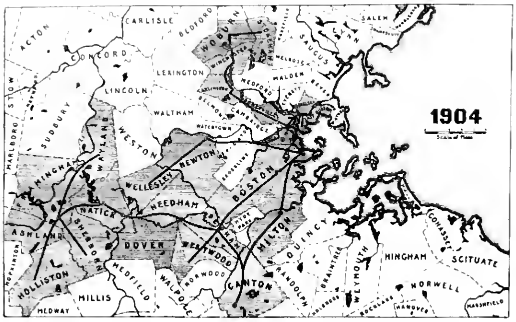


FIG. 7.—MAP OF BOSTON EDISON LIGHTING AREA, 1904.

of three-conductor bus-bars in brick and stone compartments on the floor below. On these bus-bars each connection between a cable and its bar is contained in a separate compartment. Some of the transmission lines to the distant towns supplied by the Edison system are connected to these 6,900-volt bus-bars through 15,000-volt, 300-amp. oil switches. For some of the other transmission lines a voltage of 4,600 is desired, and double sets of three-phase bus-bars of this voltage are, accordingly, mounted in compartments like those for the 6,900-volt bars. In order to obtain the 4,600-volt current and also the 6,900-volt current while the turbine plant has been under construction, transformers have been resorted to. These transformers draw their energy from the main generators in the old L Street station, which operate at 2,300 volts, 60 cycles, three-phase. Space for the transformers in question has been provided by a building at the rear of the old station.

This building is a one-story structure of brick, steel and concrete, with the transformers in the main room and air chambers underneath. In this building there are at present six air-blast transformers of the General Electric make. Each of three of these transformers is rated at 900 kw and has a ratio of three to one between primary and secondary windings, so that with 2,300-volt current from the old generators at the L Street station, a current of 6,900 volts can be delivered to the bus-bars in the switch house. The other group of three transformers have a capacity of 500 kw each, and change the current from 2,300 to 7,960-2,650 volts, from which the pressure of 4,600 volts for the bus-bars can be obtained by suitable connections. Two blowers each driven by a 5-hp, 6-amp., 550-volt induction motor are used to maintain the air pressure in the chamber under the transformers.

The 900-kw transformers are connected to the high-voltage bus-bars through 15,000-volt, 500-amp. oil switches, and the 500-kw transformers are so connected through 15,000-volt, 300-amp. oil switches. To connect the primary windings of the 900-kw transformers with the 2,300-volt bus-bars of the old generators, two 1,200-amp., 2,300-volt oil switches are employed. From the 4,600 and 6,900-volt bus-bars at the L Street station energy is transmitted to the various sub-stations of the Edison system.

Though the design of the new station at L Street contemplates its ultimate extension, so as to include a generating capacity of 60,000 kw, the present structure is of much smaller capacity. The turbine room now nearing completion covers one-third of the area for which the entire turbine house is designed, and provides room for four of the 5,000-kw turbine units. Present plans, however, call for the installation of only two of these turbine generators. Following the present equipment of the turbine room the boiler house has been constructed so as to allow the erection of two rows of boilers, sixteen in all, connected with a single chimney.

These equipments give the new turbine plant a generating capacity of 10,000 kw, and a little more than double the capacity of the L Street station. At this point it is interesting to note the rise in generating capacity of the Boston Edison system. The first station of this system was a rented building located between Bumstead Court and Head Place, and contained at the start a Babcock & Wilcox boiler rated at 200 hp, one 90-hp Armington & Sims engine and two Edison dynamos, type H, of about 400 16-cp lamp capacity each. On the basis of 4 watts per candle-power the kilowatt rating of each of these dynamos would have been 25.6 and 51.2 kw for the pair. This station was first started on February 20, 1886. The equipment at this station was soon increased by the addition of other boilers, similar engines and four type H and two type S Edison dynamos, so that it had a capacity of 2,400 16-cp lamps, or 153.6 kw on the 4 watts per candle-power basis in the H dynamos before the end of

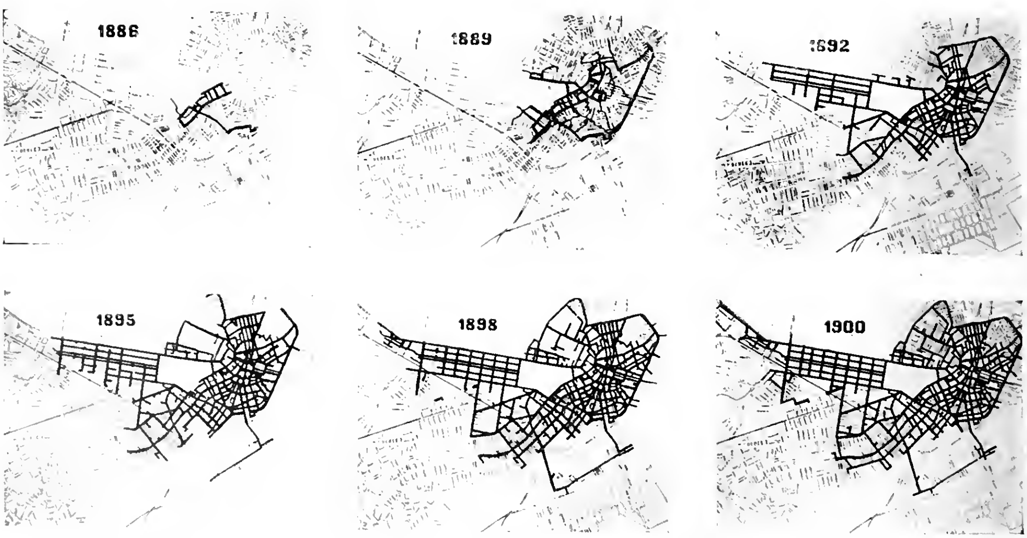


FIG. 8.—MAPS SHOWING GROWTH OF BOSTON EDISON LIGHTING AREA AND CIRCUITS.

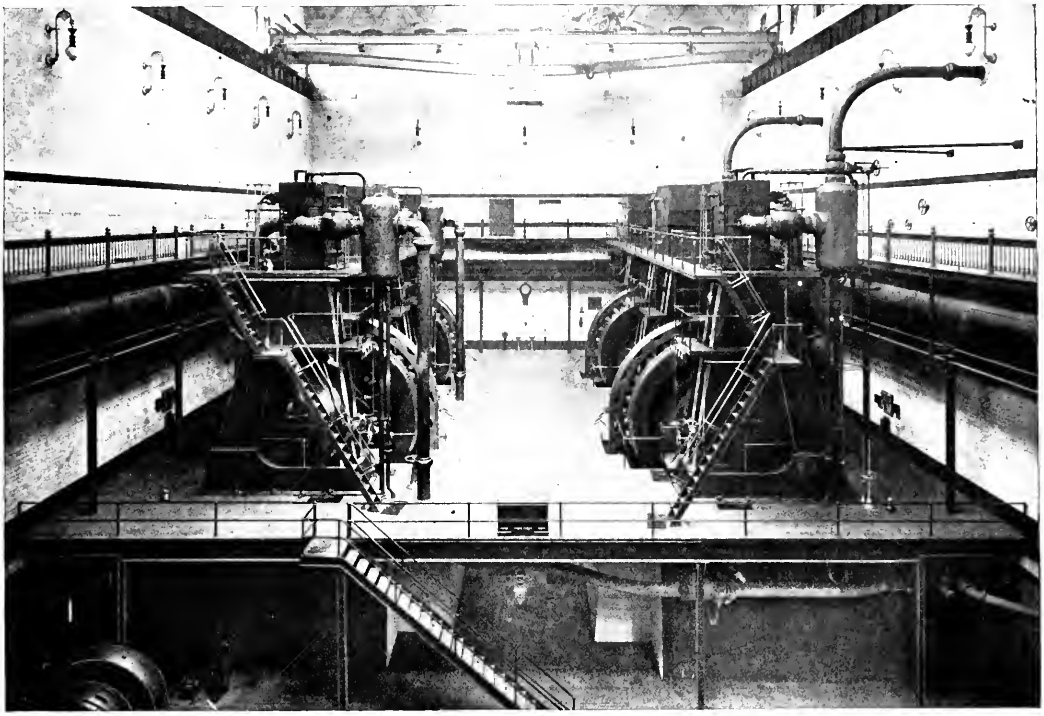


Fig. 9.—New Engine Room, Third Station, Boston Edison System.

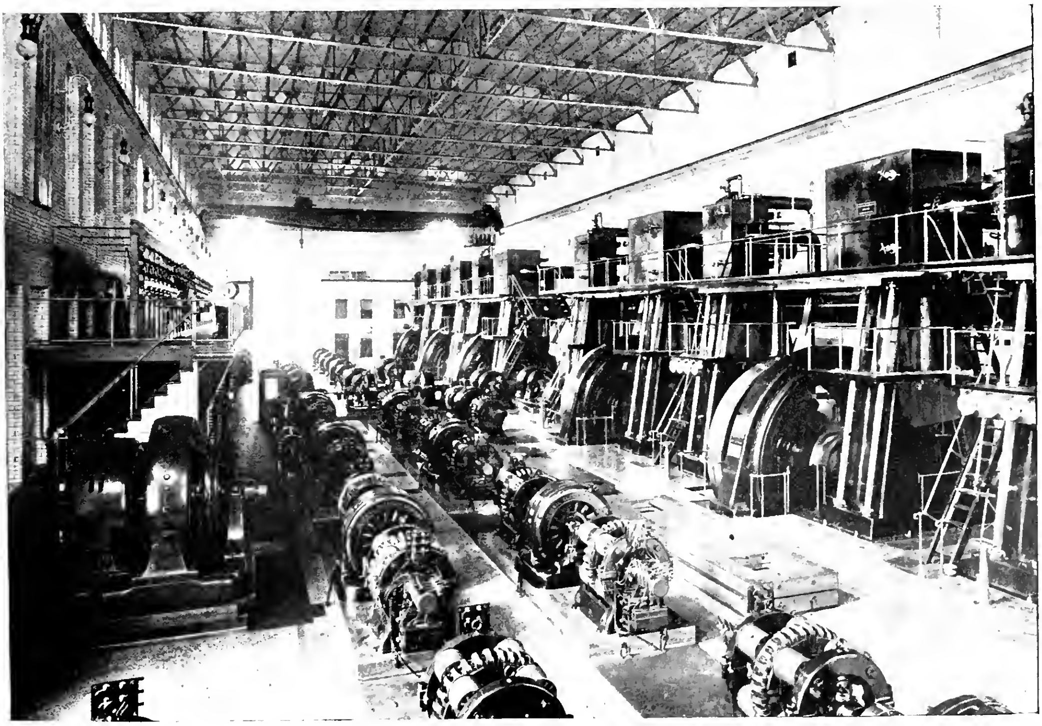


Fig. 10.—Engine Room, L Street Station, Boston Edison System.

FIG. 11.—CONVEYOR BRIDGE.

FIG. 14.—COAL CONVEYOR.

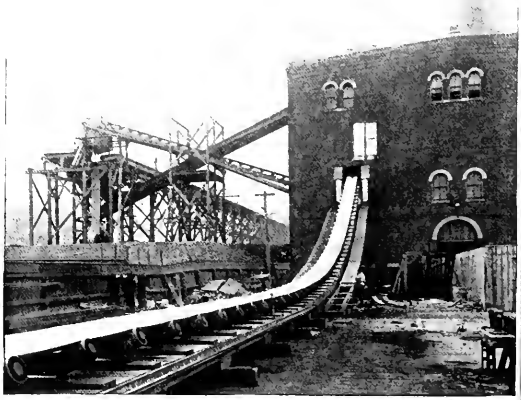


FIG. 12.—GENERAL VIEW OF COAL CONVEYOR.

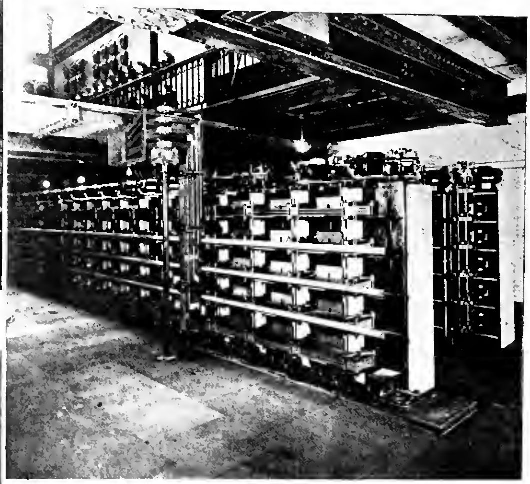


FIG. 15.—BUS-BARS, THIRD STATION.

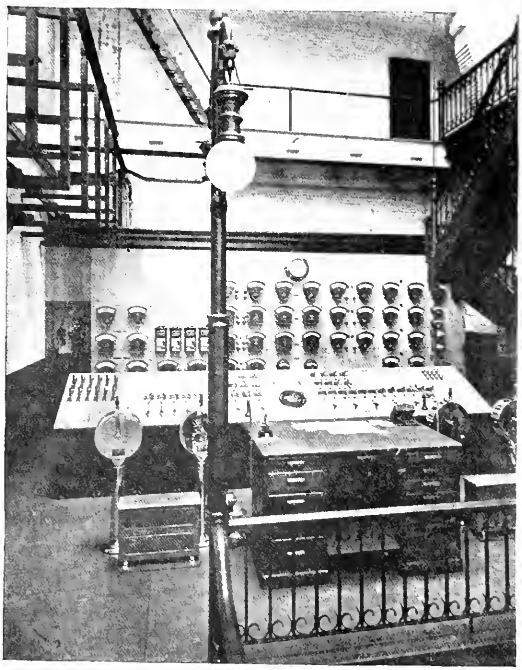


FIG. 13.—OPERATING BOARD, THIRD STATION.

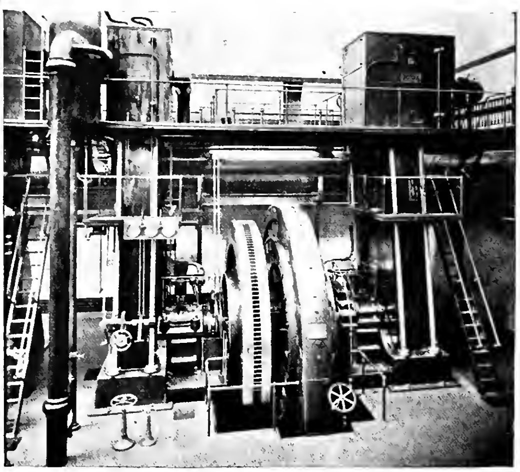


FIG. 16.—ONE OF THE LATEST GENERATORS AT THE THIRD STATION.

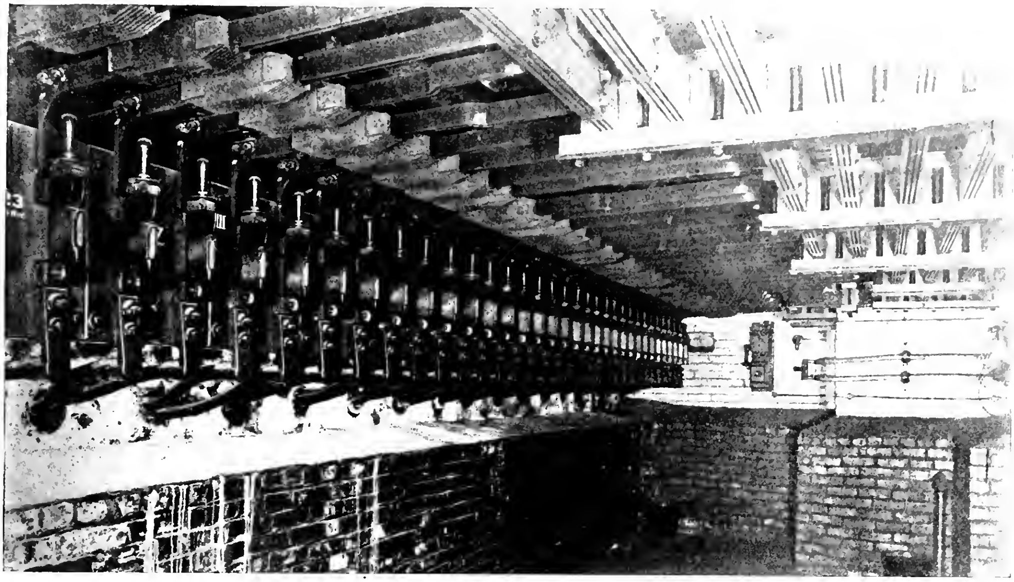


Fig. 17.—Cables Entering Third Station.

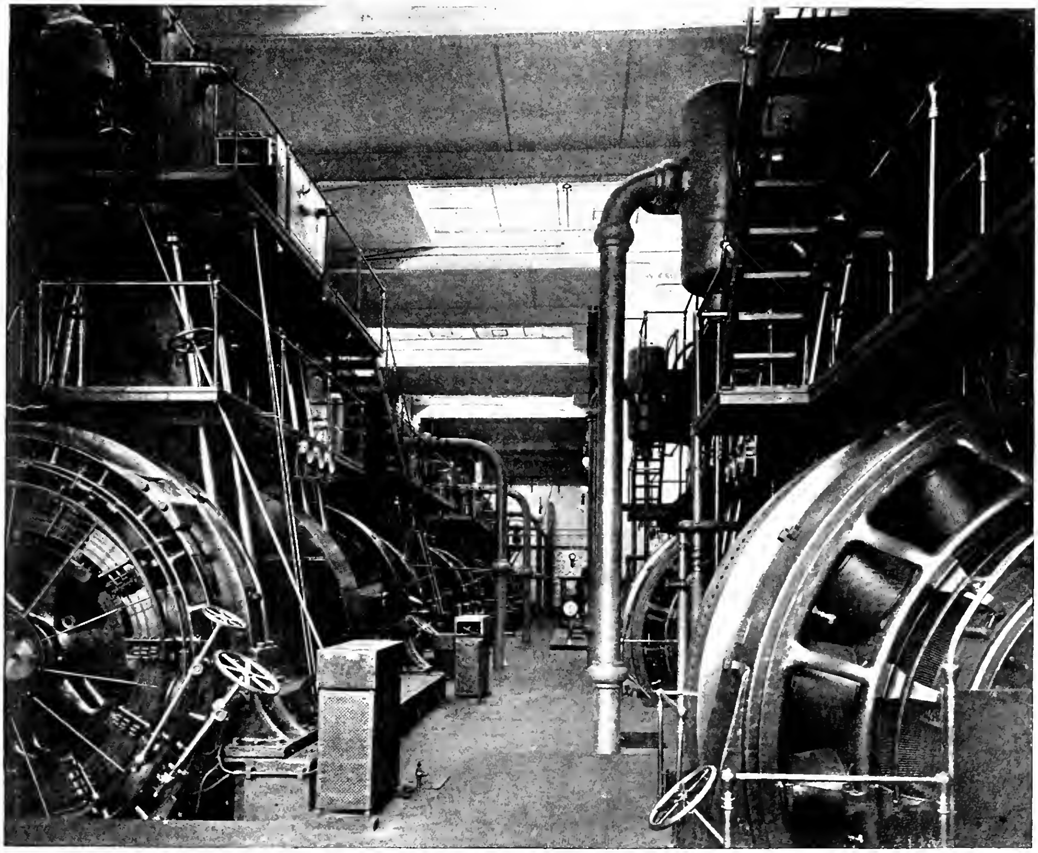


Fig. 18.—View in the Old Engine Room, Boston Edison Atlantic Avenue Station.

the year in which it was started. Even this rapid increase was not sufficient to meet the growing demand for electric light, and a new two-story brick station, 50 by 70 ft. in ground area was erected adjoining the old one in the early months of 1887. This new station was designed for twenty Armington & Sims engines of 150 hp each, and forty Edison No. 20 bipolar dynamos. Two of these dynamos were belted to each engine, and were operated in series on the three-wire system, with approximately 250 volts on the outside wires. This station was started in June, 1887, with seven of the engines and fourteen of the dynamos just named. Rating these fourteen dynamos at 60 kw each gives the capacity of the new station as 840 kw at the start.

In order to reach the north end of the city a second station was built shortly after the first and consisted of a two-story brick building with a ground area 164 ft. deep between Hawkins and Bowker Streets, and a frontage of 38 ft. 3 in. on the former and 15 ft. 3 in. on the latter. This second station was started on December 21, 1887, with an equipment of two Heine boilers, one of 200 and the other of 400 hp, four Armington & Sims high-speed engines of 150 hp each, like those at the first station, and eight of the No. 20 Edison dynamos belted in pairs to the engines. At 60 kw each the rating of these eight dynamos would amount to 480 kw, and this added to the capacity at the first station gives a total of 1,320 kw for all the dynamos of the system on the date last named. This second station was designed for an ultimate equipment of 12 of the 150-hp engines and 24 of the 60-kw dynamos, which with the 40 dynamos that could be installed at the first station would give a total equipment of 64 of these 60-kw dynamos.

This limit to the generating capacity of both the second and third stations was reached before the middle of 1891, when 64 dynamos had all been installed, giving a capacity of 3,840 kw. A third generating station was then seen to be necessary and a site on the harbor front at the foot of Pearl Street, between Atlantic Avenue and the water was selected. This site had the advantages not possessed by the first and second stations, of sea water for condensing purposes, and of the direct delivery of coal from vessels. Ground was broken for the third or Atlantic Avenue station on October 10, 1891, on the site just mentioned where English tea ships were unloaded free of charge almost 118 years earlier; that is, on December 16, 1773. This third station began operation in the latter half of 1892, and in its equipment as in its location it differed much from the two earlier plants. The boilers were all of the Babcock & Wilcox water tube type, and each had a water heating surface of 3,680 sq. ft. and was rated at 368 hp. Instead of small horizontal, high-

FIG. 19.—SWITCH HOUSE, THIRD STATION.

speed, simple, non-condensing, belted engines, like those at the first and second stations, the engines at the third station were of the large slow-speed, vertical, triple-expansion, condensing, direct-connected type.

Each of the first four engines installed at this third station had three vertical cylinders, carried a dynamo at each end of its shaft, and was rated at 660 hp with 120 r.p.m. and 160 pounds steam pressure. These engines were built by the J. Morgan Poole Company. Two multipolar dynamos were connected at opposite ends of the shaft at each of these four engines. Each dynamo was of Edison General Electric make, had 14 poles, was rated at 200 kw, and developed continuous current at 160 volts. This voltage of 160 for the dynamos at the Atlantic Avenue station was adopted in order to provide for the loss of pressure in the feeders between this station and the greater part of the service area of the Edison system at that time.

These eight dynamos of 200 kw each added a generating capacity

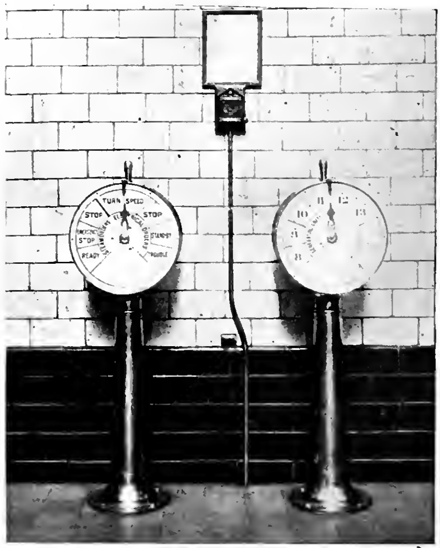


FIG. 20.—CONTROL DIALS, THIRD STATION.

of 1,600 kw to the Edison system, and brought the combined capacity of the three stations up to 5,440 kw, in 1892. This equipment, with the aid of storage batteries served to carry the increasing load of the Edison system until the year ending at the middle of 1896, during which a fifth vertical engine with two direct-connected generators was added at the third station. This engine was of the McIntosh & Seymour make, cross compound, condensing and rated at 1,200 hp with 100 r.p.m., and 160 pounds steam pressure. Each end of the shaft of this engine carries the armature of a 12-pole, 400-kw, 160-volt, continuous dynamo of General Electric make. These two dynamos brought the generating capacity of the three Edison stations up to 6,240 kw in 1896.

By 1899 another increase in generating capacity was necessary and this was made by the addition of two vertical engines, each direct-connected to a single multipolar dynamo. These engines are also of the McIntosh & Seymour make, cross compound, condensing, each rated at 1,200 hp with 160 pounds steam pressure and 100 r.p.m., and are located in the original engine room at the third station. Unlike the first five engines at that station, the two under consideration, numbered 6 and 7, carry only one generator, and this generator is mounted between the main bearings instead of at the end of the shaft. The two generators connected to Nos. 6 and 7 engines were made by the General Electric Company, and each is rated at 800 kw and 300 volts, continuous current.

These 300-volt generators, unlike the other ten in the old engine room of the third station, are each connected to only the outside wires of the three-wire system. Ballancing of the load on the two sides of the system is thus left to the other generators. The two dynamos driven by each of the first five engines at the third station are connected in series with their common terminal on the neutral wire of the system, and the other two poles of these two dynamos are connected respectively to the positive and negative wires, just as is the case with the pairs of bipolar dynamos belted to single engines at the first and second stations. By the two 800-kw dynamos the generating capacity of the three stations was increased to 7,720 kw, in 1899, deducting 120 kw for the capacity of two of the 60-kw bipolar dynamos that had been taken for use as a motor-generator. Even this capacity was seen to be inadequate, especially as it was no longer desirable to operate the simple non-condensing engines at the first and second stations, and an extension of the third station building was begun in March, 1900, and completed the following year.

The old engine room at the third station had an area of 60 by 160 ft., including the switchboard room, which was 70 by 126 ft. in area. In this old engine room the 12 direct-connected generators have a combined capacity of 4,000 kw. For the new engine room at this station the ground area is about 150 by 85 ft., and the intended equipment is six direct-connected units of 1,600-kw capacity each. These figures for areas do not include the boiler room. Two of the generating units just named were installed in 1901, and two more have since been added. Each of these units consists of a McIntosh & Seymour vertical engine direct-connected to a General Electric generator mounted between the main bearings.

The engines are rated at 2,400 hp each with 160 pounds steam pressure and 100 r.p.m. All four engines are cross compound and they exhaust into a common condenser pipe of 50 in. diameter that extends entirely around the new engine room. The 1,600-kw generator driven by each of these engines operates at a maximum voltage of 300, and delivers continuous current to the outside wires of the three-wire system. One of these generators is designed to deliver both alternating and continuous current, has 30 poles and at 100 r.p.m. develops 184 volts alternating, six-phase, at 25 cycles per second. It was the intention when this generator was installed to use step-up transformers with it and obtain a high voltage for transmission to sub-stations, but the purchase of the L Street station of the Boston Electric Light Company shortly thereafter made it unnecessary to carry out this plan. With generators of 4,000 kw total capacity in the old engine room of the Atlantic Avenue station, and generators of 6,400 kw in the new engine room the total capacity there amounts to 10,400 kw. The old bipolar dynamos of 3,720-kw capacity, more or less, at the first and second stations can hardly be considered live generating apparatus at this date, but probably some of them could be put into service in case of a break-down at other stations.

Boilers at the third station have been increased in number as engines were added from time to time until now there are fifteen, all of the Babcock & Wilcox water tube type. Seven of these boilers contain 3,680 sq. ft. of water heating surface each, and the remaining eight each have 4,181 sq. ft. of such surface. In 1901 the sale of all the assets of the Boston Electric Light Company to the Edison Electric Illuminating Company brought the L Street station in South Boston to the latter company. This station was built in 1898 at the water front, as previously mentioned, on land formerly occupied by the Harrison Loring shipyard. In ground area the original L Street station, including the boiler room and coal pocket measures 174 by 244 ft. The boiler room is separated from the engine room by a brick wall and contains 12 Babcock & Wilcox boilers set in six batteries. Each of these boilers has a nominal rating of 500 hp and operates at 160 pounds as a standard pressure. In the engine room there are six vertical cross compound condensing engines of the McIntosh & Seymour make, each rated at 2,350 hp, with 160 pounds steam pressure and 120 r.p.m. Between the main bearings of each of these engines there is mounted a General Electric alternator with a rotating magnet frame of 60 poles.

Each alternator is rated at 1,500 kw and 2,250 volts, three-phase and 60-cycle. These six main generators supply current to 23 motor-generator sets located in the same room and also operate the transformers already mentioned that step up to 6,900 and 4,600 volts for the transmission lines, besides delivering energy to the distribution system in Boston at 2,250 volts. In these six alternators there is a combined capacity of 9,000 kw, and with the 10,400 kw of generator capacity at the Atlantic Avenue station the Edison system has at the present time 19,400 kw of main generators in position. This takes no account of the old bipolar dynamos at the first and second stations. The two 5,000-kw turbine alternators to be installed at the new L Street station will thus raise the capacity of live generating apparatus at L Street and Atlantic Avenue to 29,400 kw.

This rise of generating equipment from the two 25-kw dynamos of 1886 has been brought about by the increase of connected loads, the purchase of other lighting systems, and by transmission of energy to towns and cities distant in some cases more than 25 miles from either of the generating stations. At the middle of 1887, about 16 months after the little plant at Head Place began to operate, it was supplying current to 8,500 incandescent lamps on the premises of 200 customers, and to 80 electric motors with a total rated capacity of 250 hp. At the middle of 1901, before the purchase of the Boston Electric Light system had been completed, the circuits of the Edison Company were connected to 2,503 arc lamps, 247,935 incandescent lamps and to 2,621 motors with an aggregate rating of 10,651 hp. On the same date the Boston Electric Light system was operating 4,913 arc lamps, 112,636 incandescent lamps and 1,849 motors with an aggregate rating of 5,408 hp. The absorption of the Boston system and the growth of another year brought the load on Edison circuits at June 30, 1902, up to 442,034 incandescent lamps, 4,913 arc lamps and 18,621 hp in capacity of connected motors. Since the date last named the purchase by the Edison Company of a number of electric lighting systems in cities and towns within a radius of 25 miles from Boston, aided by the growth of business in that city, has given its lines a connected load of 681,162 incandescent lamps, 9,803 arc lamps and 24,225 hp in capacity of connected motors. All of the loads combined represent an equipment of 1,152,379 incandescent lamps of 16 cp each.

Veto of Niagara Power Bill.

Governor Odell, of New York, has vetoed the bill of Assemblyman Thompson enlarging the scope and powers of the Niagara, Lockport & Ontario Power Company. In his memorandum the Governor says that, while the bill is desired by the immediate locality concerned, he is convinced that throughout the State it is almost universally disapproved. He summarizes the history of the corporation since 1894, when the company was chartered by special act "to furnish pure and wholesome water for domestic purposes to the City of Lockport, as well as to generate and sell electricity in the Counties of Niagara, Orleans and Erie," and remarks that the time in which work was to have begun has about elapsed "without advantage having been taken of the valuable rights conferred by the original act." It is now proposed, he points out, to eliminate the water supply feature and extend to all the counties of the State the right to sell electric and hydraulic power, with very broad powers of condemnation and few restrictions or safeguards, and without in any way exacting compensation. There is nothing, he says, to prevent the sale of this charter to a competing company, and therefore competition is not assured.

"The plea that other corporations are enjoying similar privileges to those which this bill seeks to bestow is no justification," the Governor says, "for the continuance of policies which dissipate the rights of either the State or the municipalities. That governmental policy which does not respect the expressed will of our citizens in relation to both safeguarding their rights and exacting compensation for them is sure to meet with just criticism and disapproval.

"That these privileges are valuable is beyond question, and that the State has the right to demand a proper recompense for them, therefore, should never be lost sight of. That this proposed act does not take cognizance of these facts makes it, in my mind, undesirable legislation."

Governor Odell calls attention to the widespread solicitude, expressed in protests from all over the Union, as to peril to the beauty of Niagara Falls. On the question of threatened damage to the falls, he says, there is wide difference of opinion. "If the result, however, would be less harmful," says the Governor, "than those who seek for the preservation of the falls believe, it certainly would lead, or rather, be an excuse for other companies that would in the end produce the results which are feared. The Legislature should protect the falls, rather than increase the menace to which I have referred, by restricting those corporations which are already in possession, by compelling the removal of obstructions and unsightly structures which mar the beauty of Niagara."

Municipal Plant to Be Sold.

News from the west states that another town has become tired of municipal ownership. The electric lighting plant, located in and owned by the city of Leon, Iowa, has been offered for sale. Leon is the county seat of Decatur County and has a population of 2,000.

Some Aspects of New England Central Station Development.

UNDERGROUND CABLES AND CONDUITS IN NEW ENGLAND.

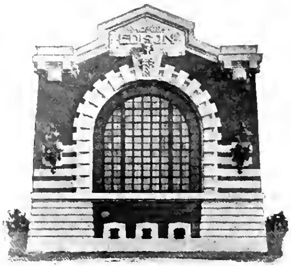


FIG. 1.—WINDOW BOSTON EDISON STATION.

EDISON tubes made up the first underground conduits and conductors in Massachusetts, and probably in New England. The five Edison companies in Massachusetts were early in the field, the Lawrence company having been incorporated in 1882, the Fall River and the Brockton companies in 1883, the New Bedford company in 1884, and the Boston company in 1885. All of these companies except that at Brockton appear to have installed underground tubes at the start, but in that city all of the electric light wires seem to have been overhead prior to the year ending on June 30, 1890.

On June 30, 1888, the Edison company at Boston had 64,530 ft., at Fall River 7,949 ft., and at Lawrence 7,000 ft. of underground tubes or conduits. For the Boston and Fall River companies the respective lengths of wire in conduits were exactly three times the lengths of these conduits, showing clearly the use of three-wire Edison tubes. At Lawrence, however, the length of wire in conduits was 41,347, showing that some conduit other than three-wire tubes was used. Though figures for the conduits of the New Bedford Edison Company are not available for the date last named, a part of the circuits there were no doubt underground, and the length of three-wire tubes on June 30, 1889, was 7,200 ft. Aside from the Edison systems just considered, the only underground electric lighting circuits in Massachusetts during 1888 were those at Pittsfield and Springfield, and the Pittsfield circuits were discontinued during the following year. The underground wires at Pittsfield measured 47,100 ft. on June 30, 1888, and belonged to the Pittsfield Illuminating Company, which operated Westinghouse dynamos. These dynamos were probably alternators of 1,000 volts, and this would indicate that the underground circuits were operated at the same pressure. As these circuits were discontinued during the following year, it is a fair presumption that their insulation gave way.

At Springfield the underground circuits were made up of single-conductor, rubber-insulated, lead-covered cables laid in wooden conduits or boxes and connected to 1,000-volt Westinghouse alternators. On June 30, 1888, the length of these conduits in Springfield was 4,700 ft., and the length of conductors therein was 29,000 ft. Unlike Pittsfield, the underground circuits at Springfield have been maintained and greatly extended, so that on June 30, 1903, the total length of conduits there was 101,385 ft., and they contained 518,992 ft. of wire. These wires varied in size from No. 8 to cables of 500,000 cm. cross section. Meantime the voltage on the underground circuits has been raised and varied so that they now operate at 2,500, 6,000 and 10,000 volts respectively. The present cables are of both the single-conductor and duplex types, and all are rubber-insulated and lead-covered. Cables operating at 10,000 volts carry direct current for arc lighting, and have one conductor each. Duplex cables carry 60-cycle, two-phase alternating currents, some at 2,500 volts for distribution from the sub-station, and others at 6,000 volts to complete the transmissions between the water power plants on the Chicopee River and the sub-station.

The rubber insulation on each conductor of the 10,000-volt cables is 7/32 in. thick, and is covered with a 5/64-in. sheath of lead. On each conductor of the 2,500-volt cable the rubber is 7/64 in. thick, and the lead outside of both conductors has a thickness of 3/32 in. The 6,000-volt cable has a rubber cover of 1/4 in. on each conductor, and 3/32 in. of lead over the pair. All of the later underground construction has been with vitrified clay conduits in lengths of 18 in., and laid in beds of concrete 4 in. thick on top, bottom and sides. In these clay conduits each single duct has a 3-in. circular opening, and each multiple duct has a 4-in. square opening. Single ducts were so laid as to break end joints, were given 1/4 in. of cement mortar between layers and about each joint of multiple ducts a strip of burlap 6 in. wide was placed after having been dipped in hot coal tar or neat Portland cement. The depth of trench in each case was such that the top of the layer of concrete over the ducts is 18 in. below the surface of the street.

In 1900 the population of Springfield was 62,059, so that it stood ninth among the cities of the State in this respect, but in the lengths of its underground cables and conduits it ranks next to Worcester and Boston. Until the year ending June 30, 1895, during which the Boston Electric Light Company and also the Brookline and Suburban Companies in that city laid considerable lengths of underground conduits, the Springfield system and the five Edison plants were the only ones in Massachusetts that maintained more than trifling lengths of electric light conductors underground. It thus appears that, with the single exception of the Springfield system, the Edison plants were more than a decade ahead of all others in the State in the construction of underground circuits.

Of course, a ready explanation of the priority of the Edison plants in underground work rests partly on the low voltage of 250 to 300, which has been maintained from first to last between the outside conductors of their three-wire distribution systems. This explanation brings out more clearly the enterprise of the managers of the Springfield system, in which alternating current of 1,000 volts was distributed through an extensive set of underground cables during seven or eight years before any successful attempt on a large scale was made elsewhere in the State to operate underground circuits of more than 300 volts.

FIG. 2.—UNDERGROUND CONDUITS, SPRINGFIELD, MASS.

The figures for underground conductors in the electric lighting systems of Massachusetts on June 30, 1894, are interesting on this point. Aside from the five Edison systems above considered, the only lighting plants with underground wires in the State, and the lengths of these wires, were the Springfield with 67,272 ft., the Brookline with 1,000 ft., the Pittsfield with 1,000 ft., the Great Barrington with 450 ft., and the Winchendon with 198 ft.

Since June 30, 1895, when the Boston Electric Light Company had 387,806 ft., the Suburban company, of Boston, 9,656 ft., and the Brookline company 14,872 ft. of wire underground, the installation of underground conduits and cables has gone rapidly forward in some cities of Massachusetts. During the following year the Boston Electric Light Company increased its length of underground wires to 942,582 ft., and 25,000 ft. of wire was put into an equal length of underground conduit in the town of Lenox. At that time the Boston Electric Light Company was operating direct-current power circuits of about 500 volts, constant-current circuits from arc dynamos that probably ranged from 2,500 to 10,000 volts, and circuits with alternating current at 1,000 or 2,000 volts. It is probable that parts of all these circuits were included in the underground work. In the Lenox underground system alternating current, probably single-phase at 1,000 volts, appears to have been used. Both the Suburban and the Brookline companies, like the Boston, were distributing 500-volt direct current for motors, constant current from arc dynamos, and alternating current for incandescent lighting, but it cannot be stated here which of these classes of service first went underground.

During the year ending June 30, 1897, the Worcester Electric Light Company brought the length of its underground conduits, which had been started during the previous year, up to 12,554 ft. On June 30, 1898, the length of wires that had been installed in the underground conduits of Worcester was 243,266 ft. At that time the Worcester company was operating 500-volt power circuits, constant-current circuits from arc dynamos, and circuits with alternating current of probably about 2,000 volts.

The next important addition to the group of lighting systems with underground conduits in Massachusetts was that at Lowell, where 8,206 ft. of wire were laid in 1,364 ft. of conduit during the year ending June 30, 1901. At that date the Lowell company was operating 500-volt power generators, constant-current arc dynamos, and 2,200-volt alternators. The Suburban company, of Boston, appears to have reached its maximum length of underground wires, 18,924 ft., during the year ending June 30, 1898, and from this date until

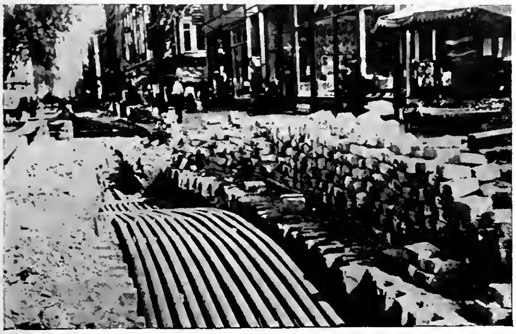


FIG. 3.—CROSSING A BRIDGE IN LOWELL WITH CABLES IN IRON PIPES.

the sale of its assets to the Boston Edison Company, on December 31, 1901, there was a decline in the length of these wires.

On February 28, 1902, the transfer of all the property of the Boston Electric Light Company to the Boston Edison Company was completed. On June 30, 1901, the former of these companies had installed 4,198,961 ft. of wire in 304,874 ft. of underground conduit. At the same date the wires of the Boston Edison Company, all underground, measured 2,029,583 ft. in 497,417 ft. of conduit. During the year ending June 30, 1899, the Malden Electric Company laid 1,200 ft. of wire in 1,000 ft. of underground conduit, but this wire seems to have been discontinued before June 30, 1902. During the year ending at the date just named the Suburban Company, of Revere, laid 6,400 ft. of wire in an equal length of underground conduits, and this remained the same a year later. This company operates with 2,300-volt alternators and 9,000-volt constant-current transformers. During the year ending June 30, 1891, the Pittsfield Electric Company laid 1,000 ft. of wire in 500 ft. of underground conduit, and the wire increased to 2,150 ft. on June 30, 1897, but had declined to 946 ft. on the corresponding day of 1904.

The Church Green plant, a system distributing direct current at about 110 or 220 volts in a small part of Boston, had laid 16,755 ft. of wire in underground conduits by June 30, 1897, but on the like day of 1902 this length had shrunk to 10,755 ft., and the system was sold to the Boston Edison Company on May 1, 1903. On June 30, 1903, the electric system at Winchendon, above noted, had increased its length of underground wires to 1,704 ft. in the same length of conduit. The Leominster plant had 150 ft. of wire underground at the date just named. In the electric system at Lynn 6,565 ft. of wire was put underground during the year ending June 30, 1902, and in the following year the length was increased to 10,618 ft. At Lenox the lengths of wires and conduits alike had increased to 51,023 ft. at the middle of 1903.

The larger electric lighting systems of the State had lengths of wires in underground conduits as follows on June 30, 1903:

Company.	Feet of conduit.	Feet of wire.
Boston Edison	876,315	6,592,181
Worcester	185,261	1,895,939
United (Springfield)	101,385	518,992
Fall River (Edison)	46,091	261,563
Brookline	26,686	84,776
New Bedford Edison	24,223	146,877
Lowell	21,050	115,525
Brockton Edison	18,503	68,364
Lawrence (Edison)	13,890	59,490

Each of the five Edison systems of the State has been consolidated with or has absorbed another competing system; but it seems that outside of Boston these other systems had no underground circuits. In New Bedford and Fall River at least, and probably in all of the other Edison plants, many of the original iron tubes buried twenty years ago are still doing regular service. In Lawrence the use of Edison underground tubes seems to have declined, for the greatest length of wires in conduits there was 72,797 ft., reached by the middle of 1891, with 7,200 ft. of conduit. Another decline in the extent of an Edison underground system is that at Brockton, where a length of 34,534 ft. of conduit and 123,903 ft. of wire therein was installed by the middle of 1894, but had shrunk as indicated by the table, in 1903.

In July, 1890, the Edison company, of New Bedford, was consolidated with the local gas company, which also did electric lighting, and at that time the Edison system included 24,000 ft. of wire in 8,000 ft. of underground conduit. At the time of the consolidation the gas company had no underground lines, but since that date the length of wires in conduits has been extended as indicated in the table. A part of the increase seems to have been made with Edison tubes, and a part with clay ducts.

On July 1, 1896, the Fall River Electric Light Company purchased the entire plant of the local Edison system, which then included 104,040 ft. of wire in 26,963 ft. of conduit. The purchasing company had no underground circuits at that time, but since then the length of wire in conduits has more than doubled. The increase of underground lines has been divided between Edison tubes and clay ducts, but future extensions will be made mainly with the latter.

As above noted, the length of underground wires in the system of the Boston Electric Light Company at the time of its absorption by the Boston Edison was more than 4,000,000 ft., and it follows that more than 60 per cent. of the wire shown in the table for the Boston Edison Company was derived from the Boston Electric system. As this latter system contained no Edison tubes, these tubes now carry less than four-tenths of the underground circuits of the Boston Edison Company.

The actual percentage of the wires of this company that are in Edison tubes must in fact be much below 40 per cent., for a large amount of clay conduit has been laid by it. The later practice in the Boston Edison system has been to lay all feeders with lead-covered cables in conduits, devoting the Edison tubes to mains and service taps. In May, 1901, before consolidation with the Boston Electric system the Edison system there included 301,329 ft. of tubes used as mains with conductors that varied in size from 200,000 to 350,000 cm., and 127,000 ft. of tubes used as feeders and containing 1,000,000-cm. conductors, all of these tubes being three-wire. There was also 17,000 ft. of tube used for the lines between the several stations and sub-stations. This gives a total of 428,329 ft. of Edison tube containing 1,284,987 ft. of conductors in use for mains and feeders. At the same time the Edison system contained 145,000 ft. of 1,000,000-cm., 35,000 ft. of 350,000-cm. cable, also 1,000 ft. of 12-conductor and 63,000 ft. of 3-conductor cable, all laid in conduits. The entire length of these cables was thus 449,000 ft. Most of this cable was insulated with rubber, but a part with paper, and 80,000 ft. of cement-lined iron duct and 371,000 ft. of clay duct were in use to carry the cables.

Between the L Street generating plant of the Boston Edison system and the sub-stations at Newton, Somerville, Woburn, Dedham, Milton and Natick, that are to distribute current in eighteen cities and towns within thirty miles of Boston, the transmission lines consist in part of underground cables. The completed length of these cables is 115,000 ft., and they are all laid in 3-in. vitrified clay conduit. Each cable carries three No. 4/0 copper wires insulated with paper and covered outside with a lead sheath that is 1/10 in. thick.

About each conductor the paper is 3/16 in. thick, the spaces between the three conductors of each cable are filled with jute, and outside of the three conductors, next to the lead sheath, there is another 3/16-in. layer of paper. These cables carry three-phase, 60-cycle current at 6,900 volts. Since June 30, 1903, the electric light and power circuits in the central part of the business section of Lowell have all been put underground. This has largely increased the lengths of cable shown for the Lowell Company in the above table, but the length of conduit is about the same. In its present state the Lowell system includes about fifty miles of cables that vary in size from duplex No. 10 pressure wires to conductors of 500,000 cm. The cable is laid in tile conduits, as a rule, is mostly rubber-insulated, and is lead-covered. Much of this cable distributes 22,000-volt alternating current, and many of the transformers are in street manholes, from which secondary circuits of 110 volts are carried. At one point where the cables cross a bridge under its paving they are carried in iron pipes to save room. In Lowell the conduit system is continuous from the generating station on the bank of the Concord River to the business section.

At Providence, R. I., the Narragansett Electric Light Company began to put its wires underground in 1899, and since that time vitrified clay conduits have been laid in more than forty miles of streets. These conduits contain more than 1,700,000 ft. of ducts, of which about 700,000 ft. are in the multiple-duct form, and over 1,000,000 ft. are single-duct. Upwards of 850 manholes give access to the duct system, the standard size of each being 7 by 7 ft. square and 8 ft. deep. In front of the battery sub-station of the system there is a great manhole 21 ft. long, 8½ ft. wide and 9 ft. deep. Some of the manholes extend below the water level in Narragansett Bay, and it was necessary to make them water-proof with linings of tar paper put on with hot asphalt and then a layer of cement concrete. In junction manholes fuses connect the cables so that a defective section may be readily located.

All of the cables in these conduits are rubber-insulated and lead-covered, and all conductors larger than No. 6 B. & S. gauge are stranded. These cables carry voltages of 250 to 500 on a three-wire system, constant current for arc lighting at voltages up to 6,500 volts, 2,300-volt alternating current, and 11,000 volts on the transmission lines to the sub-stations at Warren and Warwick. For 500 volts and under the thickness of rubber insulation on cables is 5/32 in. The cables for 2,300 volts and for constant current up to 6,500 volts have rubber 7/32 in. thick on each conductor, and on the 11,000-volt cables the thickness of rubber is 9/32 in. There are four miles of this 11,000-volt cable in the conduits, and it connects with 800 ft. of armored cable that crosses the Seekonk River. In size of conductors the underground cables range from No. 14 to 1,000,000 cm. and their total length is 1,468,200 ft., or 278.06 miles. There is also 5,000 ft. of the armored submarine cable used with currents of the several voltages, used mainly in crossing the river to East Providence. Starting from the generating station on South Street at the water front the underground cables cover the entire central business section of the city and run out into the residence portion.

ELECTRIC TRANSMISSION FROM CITIES IN NEW ENGLAND.

Transmission of energy from water powers to distant cities has justly received much attention, but another important branch of transmission has sprung up without attracting much notice. This is the transmission from comparatively large cities to smaller and distant places. By such transmissions the populations and especially the areas supplied by single electric systems have been much extended within the period since 1890. In Massachusetts the electric supply systems of Boston, Cambridge, Haverhill, Lawrence, Lowell, Lynn, Malden, Marlboro, New Bedford, Springfield and North Adams, besides those of a number of smaller places now extend to other cities or towns. From the new generating station in Cambridge current of 2,300 volts, 60 cycles, three-phase is transmitted to Belmont, an adjoining town. In the towns of North Andover and Methuen, which bound the city of Lawrence on two sides, both public and commercial lighting is supplied directly from the water power station of the electric company in that city. The arc lamps used to light the streets in these towns are on series circuits, and commercial incandescent lamps are supplied through transformers on circuits of about 2,200 volts.

From the steam power station on the river bank in Lowell electric current is transmitted to the towns of Billerica, Tewksbury and Andover, all three within a ten-mile radius. The series incandescent street lamps in Billerica are controlled by a regulating transformer at the Billerica end of a 2,200-volt line from the bus-bars at the station. Commercial service in this town is also furnished through transformers on the 2,200-volt line. In Tewksbury incandescent street lamps are operated on a series circuit. For the transmission to Andover the 2,200-volt current at the Lowell station is raised by a transformer to 6,600 volts, and this pressure is reduced to 2,200 volts at the Andover end for distribution there. A part of this 2,200-volt current goes to a constant-current transformer in Andover for the operation of series arc and incandescent street lamps. In the town of Groveland, across the river from Haverhill, series incandescent street lamps are operated from the steam-driven electric station on the bank of the Merrimac in that city.

Four cities, Malden, Everett, Medford and Melrose, are all supplied with street and commercial lighting direct from a generating plant using steam power, in the former. These cities form a rather compact area of about six miles north and south, and a like distance east and west. Circuits of series arc and incandescent street lamps in all four cities are connected to constant-current transformers at the generating station in Malden. Commercial lighting and power is distributed in these cities from 2,200-volt circuits that also run back to the generating plant. Southboro, a town that adjoins Marlboro,

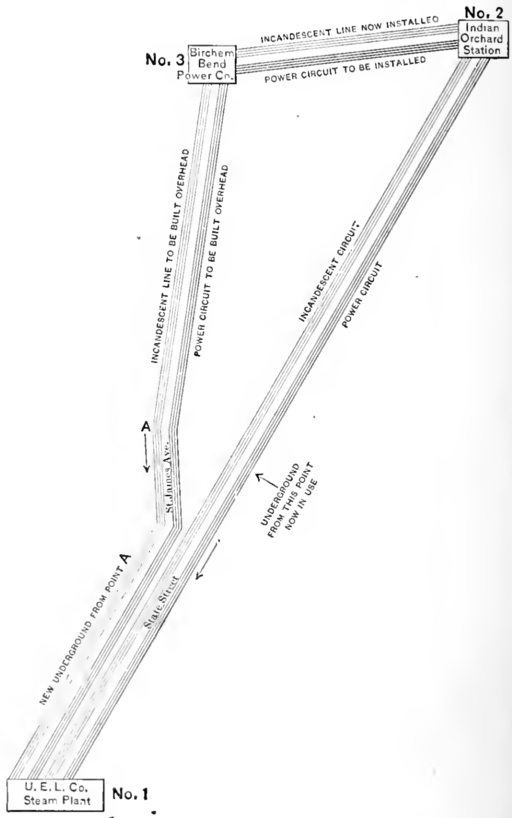


FIG. 4.—PLANT CONNECTING CIRCUITS, SPRINGFIELD, MASS.

is supplied with series incandescent street lamps, and with commercial lamps from circuits that start from the steam power electric station in that city. The steam power station on the water front in New Bedford supplies public and private service in Fairhaven by circuits that cross the river which separates the city and town. No step-up transformers are used, but all service in Fairhaven is taken either from constant, direct-current circuits or from 1,000-volt, single-phase lines that run back to the switchboard at the generating plant.

From the sub-station of the Springfield system, on the bank of the Connecticut River, distribution is carried out in that city and also in the adjoining towns of West Springfield and Longmeadow. For street and commercial lighting over this area constant-current arc circuits and two-phase circuits of 2,500 volts are utilized. The electric station in Pittsfield operates a constant-current circuit for incandescent street lamps in the town of Dalton. From the generating station in North Adams current is transmitted for public and private lighting in Adams, Williamstown and Clarksburg parts of which are eight to ten miles distant. For these transmissions the 2,200-volt, two-phase current at the main station is raised to 6,600 volts by transformers there, and the 6,600-volt current is lowered in pressure at sub-stations in Adams and Williamstown. From these two sub-stations the local distribution takes place. In the town of Blackstone, Mass., the sub-station receives electrical energy transmitted across the State line from a generating plant at Woonsocket, R. I.

Much the largest and longest transmission between a city gen-

FIG. 5.—400-KW UNIT, SPRINGFIELD, MASS., BIRCHEM BEND PLANT.

erating station and other cities or towns in Massachusetts is that which is just being put into operation by the Edison Electric Illuminating Company, of Boston. This transmission starts from the L Street station of the Edison Company on the water front in South Boston and extends to eighteen cities and towns, some of which are fully 25 miles distant.

This transmission has been made possible through the purchase by the Edison Company of the electric generating stations and systems in Woburn, Somerville, Watertown, Needham, Dedham, Milton, Dover, Canton, Natick and Framingham. The operation of these

FIG. 6.—BIRCHEM BEND CANAL AND TAIL-RACE, SPRINGFIELD, MASS., PLANT.

systems carries with it the supply of electrical energy in Woburn, Stoneham, Winchester, Somerville, Arlington, Dedham, Canton, Needham, Milton, Westwood, Wellesley, Natick, Framingham, Wayland, Ashland and Holliston. For the regulation and distribution of electric current in all of these places from the L Street generating plant, sub-stations are being equipped at Woburn, Somerville, Newton, Dedham, Milton and Natick. Between the L Street station and each sub-station a transmission circuit for 6,900-volt, 60-cycle, three-phase current has been erected. Parts of these circuits in Boston and some of the other cities through which they pass are composed of three-conductor, paper-insulated, lead-covered cables laid in tile conduits, but the greater parts of their lengths are made up of bare copper and aluminum conductors supported by wooden poles. The 6,900-volt current for transmission from the L Street station is obtained there at present by means of transformers that draw their energy from the 2,300-volt, 60-cycle, three-phase generators in the older part of that station. When the addition to this L Street plant now under way is completed, the 6,900-volt current for the transmission circuits will be developed in the armature windings of

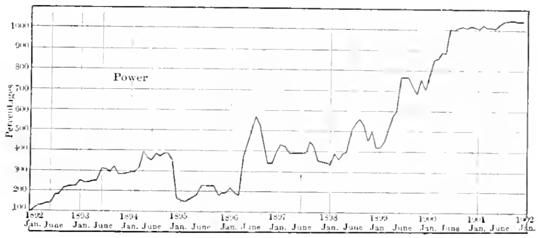


FIG. 7.—CURVE SHOWING INCREASE OF RECEIPTS, HARTFORD, CONN.

the 5,000-kw turbine generators that are being installed there. The circuits that now connect the L Street station with the most distant sub-stations of the system are thought to insure moderate transmission losses and good regulation, but when the loads at these distant sub-stations have increased, the transmission voltage at the generating plant may be raised to 13,500 by transformers.

At the various sub-stations connected to these 6,900-volt transmission circuits the line current goes either to static transformers or to motor-generators. The motors of these generating sets are three-phase, 60-cycle machines and receive the 6,900-volt current in their stationary armature windings. The generators of these sets deliver direct current. In the static transformers the three-phase current is reduced to 2,300 volts for general distribution, and for use in constant-current transformers and regulators. Such constant-current transformers and regulators supply all series circuits for both arc and incandescent lamps, and no constant-current dynamos are operated.

From the steam turbine generating station in Hartford, which also serves as a sub-station for the transmission lines that come in

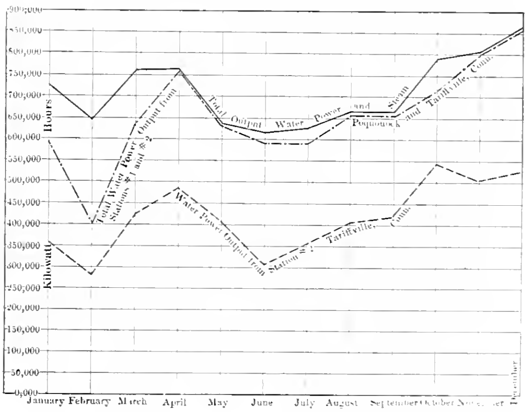


FIG. 8.—ENERGY OUTPUT CURVE, HARTFORD, CONN.

from the water power plants on the Farmington River, 2,400-volt, 60-cycle, two-phase current is sent out over feeder circuits that run to low-pressure distribution systems in adjoining towns. In this way the towns of East Hartford, West Hartford and Wethersfield are supplied at distances of five or more miles from the generating station.

At Providence there is another excellent illustration of an electric system that supplies numerous and distant surrounding towns from a large steam power station in the city.

From the generating station on the water front in Providence the ten outlying towns and cities that are supplied with electrical energy include East Providence, Barrington, Warren and Bristol on the east side and Johnston, Cranston, Warwick, Coventry, East Greenwich and North Kingston on the west side of Narragansett Bay. These cities and towns extend entirely across the State of Rhode Island, a distance of about 27 miles, and north and south along the shores of Narragansett Bay for as much as 22 miles. In the cities and towns that are nearer to Providence electrical energy is distributed at 2,200 volts, 60 cycles, single-phase, by circuits that ran directly from the generating station there. For the distribution of service in the more distant places two sub-stations have been established, one in Warren and the other in Warwick. Each of these sub-stations is distant approximately ten miles from the generating plant in Providence, and energy is transmitted to them at about 11,000 volts, 60 cycles, three-phase. In order to obtain this pressure for the transmission lines transformers are used at the main plant to raise the 2,200-volt current from the generators to 11,000 volts. The transmission line to each of these sub-stations consists of rubber-insulated, lead-covered cable laid in tile conduits for a distance of about two miles from the generating station. From the end of its underground cable the line to the Warwick sub-station is carried overhead on wooden poles. On the line to the Warren sub-station an armored cable 800 ft. long that passes under the Seekonk River connects the underground with the overhead portion of the circuit.

At each sub-station the 11,000-volt current is reduced in pressure to 2,200 volts by transformers for the distribution circuits. Constant-current transformers are also located at each sub-station for the operation of 6.6-amp. series circuits for arc lamps, and these transformers draw their energy from the 2,200-volt bus-bars there. The arc lamps operated by these transformers are all of the enclosed type.

As may be seen from the foregoing, there is a decided tendency toward the transfer of electric loads in small places to the steam power stations of large distant cities, because of the advantages of the development of electric energy on a great scale. In this way the transmission lines approach each other. Lowell, Lawrence, Haverhill and Newburyport, the Massachusetts cities along which the Merrimac River, already supply most of the electric lighting in towns that border its banks. With electrical supply from the Boston L Street station as far north as Woburn, and current from the Lowell plant as far south as Billerica, only one town, that of Burlington, intervenes between the circuits of these two steam power stations, which are about 24 miles apart. On the west Worcester is little more than 40 miles in a direct line from Boston, and the transmission lines from this latter city have already reached Ashland about 25 miles on the way. The time will probably be short before the circuits from one or the other of these large cities span the remaining 15 miles between them. In Canton the lines of the Boston Edison Company have traversed 15 of the 44 miles between that city and Providence, and there is no large generating station along the remainder of the distance.

In Bristol and North Kingston the lines from Providence are within ten miles of the steam turbine station at Newport, and it needs little gift of prophecy to see that the former rival capitals of Rhode Island are destined to furnish electric light for almost the entire State.

Another factor, the transmission of energy from water powers to a number of distant cities and towns in each case, is tending to bring scattered electric loads onto a comparatively few great systems. Perhaps the most striking example of this sort in New England is the forty-mile transmission from the isolated generating plant of 6,000-kw capacity on the Housatonic River, in Kent, Conn., to Cheshire, New Britain, Waterbury and intermediate places.

WATER POWER IN NEW ENGLAND ELECTRIC STATIONS.

During the first decade of electric lighting water power was little used in the stations of New England. In 1890 only six electric stations in Massachusetts, those at Holyoke, Leicester, Middleboro, Turner's Falls, North Attleboro and Lee were using water power, and the total capacity of all their wheels was only 685 hp. At Hartford, Conn., the first energy developed by water power was received from the Poquanock plant by a transmission of eleven miles, in 1891. It was about 1893 before the power of falls on the Winooski River several miles from the business center of Burlington, Vt., were utilized to operate the electric system in that city.

Manchester, N. H., is literally surrounded by water powers besides having a large fall near its center, but the first independent electric station built there, about 1886, was driven entirely by steam power.

FIG. 9.—EXTERIOR OF POWER HOUSE, CONCORD, N. H., WATER POWER PLANT.

The first electric lighting at Manchester was done with water power rented from the Amoskeag Manufacturing Company in 1882, but this power was abandoned when the plant was moved to the Brook Street station in 1886. It was not until 1890 that an electric station for the use of water power was built, and this station was located at Kelley's Falls, about three miles from the business section of the city on the Piscataquog River.

At Concord, N. H., on the Merrimac River, the steam-driven electric station was abandoned in 1892, and electrical supply there has since been drawn from the water power at Sewall's Falls, about four miles up stream from the business center of the city.

In Maine the great abundance of water power led to its early use in some of the electrical supply systems. At Lewiston and Auburn,

FIG. 10.—DAM AT SEWELL'S FALLS, N. H.

Me., cities that are separated only by the narrow Androscoggin River, and are a unit from a business standpoint, electric lighting seems to have been done with water power from the start, and four early water-driven stations are still in operation there pending the completion of a large modern plant about three miles up the river. Portland, the largest city of the State, depended on steam power for electric lighting up to 1898, though there are a number of undeveloped water falls within twenty miles of the business center, and one of the systems there still operates entirely with steam.

Several causes have combined to postpone the application of water power to the second decade of electrical supply. One of these causes is the idea, not yet entirely outgrown, that electric generating stations must be placed as close as possible to their loads. This idea had its only substantial foundation in the limitations of 110 and 220-volt

FIG. 11.—DAM, LEWISTON AND AUBURN, ME., PLANT.

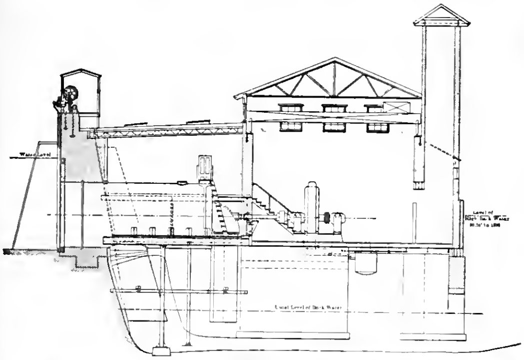


FIG. 12.—SECTION OF GARVIN'S FALLS, N. H., POWER PLANT.

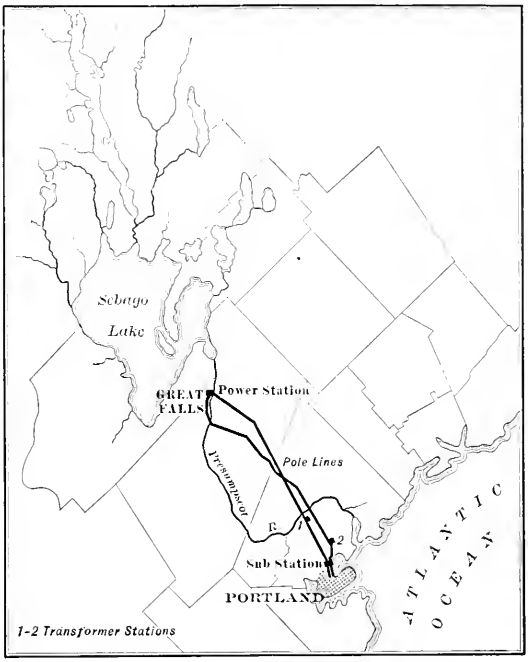


FIG. 13.—MAP OF PORTLAND, ME., TRANSMISSION LINES.

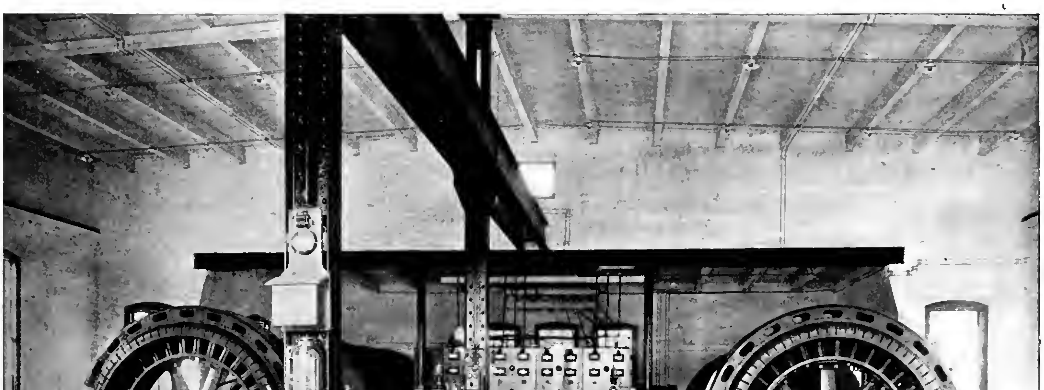


FIG. 14.—GREAT FALLS, ME., GENERATING PLANT.

NEW ENGLAND CENTRAL STATION DEVELOPMENT.

direct-current service, and even here the necessity for a short radius of distribution applies to the sub-station rather than to the generating plant. With arc dynamos that ranged from 2,500 to 3,500 volts, and with alternating generators of 2,000 volts, a generating station might have been located five to ten miles from its connected load in order to utilize water power. Even with the moderate voltages just named available for such a short transmission, sub-stations might have been installed for service with direct current at 110, 220 or 500 volts near centers of distribution. But the transmission idea had not yet gained headway, and what many engineers knew as matter of theory, but few were ready to put into practice. Probably the strongest reason for the delay in the application of water power to electrical supply was the failure to fully appreciate its advantages. A saving in the cost of fuel was long regarded as the chief advantage of water power, and the large possible reduction in the labor of operation was in large measure overlooked.

FIG. 15.—GARVIN'S FALLS, N. H., POWER PLANT.

If water power was too much neglected in the first half of the period that covers the rise of electric lighting, the mistake is being rapidly corrected. In contrast with the four electric stations in Massachusetts that used water power in 1889, the number of systems operating with this power in 1903 was eighteen. While the combined capacity of all the water wheels in the electric stations of Massachusetts was only 545 hp in 1889, the year of 1903 found wheels of 10,334 hp so used among the electric water power system of Massachusetts as those of these of Springfield, Holyoke and Lawrence. In Maine more than a score of lighting systems utilize water power, including Augusta, Waterville and Bangor. New Hampshire, like Maine, depends largely on water power for electrical supply, and many of the smaller places as well as Concord and Manchester are lighted from this source. Besides Burlington, the largest city in the State, Montpelier, Bennington, Bellows Falls and numerous other places in Vermont are supplied with electrical energy from water power. Hartford afforded for some years the only prominent example of electrical supply from water power in Connecticut, but recently Waterbury, Cheshire and New Britain have begun to draw energy from an electric station on the Housatonic River.

The distances over which water power is electrically transmitted in New England are as a rule moderate. At Bangor, Me., the electrical supply comes from a station five miles up the Penobscot River at a point in the town of Veazie, where a dam is located. The great electric water power station on the Androscoggin that is being constructed for the supply of Lewiston and Auburn, Me., is only three miles up stream from the business center of these cities. To reach Portland, Me., the electric energy developed at Great Falls on the Presumpscat River is transmitted about fourteen miles. Of the four water-power plants that develop electric energy for Manchester, N. H., one is four miles, one six miles, one ten miles, and one fourteen miles from the sub-station in that city. Of the two water-power plants that generate electric current for the Springfield, Mass., system, the more distant is about six miles and the other about 5.5 miles from the sub-station near the business center.

Of the two water powers that supply energy to the electric system in Hartford, Conn., that at Poquonnoc is eleven miles, and that at Tariffville, thirteen miles from the city sub-station. Probably the longest transmission in New England, between a water power station and a city that it serves, is that extending from the electric plant near Bulls Ridge on the Housatonic River, in the town of Kent, Conn., to a sub-station in New Britain, a distance of about thirty-eight miles in an air line, and probably more than forty miles by the transmission circuit. This water power plant and rather long transmission system is owned by the New Milford Power Company, and the energy is to be used on the extensive system of the Connecticut Railway and Lighting Company, especially at Waterbury, New Britain and Cheshire.

FIG. 16.—GREAT FALLS, ME., WATER POWER PLANT.

As might be expected, the rather short electric transmissions of New England have not led to the use of extremely high voltages.

The line between Great Falls and Portland operates at about 10,000 volts, and the same is true of the transmission circuits entering Manchester and Hartford. Probably the highest transmission voltage in New England is that of 33,000 on the line above mentioned from Kent, Conn., to Waterbury, New Britain and Cheshire. The four transmission systems just named, and also most of the smaller ones throughout the same territory, operate with sixty-cycle, three-phase current. Where the line voltage is not more than 10,000 to 12,000, which is true for the great majority of transmissions, the more common practice is to develop this voltage in the generator windings and thus avoid the use of step-up transformers. This practice as to the equality of generator and line voltages exists in the Lewiston, Portland, Manchester and Springfield systems, but the contrary is true for Hartford and Kent. At both of the Farmington River plants that develop electric energy for Hartford the voltage of the main generators is 500 two-phase, and this is increased to 10,000 volts, three-phase by step-up transformers.

The generators just installed at the Bulls Bridge plant in Kent are rated at 1,150 volts each, and the transformers increase this pressure to 33,000 volts. Electric water power stations of New England are more notable for their numbers than for their individual capacities, but there are a few of these plants that compare favorably in size with the great majority of similar plants in other parts of the country. At the Great Falls plant whence energy is transmitted to Portland the capacity of each of the three-phase, 60-cycle generators is 500 kw, giving a total capacity of 2,000 kw for the plant. In the Springfield system the combined capacity of generators at the Indian Orchard plant is somewhat more than 2,000 kw, and the two 60-cycle, two-phase, 6,000-volt generators at Birchem Bend are rated at 400 kw each, so that these two water power stations have a generating capacity of fully 2,800 kw. At one of the Farmington River stations of the Hartford system, that at Poquonnoc, each of the two generators is rated at 600 kw, and the Tariffville system has two 750-kw generators, so that this system can draw 2,700 from water power, or very nearly the rated output of the two water-driven stations of the Springfield system. The Winooski plant that supplies light and power for the city of Burlington has a generator capacity of 1,080 kw, made up of three 2,300-volt, 60-cycle, three-phase alternators and six series arc dynamos. The Concord, N. H., system has a capacity of 1,000 kw in its generators at Sewall's Falls, this capacity being made up by five 2,600-volt, 60-cycle, three-phase alternators, and two arc dynamos.

An unusual feature of the Manchester system in the same state is the delivery of energy from four water powers to the same set of brushes at the sub-station in that city. At three of these water powers, Kelley's Falls, Gregg's Falls and Hooksett, the capacities, all in alternating generators, are 930 kw, 1,200 and 600 kw respectively. The fourth water-power station, that at Garvin's Falls, formerly contained only two generators each rated at 650 kw, sixty-cycle, three-phase, but a new dam and canal, together with a large extension of this plant have been in process of construction for the past year; this extension is designed to give the plant six generators of the type and capacity just named. These six generators will have a combined capacity of 3,900 kw, and this with the 2,730 kw of the other three plants will raise the rating of water-driven generators in the system to 6,630 kw. This capacity of water-power stations is greater than that possessed by any other electrical supply system in New England. Probably the largest generating capacity of any one station devoted to electrical supply is that of 6,000 kw in the new plant at Kent, Conn. This capacity is made up of six equal, three-phase, sixty-cycle generators, each of which is direct connected to a pair of horizontal turbine wheels. These generators operate at 1,150 volts, and six transformers are used to raise this pressure to 33,500 volts for the transmission line. Even the capacity just mentioned will be exceeded at the new water power plant above Lewiston and Auburn on the Androscoggin, which when completed will contain ten generators of 750 kw each. All of these generators will be three-phase, sixty-cycle, 10,000-volt machines, and each will be driven by a pair of direct-connected, horizontal turbine wheels. The generator capacity of this plant on the Androscoggin will thus just equal that of the celebrated station of 7,500 kw at Canon Ferry on the Missouri River, and will exceed the capacity of any of the famous water-power stations in California save that of 10,000 at Electra, and that of 11,250 kw rating at Colgate.

Unlike these notable California systems the electric water power stations of New England have to deal, as a rule, with rather low heads of water. At the Indian Orchard and Birchem Bend stations of the Springfield, Mass., system, the heads of water are 36 and 14 ft. respectively. At the Burlington, Vt., station the wheels work under a water pressure of 31 ft. Sewell's Falls, on the Merrimac River, afford a head of 15 ft. for the wheels that drive the generators of the Concord, N. H., system. Several miles down stream comes Garvin's Falls, with a head of 30 ft. that will be maintained by the massive stone dam now under construction, and still further down toward Manchester are the 16-ft. falls at Hooksett, both of which develop energy for distribution in that city. On the Piscataquog River, which joins the Merrimac at Manchester, are Kelly's Falls of 24 ft., and Gregg's Falls of 51 ft., both of which develop energy for the city last named.

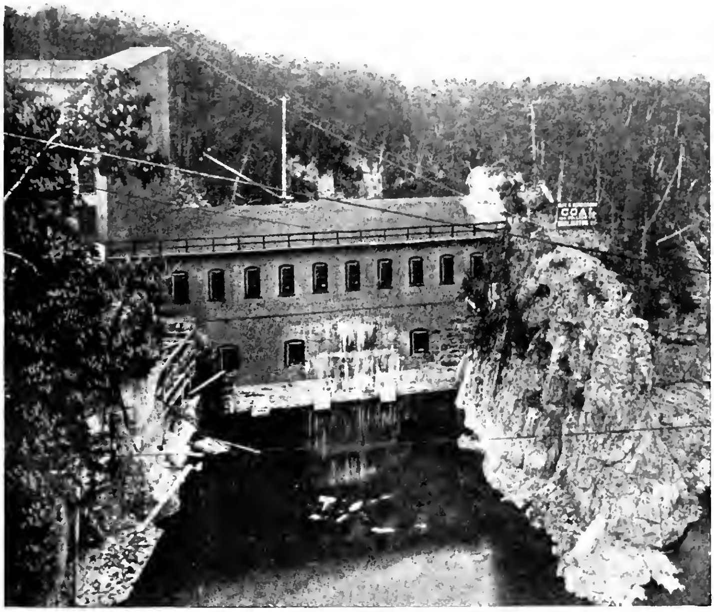


FIG. 17.—BURLINGTON, VT., WATER POWER PLANT.

To develop 10,000 horse power in the new station above Lewiston, Me., a fall of 32 ft. in the Androscoggin will be maintained by the new concrete dam. At Great Falls the generators that develop electric current for distribution in Portland are driven by wheels that work under a head of 37 ft. The stations on the Farmington River that develop energy for distribution in Hartford operate with water heads of 23 and 32 ft. respectively, the earlier plant having the greater, and the later, or Tariffville, plant the lesser head of water. At the 6,000-kw station in Kent, Conn., the largest now driven by water power in New England, the greatest head of water, that of 115 ft., is also found. It is worth noting that the greatest station capacity, the largest head of water, the highest voltage, and the longest transmission in the entire territory under consideration are to be found in the system of which the plant just named forms a part.

All of the water power stations above mentioned, and most if not all of the smaller ones in the same states, are equipped with turbine wheels. In all of the recent plants the turbines are of the horizontal type, and are direct connected to the generators. At some of the older and smaller stations the turbine wheels, though horizontal, are belted to one or more shafts that in turn drive the generators, through belt connections, as is done in the Burlington plant. In other cases, as at the station of the Concord system, each pair or set of horizontal turbines is belted to a single generator. The old type of connection in which vertical turbines are geared to a horizontal shaft, and this shaft is belted to the generators, is being generally abandoned though still in use at a few of the older and smaller stations. Storage of water for use at electric stations has not received the attention that it deserves, but some of the plants are well situated in this respect.

Above the Burlington plant on the Winooski the dam forms a pond three miles long, and during more than ten years of operation the use of steam has been necessary on only two days because of lack of water. The new stone dam at Garvin's Falls on the Merrimac River sets back the water to a distance of several miles up stream. In the great upland bogs of Brookfield the water is held as in a sponge, and the Chicopee River which rises there has a remarkably constant and even flow, so that the stations at Indian Orchard and Birchem Bend generate more than 90 per cent. of the entire output of electrical energy in the Springfield system. Although the Farmington River has a rapid descent, and the facilities for the storage of its water are far from what could be desired, only 1,009,598 kw hours out a total of 8,577,699 kw hours distributed by the Hartford system during the calendar year of 1901 was derived from steam power. In other words, water power furnished 88.2 per cent. of the energy output of the system in that year.

In Concord, N. H., the average week-day output of the electric system was about 6,800 kw hours during the year ending June 30, 1901, and the total rated capacity of all lamps and motors connected to the system was 1,850 kilowatts approximately. In this same year only about 500 tons of coal were consumed in the operation of the Concord system, and the water power at Sewall's Falls did the remainder of the work. Few, if any, water powers in New England are more constant than those along the Presumpscot River, which forms the only outlet of Sebago Lake. This lake has an area of fifty square miles, and a drainage of 470 square miles, so that each square mile of the lake area receives drainage from less than ten square miles of territory, on an average. A result is that records extending over more than ten years show a maximum variation of only 5.75 feet in the lake levels. A dam at the outlet of this lake regulates the height and flow of water, and gives it exceptional value as a reservoir. Besides the storage between wet and dry seasons afforded by this lake, the station at Great Falls has a pond behind its dam that is about one mile long, 1,000 feet wide, and 15 ft. deep, the Portland electrical supply system. During the year 1903 not a pound of coal was burned by the Portland system.

The electric systems centering at Lewiston, Portland, Burlington, Concord, Manchester, Lawrence, Holyoke, Springfield, Hartford and Waterbury will have generators of 31,674 kw total capacity connected to water-wheels in their stations, when the plants now under construction at Lewiston and Garvin's Falls are completed. As there are eighteen electric stations using water power in Massachusetts, and more than twenty such stations in Maine, the total capacity of generators driven by water power in the electrical supply systems of New England is probably between 40,000 and 50,000 kw.

With all this, the development and transmission of water powers is still in its early stages, and another twenty years of electric lighting will see the greater amount of energy used in supply systems drawn from the rivers of New England.

Electrical Standardizing Bureau for Canada.

A deputation of Canadian electrical interests has waited upon the Minister of Inland Revenue asking that the government establish an electrical standardizing bureau, to be maintained independent of any other branch of the public service, and placed in charge of a qualified electrical expert, at whose disposal should be placed trained assistants and proper facilities. The delegation also asked that the law be amended so that if any device was found in the possession of any one to prevent the proper registration of electric current, it should be prima facie evidence for his prosecution and conviction.

Report of St. Louis Railway Test Commission.

A full meeting of the executive committee, appointed to determine the nature and scope of the electric railway tests to be made at St. Louis and elsewhere during the coming summer, was held at St. Louis on Friday and Saturday, May 6 and 7. The committee consists of Prof. W. E. Goldsborough, chief of the Department of Electricity, Universal Exposition, chairman; Prof. H. H. Norris, Cornell University, superintendent of electric railway tests, and Profs. B. V. Swenson, University of Wisconsin, and H. T. Plumb, Purdue University, assistant superintendents of electric railway tests. After careful study of the reports of the engineering committees of the suggestions of the advisory committee, and of the excellent facilities afforded by the Exposition officials, the executive committee decided to undertake the following series of tests:

(*a*) Tests on the service capacities of electric railway motors. Equipments will be operated upon the special tracks at different rates and durations of acceleration, coasting and braking, with different lengths of stops, in order to determine the heating of the motors under conditions approaching as nearly as possible those of commercial practice. The motors will also be tested separately for heating and for the determination of their torque curves and accelerating power. This will render possible the comparison of the performance of the same equipment upon the track and test stand.

(*b*) Acceleration tests. Acceleration tests upon single cars and upon multiple equipped trains will be made to determine the ability of the equipment to bring the cars to speed quickly and economically.

(*c*) Braking tests. Braking tests upon single cars and multiple equipped trains will be conducted in order to determine the quickness of action, the shapes of the braking curves, the relation between the braking forces and the applied pressures and the best methods of application of the braking forces.

(*d*) Tests upon train resistance. Determinations of the resistances due to the rails, to the journals and gearing and to the air will be made by systematic and complete series of runs. The effect of the shape of the car body will be carefully investigated. The methods to be used in measuring train resistance comprise the use of calibrated motors as the sources of power, the hauling of the car under test by calibrated dynamometers, and by noting the falling off in speed while the cars are coasting. The pressure of the air upon different parts of the car will be recorded by means of self-registering pressure gauges. In addition to this definite series, a number of other tests will be conducted upon various exhibits in the Palace of Electricity in order to determine their efficiency and reliability.

Sections (*a*), (*b*) and (*c*) of the tests will be carried on upon the tracks which have been built for the purpose by the Exposition. These are of substantial construction, conveniently located, and of a total length of about 4,500 ft. For the tests described under section (*d*) the Indiana Union Traction Company has provided a stretch of eight miles of straight and heavily ballasted track. The resistance tests will be made after the completion of the programme.

In all of the above work, graphical records of the measurements will be obtained by the use of autographic instruments which will be either built for the purpose or supplied through the co-operation of the manufacturing and operating companies and the technical colleges. The National Bureau of Standards will materially aid in this work by providing facilities for the calibration of all of the instruments. For the purpose of comparison, the various railway equipments will be divided into several classes, including car weights up to forty-five tons, as follows: (*a*) Light city service equipments, (*b*) heavy city service equipments, (*c*) light interurban service equipments, (*d*) heavy interurban service equipments.

The actual work of observation and calculation will be carried on under the personal supervision of the superintendents by a corps of young men carefully selected from among the graduates of leading technical schools, the total number of observers being between thirty and forty. The Exposition management is co-operating enthusiastically with the railway test commission in providing ample facilities for the tests and substantial results of permanent value to the profession are confidently expected.

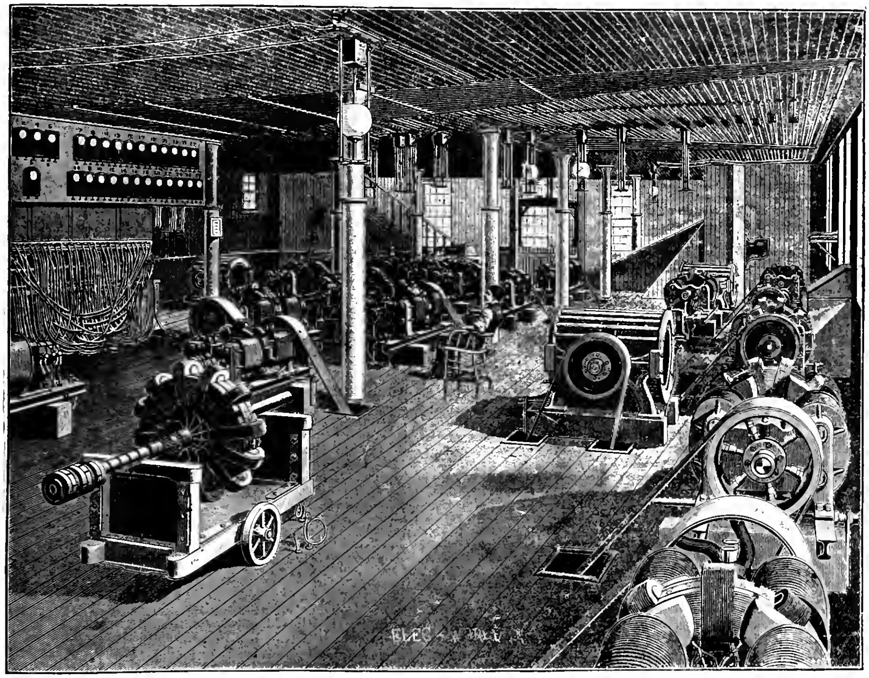
At the present time a large part of the equipment is already at St. Louis, the organization is complete, and the ranks of the testing corps have been filled with earnest young men.

The Boston Electric Light Convention of 1887.

IT is seventeen years since the National Electric Light Association visited the city of Boston, although the electrical development there has been such as to justify a more frequent return. So much electrical history has been written since 1887 it has occurred to us that many readers of the Electrical World and Engineer would like to refresh their memories in regard to what was done by the Association on the occasion of its previous visit; while those who have entered the field of electric light and power since that time will also be put more closely in touch with its evolution and development, by the present brief retrospective sketch. Neither the art nor the Association was very old at the time referred to, and to all except those gifted with prophetic minds the present close harmony and alliance between the arc lighting and incandescent lighting branches of the industry then seemed impossible. In fact the tendencies which have made electric lighting one art instead of two were already at work, but were not fully recognized. Aside from the inevitable trend of financial and commercial interests towards consolidation there were two agents beginning to make themselves felt, to which alone might be attributed almost entirely the present status of the art and the industry, namely the adoption of the alternating current and the introduction of the direct-current motor. It is sharply within the memory of veterans who attended the Boston convention seventeen years ago that the impressive feature of that affair was the large exhibit made of direct-current motors, although singularly enough these were designed for arc lighting circuits, to be operated in series, rather than for the incandescent circuits to be operated in parallel, as virtually all motors are to-day. The same year, 1887, was a landmark also as being the time when Tesla came to the front and changed the whole aspect of things with his polyphase inventions and motors.

In connection with the visit to Boston the Electrical World and Engineer of that day presented to its readers an elaborate wood cut engraving which we are emboldened here to reproduce for its historical interest, showing the interior of the Ferdinand Street station of the Boston Electric Light Company—one of the four stations then under the management of the late F. A. Gilbert. The dynamo room here shown—one of three floors—contained 16 Brush arc dynamos of 65-light capacity, and 7 of 30-light capacity, two Thomson-Houston arc machines of 30 lights, and one of 50-light capacity. This gave the station a total capacity of 1,360 lights, all of which were in use. With regard to electric lighting in general in Boston at the time of the last convention, it is rather difficult to give the exact figures, but the arc lighting system at that time had apparently a station capacity of about 3,000 arcs and in 1888-9 had 2,171 in service. At the end of 1887, the Boston Edison Company had connected on its three-wire system an equivalent of 8,380 incandescent lamps of 16 cp and about 80 motors of an aggregate of 300 hp. All these various services being now consolidated under the management of Mr. C. L. Edgar, the growth since that time can be summarized by stating that the Boston Edison Company at the beginning of May, 1904, was operating 642,406 incandescent lamps, 9,546 arcs and 23,891 hp of motors. Our readers can see for themselves at a glance how manifold has been the increase.

The convention of 1887 was called together by President J. Frank Morrison, at the Parker House on August 9, and the list of those in attendance revives memories of men who did valuable work in the development of the industry, and have passed away. Mr. Morrison, in his address, called attention to the development of the alternating-current system, then in its infancy, but, strangely, his remarks did not include anything about electric motors—possibly for the disinterested reason that he was devoting a great deal of his remarkable personal energy to their introduction. An interesting report was made by the legal committee on the "Status of the Patent System," signed by Messrs. J. F. Morrison, Frank Ridlon, Walter C. Kerr, Frank J. Sprague and A. Steuart. This is a rather striking group of names, and it is pretty safe to say that the gentlemen have never been associated technically since. Dr. A. V. Garratt then presented an extremely interesting and valuable report on "Wire Gauge," which he accompanied by an elaborate table, the calculations in which were made by himself and Messrs. H. H. Eustis and P. Keilholtz. A further interesting report on the subject of wire was that of the Committee on Insulation, consisting of Prof. E. J. Houston, W. D. Marks, Carl Hering and M. M. Garver. The report was an admirable document and most of its ideas and recommendations have now become part of the art; in fact, the National Code may be said to have here had its beginnings.



Brush Lighting Plant, Ferdinand Street, Boston, 1887. *(From a Wood Cut in The Electrical World.)*

The subject of alternating current came up again in the report or paper read by Mr. M. M. Slattery, so well remembered from his connection with the subject in the early days of the Fort Wayne Company. The wonderful development of the system since that time has justified the advanced stand then taken by this lamented pioneer—with perhaps one point of difference, that whereas he urged that the adoption of the alternating system with its smaller wires would release the companies from the attacks then waging on overhead wires, it may be said that modern central station polyphase work has been one of the greatest compelling causes for undergrounding the circuits.

Mr. E. R. Weeks, of Kansas City, now a past president of the Association, presented a thoughtful paper on "Electrical Education," and here again one finds the keynote of progress struck. Aside from the better education of engineers and employees and the establishment of mutual improvement societies amongst the men, Mr. Weeks advocated examinations by municipalities as to the competence of men engaged in electrical occupations, since the safety of life and property in growing degree depended upon their faithful and intelligent work.

Lieut. J. B. Murdock, at the beginning of the second day—when the convention was called to order by Mr. Ralph W. Pope—read a valuable paper on "Electric Lighting for the New Cruisers." We are now familiar with the idea of the new navy, but at that time it was not a "fleet in being," nor were marine lighting methods very well developed; and this paper summarized all that had been done and most of what was known up to that time. There is perhaps no particular reason why the Association to-day should not still consider such subjects, but it is the fact that of late years it has pretty well discontinued all discussion of work connected with isolated plants, except so far as such plants come in competition with central stations. To this extent the Association has narrowed its functions, so that papers read on the subject of isolated plants are to be expected before bodies like the American Institute of Electrical Engineers, or the New York Electrical Society. The Association can well assert that the greater magnitude of the industry to-day gives it subjects enough for treatment without going beyond the central station borders. It may be noted in this connection that at the meeting a large part of the time, as usual, was taken up with a discussion on the new constitution. In those days the constitution was a burning question, because one or two pretty palpable efforts were made, by men with more daring than judgment, to capture the machinery of the Association in order to promote certain objects which were hardly calculated to enhance the usefulness of the organization; and for some few years the proceedings of the body were considerably enlivened by this kind of politics. Fortunately, for some time past the Association has been able to give its attention strictly to the treatment of the technical and commercial questions in which it is broadly interested.

One of the most important features of the proceedings was that dealing with storage batteries. Mr. C. O. Mailloux read a masterly paper on the "Status of the Battery," and justified, as he has always done, his strenuous advocacy of that useful implement. And while it has not realized all the hopes of its friends in connection with traction work, it has certainly proved of immense value in connection with electric lighting. Though some of those present may have thought that Mr. Mailloux overstrained his statement of the case in this respect, subsequent events are all that Mr. Mailloux needs to point to for vindication. A melancholy interest attends the other paper on storage batteries, which was submitted by the late Mr. Anthony Reckenzaun, and which dealt specifically with batteries for electric locomotion. This brilliant young engineer, whose loss was so keenly felt on both sides of the Atlantic, made a modest presentation of a great deal of his own work, creating a highly favorable impression. But it is melancholy to reflect that, although we have now hundreds of electric automobiles in operation, there is probably not a single storage battery car turning its wheels today in the United States. In connection with this paper, the subject of electric motors came up and was interestingly discussed, but incidentally let us note that the subject of the stationary power motor was passed over almost without a word of reference, apparently because the versatile Mr. Sam Duncan, of Pittsburg, thought it better to turn in the documents in regard to that item to the Executive Committee. This, however, was redressed largely by the splendid exhibit of Baxter motors made at the hotel.

The last item on the programme was a discussion of "Underground Wires," in regard to which there was a sharp little discussion, and then Mr. Duncan touched on a delicate matter in calling attention to "pools" which had been formed on arc light carbons. This gentleman remarked that if the arc light men had got to break down such a pool every two months they ought to be in shape to do it. The result was that a committee of three was appointed to deal with the matter. We should hardly like the job of compiling a list of all the pools which have been formed in the electric lighting field since that time, some of which have succeeded, and others of which were badly "busted." A few could be mentioned which are understood to have a lively and healthy existence at the present time.

Part of the convention was a very fine exhibit of electrical apparatus, including several scores of exhibitors. This feature of the convention is still maintained, although hardly with the vigor and magnitude of earlier years, since apparatus is now standardized, and people are tolerably familiar with it. The great feature of the outside exercises, however, was the trip given to about 250 of those present by the old Thomson-Houston Company. The excursion included a trip on a steamer, a visit to the Thomson-Houston works at Lynn—where were found Prof. Thomson and E. W. Rice, Jr., and A. L. Rohrer—and a banquet at the Point of Pines. The factories, at that time as now, under the direction of Mr. C. A. Coffin, embraced about 80,000 sq. ft. of floor space, and the main item in connection with them was that they turned out 300 arc lamps weekly. Mr. Coffin's report for the General Electric Company this year, 1903-4, shows a floor space for the General Electric Company of 3,700,000 sq. ft., and 17,000 employees. The Lynn works alone during the past year have had an increase to their buildings of over 300,000 sq. ft. The banquet down by the seashore that night was a remarkably interesting affair, and was signalized by the fact that Mr. Coffin so far forgot his wonted reticence as to make quite a long speech, which was couched in felicitous terms, included two or three good stories and evoked thunders of applause. The response and recognition in behalf of the Association to this hospitality and to Mr. Coffin personally were not only due and appropriate; but, in view of the intimate intertwining of the relationships between the great manufacturing company and the electric lighting art, which has continued from that day to this, the record does one good to read and recall these seventeen years later. In fact, this brief review which touches only the salient points of a busy week, may serve to bring up in the minds of our readers some reminiscences of other events worthy to be gone over again by the survivors of a memorable convention.

"Let the Trolley Lights be Burning."

In the future we may hear of trolley cars as lifeboats. An ingenious use of a car and its arc headlight was recently made at Redondo, Cal., on the Pacific Coast. A lumber schooner anchored off the beach broke her chains at night and was blown on to the lee shore. Efforts were immediately made to rescue the men, and one of the interurban cars of the Los Angeles & Redondo Railway Company was run to a point whence the beams of its headlight could be thrown on the vessel. In this manner assurance of help was given to the crew of the boat and the light aided the rescuers in getting a life line to them. Probably we shall now hear of English bathing machines available as trolley cars by day along the beach and as lighthouses by night. These machines anyhow could be hauled up and down by motors, and could light up the esplanade at night.

Radium "Mother Ore."

The *Neue Wiener Tageblatt*, Vienna, reports that at a meeting of the Mineralogical Society Dr. F. J. Becke spoke of uranium pitchblende ore, the mother ore of radium. Prof. Becke, jointly with Prof. Suess, has made very searching investigations at Joachimsthal, the place where uranium is mined. It occurs mainly in mica slate, in the deep workings of the former levels of the silver mines of Joachimsthal. He mentioned the experiments which were made with uranium pitchblende ores at the Imperial Museum of Natural History. These ores have been in possession of the museum since 1806. The experiments demonstrated that, in spite of their age, they have lost absolutely nothing of their intensity of radioactivity and of the energy of their electric properties. They do not differ in any way from the ores now taken at Joachimsthal.

A Resumé of Incandescent Electric Lamp Exhausting.

By S. E. Doane.

The exhausting of incandescent electric lamps has developed into a highly specialized branch of the lamp manufacture. In order to crowd a description of the development of this portion of the art into the limits of one article, it will be necessary to abbreviate portions of this description considerably. The history of the art up to the development and adoption of the present chemical exhausting method will be passed over rapidly. The latter method will be considered as thoroughly as the allotted space will permit.

The first incandescent lamp of the modern type ever constructed was exhausted on a mercury pump. Mercury pumps were used for lamp exhausting for nearly twenty years before they were superceded by the present chemical process. These mercury pumps were of two general types. Each type had its advantages and disadvantages, but overshadowing all was the need for better brains than could be obtained for the attendance demanded by all mercury pumps.

Either type of pump required active, intelligent men of strong physique. Men with these three qualities were fitted for far more pleasant duties, so that the supply of such men was always far short of the demand. The result was that the pump rooms always contained many men who, while possessing some of these qualities, were not completely qualified for the exacting service. Many of those who were qualified, and who, for brief seasons, filled the hearts of the lamp manufacturers with joy and hope for the future, would be found after the first pay day to be confirmed drunkards. Drinking men seemed more numerous in the pump rooms than elsewhere. I can see, as I look back, that this was because we tolerated more of it in the pump rooms than elsewhere. We were thus obliged to put up with insufficient mental capacity on the part of strong, faithful workmen, accepting the widened voltage range, shortened life and decreased candle-hour performance of the lamps improperly exhausted, year after year, gradually improving our condition as we developed the processes. The changes and improvements did not essentially modify the general practice, which was as follows:

The mercury pumps used by all lamp manufacturers in this country, which commenced operation not later than about 1885, were of the Sprengel type. Many of the companies began about this date to change to the Geissler form of pumps. Companies starting at a later date without exception so far as the writer can learn, used the Geissler form. The reasons for this will appear as we discuss the faults of the Sprengel pumps.

The Sprengel pump consisted essentially of a stream of mercury falling through a glass tube. All systems of this class had the following good qualities and faults:

The pumps gave a good vacuum, were cheap, simple to construct and to repair. When a pump failed only one lamp was injured. Every lamp was individually exhausted, which insured its being exhausted at just the proper voltage, when conditions were uniform, providing the operator was competent. We were content to have a pump which would procure for us a good vacuum, when the business was young. It was some time before we awoke to the fact that there were other requirements.

As we discovered the various new requirements, we also discovered fundamental faults with our apparatus and methods. These faults were finally found to be so serious that so far as I can learn every company in the country but one abandoned the Sprengel form of pumps for the Geissler form before ultimately adopting the chemical exhausting process.

At least every third man in the pump room (the men worked in teams of three in the best developed system) had to be an expert. The men were much exposed to the poisonous fumes of the mercury. Their hands were almost always black with an amalgam of mercury and grease. Many men were incapacitated because of mercury poisoning, and as this became known it became more difficult to secure the requisite grade of intelligence.

The men were required to be on their feet all day, working almost constantly with their hands on a level with their shoulders, a blazing row of lamps in front of them and sometimes behind them. While every effort was made in summer to keep the pump rooms cool, air drafts were tabooed and there was no way of escaping the light and radiant heat from the lamps. Add to this the danger to health and it will be seen how difficult it was to obtain the kind of men required.

Pumps did not all work at the same speed. The glass tubes from which the pumps were made were of different diameters, which was one reason for the differing speeds. The cleanliness as well as the diameter of the principal glass tube of the pump affected its speed. The diameter of the hole in the glass tube attached to the lamp through which the air was exhausted also affected the speed. The differing speeds was a matter of much importance for the following reasons:

The completed lamp must not only be free from gases and vapors, but must also have had those parts capable of giving off gases and vapors, thoroughly freed from them. The only way we knew to accomplish this was to highly heat everything we wished to free from gas. We had three things to heat: the glass, the filaments and the joints between filaments and leading-in wires.

The glass was heated by an asbestos cone-shaped hood painted black on the inside. The heat from the lighted lamp furnished all the heat necessary. The lamps could be heated hot enough to cause the bulb to collapse if the hoods were made too thick. The filaments were also heated sufficiently by the current, but the joints were not heated sufficiently unless the current was passed through the lamps at a time when the gases were of just the right pressure to allow current to pass across the vacuous space from joint to joint. The current would not pass across this space, if the gas pressure was either too low or too high, and we had very little latitude in this respect. If we put sufficient voltage on the lamps to pass this current from joint to joint before the gas pressure in the lamps was sufficiently high, we burned the surface of the filaments. Filaments thus burned varied in color from light bronze to sooty black. If we waited too long and the gas pressure had been a little too much reduced, we could only pass this current from joint to joint by putting a destructively high voltage on the lamp, and if it had been too much reduced we could not heat the joints at all.

We found difficulty in making uniform filaments, which difficulty we still have, in a much reduced degree. This non-uniformity made it necessary for us to burn each lamp on these pumps at a different voltage, as at the same voltage a lower voltage lamp would get hotter than a higher voltage lamp and a hotter lamp would exhaust more quickly than one relatively cooler. Thus it will be seen, lamps were exhausted at various speeds for the reasons that (1) the pumps themselves were of different speeds; (2) the tubes through which we exhausted the lamps were contracted to slightly different diameters, and (3) the lamps were only exhausted at the same temperatures when the judgment of the operator was good.

The Geissler pump enabled us to get around these difficulties, but also introduced some of its own. The advantages were as follows:

1. The pumps were all of the same speed. 2. While the lamps were not exhausted through tubes any more uniform, the "slow" lamps being connected to the same reservoir as the "fast" lamps they balanced up fairly well, as we had twenty or more lamps on one reservoir. 3. We could not exhaust the lamps at so nearly the same filament temperature, but the conditions under which we exhausted made all the lamps of the same temperature of glass, and consequently of the same temperature and pressure of gas. This was because all the lamps on one Geissler pump were heated in one hood. This hood was raised to a high temperature by gas flames. We did not depend upon the filaments to produce the initial temperature which very much reduced the liability to burn the filaments.

In addition to these three important advantages we could keep all hoods at the same temperature, start all pumps simultaneously, give all pumps the same number of strokes, flash all lamps simultaneously, thoroughly protect the mercury from contact with the air, and we required only one high-grade man in the pump room, where formerly one-third of the operators had to be high-grade men.

We now felt that a great stride had been made in the exhaustion of incandescent lamps, but additional experience with the Geissler pump brought to light faults which still left much to be hoped for. The faults were as follows:

1. They were more expensive to operate, for the following reasons: (*a*) If one lamp leaked, the whole lot of lamps on this pump could not be exhausted. If the leak was only a small one, we would damage all the lamps on the pump. (*b*) The pumps were fragile, and if a lamp was accidentally broken, or if in any other way air was admitted accidentally, the pump was liable to be ruined. Lamps had to be more carefully inspected for leaks and glass work had to be more carefully done.

2. We still were unable to make lamps of exactly the same voltage. The lamps on one pump would necessarily have to be handled as a unit, which would mean that lamps designed for the same voltage would all have to be exhausted at the same voltage.

It became increasingly apparent as the effort was made to improve quality and reduce cost, that it would be strongly advisable if some means be found for individually exhausting lamps which did not possess the prohibitive faults of the Sprengel pump system. Some of the companies went so far as to construct some very small Geissler pumps to take one lamp each. It is hard to say what the outcome of this would have been, had not the chemical process been developed about this time.

The mechanical pump systems came into use about this time. All of them were open to the objections which held with the Geissler. Pump makers did not seem to appreciate the fact that whether a pump used mercury or not, it was simply and solely a pump. Some very good mechanical pumps were made, but most of them had a capacity greater than that of any Geissler pump. In order to get a reasonable output for the money invested, it was necessary to exhaust an even larger number of lamps simultaneously. This offered no escape from the troubles of the Geissler pump systems, and hence came into only limited use.

The chemical process was brought to us by a lamp maker. He knew the drawbacks of the mercury systems. This process possessed the advantages of the Sprengel system, the advantages of the Geissler pump system, and also some advantages of its own, without the conspicuous disadvantages of any of the previous systems.

While the Sprengel pump system only required that every third operator should be an expert, the chemical system required that every operator should be an expert, but it made it possible for us to secure experts, by entirely removing the disadvantages which made it so difficult for us to get a good class of operators. We found we had no difficulty nor do we now have any difficulty in securing plenty of young women of good intelligence who find the chemical exhausting work rather pleasant than otherwise. Every operator sits down to her work, has only one lamp on the pump at a time and is able to exhaust every lamp according to its individual requirements.

Two articles of any kind differ in some slight degree. This is true of incandescent lamps with special reference to the manner in which they exhaust. It may be that in one the joints between the filament and the platinum wires are larger or the joints are a little closer to the glass stem, or that the lamp has not been heated quite so hot in the preliminary heater or perhaps the bulb is of slightly different internal dimensions. Be the causes what they may, the differences are sufficiently marked to be quite apparent to the operators. This was all fully realized during the closing days of the mercury pump systems, but the vital difference this made to the candle-hour performance of the lamps has never been so fully appreciated as since we began to use the chemical process of exhausting. The chemical process of exhausting consists roughly of mechanically exhausting a heated lamp to a pressure represented by a column of mercury about .125 mm. high. This is equivalent to about 1/6000 of an atmosphere. The lamp is sealed off from the pump and phosphorous is vaporized and passes into the lamp bulb while the filament is very hot and while an electric current is passing through the gaseous contents of the bulb. The vapors of this metal enter into an electrochemical combination with the gases, forming solid precipitates, if the conditions are proper.

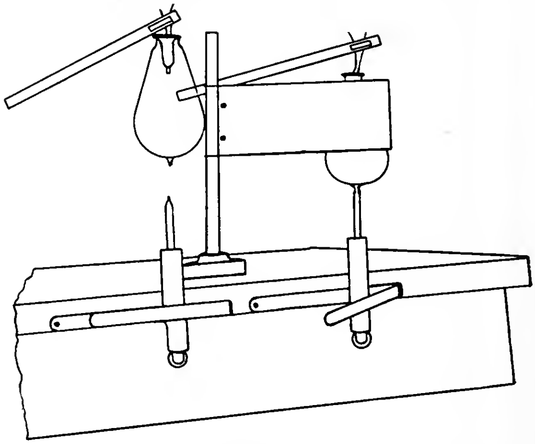
This whole operation from the time the lamp is first lighted up on the pump to the time it is completely exhausted requires approximately sixty seconds. During this time the following changes take place in the lamp bulb:

About one-half minute after the lamp is first placed upon the pump and before the lamp is shut off from the pump, current is passed through the filament. Current also passes from joint to joint across the vacuous space, heating both joints white hot. The joints are held at this temperature for a few seconds after which the current is reduced and the pump is given a few seconds to remove the gases which are dislodged by this heating. This takes about five seconds under usual conditions. The tube connecting the lamp to the pump is then closed very close to the lamp. The current is again increased until it again passes through the vacuous space from joint to joint. The first effect of this current flow is to again raise the temperature of the joints to a white heat. After about a second, without changing the voltage around the lamp, the blue flame which was playing between the joints, gradually expands, the color gradually changing from the first dark blue shade to a beautiful light blue, the joints meanwhile cooling somewhat. As soon as the lamp reaches this condition, the phosphorous which has previously been painted on the inside of the glass tube leading from the lamp is vaporized and the vapors passing into the lamp bulb react with the gases in the bulb, causing the blue to disappear. The effect of the sudden disappearance of the blue color is to make the lamp look very yellow. It is a common expression in the lamp factories to say relative to this portion of the exhausting process, that the lamp "turns yellow."

In order that the current may pass from joint to joint across the vacuous space the pump must necessarily produce a higher vacuum than is usual with mechanical pumps. The pump used in this work is of the ingenious variety which depends upon an oil-covered piston to displace all the air in the pump cylinder. The pump is so constructed that a little oil is always passing into the cylinder and is forced up through the exhaust valve with the gases which are being expelled. This oil is used over and over again. It is free from occluded gases, contains no volatile oils, and has a low surface tension. Care is taken to select an oil with these characteristics.

A mechanical pump of this description never produces a vacuum so high that there is any difficulty in passing current from joint to joint in the lamp being exhausted upon it. Care has to be taken with these pumps to be certain that they are always in such condition that they will produce a sufficient vacuum.

The present exhausting system has its faults. Any exhausting system will have faults, until a system is devised which automatically



CHEMICAL EXHAUSTION OF LAMPS.

keeps itself in repair and also automatically and perfectly exhausts lamps without the interposition of human judgment. The faults which concern us the most are as follows:

1. We must still have expert operators. 2. We still depend upon a system of pipes and valves which will occasionally develop leaks. 3. Pumps occasionally get out of order. 4. The chemical reactions which produce the vacuum are sensitive and atmospheric and chemical conditions occasionally give us new problems.

A better understanding of how this chemical exhausting is performed will be gained from the following description referring to the accompanying sketch. The operators are all seated in front of a long bench behind which are a number of little pumps. These pumps occupy about four feet of floor space and stand less than three feet high. They run continuously, being piped by the shortest possible connections to the face of the bench. Each operator utilizes one cylinder each of one of these pumps.

In the sketch the lamp on the left is exhausted and ready to be removed from its clip. The lamp on the right is shown thrust into a bit of rubber tubing. This tubing passes through a pinch cock on the edge of the bench.

In front of the lamp is a piece of metal that shields the eyes of the operator when the lamp is brightly lighted. The piece of metal can be swung around so that it can shield the operator from the light from either lamp.

While the lamp on the right is being exhausted, the lamp on the left is being removed from the clip which suspends it by the leading-in wires, another lamp is then thrust into the rubber tubing and connected to the clip. By this time the lamp on the right is sufficiently exhausted and current is passed through it by means of a rheostat on the left of the operator, and the process of exhausting is completed as indicated earlier in this article. After the exhausting is completed the tube through which the air is exhausted is sealed off by the blow pipe flame which much resembles the jeweler's blow pipe flame, familiar to every student.

Bits of glass, dust, moisture from the air, phosphorous, etc., collect in the pipes and interfere at times with the action of the pinch cock valve. It is necessary to watch very closely to see that the lamps are being exhausted under the desired conditions.

Each type of lamp behaves a little differently from another type.

The tubular lamp is difficult to exhaust because the phosphorous gases are heavy, the residual gases in the lamp are light; the phosphorous is in the form of gas at a high temperature only, and the lamps cool quickly from the high temperature of the heater in which it was heated before being placed upon the pump.

The space in this lamp is narrow and long and as the glass of the lamp is always somewhat cooler than the phosphorous vapors, this added to the other difficulties mentioned makes it necessary that the tubular lamps be handled by our most skilled operators.

Lamps with small bulbs are difficult to exhaust for the last-named reason and also because they are so small that it is difficult to avoid vaporizing too much phosphorous. If too much phosphorous is vaporized the bulb of the lamp is discolored. Each size of lamp and each shape of bulb behaves a little differently from any other size or shape of bulb. The two examples are given above as illustrations only.

As the tube, through which the lamp is exhausted, which also carries the phosphorous must necessarily be of a resonable thickness, in order not to collapse when the blow pipe flame is applied to vaporize the phosphorous, it also must possess considerable heat capacity. As often only a very small amount of phosphorous vapor is required for the reaction there is every opportunity for an unskilled operator to use too much phosphorous, thereby making a lamp unsalable. An operator on a small lamp, or on a tubular lamp, or on a lamp in which the reaction is progressing freely, must be especially careful to withdraw the flame from the phosphorous-carrying tube long before the reaction is completed, as the phosphorous will continue to vaporize until the tube has cooled considerably. If an operator is sufficiently skilled, she can tell by watching the progress of the reaction in the lamp bulb as indicated by the changing color and form of the blue light which fills the bulb, when the reaction is about to be completed. A skilled operator will exhaust lamps with almost no rejections from one day to another. Such an operator is always very fast and always produces lamps of high quality. The contrary is true of one who is not skilled.

One reason that an operator who can always quickly vaporize just enough phosphorous and who does not vaporize too much phosphorous produces high-quality lamps is that the voltage at which it is necessary to operate these lamps in order to produce the temperature and the cross currents is such that if a lamp were burned at this temperature for many seconds the lamps would have passed much of its useful life. It is obvious that every second that can be saved when the lamp is being burned at this temperature adds hours to the life which the prospective customer will obtain from this lamp. This assurance that all the lamps exhausted by an expert operator will give practically the same life and candle-hours, other conditions being equal, is of great value.

Under the mercury pump régime the lamps burned not less than twenty minutes each at a voltage not less than 10 per cent. above normal. During only the last few minutes would the vacuum approximate that at which the lamps would ultimately burn. The lamps on the mercury pumps were also burned in addition to this at a voltage at least as high as that ever reached by the chemical methods and for a longer time.

Burning lamps at high incandescence before the vacuum becomes sufficiently good discolors the filaments. This raises the voltage at which the lamps deliver the candle-power for which they are designed, providing a good vacuum is ultimately produced in these lamps. When such lamps are shipped to the customer they are labeled to be operated at higher voltages than would have been the case had the lamps been exhausted by the modern process. In the days of the mercury pumps one of the principal causes for rejection of the lamps from some of the pump room operators was the blackened filaments resulting from this cause. In rejecting lamps for this cause, lamps with filaments only slightly burned were necessarily passed for shipment.

Such lamps would rise rapidly in candles at the beginning of their life and fall almost as rapidly after the first 50 or 100 hours. This condition has been almost entirely eliminated. Much of the improvement in lamp quality in recent years can be traced directly to better methods of exhaustion.

Lamps in which the gases have not been thoroughly eliminated from the joints between the filaments and the platinum wires will fall rapidly in candles when put into service. Much of the rapid decline in candles in the lamps exhausted on mercury pumps was due to the joints between the filament and the platinum discharging gases while in service.

The closer specifications to which modern lamps can be shipped can also be partly traced to this improvement in exhausting as indicated in the preceding paragraphs. When the history of the development of the incandescent lamp is written the most interesting chapters will be those which deal with this portion of the story. Only a very brief outline of the subject has been given above. Many hundreds of experiments and life tests and the expenditure of a great deal of money is summed up in this brief description.

Electric vs. Steam Locomotives.

Discussing the above topic, Mr. E. C. Boynton says, in a recent letter to the *Street Railway Journal:* "The writer, who has some knowledge of both sides of the question—that of the contest for supremacy between the steam and electric locomotive—is of the opinion that the fight has only begun. Certainly most steam engineers are to-day as confident of victory as ever, and do not consider the contest at all one-sided, as our electrical friends seem to think it. The strongest argument of the steam engineers is their contention that they will never be beaten in the long-distance haul. They do not necessarily mean high speed or great mileage per locomotive day, but length of track. They believe that there is a limit to the distance which it would pay to equip with electric traction a railway doing a general freight and passenger business, and in the present state of the electrical art they are right. They are not yet ready to admit defeat even in short-haul suburban passenger traffic, and will await the result of those, to them, experiments which are about to be tried at enormous expense by several railways.

"To one who has watched the improvements in both kinds of locomotives during the past five or six years, it is difficult to decide whether the steam or electric locomotive has improved the faster. The steam locomotive of to-day presents about the same comparison to that of the earlier date as does the modern interurban car to that of six years ago. The improvements in the steam locomotive, as exemplified in the 'Atlantic' and 'Lake Shore' types have been many. They include the wide fire-box, with its immense grate surface, and the increase in size and capacity of the boiler. The boiler pressure has been carried up to 250 pounds per square inch, and the steaming capacity of the boiler, even with poor fuel, has been made sufficient to supply the largest cylinders which could be used with the tractive weight of the engine. The use of the piston valve and the various types of compound cylinders has added greatly to the general efficiency.

"It must not be supposed that this increase in efficiency means higher speed with a decrease in consumption of fuel, water and oil. The steam engineer was not trying to do that, but to reduce the cost per ton-mile hauled, and he has succeeded. He hauls freight and passenger trains of far greater weight than before, and at higher speed at less cost.

"A somewhat mistaken idea has been held by many that the steam locomotive designer is trying to save weight. This is not always so, but frequently railways ordering new power specify the maximum weight, generally on account of the strength of their bridges, and sometimes the weight of their rails."

Government Telephony in France.

A cable dispatch from Paris says: "Drastic proceedings in the telephone administration of Paris, shown in the case of Mlle. Sylviac and others, are exciting a storm of protest in all directions. Among others a meeting has been held at the Palais de Justice at which 200 young lawyers were present. Four speeches were made against the assumption by the government of power to fine subscribers at will, and by 180 votes against 20 the telephone administration was scathingly censured."

Measurement of the Insulation Resistance of an Electric Wiring System.

By Edwin F. Northrup.

The writer recently had occasion to measure the insulation between each bus-bar and the gas pipes of the wiring system of a large city office building at a time and under circumstances where it was not practicable to shut off the power.

The measurement was made by two methods. As these methods are both generally applicable for determining the insulation resistance of each side of any wiring system while the power is on, we have deemed them to be of sufficient value to warrant description.

I.—Voltmeter Method.

Let A (Fig. 1) represent any wiring system in which X_1 and X_2 are the insulation resistances between the bus-bars, B_1 and B_2 and

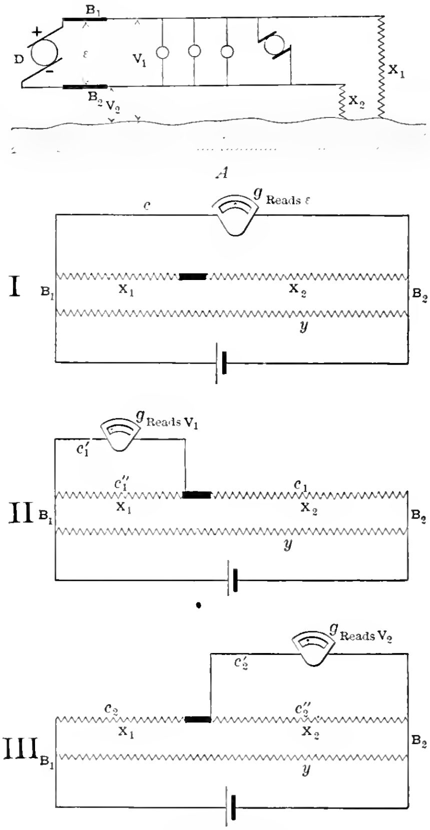


FIG. 1.—VOLTMETER METHOD.

the earth (the gas or water pipes being taken as at the potential of the earth). In Fig. 1, *I, II* and *III* are equivalent diagrams in which y represents the unknown resistance of all the lamps, motors, etc., across the line.

If direct current is supplied to the bus-bars, a Weston direct-current voltmeter should be used. If the current is alternating, then an alternating-current Weston voltmeter will be required. The resistances, X_1 and X_2, are determined by knowing g, the resistance of the voltmeter, and by taking three voltmeter readings.

1st. Measure the voltage, which we will call E, across the bus-bars (Fig. 1) *I*.

2nd. Connect the voltmeter between the bus-bar, B_1, and the earth, and take its reading, which we will call V_1 (Fig. 1) *II*.

3d. Connect the voltmeter between the bus-bar, B_2, and the earth and take its reading, which we will call V_2 (Fig. 1) *III*.

If the readings in either of the two latter cases are only a fraction of a scale division, then the insulation resistance is too high to be measured by this method and we may resort to the second method to be described. Having taken the above three readings, it can be shown that

$$X_1 = \frac{g\ (E - V_1 - V_2)}{V_2} \qquad (1)$$

$$X_2 = \frac{g\ (E - V_1 - V_2)}{V_1} \qquad (2)$$

The current, I, which leaks to the ground will be:

$$I = \frac{E}{X_1 + X_2}$$

In the particular case above referred to, in which the insulation resistance of the wiring system of a large office building was determined by means of a Weston voltmeter, the following readings and resistances were obtained:

g = 12,220 ohms,
E = 113 volts,
V_1 = 1 volt,
V_2 = 4 volts.

$$X_1 = \frac{12{,}220\ (113 - 1 - 4)}{4} = 329{,}940 \text{ ohms,}$$

$$X_2 = \frac{12{,}220\ (113 - 1 - 4)}{1} = 1{,}319{,}760 \text{ ohms.}$$

The above example shows that where the sum of the resistances, X_1 and X_2, are not over one or two million ohms, the voltmeter method is sufficiently accurate for the purpose. If one side of the line is grounded—that is, if $X_2 = 0$—then from (2) $E = V_1 + V_2 = V_1$, as $V_2 = 0$, and the method fails to give X_1.

Expressions (1) and (2) above are obtained as follows: The meaning of the letters used are indicated in *I, II* and *III* (Fig. 1), C_1, C_2, etc., being currents and g the resistance of the voltmeter.

$$C_1 = \frac{E}{X_2 + \dfrac{g X_1}{X_1 + g}},$$

$$C_2 = \frac{E}{X_1 + \dfrac{g X_2}{X_2 + g}},$$

$$C_1{}^1 = \frac{X_1}{g + X_1} C_1 = \frac{V_1}{g}, \quad \text{or} \quad C_1 = \frac{V_1\ (g + X_1)}{X_1\ g},$$

$$C_2{}^1 = \frac{X_2}{g + X_2} C_2 = \frac{V_2}{g}, \quad \text{or} \quad C_2 = \frac{V_2\ (g + X_2)}{X_2\ g}.$$

Hence, we have the two relations,

$$\frac{E}{X_2 + \dfrac{g X_1}{X_1 + g}} = \frac{V_1 (g + X_1)}{X_1 g}, \quad \text{and} \quad \frac{E}{X_1 + \dfrac{g X_2}{X_2 + g}} = \frac{V_2 (g + X_2)}{X_2 g},$$

from which the values for X_1 and X_2 are obtained as given above in equations (1) and (2).

Any instrument, as a galvanometer, in which the deflections are proportional to the currents may be substituted for a voltmeter. In such a case, if D, d_1 and d_2 are deflections corresponding to the readings E, V_1 and V_2, and G is the total resistance in series with the instrument, we have as before:

$$X_1 = \frac{G\ (D - d_1 - d_2)}{d_2} \qquad (3)$$

and

$$X_2 = \frac{G\ (D - d_1 - d_2)}{d_1} \qquad (4)$$

If two or more electric lamps are connected in series, their resistances, while carrying current, can be determined by means of three readings, as above.

If $X_2 = \infty$, $V_1 = 0$, and $X_1 = \frac{g\ (E - V_2)}{V_2}$, which is the ordinary expression used in measuring a resistance with a voltmeter by reading the voltmeter with the resistance in series with it and again with the resistance cut out.

II.—GALVANOMETER METHOD.

This method may be used when greater accuracy is required or when the insulation resistance to earth, of at least one side of the line, is over a megohm.

The wiring system is represented in 1 of Fig. 2, and 2 of Fig. 2 gives equivalent circuits.

The method consists in connecting across the bus-bars a mod-

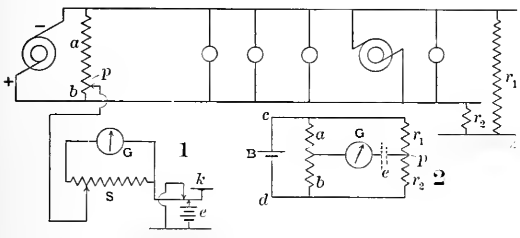


FIG. 2.—GALVANOMETER METHOD.

erately high resistance and finding on this resistance a point, p, where the potential due to the generator is the same as that of the earth, and then with the aid of a sensitive galvanometer and an external source of e.m.f., measuring the resistances, r_1 and r_2, to earth in the following manner: k is a key and S an Ayrton universal shunt. This latter may be omitted if the source of e.m.f. can be varied in a known manner.

It is evident from Fig. 2 that a balance will be had when $\frac{a}{b} = \frac{r_1}{r_2}$, the key, k, being in its upper position. If k is now depressed, the resistance, R, encountered by the current generated by the source, e, will be

$$R = g_1 + \frac{1}{\frac{1}{b + r_2} + \frac{1}{a + r_1}}$$

where g_1 is the resistance of the galvanometer; but in comparison with r_1 and r_2, g_1, a and b can be neglected, and

$$R = \frac{r_1\ r_2}{r_1 + r_2}.$$

By construction, $\frac{r_1}{r_2} = \frac{a}{b} = N$, a known ratio. From the last two relations we deduce

$$r_2 = \frac{R\ (N + 1)}{N}$$

and

$$r_1 = R\ (N + 1)$$

Taking d as the deflection of the galvanometer and K as the galvanometer constant, the current through the galvanometer is $\frac{e}{R} = \frac{d}{K}$, or $R = \frac{e K}{d}$.

K should be defined as the resistance which must be inserted in circuit with the galvanometer (including its own resistance), so that it will give, with one volt, a scale deflection of one scale division at the distance at which the scale is placed from the mirror during the test, usually taken as one meter.

Then we will have:

$$r_2 = \frac{e K\ (N + 1)}{N d}$$

and

$$r_1 = \frac{e K\ (N + 1)}{d}.$$

Taking $K = 10^8$ as an average value for an ordinary D'Arsonval galvanometer and $e = 100$, $n = 2$, and $d = 100$, we have:

$$r_2 = \frac{100 \times 10^8\ (2 + 1)}{2 \times 100} = 150 \text{ megohms,}$$

$$r_1 = \frac{100 \times 10^8\ (2 + 1)}{100} = 300 \text{ megohms.}$$

This example shows that a galvanometer of very moderate sensibility will measure in this way a very high insulation resistance. If, on the other hand, the insulation is low, small battery power may be used or the deflection of the galvanometer can be cut down to 1/10, 1/100, 1/1000 or 1/10000 by the Ayrton shunt. The only difficulty likely to be experienced in applying the above method is that, while making the test, the relative values of r_1 and r_2 will keep changing, due to motors or lights being thrown on or off the line. In this event it is only possible to obtain a sort of average value for the resistance to earth of each side of the line.

Evidence by Telephone.

The following is a suggestive comment by the New York *Times* on the receiving of evidence by telephone: "A notable incident of an otherwise uninteresting murder trial now going on in this city followed an attempt by the prosecuting attorney to utilize a means of communication that is considered, outside of court rooms, perfectly satisfactory for almost every purpose, including many of the greatest importance. The prisoner had testified that he had owned the revolver with which he did the killing—in self-defense, he asserted—since 1901, while the prosecution, having noted the number on the weapon, had learned from its manufacturers that it was made in 1903. This information, with its obvious bearing on the prisoner's credibility, and, in a slighter degree, on the question of premeditation, had been obtained by long-distance telephone during a recess of the court, and the prosecutor naturally wanted to get it before the jurymen. He therefore proposed the immediate installation of a telephone in the court room, in order that the jury might hear a repetition of his inquiries about the pistol and the manufacturers' replies. This plan was in complete accord with the habitual conduct of business affairs at the present time, and its convenience and economy would have recommended it to any layman desirous merely of ascertaining a needed fact, quickly and correctly. Telephones, however, were invented some years since the rules of procedure in murder trials were established, and no sooner had the suggestion been made than the prisoner's counsel leaped to his feet with a vehement objection, based on the fine old principle that it is a defendant's constitutional right to be confronted by the witnesses against him. Of course the judge held that the objection was well taken and the telephone plan had to be abandoned. The question of the pistol's age was of no particular consequence, and perhaps the prosecutor made his point with the jury about as well as if he had been allowed to do what he desired, but the episode illustrates again the curious inharmony between court methods and principles of action and those accepted and followed in the ordinary relations of life."

The Protection of Telephone or Telegraph Lines When in Hazardous Proximity to High Tension Lines.

By Robert E. Chetwood, Jr.

There appeared recently in this paper an article by Howard S. Knowlton entitled "The Prevention of Crosses Between Signalling and High-Voltage Circuits," the principal features of which were descriptions and illustrations of what are commonly termed "short span" crossings. The descriptions and illustrations given by Mr. Knowlton were those originally contained in specifications, now obsolete, which were prepared by one of the leading Bell telephone companies at the time when it first became necessary to make provision for the crossing of high-tension and telephone lines. Since these specifications, which form the basis of Mr. Knowlton's article, were issued, the increase in the number of both telephone and high-voltage lines has been so rapid that the entire subject of the protection of telephone circuits when in proximity to high-voltage wires has been carefully studied and various types of protected crossings designed. It is the purpose of this article to describe several types of protected crossings in the design of which the writer has been identified.

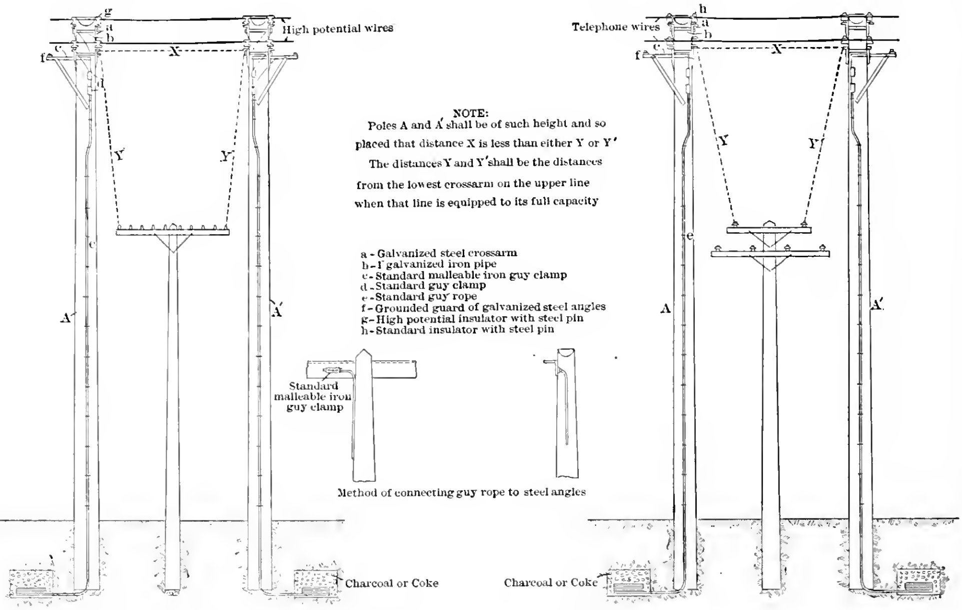
In Figs. 1 and 2 are shown the construction of short span crossings, Fig. 1 illustrating a short span in the high-tension line and Fig. 2 showing a short span in the telephone line. It will be readily seen that the construction illustrated, while embodying the fundamental feature, differs radically in the details from those described in the article referred to. The short span crossings described by Mr. Knowlton failed to provide any protection against one of the greatest and most frequent sources of danger, namely, the puncturing of the insulators on the high-tension line, resulting generally in the burning through of the wooden cross arm, thus allowing the high-tension wire to come into contact with the wires of the telephone line crossing below.

In the construction illustrated in Fig. 1, the cross arms and pins are of galvanized steel angles and are grounded by means of a galvanized-wire rope of ample current-carrying capacity for the line in question. Besides the use of grounded steel pins and cross arms the poles forming the short span are fitted with an extension guard of galvanized steel angles. This guard projects out from the pole about eighteen inches and is two feet longer than any cross arm, the object being that in the event of a wire breaking in an adjacent span it will be in contact with this grounded guard before and at the time it may swing into contact with the wires of the line below.

Other details in which it differs from the construction recommended by Mr. Knowlton is that it requires the poles of the short span to be double-armed and the line wires securely tied to the insulators on the arms. The dead-ending of heavy high-tension wires and completing the circuit by means of a loop is not considered good practice, inasmuch as the power wires are likely to be injured in dead-ending. The construction also requires the outside wires on the cross arms of the short span to be tied to the inside or pole side of the insulators, in order that in the event of tie wires breaking or unrolling, the line wires will be held on the grounded cross arms by means of the steel pins.

The method of grounding the wire ropes, as shown in the figure, is to make their ends up into coils of at least six turns and not less than eighteen inches in diameter and to bury them at or near the base of the poles. The holes in which the coils are placed should be not less than six feet deep and should be dug until moist earth is reached. Over the coils is dumped three bushels of fine charcoal or coke. In some instances it will be necessary to carry the wire ropes some distance from the base of the poles in order to obtain a good ground connection.

The short span type of crossing for high-voltage and telephone lines is undoubtedly the most desirable one and the short span



Figs. 1 and 2.—Construction of Short Spans at Crossings with High-Potential Lines.

should, if possible, be constructed in the high-tension line. To assist in obtaining a short span crossing with the short span in the high-voltage line, the spacing of the pins on the telephone cross arms can be reduced so that a six-foot cross arm may be used instead of the standard ten-foot arm. This, of course, will allow of a shorter span, and, therefore, shorter poles in the power line.

A crossing constructed as above is as near safe as it is possible to conceive. If it is found impossible to make the crossing with the power line overhead, by using the same precautions, the telephone or telegraph line can be the overhead line.

While the short span method of crossing is the ideal method it so happens that in the majority of cases the crossing comes at the intersection of streets or roads where the conditions would require the use of poles of such a height and such guying rights as to render the method obviously impossible. The best method of crossing under these conditions is to have the high-tension line cross over the telephone or telegraph line and to protect the lower line, as shown in Fig. 3.

This protection consists in stringing between the poles of the telephone line, as close to their tops as is possible, a grounded steel rope of such size that it will safely carry at least three times the normal current in the power wires, and below this grounded rope of placing an insulated screen of 12 No. 6 B. W. G. galvanized-iron wires. The telephone line wires are then carried as usual on cross arms located below the arms carrying the screen of No. 6 wires.

The action of such protection is as follows: The grounded rope, being of such size that it will safely carry three times the normal current in the power wires, will generally be between one and one-half and two times the diameter of the power wire; in fact a good rule to follow is to select a size of rope that is one and a half times the diameter of the power wire. In case a power wire breaks or sags, this grounded rope will be directly in its path and the contact between the two, depending of course upon the type of the transmission system involved, will or will not operate the safety devices at the power station. It will in any event probably lower the voltage on the power wires and render it incapable of doing any damage to the telephone wires.

It is also extremely probable that the grounded rope will fuse the power wire whenever an arc is formed between this wire and the grounded rope. It is believed that it is the heat generated by the arc rather than the amount of current that flows that will cause fusing. That being the case, the grounded rope, being of iron or steel, having a higher fusing temperature than copper or aluminum and having a greater radiating surface, will probably fuse the high-tension wire, allowing it to fall harmlessly to the ground. The insulated screen of 12 No. 6 B. W. G. galvanized wires, which extends a foot on each side beyond the telephone wires, serves as an additional protection to the telephone or telegraph wires while the power wire is in contact with the galvanized rope or after it has been fused by this rope.

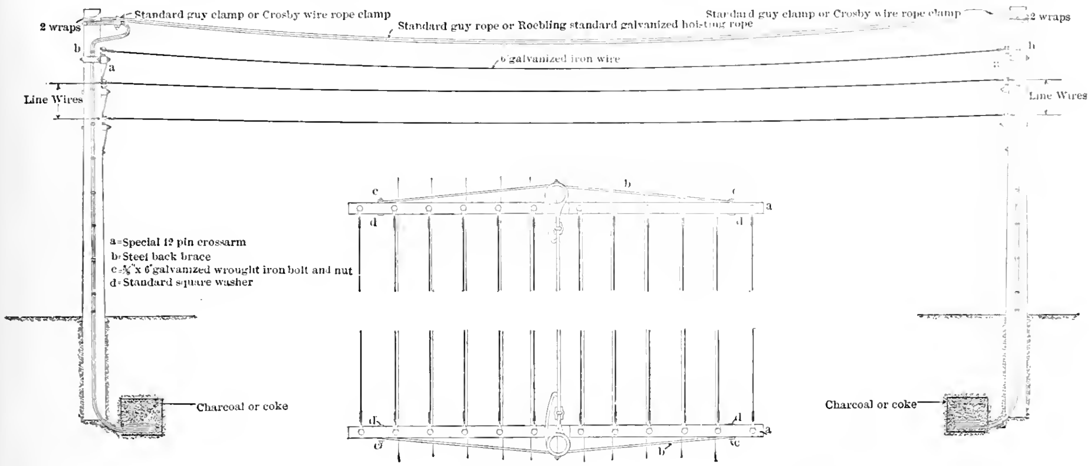


Fig. 3.—Protection for Telephone Wires Crossing Under High-Potential Wires.

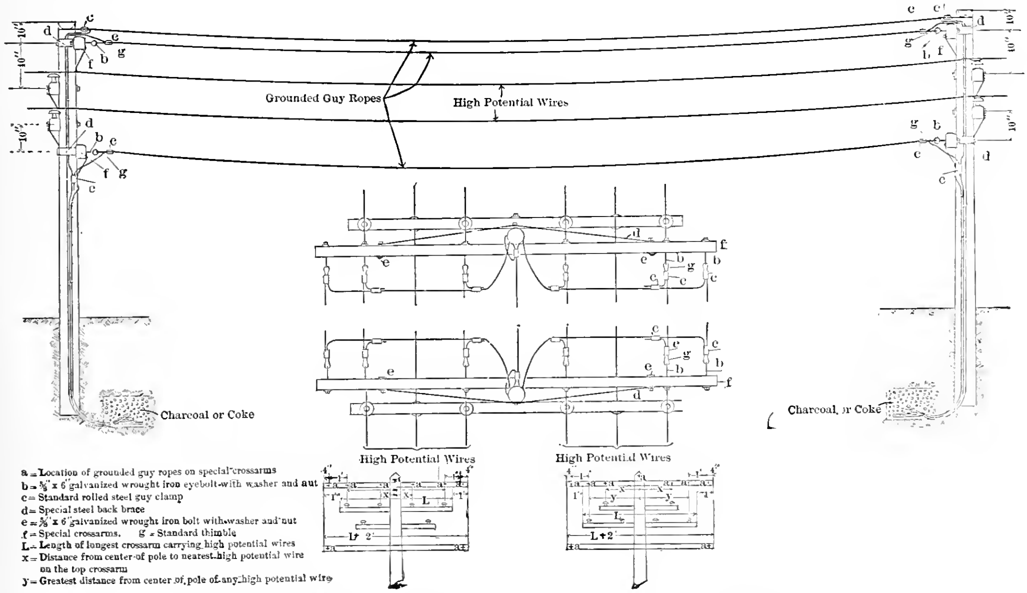
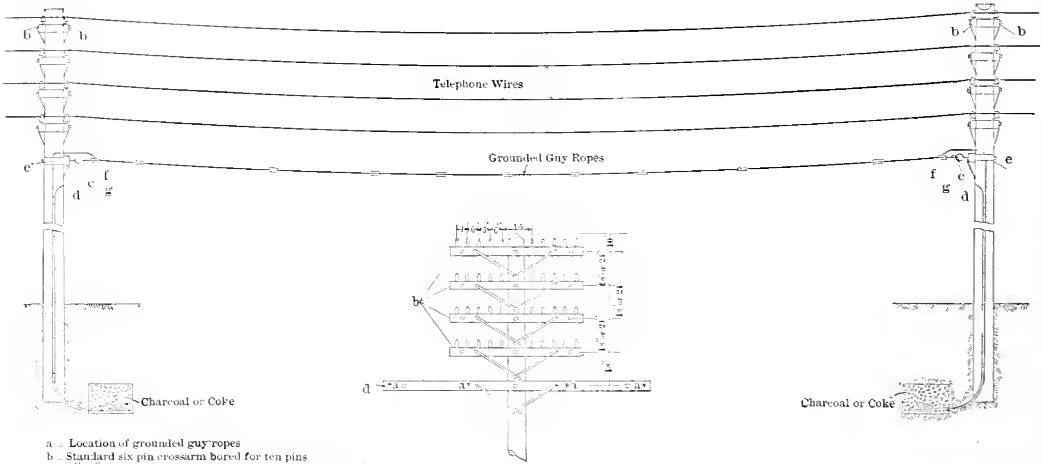


Fig. 4.—Protection for Telephone Wires Crossing over High-Potential Wires.

Of course the efficiency of the grounded rope depends greatly on the ground connection secured, and this part of the construction should be given great attention. In general a good ground can be obtained as previously described, but in some cases extraordinary measures must be taken to make sure of a permanent and perfect ground connection.

When, due to excessive cost or to local conditions, it is impossible to make a short span crossing, and, furthermore, it is necessary for the telephone or telegraph line to cross above the high-voltage line, the crossing should be protected as shown in Fig. 4, where the protection is placed on the high-potential line, or as shown in Figs. 5 and 6, where the protection is placed on the telephone line.



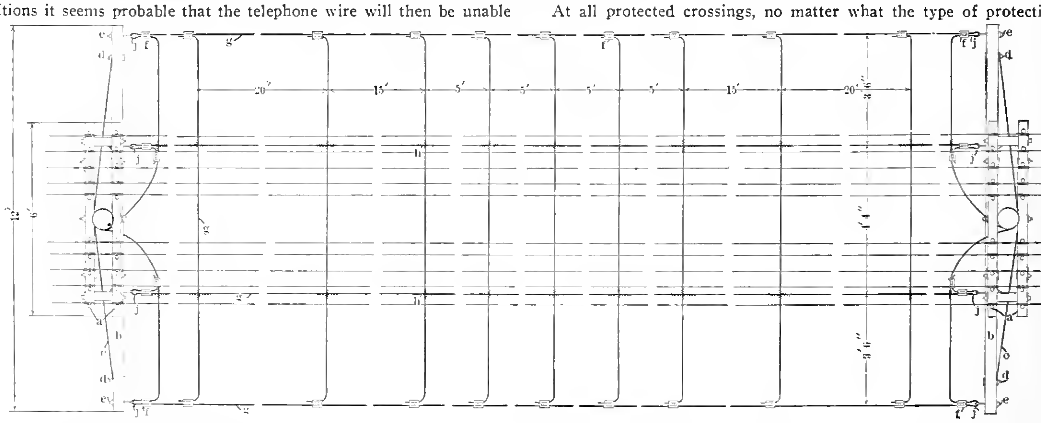
a = Location of grounded guy ropes
b = Standard six pin crossarm bored for ten pins
c = ⅝" x 6" galvanized wrought iron eyebolt with washer and nut
d = Special 12' crossarm
e = Steel back brace
f = Standard rolled steel guy clamp
g = Standard thimble

FIG. 5.—SIDE VIEW OF PROTECTION FOR TELEPHONE WIRES CROSSING OVER HIGH-POTENTIAL WIRES.

The protection shown in Fig. 4 consists of placing on the power line grounded wire ropes, so situated that a telephone or telegraph wire in falling will be in contact with a grounded rope before and at the time of contact with a high-potential wire. Under such conditions it seems probable that the telephone wire will then be unable to transmit any voltage of a dangerous value past the point of contact with the grounded rope. This grounded rope must, of course, be of such size as will insure the fusing of the telephone or telegraph wire and which will also carry without fusing several times the normal current carried by the power wire.

The location of the grounded ropes should be determined as shown in Fig. 4, and the construction should be mechanically strong. It is obvious that the power line must be dead at the time such protection is installed, a condition that is sometimes hard to meet. The details of the construction are sufficiently well illustrated by the figure to need no further comment.

In Figs. 5 and 6 are given two views of the type of protection that should be used when it must be located on the telephone or telegraph line. It consists of a grounded net situated directly below the telephone wires and with which a telephone wire must be in contact before and at the time it comes in contact with a high-potential wire on a line crossing under the telephone line at right angles. The construction involved is readily understood from the figures.



a = Standard six pin crossarm bored for ten pins
b = Special twelve foot crossarm
c = Steel back brace
d = ⅝" x 6' galvanized wrought iron bolt with washer and nut
e = " " " " Eyebolt " " " "
f Standard rolled steel guy clump
g = Standard guy rope
h = 6 galvanized iron wire
j = Standard thimble

FIG. 6.—TOP VIEW OF PROTECTION FOR TELEPHONE WIRES CROSSING OVER HIGH-POTENTIAL WIRES.

At all protected crossings, no matter what the type of protection may be, the poles of both lines should be specially selected in regard to strength and should be so guyer as will make their breaking or falling well nigh impossible. The guys attached to the poles of both lines should be grounded and the insertion of suitable strain insulators in the guys attached to the telephone line at or near the telephone poles is recommended as an additional measure of safety. In no case should the guys of one line be attached to the poles of the other line.

The above methods of protecting telephone or telegraph lines at points where they come into hazardous proximity to high-tension lines are those in use by one of the largest Bell Telephone companies. They are the result of considerable study and have been constructed at a number of crossings. While the expense of the construction, especially in making short span crossings, has been considerable, the measure of safety that has been procured not only to their own property but to that of their patrons overbalances any consideration of expense.

Electrical Illumination of the Louisiana Purchase Exposition.

By CLOYD MARSHALL.

THE spectacular effects which make one exposition more notable than its predecessor, are due largely to electric lighting. Electrical engineers have learned much about illuminating effects from expositions, for nowhere else are presented the problems of brilliantly lighting such great areas, both indoors and out. After much discussion and experiment it has been decided that the most satisfactory result of illuminating the grounds and architecture, can be secured by the use of incandescent lamps alone. By spacing the lamps at short intervals, the effect is a line of light marking each architectural outline. Within the buildings the result derived is wholly different, for the light must be such that the visitors can examine minute details, and read inscriptions anywhere. Arc lights of high candle-power, with suitable reflectors, give, in general, the best results.

The lighting at the Louisiana Purchase Exposition has been carried out on this general plan. The area of the Exposition grounds is about two square miles, of which the buildings cover approximately 130 acres, and it has been a herculean task to properly light so great an area.

The main picture of the Exposition, embracing the Grand Basin, the Plaza of St. Louis, Festival Hall, the Colonnade of States, the Electricity, Education, Manufacturers' and Varied Industries Buildings, has been lavishly festooned with electric lights. Festival Hall, with its dome rising 325 ft. above the Plaza, is marked in every outline with incandescent lamps. There are two flanking colonnades extending in an arc a quarter of a mile in length, terminating in a pavilion at either end. Each light unit on the colonnade consists of three incandescent lamps, white, amethyst and emerald, which, by means of the regulating devices, give beautiful color effects. About 20,000 lamps are used to make this a crowning feature. All cornice lines, columns, the vertical lines of the corners and main entrances, and all architectural decorations of the surrounding buildings, are marked with incandescent lamps, spaced 15 in. centers. Around the Grand Basin and lagoons are railings supported by ornamental lamp posts, as shown in the illustration. Sixty 8-cp incandescent lamps are carried on each post, and Meridian lamps are supported by the four arms.

All the central buildings have colonnades, which are even more beautiful by night than in the day time. At the rear of each column is a vertical line of lamp. The light striking the building walls behind brings the columns in sharp outline against a bright background. The outlines of the other buildings are more subdued than the brilliant spectacle around the Grand Basin, yet at night the whole Exposition appears as a city of light; and this will doubtless appeal to the imagination of the greatest number of visitors.

Power sufficient for this purpose had to be secured from three sources, an exhibitors' power plant, consisting of about fifteen direct-connected units ranging from 400 to 5,000 hp each; the Westinghouse service plant of four 2,800-hp units, and 7,500 kw to be rented from the Union Light & Power Company, of St. Louis. Of this 10,000 hp is to be used for lighting alone.

From the switchboard in the west end of the Machinery Hall mains extend through the conduits to the various sub-stations about the grounds. These conduits consist of pump log ducts which were familiar to the engineer in years gone by, but to-day are almost a curiosity. However, for a year's service these will answer the purpose very well and will likely never be removed from the trenches. The trenches are lined with boards and the ducts having a square cross-section can be placed in number suitable to accommodate the circuits. Under the lagoons the ducts are laid in cement. Manholes of timber construction are placed at convenient intervals along the principal thoroughfares. For power and lighting lead-covered cables are used, and these will be removed for further service after the Exposition. All telephone, telegraph and other wires about the grounds are carried in these same ducts, and no wires of any description are overhead.

The power supply is a 6,600-volt, three-phase current, direct from the large generators to the step-down transformers in the sub-stations. The one in Electricity Building is a typical installation. The mains reach the switchboard through the conduits and to the primaries of the twelve transformers. Three are General Electric oil-cooled, 100-kw, three-phase transformers, giving a secondary voltage of 110 volts for power within the building. The three larger General Electric 250-kw transformers with a secondary of 110 volts furnish power for decorative lighting on the outside of the building. The 200-kw Westinghouse rotary converter is supplied from three 75-kw transformers at 388 volts, and delivers 550 volts direct current for power to operate exhibits. Two motor-generators of 100 kw each supply an Edison three-wire system throughout the building. Insulated cables are carried up from the sub-station switchboard, and extend entirely around the building, supported by porcelain insulators on the trusses. Different circuits are tapped in as the exhibitors may need for power or light, and the wires are supported on cleats attached to the girders. These run to a post in the exhibitors' space and down to a switchboard.

For decorative lighting the cables run to the roof of the building. On the balustrade above the cornice line are switchboards, and from these the lighting feeders extend around the entire circumference of the building. The small circuits are connected at convenient points and run to the columns, flag staffs, or along the cornice line. The wiring is concealed where its presence would detract from the appearance of the structure, and in such places rubber-covered wire only has been used, and is brought to the surface through porcelain tubes. In such cases the sockets are attached to the woodwork and

FIG. I.—COLUMN ALONGSIDE OF LAGOON.

embedded in the staff so as to appear a portion of the column or ornament. This work has been done since last summer and fall and to prevent deterioration during the winter the sockets were filled with a tar composition which was readily removed before the lamps were put in place. Along the cornice lines and other places too remote to notice the circuits are carried on porcelain cleats, and in such cases slow-burning weather-proof insulation was used.

The arc lights within the building are in series on a 3,500-volt, 50-cycle circuit. Except in the Electricity Building, the sub-stations are enclosed in brick structures to reduce the fire risk to a minimum. Although all this work is for temporary purposes only, it has been so well planned and executed that when the lights were turned on and the circuits tested, not one serious flaw was found.

One of the interesting and novel features of the interior lighting is the application of Nernst lamps on a large scale to the lighting of the fine arts exhibit. In arriving at the decision to adopt the Nernst lamp, the art gallery officials made careful tests to determine the practical value of its advantages in this field of lighting, namely, white quality, steadiness and economy. In addition, it was claimed that owing to the downward distribution of the light, a great uniformity of illumination would be secured over the wall space usually occupied by an art exhibit, the weaker rays being in the direction of the upper and the nearer portions of the wall, and the stronger rays

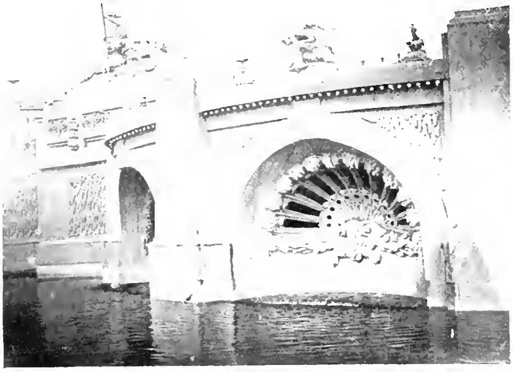


FIG. 2.—THE CASCADES—LAMPS UNDER PARAPET.

FIG. 5.—LOOKING FROM FESTIVAL HALL—LAMP STANDARDS.

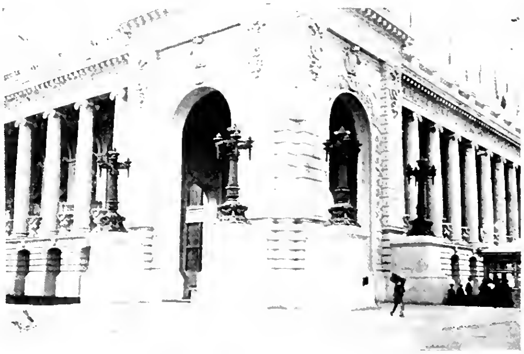


FIG. 3.—LAMPS ON THE INDUSTRY BUILDING.

FIG. 6.—TERRACE OF STATES SECTION—LAMPS ON COLUMNS.

FIG. 4.—ILLUMINATED COLUMN ALONG THE TERRACE OF STATES

FIG. 7.—EDUCATIONAL BUILDING—LAMPS INSIDE ROW OF COLUMNS.

ELECTRICAL ILLUMINATION AT THE LOUISIANA PURCHASE EXPOSITION.

in the direction of the lower and more distant portions. Where the exhibits occupy the walls exclusively, the uniformity and intensity of the wall illumination is greatly improved by the use of a specially designed reflector on each lamp, similar to that shown in Figs. 1 and 2.

This reflector is of light, rigid construction and is fastened to

FIG. 8.—NERNST LAMP WITH REFLECTOR FOR ART GALLERY.

and supported by the lamp, in the same manner as the standard shade. Of course, this reflector also acts as a shield, preventing

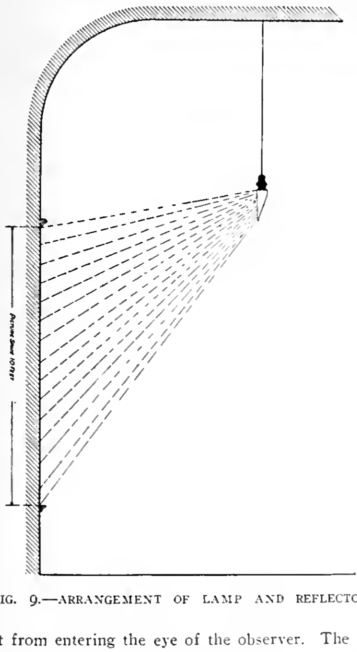


FIG. 9.—ARRANGEMENT OF LAMP AND REFLECTOR.

direct light from entering the eye of the observer. The preliminary tests which were made using this reflector and under conditions approximating as near as practicable the actual art gallery conditions, were attended with very satisfactory results.

The plans involve the use of 1,541 Nernst lamps of different sizes, making a total of 4,780 glower units, with a total consumption of

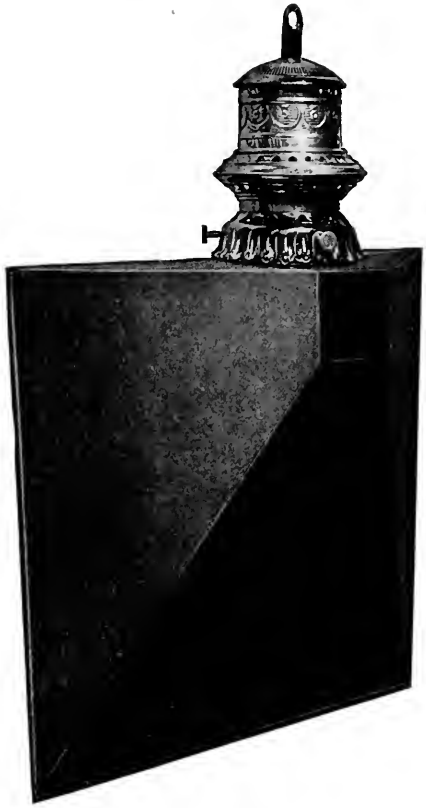


FIG. 10.—NERNST LAMP REFLECTOR FOR ART GALLERY.

401,520 watts. The sculpture halls will be lighted by means of large clusters, each consisting of 19 six-glower lamps at 60 ft. elevation. In the art gallery section the three-glower lamp, with the special reflector will be the standard unit, these being arranged around the four sides of the room 8 ft. from the wall, as shown in the cut. The lamps will all be supplied with 25-cycle current from a single-phase, 210-volt circuit, a portion of the load on the latter being used for power purposes.

New Hudson River Tunnels.

The New York State Board of Railroad Commissioners last week granted a certificate of public necessity to the Hudson & Manhattan Railroad Company to build two single-track tunnels under the Hudson River from Church Street, between Cortlandt and Fulton Streets, New York, to Exchange Place, Jersey City. It is stated that the company has bought the western part of two blocks bounded by Church, Fulton and Cortlandt Streets and Broadway. The Havemeyer Building occupies one of these plots.

The two tunnels will form a continuous loop. The south tunnel will come from the river under Pier 13 and Cortlandt Street to the loop station at Church Street, running around into the north tunnel under Fulton Street and Pier 14. From the terminus there will be a footway under Dey Street to Broadway and the subway station there and up to Broadway and John Street, the passageway being under the subway level. A very comprehensive system of connections with existing and developing lines of communication is contemplated by the plans.

The Magnetite Arc Lamp.

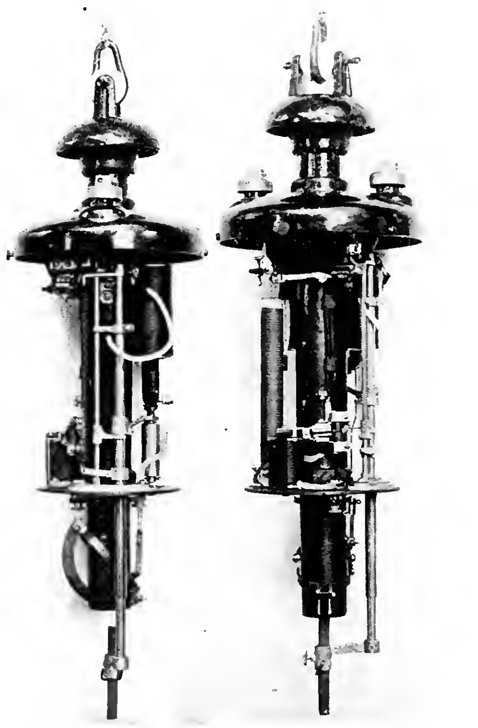
By Charles Proteus Steinmetz.

WHILE in the transformation of electric into mechanical power very high efficiencies are reached, values of 90 per cent. to 95 per cent. being quite common, the efficiencies of the present method of producing light from electric energy are extremely low, only about 2 per cent. in the incandescent lamp, perhaps 5 per cent. in the arc lamp. The reason hereof is to be found in the use of heat as an intermediary form of energy, which always leads to low efficiency. To study the methods of producing light from the point of view of developing more efficient methods, some years ago an electrochemical laboratory was established by the General Electric Company and one of the results of the work of this laboratory is represented in the magnetite arc lamp.

The most efficient illuminant heretofore known was the carbon arc, but its efficiency is due to the extremely high temperature, and, therefore, great brilliancy of the incandescent crater of the carbon; and very little light is produced by the arc flame and that of a rather undesirable violet color.

Improvements in efficiency have been made in the last years by adding metal salts as calcium-fluoride to the carbon, which evaporate in the arc, making it luminous and so increase the efficiency, but since all such substances produce a smoke or dust, which has to be disposed of, the carbon cannot be enclosed air-tight and the flame carbons, therefore, give a short burning arc requiring frequent trimming.

In these flame carbons, on which a considerable amount of work



FIGS. 1 AND 2.—3½-AMPERE LUMINOUS ARC LAMP.

was done, the arc-coloring substance is added to the positive terminal as the hottest, from which evaporation takes place more rapidly than from the negative. When used in this manner only calcium compounds seem to give a very good efficiency, and they are mostly used. Their light, however, is of a reddish yellow hue.

Even with its much greater efficiency, due to the short life and the yellow color, the flame carbon arcs do not seem to me to quite meet the requirements of an illuminant able to compete with the enclosed arc of to-day for general illumination, but as the first fundamental condition to be met by an illuminant which should be superior to the present arc lamp for general illumination, I consider besides very high efficiency, long life and white color of the light. While variously colored lights may find some application for decorative purposes, for general illumination, for replacing the daylight during the night, a white light is most desirable, even necessary wherever color values have to be judged.

The condition of long life, with an open arc, excludes the use of carbon in the electrodes and some other carrier of the current in the arc flame must be found. The material which in an arc lamp electrode, by replacing the carbon used at present, would constitute an essential advance in the art of illumination, must, therefore, fulfill the following conditions:

It must be a good conductor when solid and its vapors must be conductors of the arc.

It must be incombustible so as to give a long burning arc.

It must give a spectrum of high brilliancy; that is, an arc of high efficiency.

The light must be distributed approximately uniformly over the whole spectrum; that is, it must give a white light.

In magnetite, or the black oxide of iron, one of the most common iron ores, a substance was found having the required characteristics.

By very extensive investigations of the phenomena taking place in the electric arc with different materials as arc terminals, it was found that the material which carries the arc flame issues from the negative terminal as a high velocity blast which, when striking the

FIG. 3.—MAGNETITE ARC.

positive, produces heat. If, therefore, the positive terminal cannot conduct this heat away, it may get hotter than the negative and does so in the carbon arc.

Therefore, in the carbon arc the positive terminal burns away more rapidly. The greater heat produced at the positive terminal is the reason for introducing arc-coloring substances in the flame carbon arc lamps into the positive electrode. They are introduced into the arc by evaporation, and at the hotter positive electrode evaporation is more rapid. This also has led to the misconception that the positive terminal feeds the arc while in reality it has no direct influence on the phenomena in the arc, but the spectrum of the arc is that of the negative terminal, except where material of a boiling point lower than the temperature of the arc flame is introduced into the arc.

If the positive terminal is made large enough and a good conductor of heat so as to carry away the heat, it does not wear away, but material from the negative terminal deposits on the positive, as drops of magnetite on the copper positive of the magnetite arc lamp if the latter is too large. By giving the positive terminal, therefore, a sufficient heat conductivity not to get too hot, but sufficiently hot to avoid the deposition of material on it, a non-consuming positive electrode is produced. This is the case in the magnetite arc lamp. In this only the negative or lower electrode consists of magnetite, and is consumed. The positive terminal is not replaced, but is a copper segment, which constitutes a permanent part of the lamp.

The metals of the iron group yield a brilliant arc flame of very high efficiency and white color. To give a long life the metals which are combustible are not well suited, but a stable oxide of these metals must be used; that is, a compound which cannot burn any more. Amongst the conducting oxides, magnetite fulfils best the requirements of a carrier of the arc flame, since it is well conducting, stable at all temperatures, very plentiful in nature, and gives a white arc of high efficiency.

Pure magnetite, however, is not quite satisfactory, since its efficiency is not very high, hardly twice as high as that of the ordinary carbon arc; and the arc tends to flicker and the rate of consumption of the electrode is rather high; as high as 1/8 in. per hour. This, while very much lower than the rate of consumption of flame carbons, of 1 in. to 2 in. per hour, would still give only 50 to 60 hours' life with the standard size of electrode adopted for the magnetite arc lamp, of 8 in. length. Therefore, with the magnetite as carrier of the arc flame are incorporated other substances in small quantities as arc-steadying compounds—titanium compounds for increasing the efficiency, etc.

In the manufacture of these magnetite arc electrodes, by partially reducing the material to metal, a greater density is produced and so a

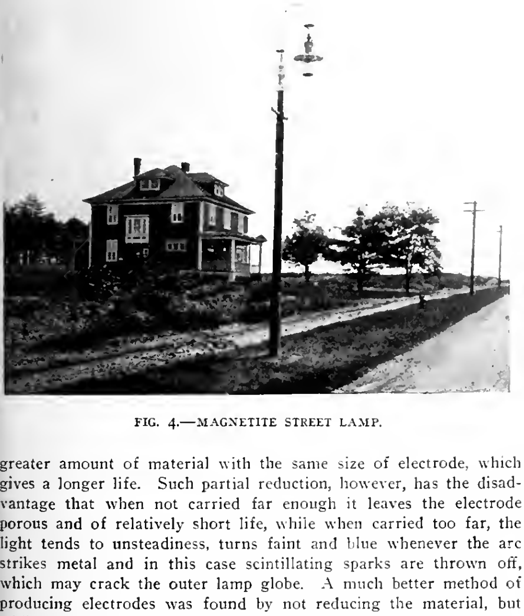


FIG. 4.—MAGNETITE STREET LAMP.

greater amount of material with the same size of electrode, which gives a longer life. Such partial reduction, however, has the disadvantage that when not carried far enough it leaves the electrode porous and of relatively short life, while when carried too far, the light tends to unsteadiness, turns faint and blue whenever the arc strikes metal and in this case scintillating sparks are thrown off, which may crack the outer lamp globe. A much better method of producing electrodes was found by not reducing the material, but adding a restrainer; that is, a substance which added to the electrode material in small quantities reduces the rate of consumption. Hereby, without any loss of efficiency, rates of consumption of 20 to 30 hours per inch are produced, which give a life of 150 to 200 hours for the 8-in. electrode. With very little sacrifice of efficiency a life of 500 to 600 hours is produced and such an electrode has about the same life as an incandescent lamp; that is, the arc lamp requires trimming about as often as an incandescent lamp requires renewal. This latter feature, however, while obviously valuable in cases where trimming is difficult, as with lamps in inaccessible places or during protracted strikes, etc., for general illumination is hardly needed, since it would in street lighting give a life of two months; and a street lamp should be looked after oftener than this.

A simple and satisfactory form is an electrode in which the material is compressed as impalpable powder in a thin iron tube, which is then sealed over by the arc.

In the carbon arc lamp the light comes from the incandescent crater of the positive carbon and not from the arc flame. Hence, the arc lengths should be made as short as possible without obstructing the escape of light from the crater. In the magnetite arc, however, no light issues from the terminals, but all the light comes from the arc flame, and an arc length from 3/4 to 1 1/8 in. is, therefore, most efficient. Furthermore, to give a constant volume of light the arc lengths should be constant. This leads to a feeding mechanism differing from the "floating system" of the carbon arc lamp and much simpler; that is, a feeding device maintaining constant arc length. The operation of the magnetite arc lamp is, therefore, as follows: When the power is put on the lamp, the arc is struck by separating the electrodes to a definite distance, say 7/8 in., and then the electrodes are locked in this position and remain fixed until after some hours or so, by the consumption of the negative electrode, the arc length and thereby the arc voltage has increased sufficiently to operate the feeding mechanism which resets the arc to its original length.

Insurance Features of Street Railway Property.

An important and interesting brochure has been issued by the committee on special hazards and fire record of the National Fire Protection Association devoted to the subject of insurance of street railway property—car barns, car houses, rolling stock, etc. A number of contributors furnish articles and discussions bearing on the topic and several fires are analyzed in detail. The pamphlet is one of 42 quarto pages. Mr. S. H. Lockett, manager of the Insurance Survey Bureau, of Chicago, has a separate article on "Street Railway Property," in which a number of points are discussed. In his introductory remarks he says:

Losses in this class have attracted a great deal of attention to it, and a few words regarding the business may not be amiss. The days of the old horse car are so nearly numbered that horse car barns and systems are hardly worthy of consideration as a class. Indeed, cable lines are also fast disappearing, or, at least, are numerically and in value unimportant as compared to electric, so that underwriters will have to concern themselves principally with trolley and storage battery systems in the future. The retirement of horse and cable systems, however, will have its effect for some time upon the moral hazard of the entire class, and the acceptance of the surviving cable and horse systems, or such systems undergoing a transition to electric motive power, should involve the consideration of many facts. It must not be overlooked also that the adaptation of old systems to new conditions has as well an appreciable effect upon the physical hazard of the class. Large first cost makes the installation of new cable lines rare, and, owing to the increasing difficulties in municipal streets, this first cost is augmenting to such an extent that the building of cable lines is uninviting as a business proposition. This being true, the second-hand value of cable cars is becoming less, and there is a patent moral hazard attached to their insurance. Physically, there has been a marked unsuitability of old horse car barns for electric car storage purposes. This has been due to several facts. Electric cars are larger and longer, necessitating different track and post arrangements. They are also more numerous on the same lines, since traffic has increased with the greater speed and consequent mileage coverable, and the old barns proved too small. Again, the repairs on electric cars are more frequent than in the case of horse cars, owing to the greater number and size of horse cars, as well as their speed, longer travel and the constant increase of general urban and municipal traffic, which are bound to make wear and tear and accidents more excessive. These repairs have resulted in many new processes and hazards which cannot be accommodated in the old buildings. Yet again, owners themselves have appreciated the undesirability of exposing larger values in the later cars to the ill arrangements and poor construction of the old barns which, in many cases, were converted to car barns during the precarious infancy of street traction enterprises. To a somewhat less extent the above remarks are true of cable systems. There is still much poor construction in progress, more particularly in the case of interurban systems handicapped financially and banking on the future increase of business between growing communities, but it will be found that the record of street railways as a class will be much better than it has been, partly because they have passed the nascent stage and are sounder institutions, anxious to prevent the interruption of their business by fire, and partly because of the insistence of insurance companies upon better construction and practices. The business is heir to some ills, however, for which there is no panacea and seemingly no anaesthetic. Not the least of these is the immense area of the barns made necessary by the number and size of the cars and the exigencies of street railway service. The mutual exposure under a common roof of several valuable buildings on wheels, as it were, making any barn fire a sort of conflagration, is another ill which, however, may be cured by the introduction, as is done on the steam roads in some cases, of steel cars. Another ill for which there is a definite remedy, not heretofore applied, is the poor wiring and heating arrangements of the individual cars, each one of which is more valuable than the average dwelling in which such arrangements would not be tolerated. As an evidence of the importance of this one feature it is a fact, according to the United States Census report of 1902, that 50 per cent. of all the street cars in use were heated and 90 per cent. lighted; of those lighted 90 per cent. and of those heated 63 per cent. used electricity. As the bad car lighting and heating arrangements are practically universal as far as electrical equipment is concerned, it is plain that the conditions are worse than if a number of frame dwellings with poor wiring and heating arrangements exposed one another, since there is always a good chance of confining a fire to one building, whereas the destruction of one housed car nearly always means the loss of all. Unfortunately, we have not regarded car barns as we do conflagration districts, otherwise car builders would long ago have been required to equip their cars electrically and otherwise in accordance with the best accepted practices.

As affecting the chances of litigation and, consequently, the financial obligations under which a road may have to stagger, statistics show that one person is killed per annum at the present time for each 55 cars in use, or one for each 4,000,000 rides taken. The non-fatal accidents are one for each 101,000 rides, these figures including passengers and others injured, say, in collisions, wrecks, run-overs, etc. It is quite evident, therefore, that a company doing a fair business will be more or less involved in suits, and for this reason the acceptance of large lines should be accompanied by an investigation into existing litigation and into circumstances likely to affect future litigation of this sort. Investigation would naturally be made into other matters affecting the moral hazard, especially in the case of new enterprises where disgruntled persons on the right of way, condemnation proceedings and similar forces must not be neglected. It would appear in this connection, for instance, that lines operating in rural districts, while less subject than municipal roads to accidents, in proportion to mileage, number of cars operated and passengers carried, are not freer from suits of various sorts because of the notoriously litigious spirit pervading the bucolic soul.

The Electrification of the New York Central.

A few months ago, upon the occasion of the announcement of the intention of the New York Central & Hudson River Railroad Company to adopt electricity for the Atlantic seaboard end of its system, we took occasion, in commending this progressive plan, to outline the reasons which we assumed were influencing the management, and which had governed the decision of the engineering staff and the consulting engineers. While to the electrical public such a decision, momentous as it is on the part of a great railroad, appears inevitable, there is no doubt that to a great many of the leading steam railroad officials of the country the determination reached seemed more or less hazardous, while even in electrical circles there was agreeable surprise at the fact that the company, instead of restricting electricity to its Manhattan terminals, had resolved to extend the electric zone as far out as Croton and White Plains. In other words, the action of the New York Central Company was presented in somewhat sharp contrast to that of the Pennsylvania Railroad Company, which, instead of going, as well it might apparently, just as far out on the Jersey meadows with its electrical facilities—say 30 or 40 miles—is restricting the use of electricity to a very narrow zone of four or five miles adjacent to the new station, i. e., virtually for the tunnel under the North River alone, inclusive, one might say, of the tunnel to Long Island also.

Whenever Vice-President Wilgus and his consulting staff make public the details of their elaborate study of this problem, either in the columns of the technical press or before some of the technical societies, it will necessarily constitute a most interesting, vital and valuable elucidation of the present status of steam and electricity in the field of locomotion; and it is to be hoped that they may soon feel at liberty to take the engineering profession at large into their confidence. Meantime, however, we believe we do not overstep the bounds in presenting briefly what we gather to have been the reasons for this remarkable extension of the electrical zone by the New York Central, so that for two-score miles out both the suburban and through trains on the system are soon to be handled exclusively by electric locomotives, data in regard to which have already been presented in our columns. So far as we can ascertain, the main considerations upon which Mr. Wilgus and his board had to predicate their noteworthy conclusions were (1) compliance with the law in the region south of the Harlem River—i. e., Manhattan Island—and the probability of other restrictive measures applying as far out as Yonkers and Mount Vernon; (2) the peculiar topography of the region in the vicinity of New York as well as the very high cost of land, both causes pushing the location of the power plant and other facilities to the outer limits of what might be regarded as the suburban region; (3) the desire to secure opportunities for increasing traffic by means of greater speed, smaller units, more frequent service, suppression of smoke, cinders, noise, gas and a more attractive régime in general than would have been found possible so long as steam was adhered to; (4) minimization of annoyances, loss of time, congestion and dangers on account of changing motive power or changing passengers on suburban trains, etc.; (5) development of profitable long haul passenger and freight business due to the inevitable filling up of the whole region north of New York, which, for lack of transportation facilities had been checked in a growth at all comparable with that which has been enjoyed in the suburban regions of New Jersey, such as the Oranges, Englewood, Plainfield, etc.; (6) an underlying reason, probably, that the creation of its own electric service within the suburban area would release the company from the pressure of competition which would unquestionably arise otherwise from competitive rapid transit lines.

It is evident from the most cursory study of these main considerations that once the change to electricity in any extent was agreed upon, the cogency of the arguments in its favor became more and more pressing; and it is creditable to the courage and mental grasp of the men dealing with the problem that they are willing to carry the proposition with all it involves through to the logical and, one might well say, inevitable conclusion. The more one looks into the subject the more evident it becomes that at such points as Croton and North White Plains the best available facilities are now to be had for making the change from steam locomotives to electricity, while the bids and designs submitted as to the electric locomotives remove the earlier operative objections as to the high cost and inability to handle heavy loads at high speeds. It is not only a great thing for the company thus to rid itself of the combined or conjoint electric and steam terminus with consequent double equipment, but it is really a splendid boon for the whole region to be released from the disagreeable features incident to steam traction and to realize at one sweep all the benefits of electric traction in suburban traffic as well as in the through part of the service. In fact, whatever may be the gain connected with the through service, we are very much of the conviction that, foresighted as the staff has shown itself to be, it will be more than agreeably surprised to watch the beneficial results in the upgrowth of new suburban business. The region north of New York is admirably suited for residential purposes, and with the availability of electric facilities, must develop enormously, especialy as all the serious objections entertained toward the old tunnel at the New York end will be abolished. What electricity can do in the general increase of traffic has been shown on Manhattan Island, and the wider area referred to is, after all, a constituent and integral part of the same region, and should indeed have been annexed residentially to New York long ago.

It is from such points of view as these that we believe Mr. Wilgus to have addressed his energies to the problem, and we have no hesitation in avowing a belief that he and his advisors will be more than justified by the results. It has required courage of a high order to undertake such vast changes—without parallel in the domain of transportation—but the public of New York and of the country at large will in a few years have abundant warrant to congratulate itself upon the revolution; while the large capital necessary for such work on this broad plane will not only have recouped itself, but have done much to increase the yield of the older investment. Moreover, it is very encouraging to know that we are not dealing with a project to be carried out at some time or other, but one upon which the necessary work is now being pushed with great energy and vigor.

Storage Battery Plate Construction With Special Reference to High Discharge Characteristics.

By W. W. Donaldson.

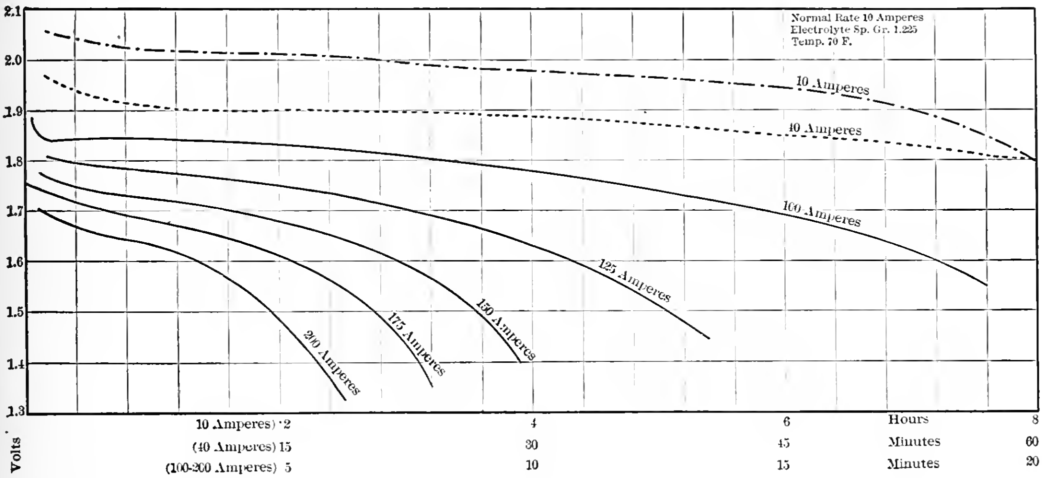
The constantly increasing use and adaptation of electric storage batteries and the proved economy resulting, have had the effect of making electrical engineers look more closely into the features of the plate construction of lead batteries. Although the detailed characteristics are of importance to whatever form of work and conditions batteries are subjected, when high discharge rates are used, the question becomes a much more complicated one than when normal rates are the rule. The largest field in stationary work where abnormal discharges are required is where batteries are used to take the peaks of rapidly fluctuating currents, and these conditions are much more frequently met with in the operation of electric railways. The normal ampere-hour capacity of storage batteries is usually based on a rate which will be maintained for a period of eight hours within an economic voltage range. Such a basis is merely an arbitrary one, as the true practical capacity is when there will be no increase made by further reduction in the discharge rate. This "limit of capacity" is reached much sooner in certain forms of plates than in others, and it is this limitation point which is a direct indication of the superiority of one type of plate over another for watt capacity at high discharge rates.

High discharge rate applications have so multiplied and the storage battery is of so much value for such work that the energies of inventors and of the manufacturers of batteries are being directed toward producing plates in which the "time limit of capacity" is small and inversely, the "rate limit of capacity" is large. At the present time the so-called high discharge rate is four times the normal or eight-hour rate, and the time during which such a rate may be maintained within an economic voltage range, varies from 50 to 70 minutes in different types of plates. If one hour be taken as a mean, then the capacity in ampere-hours is 50 per cent. of the eight-hour capacity. Installations are now made on the hour basis of discharge with allowable "instantaneous" discharges of 50 per cent. additional or six times the normal eight-hour rate. In railway installations where the battery is simply used to take the peaks of short duration, even the full hour capacity is never used. A 20-minute capacity at the same rate of discharge would fulfill all the requirements as far as regulation goes.

Considered as a reserve source of current, the capacity of batteries as installed on their present basis, would be a mere drop in the bucket in supplying current for the operation of a road. In some cases this reserve is found to be of advantage, but in the majority of installations the reduction in first and maintenance cost, if batteries of one-half the present size were used, would much more than compensate for the reserve feature. It must be remembered also that in fluctuating work, the "floating voltage," the point at which the battery stands when neither charging nor discharging, is at the most efficient point when it changes least on charge and discharge, and this is found to be when the battery is three-quarters full. This of course varies with different types, the object being to produce a plate with an efficient floating voltage when it is in as near a charged state as possible. Taking the three-quarter state of charge as the operative condition, the actual effective capacity of batteries for this work is then thirty-seven and one-half per cent. of the eight-hour capacity. Such a state of affairs must conduce to investigation and improvement. Advance in plate construction must result in either increasing the ratio of useful to actual capacity in ampere-hours, or, letting this ratio stand, increasing the discharge rate for shorter periods of time, without shortening the effective life. The discharge curves given below are from a well-known type of plate and show the effective voltage and current capacity for periods of from five minutes to eight hours.

The question arises to what extent and in what ratio will the life be affected by discharging for short periods at these various rates, and whether the greater discharge output than at present used, together with relative decrease first cost and interest charges would more than offset the greater depreciation, should it occur. There should be two types of plates, one designed for two and one hour rates of discharge and with large capacity, and the others for twenty and ten-minute rates, and with relatively small capacity. The latter type of plate is the one which offers the greatest field for the investigator. A plate properly constructed for even moderate rates, should not greatly depreciate when discharged at eight times the normal for short duration peaks, and at twelve times for "instantaneous" peaks. By depreciation is meant not only that the structure of the plate should be preserved, but that the ampere-hour and voltage range should not be lowered. Many plates will, after long use, still be in good condition as far as their structure goes, but will have lost capacity. Structure must be maintained to insure capacity, but properly maintained capacity is bound to be accompanied to a limited extent by a weakening of the structure. The best plate is the one which, towards the end of its useful period, goes to pieces very rapidly and loses its mechanical and electrical efficiency simultaneously. It is the "electrical" characteristics which should have the first consideration in the design. "Provide for good electrical conditions and the mechanical will take care of themselves."

In considering the construction of plates best adapted to high discharge work, the positive and negative must be considered separately. The fundamental requirement for both plates is that their active material must be formed by an electrochemical action. No paste or applied active material should enter into the construction of either plate for stationary high discharge work. Considering the positive or electronegative grid first, this should be "integral": that is, no mechanical or autogenous joints should be present. The plate must not be "built up" of separate parts, nor should the active material be relied on as a conductor of current derived from other but its own reaction: that is, no extraneous current should pass



Discharge Curves.

through it. Time and use always affect such contacts, and loss of capacity follows. No other metal save pure lead should be used, mixtures and alloys always complicating and retarding the proper chemical actions. "Casting" of the basic plate should be avoided, as hard rolled lead gives a density and homogeneity far superior to cast metal.

Of whatever form the plate may be, a "center web" or conductor is necessary for the most even distribution of current, this central conductor in a well-constructed plate never being subjected to the reversals due to charge and discharge unless a very complete discharge at very low rates is used. Rigidity, in excess of that required for proper electrical conditions, need only be provided for in direct ratio to the total weight of the plate. Any allowance beyond this reduces the percentage of effective active support. The "main" conducting and supporting frame, which should never be counted on for any active formation, should not exceed 15 per cent. of the weight of the plate proper, and this, with 10 per cent. in addition (the residue of the "active support") should be all that remains of lead when the plate has lost its useful capacity; that is, a total of 25 per cent. of the original weight of metallic lead. The "basic convertible active lead" should be initially about 85 per cent. of the weight of the plate proper, and all but about 14 per cent. of this should be convertible into the active agent, peroxide of lead. The support area for the active material contact should be not less than 175 sq. in. per pound of plate proper, and should not be greater than 250 sq. in. per pound of support contact; that is, the thickness of this support contact after formation should not be less than 20/1000 of an inch, which allows 10/1000 as a conductor for each layer of active material.

One of the most important, in fact it might almost be said the most important, factor of a plate for such work as we are considering, is that the metallic contact of the active material support with the main conducting frame should be of such a character as not to be impaired or lessened by any action due to subsequent formation of active material. Too much stress cannot be laid on this requirement. As much of the surface of the active material support as possible should be bathed by free electrolyte, and provision be made for vertical capillary diffusion, rather than for horizontal or through-and-through circulation. The active material support surface presented for discharge action should not be less than 33 sq. in. per ampere, for a rate corresponding to eight times the normal. The plate as a whole should be as thin as is consistent and should not exceed one-half inch from face to face. Provision for the retention of the active material must be such that its dislodgement cannot be accomplished by the formation and expulsion of any of the gases incident to the chemical actions or by the change in volume due to its conversion.

Having now covered in a general way the positive support plate, we should consider the active material, peroxide of lead. As it is impossible by the use of applied active material to produce a plate to meet the requirements as to life in high discharge work, this material must be formed electrochemically by some such method as charging continuously at a pressure considerably below two volts, as by the Planté method of charging and discharging and reversing in acid solutions above two volts, or by charging in forming solutions which act directly on the lead itself, producing nitrites, and sulphates and oxides of lead, which are in turn peroxidized by the action of the current. The last method being the cheapest is usually employed.

One requirement for high discharge work is that the active material must be in the form of a very thin layer and should not exceed 8/1000 of an inch in thickness, with a conducting backing 25 per cent. greater or 10/1000 of an inch thick. Such a layer would correspond to .8 of one cubic inch of peroxide per 100 sq. in. of contact support, or (allowing 2.1 ounces per cubic inch) 1.68 ounces per 100 sq. in. This volume of peroxide at a capacity of 2.5 ampere-hours per ounce will give 4.2 ampere-hours per 100 sq. in. at a normal rate of discharge. The weight and capacity per cubic inch of peroxide vary greatly, but these figures are conservative and are easily followed. The ratio of weight of active material to active support should be as 1 to 1.9 (approximately 33⅓ per cent.) and the active material should not be over 18 per cent. of the weight of the plate proper. The porosity, granular and molecular, should be such as to allow the mass of the active material to hold at least its own weight of electrolyte and thus allow for good diffusion of the acid.

Diffusion is necessary for the chemical combinations and consequent production of current, the e.m.f. of the positive plate on discharge being a function of acid concentration. The greater the surface exposed to acid, the better the diffusion, if details of structure are proper. If the peroxide of lead is formed from the basic lead support, it becomes part and parcel of it and the two are knitted firmly together in intimate contact. After time and use this cohesion becomes impaired unless the arrangement of the grid is such as to maintain a constant pressure of the active material against its lead support. If such pressure be maintained and the active material held firmly in place, the tendency for further peroxidization of the support is greatly lessened; and if the formation has been properly carried on, there is a protective coating so dense as to almost stop further action if the original outside layer maintains its proper position relative to the support.

The laws governing the construction of the negative basic plate for high discharge work are the same as for the positive except that there need be no provision made for the formation of active material subsequent to the initial deposit, nor need the current-carrying capacity of the active support be as large. The plate should be integral and of pure lead, alloys causing increased local action with the active material, and local action is one of the chief causes of capacity loss in many forms of negatives. Active contact support should be at least 300 sq. in. per pound of plate proper and grid support 40 per cent. of total weight of plate proper. The support contact should be not less than one-third that of the active material in thickness. The number of square inches of contact support per ampere of discharge should be no less than in the positive, and although the negative plate is, as a whole, of much lower resistance than the positive, a central diaphragm or wet conductor is of value as the principal starting point and distributor of current. One all important necessity of the negative grid is that it should be made in such a way that not more than 10 per cent. of its superficial area be exposed to the electrolyte; less than this amount is even advisable, as the larger the surface of the active material which is bathed by free acid the better will be the maintenance of the negative voltage on high discharge work.

Provision for the retention of the active material forms a chief factor, as dislodgment is very apt to occur by the force of gas accumulation and expulsion, and loss of this kind in the negative cannot be compensated for by further formation as in the positive. This retention of the original volume of negative active material is one of the most difficult things to accomplish. Various, one might say "artificial," methods have been resorted to, but such methods are, as a rule, make-shifts and in the end react badly on acid diffusion and consequently affect voltage. If the proper electrical conditions of the negative plate are adhered to, the mechanical strength will take care of itself. Efficient negative active material, finely divided spongy lead, can be produced by the same methods as explained in connection with positive material. Negatives with applied active material are the most popular and cheapest to prepare, but the "life is not in them" in comparison with those electrochemically formed. The moleculear porosity of spongy lead should be such that it contains at least twice its volume of acid, although this ratio can be increased if the design of the plate should warrant it. Spongy lead does not thrive in strong acid, so every provision possible must be made for acid diffusion and renewal in the pores.

The volume of material should not exceed one cubic inch to each 100 sq. in. of support contact, and the capacity should not be less at normal rates than 4 amp.-hours per cubic inch. In a correctly designed plate this should give 15 amp.-hours per pound of plate proper. Such should be the initial capacity of the negative, but only 60 per cent. of this should be used; that is, the capacity of the positive should be 60 per cent. of the negative, so that the capacity output is limited by the positive, as working negatives down to low voltages is very deleterious, increasing largely local action. There is another reason for having a surplus increased capacity in the negative, which is that as time goes on, there is a shrinkage and molecular change, the former causing a loss of mechanical and electrical connection of the active material with the support, which, together with the molecular change, causes loss in capacity. If the active material be formed from the lead plate itself, it is part and parcel of it and is in continual intimate contact, so that any loss in capacity which occurs should be charged to the molecular change. When from either of these two causes or from both, too great a capacity loss occurs, the plate should be capable of complete reversal and reformation without injury or loss of active material. The life of the negative plate is generally held to be twice that of the positive (what is meant by "life" being rather an unknown quantity); but there is no reason why this ratio should not be more than doubled if strict and scientific principles are adhered to in the construction.

As I stated at first, electrical engineers and those directly interested in the use of storage batteries would find their time well repaid if they searched for strong and weak points in plates which they contemplated buying, with the same ardor they expended on the other parts of electrical equipments.

Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting of the Institute was held in New York City at the Chemists' Club on May 17 and 18. In view of the fact that the Institute will take so prominent a part in connection with the Electrical Congress at St. Louis in September, the directors did not lay out a very extensive programme. This would explain the small attendance of members—the number at no time exceeding 150.

On Tuesday morning, May 17, papers were presented to Mr. W. L. Waters on the "Predetermination of Sparking in Direct-Current Machinery"; by Mr. E. H. Anderson on the "Effect of Self-Induction on Railway Motors," and by Dr. W. E. Winship on the "Calculation of Line Batteries." The reading of these and the discussion which followed lasted until 1.30 P.M., when lunch was served. There was no regular meeting in the afternoon, but on the invitation of the Interborough Company the members visited in a body the Rapid Transit Subway, entering at Columbus Circle and Fifty-ninth Street and walking down the track to Fiftieth Street, from which point a visit was made to the sub-station at Fifty-third Street. Members were received by Messrs. L. B. Stillwell and H. G. Stott, who explained many features of the work. The subway was found in a well advanced condition, but doubts were expressed whether it could be ready before late fall, especially as all the rolling stock has to be got into operation.

At the evening meeting the result of the annual election was declared, on the report of the tellers. The successful candidates were as follows: President, Mr. John W. Lieb, Jr.; vice-presidents, Prof. W. E. Goldsborough, J. J. Carty, Col. S. Reber; managers, Messrs. H. G. Stott, L. A. Ferguson, J. G. White and Dr. S. S. Wheeler; secretary, Mr. Ralph W. Pope; treasurer, Mr. G. A. Hamilton. The report of the board of directors was then read, showing that the growth of membership had been maintained. The total May 1, 1903, was 2,229, and the net total of membership April 30, 1904, was 3,027. The ordinary receipts of the Institute during the year had reached the substintial sum of $40,986, and a balance was shown of $4,592. After making various allowances and deductions to funds, the net balance in cash or its equivalent of $12,337 was shown to be immediately available for any ordinary or unusual expense of the Institute. The balance sheet showed the finance committee to have done excellent work and the Institute to be in thoroughly sound and prosperous condition. The inventory value of the library, as shown in the report of the library committee, was increased to $21,737, the former valuation having been based upon a nominal valuation for insurance. A sum of $3,118.75 was expended upon the library during the year. With regard to the local organizations, in respect to which Mr. C. F. Scott made a further separate report during the evening, it was shown that there are at present twenty-nine Institute branches, fifteen of which are in cities and fourteen students' meetings in technical schools. The aggregate attendance at such meetings is 1,250, about 400 being students. With respect to the Electrical Congress, the details already given out were repeated, and it was stated that at the time of the report the Congress subscribers numbered about 1,600, while 157 papers had been promised from leaders in the profession. It was also stated with regard to the adoption of a standard cell that this matter will be submitted to the International Electrical Congress, and that the cadmium cell of Mr. Weston is proposed as a universally recognized standard. Details were also given as to the Union Engineering Building, and condition of the project; and supplementing the statement in the report, Mr. Calvin Rice, chairman of the building committee, was able to state that already $47,200 had been pledged and that the work of the committee was being actively pushed.

As an instance of the *esprit de corps* existing in the Institute, it was stated that Boston had pledged its best efforts, while the local section in Iowa had already sent in the generous subscription of $600. It may be added that on Wednesday Mr. Arnold, at the morning session, announced amid considerable applause that Mr. Edison had just given $5,000 to the fund, bringing it well above the $50,000 mark. Since then, a subscription from Dr. M. I. Pupin of $5,000 has been announced, and before the meeting closed the fund was above $60,000.

With regard to meetings, it was stated that the annual convention at Niagara Falls in 1903 had brought out an attendance of nearly 500 members and guests. It was also stated that preparations were being made for a special meeting at Chicago on June 21 and 22 to be devoted exclusively to transmission subjects.

A paper was presented during the evening by Mr. B. G. Lamme on data and tests on 10,000-cycle per second alternators.

The session on Wednesday morning was followed by luncheon, and the afternoon was spent in a visit to the library and technical laboratory of the Columbia University under the guidance of Profs. F. B. Crocker and George F. Sever.

Mr. John William Lieb, Jr., the new president, was born in Newark, N. J., February 12, 1860, he attended the Newark Academy and the Stevens High School, Hoboken, N. J., and graduated from the Stevens Institute of Technology in 1880 with the degree of mechanical engineer. In 1880 he engaged as draughtsman with the Brush Electric Company in Cleveland. He entered the employ of the Edison Electric Light Company, New York, in 1881, as draughtsman, and was transferred to the experimental department at the Edison machine works in 1882. He assisted in the tests of the first "Jumbo" direct-connected Edison dynamo, and by Mr. Edison was put in charge of the installation of the electrical equipment of the old Pearl Street Edison station, under the direction of Mr. C. L. Clarke, chief engineer. He also assisted in the tests and experiments incident to the starting up of that pioneer station, the first commercial station in the United States supplying current for incandescent lighting and power from an underground system. On the inauguration of regular service, September 4, 1882, under the auspices of the Edison Electric Illuminating Company of New York, Mr. Lieb was appointed its first electrician.

J. W. LIEB, JR., PRESIDENT-ELECT, A. I. E. E.

A syndicate of Italian capitalists with Prof. Colombo as technical adviser, having purchased a complete equipment of boilers, engines, dynamos and Edison underground system for Milan, Italy, Mr. Lieb was selected and dispatched by Mr. Edison to direct the installation. The Milan station, equipped with Babcock & Wilcox boilers—six 150-hp Armington & Sims engines and Edison "Jumbo" dynamos, began regular service in 1883 and Mr. Lieb remained in charge as manager on the organization of the Italian Edison Company. He was appointed in turn its chief electrician, director of stations and chief engineer in general charge of the technical department of the company, engaged in manufacturing electrical apparatus, installing isolated plants and constructing and operating lighting and power stations throughout Italy. Mr. Lieb's company was among the very first to exploit the alternating-current system, beginning with a plant in Milan, Italy, in 1886, and using also the Thomson-Houston arc system extensively. His last work in Italy was in the electric railway field in connection with the installation of the trolley system in the city of Milan.

Being offered an appointment with his old company—the Edison Electric Illuminating Company of New York—Mr. Lieb returned home in 1894, at first in the capacity of assistant to the first vice-president and advancing by steps to third vice-president and general manager. On the consolidation of various lighting interests in New York City, under the corporate name of the New York Edison Company, he was appointed third vice-president and associate general manager, which position he now holds. He is also president of the Lamp Testing Bureau and director in several electrical corporations.

Mr. Lieb is a vice-president of the American Institute of Electrical Engineers, member of council of the American Society of Mechanical Engineers, member of the American Society of Civil Engineers, past president of the Association of Edison Illuminating Companies, past president of the New York Electrical Society, second vice-president of the National Electric Light Association, member of the Associazione Elettrotecnica Italiano, Franklin Institute, American Academy of Political Science and the Engineers' Club of New York City. He is also chairman of the general reception committee of the Institute for the International Electrical Congress.

Below are brief abstracts of the several papers. An abstract of the discussion will be given in the following issue.

Mr. W. L. Waters read a paper on "Predetermination of Sparking in Direct-Current Machines," in which he pointed out the insufficiency of a theory of commutation based on reactance voltage without accounting for other factors entering, and showed that the design of a direct-currentd machine with respect to sparking is a compromise between a number of conflicting conditions. A formula is developed in the paper which is stated to include all the important factors affecting sparking; and while empirical, it has been gradually built up as the result of experience, different terms having been added from time to time to take different conditions into account. It does not, however, take into account all the conditions that affect sparking, and one is cautioned that it must be used with considerable discretion.

"Effect of Self-Induction on Railway Motor Commutation" was the title of a paper read by Mr. E. H. Anderson, the subject matter being based upon a study of oscillograph records, of which 13 are photographically reproduced in the paper. The fundamental causes of sparking are stated to be, first, the interruption of the line current flowing through the conductors connected to two adjacent commutator bars; and, second, the interruption of a local current produced by a voltage generated in the conductors connected to the commutator bars which lie under the brushes, this voltage being due to the shifting of the field caused by the armature magnetizing effect, and is influenced somewhat by the voltage per bar of the motor. The voltage from this latter cause is additive to the first mentioned or reactance voltage of commutator based upon line current. The local current should be cut down as much as possible, and consequently railway motors have, as a rule, low armature turns and very high flux and field turns compared with those used in the direct-current generator. Since in large motors the local copper circuit is of low reactance as compared with the brush contact, nearly all the energy of the local current is delivered as heat on the commutator. Should the motor be very large, the stability of the field relatively to the armature must be great in order to limit the local current to a low value, as otherwise the motor will spark and glow at the brushes. On the other hand, in small machines the resistance of the local copper circuit may be high compared to the carbon contact resistance.

Stability of flux is quite essential to good commutation, and this may be secured by the usual method of great saturation or by compensating for the distributing element by means of armature reaction. The latter method points to a motor with distributed winding of the field, pole pieces of great pitch, equal density over the pole face and relatively few turns.

The paper refers to experiments with large direct-current motors, which motors have a tendency to flash when running at free speeds and light currents, the current being interrupted and contact restored again with full pressure across the motors. It is found that motors with exceedingly good commutation at normal loads or on overloads at rated pressure, and even motors which commutate without flashing over with full load current at double-load voltage, have a peculiar tendency to flash over when the current is changed rapidly or the circuit interrupted and made again with full pressure on the motors. Two causes are given for this, one a transformer pressure induced in the armature coils lying under the brushes owing to the rapid change of current, thereby causing large local currents to flow in the coils and through the brush contact. On interrupting this current as the coil passes from under the brush, there is a flash between bars and the line current will follow this local brush from bar to bar. The predominating cause, however, is the slowness of the main flux to respond to excitation, thereby allowing a great rush of current. The paper gives in detail a number of tests made in the study of this phenomenon, but no remedy for its ill effects is offered..

The papers of Messrs. Waters and Anderson were discussed at length by Messrs. E. R. Douglas and Thorburn Reid, both of whom entered with much detail into the various phenomena of commutation, their cause and the manner in which their effects may be met.

Mr. W. E. Winship presented a paper entitled "The Calculation of Line Batteries," in which formulas are deduced for the calculation of storage batteries for use in electric railway work, and with particular reference to "floating" batteries. It is stated that the capacity of a battery should be reckoned approximately at the rate corresponding to the duration of all the net discharges and not at the rates at which the separate discharges occur. This follows from the reason that if a battery is discharged at a high rate for a short time and then is allowed to recover, and the same cycle is repeated a number of times, the ampere-hour capacity of the battery very nearly approximates the capacity at the rate corresponding to the total time elapsing.

In addition to the method of calculation presented, it is stated that comparative calculations should also be made considering, first, the cost of copper alone, and the cost of copper and batteries for equivalent line voltages; also the cost and depreciation in the two cases together with the transmission losses. The battery should be credited with the influence which the load equalization affected would have on the cost of power production; and the emergency value of the battery in case of temporary break-down should receive consideration. With fairly long lines, the ends of which are 6 to 10 or 12 miles distant from the power house, and the cars running are relatively few in number and heavy, a battery installation will generally cost less than equivalent copper. If there are grades and the cars stop and start at a distance from the power house, the value of the battery as a load equalizer will nearly always justify its installation.

Mr. B. G. Lamme presented a paper entitled "Data and Tests of a 10,000-cycle-per-second Alternator," which describes the construction and test of a 2-kw, 150-volt, 10,000-cycle alternator designed and constructed at the Westinghouse works for M. Maurice Leblanc for use in certain special telephone work.

Mr. H. H. Barnes presented a paper entitled "Notes on Fly Wheels," in which he considered the subject from the standpoint of electrical generation. A formula is given for the calculation of a fly-wheel, taking into consideration the avoidance of resonance. The main conclusions are that the fly-wheel, as distinct from the assistance given either by the engine governor or the damping of the unit, is impotent to insure satisfactorily synchronous operation. Except for these two influences the tendency toward accumulative surging existing in the unit would predominate and parallel running would be impossible. A somewhat lighter fly-wheel is advisable than would be considered conservative in practice to-day. Electromechanical resonance is a serious danger that must be avoided by making a proper choice of fly-wheel, which should at the same time be satisfactory for general operating purposes.

Prof. W. S. Franklin read a paper entitled "The Single-Phase Induction Motor," in which is discussed the various factors entering into design, and formulas deduced for the calculation of such a motor.

Mr. George H. Rowe, in a paper entitled "Wave Form Variations of a Long-Distance Line," gave an account of a study of the lines of the Standard Electric Company, California, made by means of the oscillograph. The paper contains a number of reproductions of records taken with the oscillograph, which is stated to offer the best means of studying variations in wave form, amplitude factor, surgings, pumping, etc. The best form for this work is the moving film or falling-plate type, without a synchronous motor attachment; and it should be insulated for use in high pressures and fitted with non-inductive metallic resistances. Among the conclusions of the paper are that it is advisable to substitute induction motors for synchronous motors on lines with large charging current, the latter being used as synchronous compensators properly distributed. It is impossible to design machines to satisfy all wave forms, and the variation in amplitude factor in a long line must be considered. The core loss variation should also be considered, and the charging current may differ from that calculated on the assumption of a sine law. Assumption of sine wave form on long lines and applied to insulator and insulation testing may lead to error. The variation of wave form is partly due to the distorting effects of the hysteresis loop under different conditions of load.

The Nernst Lamp.

IN 1897 Prof. Walther Nernst, of the University of Göttengen, filed his first patent application on the principles of the lamp which bears his name, and concurrently rumors concerning the new lamp began to appear in the technical press. It was not, however, until the spring of 1899 that the issue of the first of a series of patents disclosed to the public the main features of the invention, and not until two years later that the detail patents appeared. Almost a year before the issue of the first patent, however, the distinguished German professor on a visit to this country brought his invention to the attention of Mr. George Westinghouse, with the result that the American rights were disposed of; and with characteristic promptitude Mr. Westinghouse at once gathered a technical staff for the development of the new light to the commercial stage.

What has been accomplished by this staff is strikingly illustrated by a comparison of the Nernst lamp of to-day with that illustrated in the early patents. Such a comparison does not, however, involve any reflection on the inventor; as compared, for example, with the problems presented in the development of the incandescent lamp, the difficulties to be overcome in reaching the commercial stage with the Nernst lamp were enormous. In addition to the difficulties of purifying and treating in commercial quantities the component rare earths of the glowers, were problems relating to regulation, preliminary heating and automatic circuit control, and those of another order none the less simple relating to glower terminal connections, and to the numerous constructional details which each step presented for solution. Nevertheless, in but little over a year from the commencement of development in this country, Nernst lamps were in experimental use on commercial circuits, and subsequent work has been largely in the direction of refinement in processes and perfection of mechanical details.

No account of the genesis of the Nernst lamp would be complete without reference to the brilliant and self-absorbing work of the staff to which Mr. Westinghouse confided the task of its commercial development. A partial record of the work of some of these gentlemen is contained in a long list of patents, which are evidence of the masterly manner in which the scores of problems presented were given solution. Where all have given devoted service in a cause, it is embarrassing to discriminate, but none concerned will, I believe, begrudge a major share of credit to Messrs. Alexander J. Wurts, Henry Noel Potter, Marshall W. Hanks, Max von Recklinghausen, Murray C. Beebe and Edward Bennett.

That the Nernst lamp is now a fixed factor in the lighting field appears beyond dispute; and although it has been handicapped as to rate of progress by a conservatism in the central station field in vivid contrast to conditions of ten or more years ago—when merely to be new was a qualification inspiring a fervid welcome—the glower lamp in its present state calls for serious attention on the part of all central station men. In what follows some account, gathered during a recent visit to the Nernst lamp factory, at Pittsburg, will be given of the processes of manufacture of the Nernst lamp, together with a consideration of some of its features of special importance from the operating standpoint.

In view of the little-known nature of the constituents which compose the glower of the Nernst lamp—commonly known as the rare earths and of which the more recently discovered member, radium, has acquired the widest fame—their impurity in native state and the previous almost entire lack of knowledge concerning their treatment in any form, an immense amount of work has doubtless been necessary in arriving at the technical information now in the possession of the manufacturers. The list of rare earths is a long one —numbering almost two score—and it can be imagined that no small labor was involved in testing various combinations thereof, selecting the ones most suitable and determining the best proportions in the combination for a glower. Naturally information of this character is not given publicity, and consequently so far as relates the raw material and its treatment, we are limited in our statements to disclosures in the several Nernst patents.

In one of the earlier Nernst patents it is stated that the mixture which has in high degree the requirements for a glower consists of about 80 parts of oxide of zirconium, 10 parts of oxide of erbium and 10 parts of oxide of yttrium. These are taken in a powdered state, thoroughly mixed, and a paste then formed by adding water and a binding material such as tragacanth or dextrine. In later patents it is stated that very excellent results have been obtained with a mixture of approximately 70 per cent. of oxide of zirconium and 30 per cent. of oxide of yttrium. Other mixtures which are stated to have been used with good advantage are as follows: 10 per cent. of oxide of zirconium, 70 per cent. of oxide of thorium and 20 per cent. of oxide of yttrium; 70 per cent. of oxide of thorium and 30 per cent. of oxide of yttrium; 0.5 per cent. of oxide of cerium, 80 per cent. of oxide of thorium and 19.5 per cent of oxide of yttrium. These percentages, it is stated, may be widely varied, and generally speaking, the oxides of the rare earths are well adapted for use in mixtures in widely varying proportions. The patents also refer to oxide of magnesium as a suitable component.

Describing in the later patents the preparation of the material of the glowers, it is stated that the oxides to be used are thoroughly pulverized and intimately mixed, and a plastic mass then made by the use of a binder of clear starch. The water used in making the paste should preferably be distilled to avoid the presence of lime, which, being more volatile than the oxides of the rare earths, its presence is undesirable. In another connection it is stated that certain of the rare earths are inapplicable for the same reason. The plastic mass is then inserted in a press and forced through a small hole of requisite diameter, this process being the same as used in "squirting" incandescent lamp filaments. The rods or threads thus produced are then allowed to dry, when they acquire sufficient strength to be conveniently handled. It is stated to be desirable that the greatest specific gravity possible shall be given to the material. In the next process, that of heating, it is stated to be desirable for the heat to be gradually applied, but eventually carried to an extremely high degree. Upon cooling, the rods are ready to receive terminal connections.

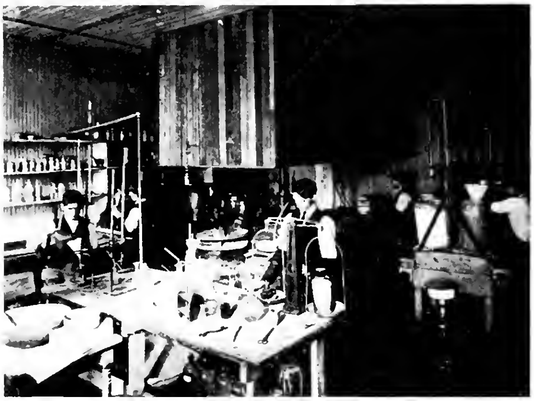


FIG. I.—A ROOM IN THE CHEMICAL DEPARTMENT.

As previously stated, the processes at present employed in treating the rare earths in their passage from the mineral form in which they are found to the state of glowers, are not given publicity. In general it can be said, however, that the processes involve chemical skill of the most expert kind, and close attention to the minutest detail. In particular, it is extremely necessary that all the chemicals employed as reagents or otherwise shall be absolutely pure. For satisfactory results, the degree of heat applied during the treating process must be exactly controlled, and also the concentration of precipitating solutions.

Though organized for work on a large scale, a walk through the factory laboratory creates the impression that one is being shown the workshop of a splendidly equipped investigator into the minutae of chemistry, instead of a department of a lamp works. One requirement in the processes is absolute cleanliness, and to assist in assuring this, that portion entering the laboratory of the grimy ambient which in Pittsburg passes for atmosphere, undergoes thorough filtration. The refinement of care with respect to the material does not cease, however, in the chemical laboratory proper. Each time that new material is prepared a portion is made into test glowers, which are then mounted as if in lamps, and a careful record of performance kept. The admirable organization of the Nernst works is very well shown in the elaborate records kept of glower material from its crude to final state. By means of this system every step from the crude material to the finished product is a matter of record, and as a consequence any abnormality can at once be traced to its source. The net result of this system of records and stage tests is to give complete assurance that when once mounted in a lamp, each glower will give the exact performance for which it was destined. In fact, throughout the factory one is everywhere

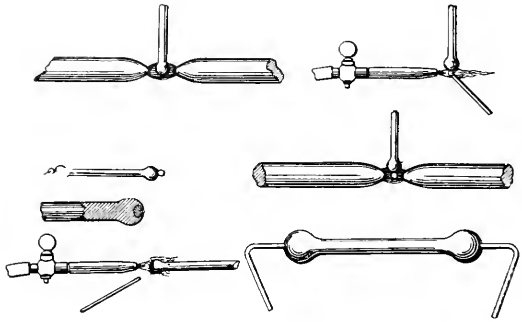


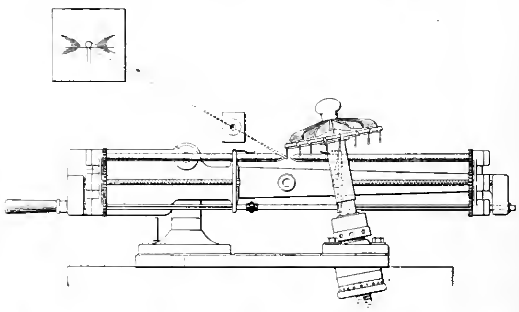
FIG. 2.—PROCESS OF MAKING TERMINALS.

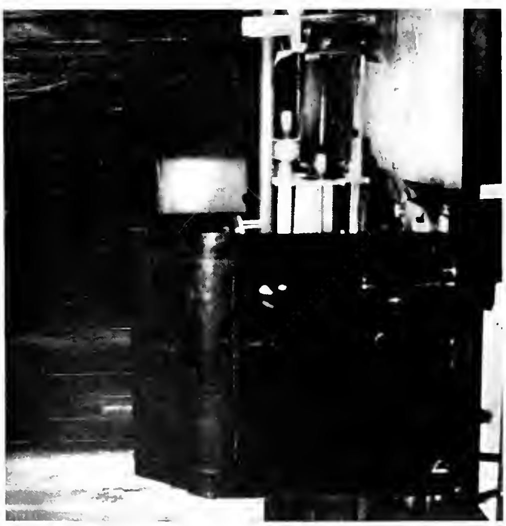
impressed at the extreme care bestowed on that part of its organization which relates to securing exact uniformity of product.

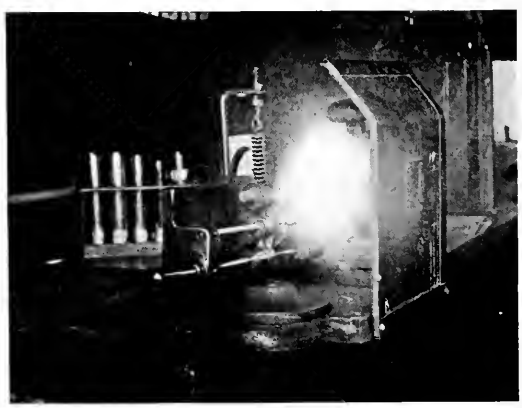
Previous to the description of the process of mounting glowers, some data may here be given as to their dimensions. At normal temperatures practically non-conductors of electric current, when heated the Nernst glower possesses most of the properties of ordinary conductors. An exception is with respect to the method of conduction, but as the electrolytic theory on this point has no bearing on what follows, it may be here ignored. To adapt to different voltages and currents, the cross section and length of the glower is consequently varied as in the case of the incandescent lamp filament. The single filament of a 25-cp., 110-volt lamp has a diameter of .025 in., and a length over all of .62 in., the corresponding dimensions for a 30-cp., 220-volt lamp being .014 in., and 1 in. In the three glower, 200-cp., 220-volt lamp these dimensions become .025 in. and 1.18 in., respectively, and .025 in. and 1.18 in. in the six-glower 500-cp., 220-volt lamp. The glowers, while perhaps intrinsically more fragile than the carbon filament, are, owing to their much greater cross section, quite sturdy when mounted and not subject to breakage in ordinary handling.

Perhaps the most troublesome problem presented in the development of the Nernst lamp was in connection with the glower terminals. The final solution as found by Mr. Marshall W. Hanks, consisted of embedding a platinum bead in the end of the glower and fusing to this a platinum terminal wire. Thus the trouble previously met through contraction in the material of the ends, turned to a positive benefit, in that the terminal is thereby more securely held. The rods of glower material are cut to a length somewhat longer than that of two finished glowers. Each end is then heated in turn in an electric arc, and as the material softens the end assumes a spherical shape. Then in an oxyhydrogen flame a platinum wire is plunged for a short distance into the heated globule, when a small portion becomes separated at a point where the wire has been previously nicked, after which the end is again placed in the arc for an instant. To the platinum globule thus embedded in the spherical end is then fused the terminal wire with the aid of an oxyhydrogen flame. The several stages of this operation are illustrated in Fig. 2, but with reference only to a single glower. Finally, the end of the terminal wire is fastened to an aluminum plug which facilitates connection of the glower to the lamp holder.

The most interesting part of this process is, however, that which relates to the manner whereby the second terminal connection of a glower is made. For satisfactory results it is, of course, necessary that the completed glowers of a given rating should be uniform as to resistance, and by means of a beautiful arrangement due to Mr. Marshall W. Hanks, this is as exactly as possible accomplished. Referring to Figs. 3, 4 and 5, it will be seen that a number of glowers are mounted on a revolving stand and the lower ends in turn brought under the influence of an arc between two carbons. A magnified image of the glower and the arc is thrown on a screen in front of the operator, and also the image of a gauge line. As witnessed in







FIGS. 3, 4 AND 5.—APPARATUS FOR MAKING GLOWER TERMINALS.

actual operation, as soon as the glower treminal comes within the influence of the arc, it is seen to swell and gradually but rapidly an almost perfectly spherical globule forms on the end; as this latter increases in size it approaches the gauge line, and when it becomes tangent with it, the operator revolves the table, the motion withdrawing the glower under operation and introducing another. In a subsequent operation the platinum bead is introduced as above described, and the platinum leading wire fused to this. The entire operation requires but a very short time, an experienced operator being able to turn out 350 glower beads per hour.

While great accuracy is possible in determining the length of the glowers by the above method, it is, of course, not possible in commercial production to prevent some variation in the voltage value of the glowers. The latter therefore have to be sorted before consignment to stock, which operation consists in the measurement of voltage while normal current passes through the glower. Naturally the proper voltage value in this test will be somewhat higher than the corresponding value in the lamp, due to the mutual heating effect of the different glowers in the case of multiple glower lamps, and to the temperature existing within the enclosing globe. In marking the standard packages, containing 10 glowers each, with the voltage of the lamp for which they are suited, it is therefore obvious that allowance must be made for this difference, in addition to 11 per cent. drop in ballast and cutout.

A very neat and original device is used for glower sorting as shown in Fig. 6, having the form of a wheel, the periphery of which carries a number of special mountings for making glower connections in a speedy and positive manner. The wheel is rotated on its axis, commutating connections being made between the glowers and supply circuit. All of the operations, including taking current and voltage measurements, are done by a single operator, the output of each operator being about 1,300 glowers per day.

Before passing to further details of manufacture, a summary may here be given of the organization of the several parts of the Nernst

FIG. 6.—TESTING GLOWERS.

lamp. As has been previously stated, a Nernst glower at normal temperatures is practically a non-conductor of electric current, and consequently to put a lamp in operation it is necessary first to heat the glower to a certain temperature. This is accomplished by means of a heater, which will be described later in detail. When a lamp circuit is closed, the current from the line first passes through the heater circuit, which circuit is automatically cut out when the glower becomes sufficiently conductive. Referring to Fig. 7, it will be seen that, assuming the glower to be non-conductive, all of the current will first pass through the heater. As the glower becomes conductive a current begins to flow through its circuit, this circuit also including an iron "ballast" or resistance wire, which will be referred to later, and a cut-out coil; when the current reaches a predetermined amount, the cut-out coil operates and the heater is cut out of circuit. Thenceforth the current passes through the glower, ballast and cut-out coil, to line. In Fig. 8 the organization of the several parts in an actual lamp is shown.

This brings us to the consideration of the second very interesting feature of the Nernst lamp—the ballast coil, due to Mr. Henry Noel Potter. As in the case of ordinary conductors, the resistance of a glower when heated varies with its temperature, and it happens that at the temperature most desirable in the working of the glower, the decrease of resistance with increase of current is quite rapid. As a consequence, without any controlling device in circuit, at this particular point a relatively small increase of current might so reduce the resistance as to quickly result in a flow sufficient to burn out the glower. Iron wire possesses the opposite property of increasing in resistance as the temperature increases, and it very fortunately happens that at a certain critical temperature this increase of resistance becomes very considerable for relatively small increases of temperature. If then an iron wire is placed in the circuit

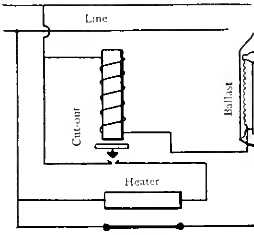


FIG. 7.—NERNST LAMP CIRCUIT.

of the glower, of a size selected so that its temperature during the normal working of the lamp is at or near the critical point, an increase of current will cause its resistance to increase in about the same proportion as that of the glower decreases. This is illustrated in Fig. 9, which gives curves of the variation of resistance with increase of temperature of a glower, and ballast, respectively (the latter to a larger scale), and a resultant curve which represents the variation of the current passing through the lamp with increase or decrease of voltage. The flatness of the glower curve indicates that a very slight change of voltage would produce a very great change in the current, while the effect of the ballast wire is to make the resultant curve almost vertical in its working part; thus a very considerable change in voltage will necessarily give rise to but a small change in current.

As constructed, the ballast is kept within remarkably small compass, the dimensions of a tube for a three-glower lamp, for example, being 11-16 in. in diameter and 2 3-16 in. long. The diameter of the wire varies from .001 in. in the smallest ballast to .004 in. in the largest. The length of the wire before being given a helical twist, is from 4 in. to 12 in. and the resistance from 25 to 80 ohms. The drop in the ballast is about 10 per cent. of the total drop between the lamp terminals. The wire is supported on a nickel standard having a cross arm to support the wire, which is threaded through porcelain insulators fused on the standard with glass. The bulb is finally exhausted and then refilled to about atmospheric pressure with hydrogen obtained electrolytically from an alkali solution.

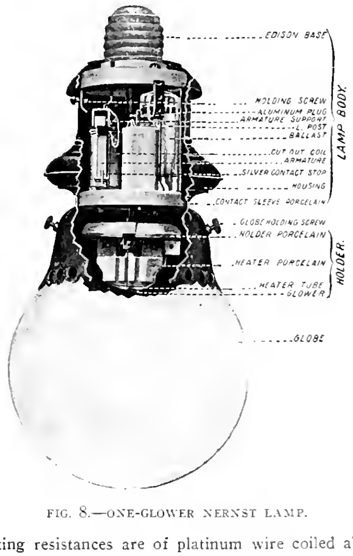


FIG. 8.—ONE-GLOWER NERNST LAMP.

The heating resistances are of platinum wire coiled about porcelain, then covered with a porcelain paste having the same coefficient of expanison as the wire, and baked. Owing to the necessity of having the porcelain uniform in quality and properties, the raw materials are worked into the finished product at the factory—not only for the heating resistances but also for the mountings in the lamp frame. In the case of the smallest lamp, after baking the covering cement, the rod carrying the resistance is heated to a red glow and wound on a mandrel to a spiral form, the heat being applied as the winding proceeds. Naturally this is a delicate operation, but the arrangement for the purpose has been so carefully worked out that the operation is carried on by boys.

A problem of no small magnitude was involved in realizing a cut-out absolutely reliable in its action yet miniature in size, capable of controlling a current rising to several amperes in value and of remaining continuously in circuit with the lighting current. As perfected the cut-out, which breaks the circuit at two points, weighs for a three-glower lamp but 3¼ ounces and occupies a space of 2 3/16 in. x 1⅞ in. x 13/16 in. The contacts are of silver. The cut-out coil after winding is impregnated with a mineral compound which allows the insulation to stand a red heat if necessary, and is finally covered with asbestos sheet. The drop in the coil is about 1 per cent. of the total drop between lamp terminals. The number of turns in a coil are so fixed that the heater circuit is cut in when four glowers of a six-glower lamp are burned out, or two glowers of a three-glower lamp, or one glower of a two-glower lamp. Fig.

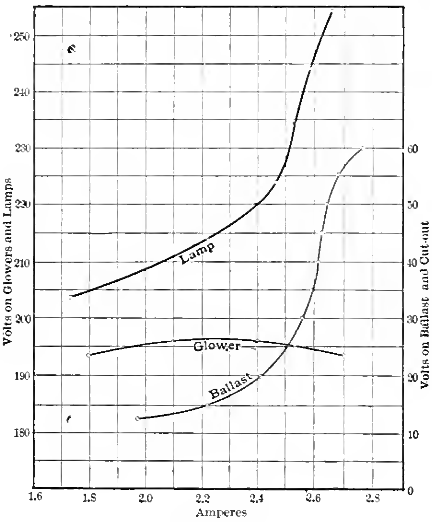


FIG. 9.—NERNST LAMP CURVES.

11 shows in outline a cut-out. As will be seen, the construction is very simple, the contact being maintained through the action of gravity; when the contact is broken the armature moves into a position with respect to the magnet poles which ensures a strong magnetic lock.

Entering a field that in late years has become strangely conservative, the Nernst light encountered as a late-comer conditions that its rivals in possession had escaped in the earlier days. Moreover, these latter have presented a solid front to what appears to have been regarded as an interloper, and every claim made for the Nernst lamp has been vigorously contested. As is apt to be the case in commercial competition, nothing meritorious has been conceded to the rival, and every statement in its favor met by a counter-statement showing instead a deficiency. What follows involves some of the controverted points, which are here presented in the light of the most reliable information which has been found available.

EFFICIENCY OF THE NERNST LAMP.

When we come to the subject of the economy of the Nernst lamp quite an array of diverse opinion is presented. Drude, the distinguished German physicist, credits the Nernst glower with an absolute luminous efficiency of 12 per cent., the corresponding efficiency of the incandescent lamp filament being variously stated by authorities at from 2.5 per cent. to 6.5 per cent.; on the other hand, the claim has been made by an incandescent lamp interest that the efficiency of the Nernst lamp in commercial service is practically the same as that of the ordinary incandescent lamp. If, however, we accept Tumlirz's constant of 5.2 for the number of candles per watt for a luminous efficiency of 100 per cent., a 3.1-watt incandescent lamp has a luminous efficienty of 6.5 per cent. and a Nernst glower of 12 per cent. luminous efficiency corresponds to a consumption of 1.62 watts per cp.

When one refers to the candle power experiments that have been

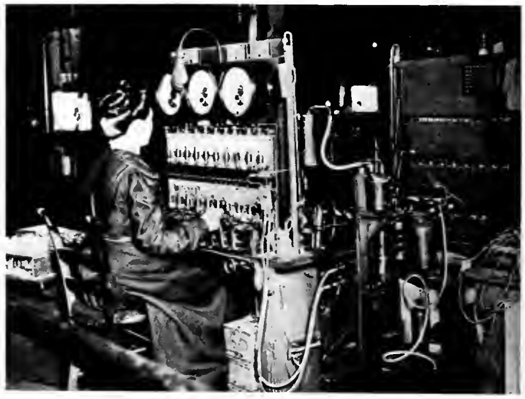


FIG. 10.—TESTING BALLASTS.

made on the commercial Nernst lamp, the results are apt to be so contingent on the experimenter's interpretation of what constitutes a candle power—whether it is to be considered in a spherical, hemispherical or some other significance—that the data are of little value for comparative purposes. It happens, however, that the Photometric Committee of the National Electrical Light Association has reported on measurements of the Nernst lamp in such a form that a comparison can be made between the performance of this lamp and that of arc lamps tested by the same committee and presumably according to the same methods. According to this report, the watts per hemispherical candle power consumed by a six-glower lamp were 1.88 per cp. with clear globe as compared with the following enclosed arcs with opal inner globes and clear outer globes: Direct-current series, 1.3 watts; direct-current multiple, 2.25 watts; alternating-current series, 1.19 watts; alternating-current multiple, 2.53 watts. With an opaque globe the consumption of the Nernst lamp was found to be 2.10 watts per cp.

Since the competition is with the multiple arc lamp, and since for interior lighting, hemispherical candle power can be accepted as a proper criterion, it will be seen that according to these tests the Nerst six-glower lamp is notably more efficient on the above basis than either the direct-current or alternating-current type of multiple

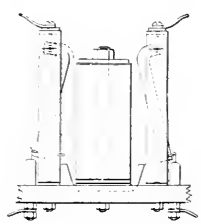


FIG. 11.—NERNST LAMP CUT-OUT.

enclosed arc lamp; and on the basis of either of the figures above given, it is still more notably efficient than the most efficient type of incandescent lamp used on commercial circuits, namely, the 3.1-watt lamp.

The lack of agreement as to what shall constitute a measure for practical illuminants is becoming daily more unsatisfactory and as a practical problem is pressing for solution—not only on account of the occasion which the present condition offers for all manner of claims and counterclaims on the part of those interested commercially in illuminants, but also because the public has a right to, and should be given in this as it has in other branches of business, some definite standard within its means of comprehension by which to gauge what it purchases. And since the user of electric lighting current only wants that commodity—if we dare to term it such—for the illumination which it produces, the measurement of illumination where it is actually needed is what, in this connection, appears to be the desideratum. This is the view of the Nernst Lamp Company, and Mr. Alexander J. Wurts, chief engineer of the company, has proposed the following method of comparing the effect of illuminating powers of artificial sources of light:

The arrangement to comprise two rooms standardized with reference to size, color and furnishings, some convenient point of view being provided from which the illumination of both rooms may be readily compared. The primary room to be illuminated with incandescent lamps, say of 8 cp., arranged to the best possible advantage for the most effective lighting of the space; the secondary room to be lighted by the lamps to be compared, arranged also for the most effective illumination. An equally effective illumination in each room is then secured by switching on or off lamps in the primary room. The energy supplied to each of the two rooms being measured when adjustment is secured, these data will then represent comparatively the efficiency of the sources of illumination compared. It is stated that accuracy within 5 per cent. is obtainable with this method. That such a method would appeal to the lay user of artificial light may be taken for granted, though it would perhaps not satisfy the physicist any more than a town clock would satisfy an astronomer. None will deny that what is sadly needed is a yard stick for illumination; what is now usually offered may be likened to an offer to a perspective user of measure of length—who would be satisfied with a 5-cent graduated stick—of a certified standard necessitating a microscope to locate the lines thereon fixing the desired length.

But it should be added that the superior economy of the Nernst lamp as registered at the meter is only a part of the claims it can put forth for recognition. The human eye does not take cognizance alone of meter efficiency, but applies criteria of its own. Owing to the approach of the Nernst light to the quality of daylight, the eye is better accommodated to illumination from this source, with a result that it will distinguish objects much better with the same measured illumination than in the case of a source not possessing this quality. To put an extreme illustration, one can easily imagine that a more satisfactory aspect of, say, a room would be obtained with the light of a single candle than with that from a 50-cp. source giving forth blood-red rays. That the beautiful quality of the Nernst light would make it a factor in the lighting field were its cost even much larger than that of its competitors less favored in this respect, is evident when we look back and note the course of the various modern illuminants—the progression from the candle to oil, from the latter to gas and finally to the incandescent lamp—in each case the quality of light dispossessing a cheaper source.

REGULATION.

One of the charges which has been made against the Nernst lamp is that it requires a closer regulation of circuit than the incandescent lamp. If this were qualified by adding that the incandescent lamp superior in this respect is a 4-watt lamp, the charge might perhaps be maintained, but in that case it would also hold good as against the 3.1-watt incandescent lamp. In point of fact, it is claimed for the Nernst lamp that a continuous five per cent. overload will not appreciably shorten the life of the glowers, whereas, on the other hand, accepted curves of incandescent lamp performance show a decrease in life of 60 per cent. under the same condition. At the present day the matter of proper regulation of circuit voltage is beginning to attract the attention which its importance demands, and the Nernst lamp has not been found wanting where this attention has been given; and where it is lacking the deficiency is equally fatal to the high-efficiency incandescent lamp. If improvements made in the electrical field during the past fifteen years had been subjected to judgment on the basis of their fitness with respect to the practice of the poorest central station, many of the most valuable advances of the period would be yet awaiting recognition. One of the benefits which the Nernst lamp will confer on the central station industry will be in strengthening further the present movement toward proper circuit regulation, in which benefit it will itself participate as only one factor among many making toward better central station financial returns.

MAINTENANCE.

Unlike the incandescent lamp, the frame and connections of the Nernst lamp form a permanent structure having an indefinite life, but its perishable parts have from time to time to be renewed. Of these the ballast has a life so long, averaging 25,000 hours, that in an organization for maintenance it plays little part. The heater has also a very considerable life, the period averaging about 8 months in ordinary use. The glower, however, like the incandescent lamp filament, has a practically definite term of use, at the end of which it would be advisable to replace the glowers whether burnt out or not. 800 hours are given as the guaranteed life on 60 cycles.

Two systems of maintenance for the Nernst lamp have been employed. In the one, all the installations within a certain radius are maintained for a fixed sum per month from a central maintenance bureau, which may be directly in control either of the Nernst Lamp Company or its central station customer on whose circuits the lamps are operating. This department of the lighting company is analogous to the meter department which is now becoming an auxiliary to all well-managed plants. Such an organization involves the services of an inexpensive class of help, consisting of an inspector who alone or with one or more assistants in the case of the larger plants, operates the maintenance system, visiting all installations periodically; for example, commercial installations may be visited weekly, and residential installations once per month, the user being instructed how to act in contingencies which may arise during the absence of the inspector. A complete stock of Nernst lamp parts is carried in the repair department. The work to be done here is so simple, owing to the careful provision made in the design of lamp details for easy renewal, that a boy or girl can in a short time acquire the necessary skill.

The second system is especially applicable to the larger installations and those in isolated localities. In these cases, the maintenance work may frequently be entirely taken care of by the building janitor or electrician, who has previously received some instruction and training, either at the company's works or from an expert repairman. Suitable quarters would be provided in the building in which a limited stock of repair parts and facilities for renewal work would be available.

The total cost of maintenance under these conditions will be comparatively low, provided the maintenance work is executed in a systematic manner; a certain portion of the day being given to inspection, with a complete inspection of all lamps installed, the repairing of defective holders being afterwards done in the repair room. We are informed that the results obtained by the company from a number of prominent installations go to show that the cost of maintenance of the smaller lamps approximates that necessary for incandescent lamps, and the cost for the multiple glower lamp is practically the same as that for standard enclosed arc lamps.

Electric Lighting Chicanery.

The following item was printed in the New York *Evening Post* in a recent issue. It is not without its humorous side: "Comparatively few persons know why an electric lighting company is so exceedingly kind to its customers as to give them new incandescent lamps without charge in exchange for those which have burned out. The employees are always so polite, almost anxious to make the exchange. Any one can find out the reason by burning new, high-priced lamps for a month, and the next month the lamps the company gives in return for old ones. His bill will show that the reason, from the company's point of view, is an excellent one. The lamps supplied by the companies are invariably 'renewed' lamps; that is to say, old lamps made new by a delicate but not expensive process; and 'renewed' lamps burn more current—much more. The millennium is not yet here." There is deep villainy for you. As a matter of fact, we should be glad to get "renewed" lamps exclusively; at least no objection would be raised. In view of the fact that they have been in use, the occluded gas in the platinum, etc., have been pretty thoroughly disposed of, and such lamps are, therefore, quite likely to beat new ones all hollow for economic efficiency. But their use is vastly exaggerated. One local company we could mention, out of over 1,500,000 lamps bought had only 6,000 "renewed," and that is probably about the general ratio.

Recent Electrochemical Developments.

PRODUCTION OF SODIUM HYDROXIDE.

Two patents granted on May 10 to Mr. Blackmore, of Mt. Vernon, N. Y., relate to the electrolytic production of sodium hydroxide. The process described by him in one of the patents is in its essential points similar to the well-known Castner-Kellner mercury cathode process, which is in actual operation on a large scale. Various modifications have been suggested for this process, relating especially to the method by which the cathodically formed sodium amalgam is removed from the electrolyzing cell for the production of sodium hydroxide in another cell. For instance, Bell proposes to use for this purpose the atmospheric pressure of the gases developed in the cell; his process has been tried on a large experimental scale by the Pennsylvania Salt Manufacturing Company at Wyandotte, Mich., during the last three years, but it does not seem to have yet been reduced to industrial practice. Blackmore in his present patent produces the movement of the mercury and amalgam through the various vessels in his apparatus solely by the differences of level of the various bodies of mercury and amalgam. These differences are maintained by a suitable adjustment of a float-fed and a float-controlled outlet, and of the height of the connecting pipes. The mercury, after the sodium has been removed from it, is pumped back into the first vessel which supplies mercury to the cathode in the electrolyzing cell.

The second patent of Mr. Blackmore refers to the production of sodium hydroxide from the cathodically formed sodium amalgam or sodium lead alloy (in the latter case a molten lead cathode being used as in the Acker process). In what follows we assume a molten lead cathode. Mr. Blackmore's apparatus consists essentially of an electrolyzing vessel with a diaphragm dividing it into two compartments. The anode compartment is in the center and contains fused sodium chloride on top of a floating diaphragm, which consists of magnetite broken into small fragments. This diaphragm floats on the molten lead cathode which extends into the outer vessel. The specific gravity of the diaphragm is greater than that of the molten electrolyte in the anode compartment, and smaller than that of the molten lead cathode. The lead sodium alloy produced by electrolysis, being lighter than lead, continually arises to the surface of the molten lead, and may be drawn off there. The author, however, considers it preferable to change it into hydroxide, and has found the following method suitable. Molten sodium hydrate is injected in a plurality of fine streams into the molten lead-sodium alloy, and is reduced by the sodium to sodium oxide with evolution of hydrogen which passes off. The sodium oxide arises and flows on the surface of the cathode and, remaining in a molten condition, it is continuously drawn off. To facilitate the oxidation of the sodium, a layer of loose granular conducting material, like iron, magnetite of ferro-silicon, is arranged at the surface of the cathode. This loose material serves to distribute the streams of sodium hydrate and bring them in thorough and intimate contact with the sodium in the alloy. "The oxidizing reaction is facilitated by the innumerable local couples due to the contact of the sodium and the relatively negative particles of iron, etc."

BATTERY INVENTION.

A patent granted to Mr. C. J. Reed, of Philadelphia, refers to the construction of a plate suitable for Planté formation. The plate consists of numerous corrugated panels with intervening strengthening ribs and side ribs, the exposed surfaces of the panels being corrugated so as to have a large surface. The plate is made by passing molten lead between corrugated rolls and subsequently subjecting the plate to lateral edgewise compression in order to reduce the grooves to the smallest practicable width.

A patent granted to Messrs. R. Fortun and E. Semprun, of Madrid, Spain, relates to a storage battery, the feature of which is the active material of the positive electrode. This active material is produced by electrolysis, between lead electrodes, of a saturated solution of oxide of lead in a lixivation of potassium hydroxide, rock candy and neutral potassium tartrate. By this action a brown substance is deposited on the anode for which the claim is made that 100 grams of this substance are capable of fixing 369 grams of oxygen. This active substance is used for the positive pole electrode in an accumulator with a solution of 17 parts of lead nitrate in 100 parts of water, acidulated with pure nitric acid until the solution registers 20° Baume.

A patent granted to Messrs. J. Noble and E. L. Anderson, of St. Louis, represents a new attempt at utilizing the heat of oxidation of carbon for the production of electrical energy. The cell consists of an aluminum plate and a carbon plate with an electrolyte of nitric acid, heated to 150° F. The cell is claimed to have an e.m.f. of 1.5 volts, the current flowing in the solution from the aluminum to the carbon. The following actions are assumed to take place in the cell. Oxygen is evolved at the aluminum anode without attacking it, while at the cathode the nitric acid is reduced to nitrogen peroxide, which oxidizes the carbon cathode, thereby forming carbonic acid gas and nitrogen oxide gas. The nitrogen oxide gas unites with the oxygen evolved at the anode and forms nitrogen peroxide gas, which passes into a condenser filled with a mass of moist carbon or coke, and is therein condensed to nitric acid, returning then to the battery. The claims of the inventors that without destruction of the aluminum plate electrical energy is produced at the expense of the change of the carbon plate to carbonic acid gas and at the expense of heat supplied from the cathode.

New Telephone Patents.

If the general activity in any field of industry may be measured by the activity of its inventors, then truly must telephony be in a prosperous state, for we have at hand this week for consideration an extraordinary number of telephone patents. These treat of a great variety of subjects, as might be expected, but for convenience they will be grouped together under topical headings in so far as possible. The first group will include patents bearing on central office apparatus.

CENTRAL OFFICE APPARATUS.

The heat coil or sneak current protector forms the subject of three patents. These all apply the same principle, viz.: the shortness of fusible metals when slightly heated. The application of the principle is, however, made in two different ways. In Fig. 1 is shown sectional views of all three new coils.

At the right is a heat coil patented by M. Setter, of Chicago. As will be noted, on one end there is a hinged plate to which a stud

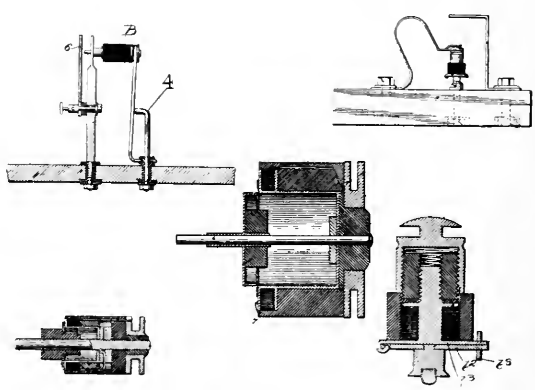


FIG. 1.—TELEPHONE CUT-OUTS.

is attached. Normally, a ring of fusible metal encircling projections from the pieces b^2 and b^3 holds them together. In this condition the coil is adapted to be mounted in a spring holder which strives to pull the ends apart. When an abnormal current passes in the circuit, which is led through the heat coil, from one terminal button to the other, the heat generated so affects the solder ring, b^8, that its tensile strength is impaired and it breaks. The hinge at once opens, giving, as it does so, an inclination to the stud, b^1, such as to cause it to escape from its holder and thereby breaking the circuit, which at once becomes grounded against the stop for the spring terminal. The other two heat coils cause a shearing of solder under exactly similar circumstances, to effect an operation of the switching members. One of these is shown at the middle of Fig. 1, while the other, together with a mounting suitable for either, is shown at the left. In both the heating coil proper is in annular form, surrounding a cup within which a plunger may be forced. The plunger is normally blocked, however, by a washer of solder, which lies between its bottom and the mouth of the cup. The tendency of the mounting springs is to cause the plunger to clamp the washer, as a plate between a punch and die. With slight heating of the coil shearing takes place, the circuit opening at the point 4 and grounding at the point 6. The chief point of distinction between the two coils of this type lies in the substitution of an insulating shearing plug in one, that shown on the left, for the metal shearing plug of the other. Of these coils Mr. Setter is the inventor of one and H. P. Claussen the inventor of the other. Both have assigned their right to Messrs. P. C. Burns and J. G. Shimsen.

A. M. Knudsen, of Chicago, has produced a combined jack and drop for switchboards in which the drop shutter is mechanically restored by the insertion of a plug into the jack in answering the call. The restoring is accomplished by a pivoted member, one end of which hangs in the path of the plug in a manner to be rotated by the insertion of the latter, while the other end engages an extension of the drop shutter so as to restore the shutter as the rotation takes place.

A second mechanically restoring annunciator is that patented by Albert Corliss, of Chicago. In this the target or shutter revolves on a pivot, the signal being displayed before a window in the casing which holds the annunciator and jack in proper relation. The restoring is accomplished by a spring member which engages a stop on the rotating shutter. This spring is elevated by the entering plug, and its end engaging the stop causes the shutter to rotate into normal position, where it becomes locked pending the arrival of another call. The American Electric Telephone Company has been assigned this latter patent.

SWITCHBOARD CIRCUITS.

Switchboard circuits are represented by three patents. One of these shows a rather simple common battery system, while the other two relate to the divided multiple switchboard. The common battery system patent has been granted to Mr. D. W. C. Tanner, of Chicago. The circuit is shown in Fig. 2. For the purposes of explanation it will be assumed that a call is started from the left-hand station. The removal of the receiver from the hook closes the circuit through relay *a*, which, responding, energizes the line lamp and busy test for the calling subscriber. The operator responds in the usual way with plug *t*, the answering plug of the connecting cords shown. This extinguishes the lamp, as the battery, b^1, opposes battery *b* and reduces the potential around the lamp sufficiently to do so, this reduction of potential, of course, being traceable to the series resistance, *c*. It will be noted that no supervisory light is shown. This is because the line lamp of the calling line serves this purpose; to this end it is arranged so that once extinguished by the response of the operator, it will not relight until both subscribers have hung up.

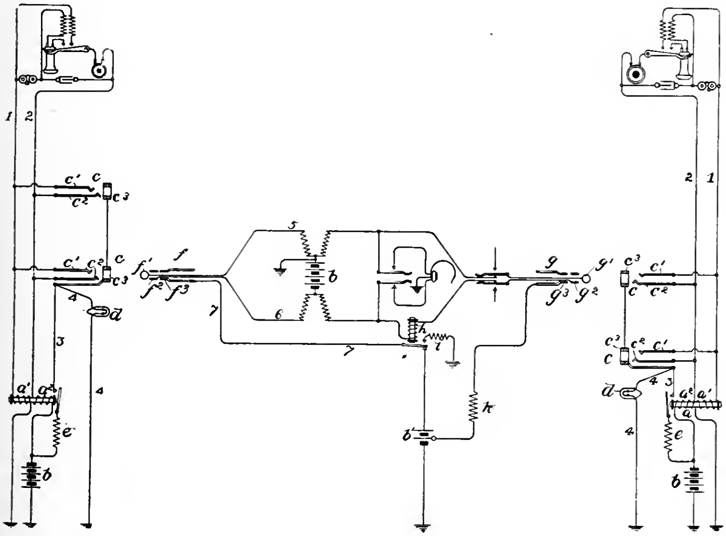


FIG. 2.—TANNER SWITCHBOARD SIGNAL.

Suppose, now, the operator to proceed with the connection by plugging into the desired line. This will put a busy test on this line from the tap, *k*, but will not cause the called line's lamp to glow, as insufficient potential is provided. Now, the called subscriber answers, energizing his relay, *a*. Still his lamp fails to glow, as tap *k* forms a shunt about it. When the subscriber answered another change occurred, as relay *h* was energized and connected the shunt, *l*, around the calling subscriber's lamp, *d*, instead of the battery, b^1. Now it is evident that *d* will only glow when both subscribers have hung up, for if the calling subscriber alone does this no battery connection exists in the lamp circuit; while if the called subscriber hangs up alone there is a return to the battery shunt, b^1. If both hang up, battery b^1 alone is effective and this lights the signal.

The circuits for divided multiple boards are both the work of E. H. Smythe, of Freeport, Ill., and show two alternative methods of accomplishing his desired result. With the divided multiple switchboard of the type in question, each line is provided with one answering jack and line signal for each division of the multiple, and in signalling he must operate that one of his signals which is associated with the division corresponding to the desired subscriber's number. At times it is found that a subscriber will call in error, and noting his mistake remakes the call to the proper division. Under such circumstances confusion would, of course, arise unless some means of preventing the co-existence of two signals from the same line. Mr. Smythe overcomes the difficulty by making the signal relays, which cause the display of the signals, interconnecting in such a manner that the one last energized disconnects or de-energizes the other. Therefore, the corrected signal at once and automatically extinguishes that made in error. Both Mr. Smythe's and Mr. Tanner's patents have been assigned to the Western Electric Company.

SUBSCRIBER'S STATION APPARATUS.

Undoubtedly quite frequently telephone users are disturbed for fear that what they say into the transmitter may be overheard by those in the immediate neighborhood. For some the sound-proof booth serves every purpose, but this because of the inconvenience of entering it and the space it occupies is not always satisfactory. To overcome this difficulty a transmitter hood has been patented. This is a metallic box adapted to be fastened upon the transmitter, and of such size and shape that when the face is closely pressed against it the lips will be in proximity to the transmitter mouthpiece. The box is of small size, the edge of the aperture coming in contact with the chin, cheeks and upper lips only. The edge is provided with a rubber cushion and is shaped to fit the face. As it is necessary to keep secret but a portion of one's conversations, the sides of the box, four in number, are made folding and are so controlled by a spring that they may be folded back. R. D. Fannon, of Chicago, is the patentee of this apparatus.

A new telephone set has been invented by Messrs. S. C. Houghton, of San Francisco, Cal., and F. M. Potter, of Syracuse, N. Y. Vertical slide bars support an adjustable frame upon which both transmitter and receiver are carried. The receiver is upon the end of an arm consisting of two bars, which are insulated from each other and serve as the conductors to the receiver coil. The receiver is held in a position to the side of and in front of the transmitter ready for use. A slight pressure upon it in a horizontal direction serves to throw the switching device, while a semi-automatic electromagnetic switch enables one to hold the line conveniently while leaving the instrument.

For use in damp places, or where water is likely to be dashed about, as on shipboard, a water-proof subscriber's set is advisable. Such is one invented by Alfred Graham, of London, England, which has been recently patented. The casing is of metal and all apparatus is contained therein, entirely protected except when actually in use.

Mr. A. W. Hill has brought out a novel transmitter in which one block of carbon serves as the body of the casing and the stationary electrode. A sectional view of this transmitter is shown in Fig. 3, which indicates how the diaphragm, mounted between rubber pads, is clamped to the carbon block by the face plate. Within a central and deeper recess in the carbon block the microphonic button is built up. The recess is lined with an insulating tubular bushing, which contains the granular carbon. The bottom of the recess forms the rear electrode, while the front electrode attached to a metal backing slides within the bushing, the joint being jacked by a felt ring.

The two remaining patents to be included under this head describe

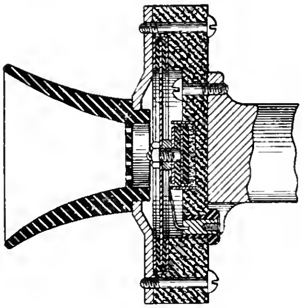


FIG. 3.—HILL TRANSMITTER.

respectively a receiver and a ringing generator. The novelty in the receiver lies in the method of mounting the magnet within the casing. The casing is in three parts, a joint being made in the body near the bell. The magnetic system carries a collar secured to it near the coils, and this collar forms the coupling for uniting the two parts of the body of the casing. The distance which the collar is screwed into the bell piece of the casing determines the air space between the diaphragm and poles. The tail piece is then screwed up like a lock nut securing the whole in adjustment. W. C. Runge has been granted the patent for this.

MISCELLANEOUS.

While the effects of electrostatic capacity have been brought well under control by the Pupin system of loading conductors, all other steps towards ameliorating its detrimental qualities are interesting. Mr. J. S. Richmond, of New York, aims to do this in his transmission system described in two recent patents. Mr. Richmond argues that with a metallic circuit in a cable of conducting material, i. e., a conducting shell, all capacity between the individual conductors and the shell will be obviated if the potential of the shell be kept a true mean between the sum of the potentials existing on the conductors at all points. He accomplishes this by finding the inductive neutral of each end of the line and grounding this. Such a process, of course, renders it necessary to use double-wound apparatus of that type designated as "split" wound, but this would not weigh against the system if the gain in transmission is found to be material. Any one who has tried to solder a wire to a gas or water pipe, or to make a secure joint by wrapping for the purpose of obtaining a ground connection, appreciates what a boon was the introduction of sheet-metal ground clamps. An improved ground clamp of this type readily adjustable to different sized pipes has been patented by Messrs. F. P. Fuller and J. J. Walsh, of Yonkers. In this clamp the actual connection seems to be made chiefly between the clamping screws and the pipe, the metal band serving merely to hold the screw ends against the pipe.

Many already know that method of handling distributing wires wherein they are carried in rings supported by a messenger strand. Such a scheme is most successful. However, it has been found advisable to hold the rings at definite distances apart by an auxiliary fastening, such as a wire or yarn running parallel with the messenger and independent thereof. F. C. Locke has obtained a patent for a method of fastening the rings based on these principles. A train telephone system for communicating to and from and between moving trains, a step-by-step selective system, and a special arrangement of telephone incandescent lamp bulbs for exhaustion, comprise the subjects of the remaining three patents. These have been invented respectively by Messrs. C. G. Otwell and S. H. Melvin, Mr. C. A. Anderson and Mr. A. D. Whipple. For information concerning them the reader is referred to the patents as the subject matter does not seem of sufficiently general interest to warrant discussion here.

CURRENT NEWS AND NOTES.

FEMALE STREET CAR CONDUCTORS.—A Springfield, Ohio, despatch dated May 17, says: After six years of experiments the officers of the street railroad company at Chillicothe have decided that the women conductors must go. The women were satisfactory, except that they were not strong enough for switching work. Switching at home would be more in their line, it would seem.

CELEBRATING TELEGRAPH ANNIVERSARY.—The Postal Telegraph Cable Company is to celebrate this week in New York the tenth anniversary of the opening of its central office building and the sixtieth anniversary of the first telegraph message. The exercises will take the form of a conference of the leading officials from all over the country, with a banquet on May 24 at the Hardware Club. The previous night there will be a large theatre party at Wallack's to see "The County Chairman." Mr. C. P. Bruch is organizing the functions.

DETECTING DIAMOND IN STOMACH.—A news note from Texas states that a thief there swallowed a diamond worth $250, and then was arrested and taken to jail. Investigation by means of the X-ray revealed that it had "become imbedded in the wall" of the man's stomach. The owner of the diamond offered to pay for a surgical operation, and it was performed with entire success, so that the owner has recovered his diamond and the thief was still alive at last accounts, with good prospects of recovery. At least, so the story goes in the dispatches.

COMMERCIAL AUTOMOBILE TESTS.—As a result of the service tests of motor wagons made under the auspices of the Automobile Club of America, gold and bronze medals have been awarded to the electric delivery wagons of the Pope Motor Car Company to carry from 1,000 to 2,000 pounds; a gold medal to the electric truck of the Electric Vehicle Company, to carry between 4,000 and 5,000 pounds, and a gold medal to the gasoline-electric truck of the Fischer Motor Vehicle Company, to carry from 8,000 to 10,000 pounds. The committee will presently issue a full report on the subject of the tests.

WIRELESS TELEGRAPHY AT THE FRONT.—Capt. James, the efficient correspondent of the New York and London *Times* at the seat of war, has been silent for some time lately. He has resumed his work, but in his wireless dispatches admits that Japan had temporarily warned him off the fighting zone, just as Russia had done, although in a slightly more polite way. "My position was difficult in the extreme. I was threatened with capital punishment by one belligerent and warned off the high seas and neutral waters by the other. Only two courses remained open: Either to submit to the Japanese wishes or claim the right of a neutral flag on the high seas, in which case the only control of either belligerent would be *force majeure*. In deference to former courtesies on the part of the Japanese, I took the former course."

SELECTIVE SIGNALLING BY RESONANCE.—Dr. M. I. Pupin is to lecture before the New York Electrical Society on May 25 at the Havemeyer Building, Columbia University, on "Selective Signalling by Electrical Resonance." Dr. Pupin will explain the principles and the essential elements of this system of transmission. These elements are: The multifrequency alternator, the transmitter, the distributors, the resonators, and the rectifiers. At the special request of the U. S. Patent Office Commissioner, Dr. Pupin has prepared an exhibit for the pavilion of the U. S. Patent Office, at the St. Louis Exposition, illustrating by a complete model the transmission of telegraphic messages by alternating currents of various frequencies, the receiving and the transmitting apparatus being electrically tuned to the frequencies which they are intended to receive and transmit. This exhibit will be shown at the lecture. The lecturer will discuss at some length the application of electrical resonances on which the development of wireless telegraphy may so largely depend.

RADIUM FOOD PRESERVATIVES.—At a recent meeting in New York City of the Food Standard Committee, L. Lieber, of H. Lieber & Co., New York chemists, spoke in defense of chemicals used in coloring foods. He said that they commonly preserve the food while exposed to light and cease to act when out of the light, so that when the food is eaten there is no interference with digestion. In his opinion these substances are much superior to the so-called preservatives. Mr. Lieber also said that the time is coming when radioactivity will entirely supplant the chemicals now used for preservatives.

POOL ROOM TELEGRAPH SERVICE.—The following is part of a series of resolutions adopted by the Western Union Telegraph Company: "The Executive Committee hereby instructs the officers and employees of the company to withdraw immediately the service of racing news from any place or places that shall be designated as unlawful pool rooms by the Commissioner of Police of New York City or the District Attorney of New York County, accompanied by a request to make such withdrawal, and to furnish hereafter such racing news only to such applicants as shall give assurance that it is not to be used for pool room purposes." The company has since discontinued its race news service and the New York Telephone Company has promised to take out its telephones in pool rooms.

GOOD BUT NOT CHEAP.—Mr. Godfrey L. Cabot, writing from Boston, Mass., under recent date to the *American Gas Light Journal,* inquires: "Perhaps some of your readers can kindly tell us whether paraffine paper has ever been tried as a protection of pipes from electrolysis. It seems to me that, by neatly fitting paraffine paper around the pipe, and wrapping outside this a bandage of cloth, soaked in coal tar pitch or asphalt, a protection could be obtained against electrolysis under the conditions usual in our streets. Care could have to be taken that the inner layer was impervious, as asphalt itself is not a sufficiently good insulator to give the required protection. I hope that some one of your many readers will be able to answer this question. Six years ago I investigated the subject of electrolysis in many European countries and found that in many places the street railway companies were compelled by law to bond their rails in an efficient manner, and that this greatly diminished the difficulty; but we are not all protected in this way."

WIRELESS TELEGRAPHY AT SEA.—Mr. G. Marconi arrived in New York City from England last week on a trip to test some new apparatus. On the Cunarder *Campania* Mr. Marconi was accompanied by his assistant, G. S. Kemp, two special operators, two secretaries, and Mr. W. W. Bradfield, chief engineer. The inventor had a state room on the port side of the vessel, and in it he installed his key, the wires leading to the truck of the foremast. On leaving Liverpool the vessel was put into communication with the shore stations at Poldhu, Seaforth Sands and Crookhaven. During the voyage the vessel logged 3,158 knots. According to his statement on the subject, Mr. Marconi continued to send messages to the Poldhu station until he was 1,700 miles at sea. After the vessel had passed the 1,500-mile mark he sent messages to Cape Breton, cutting off Poldhu after 1,700 miles. Everything sent to the land stations was received, and the only mistake made was in the name of Gen. Sir H. C. Wilkinson, a passenger on the *Campania,* whose name at a distance of 1,600 miles was received "Wilson."

ELECTRIC SMELTING OF IRON.—Dr. Haanel, Dominion Superintendent of Mines, who recently went to Europe to investigate the methods in vogue in that part of the world, of electric separation of iron ore, has just received a consignment of samples of gray, white and mottled pig iron, all having been reduced from iron ore direct by the aid of an electric furnace. Samples of cast-iron castings are also exhibited as made from the molten metal taken from the electric furnace. These castings, from but once smelted metal, are stated to be in quality equal to any cast-iron castings produced. The grey pig iron is a superior grade of foundry iron. This grade pig can be also used for the purpose of conversion into steel by the acid process. Dr. Haanel is hopeful of the process being very useful in converting the immense iron ore beds of Canada into marketable metal. The process is particularly applicable to Canadian conditions, viz.: abundance of water power for electricity, incalculable quantities of ore and not sufficient coal near to make ordinary smelting pay. Dr. Haanel thinks that the process may revolutionize separating processes, as it can be applied to all classes of metals.

LETTERS TO THE EDITORS.

The Metric System.

To the Editors of Electrical World and Engineer:

SIRS:—In view of the fact that your issue of May 7 seems to criticise the tone of our circular letter eliciting the opinion of the members of our Association on the compulsory metric system bill, I would respectfully suggest as a means, and perhaps the only means, of representing that you yourself intend to be perfectly fair in your discussion of the matter, that you print for the benefit of your fair-minded readers the circular letter in question, a copy of which I enclose herewith.

NEW YORK. MARSHALL CUSHING,
Secretary, National Association of Manufacturers of the United States of America.

[We print below the circular letter referred to.—EDS.]

"There has been such a large increase (nearly 200 per cent.) in the membership of the Association since the vote upon the adoption of the metric system was taken a year and a half ago, that your Executive Committee has thought it best to repoll the Association on this important matter. You are, therefore, requested to signify your sentiments upon the enclosed ballot, and sign and return it at once to the General Office.

"Since the first ballot was taken the adverse vote then expressed has been concurred in by the following associations: The American Society of Mechanical Engineers, the Railway Master Mechanics' Association, the Master Car Builders' Association, the Furniture Association, the National Metal Trades Association. Similar action had already been taken by the Association of Machine Tool Builders, the Engine Builders' Association, the Society of Naval Architects and Marine Engineers, the Society of Heating and Ventilating Engineers and the Providence (R. I.) Society of Mechanical Engineers.

"The metric system bill was withdrawn from the last Congress by its friends because of the shortness of the session, but with the understanding that it is to be pressed again at the present session. This bill reads:

"'That on and after the first day of January, 1904, all the departments of the Government of the United States, in the transaction of all business requiring the use of weights and measures, excepting in completing the survey of public lands, shall employ and use only the weights and measures of the metric system; and on and after the first day of January, 1907, the weights and measures of the metric system shall be the legal weights and measures of the United States.'

"Please note that this ballot does not involve an opinion on the merits of the system. You are only asked to say if you want it adopted by law."

To the Editors of Electrical World and Engineer:

SIRS:—In an editorial in your issue of May 7 you say that in addition to the three engineering bodies named in the publication of the National Association of Manufacturers as favoring the metric bill, there are at least three more among the most prominent in the country that might have been included in the list, their pro-metric votes having been officially published. I deny this statement and challenge you to print the names of the bodies.

NEW YORK. ANTI-METRIC.

[The bodies referred to are the American Institute of Electrical Engineers, American Electrochemical Society and the Franklin Institute.—EDS.]

The Harmful Suppression of Inventions.

To the Editors of Electrical World and Engineer:

SIRS:—Your editorial of April 16 concerning the working of patents brings up a question of the greatest interest. It is important, however, to distinguish between the proper suppression of inventions and their harmful suppression. It is proper that the owner of expensive machines should acquire a patent covering cheaper machines for making the same product, and should suppress the invention for a limited term, rather than scrap all his expensive machinery at once. No serious harm is done to the progress of science and useful arts in the United States, since by the end of the term of the patent the manufacturer may be compelled by competition to adopt the simplified machinery. If he does not do so, others will. For this benefit to the country the patent owner is entitled to the reward of a monopoly for a limited time either by suppression or by exclusive use.

The more harmful case is the suppression of inventions in the United States which are being worked in a foreign country. During the seventeen years of the monopoly, the foreign manufacturers are continually making practical improvements. The basic invention is not in practical use in this country, and such improvements are very unlikely. At the end of the seventeen years the original invention is public property here, but is not commercially valuable as compared with the improvements which are still controlled and used only in the foreign country. There is no incentive to the establishment of a new industry in this country under such conditions. This is exactly what has occurred in the case of dye-stuffs and other high-grade chemicals. The German manufacturers, the American market being secured by patents, have established a supremacy which it will be impossible to overcome for many years. The same thing is apt to occur in the establishing of any new industry in future. The constitutional provision upon which the patent laws are based applies to the promoting of the progress of science and useful arts in the United States. This use of a patent has only the effect to retard such progress.

This violation of the intention of the constitution should be a good ground for repealing a patent, but the difficulties in the way of repeal are so great that it is doubtful if it will ever be tried. It remains, therefore, for Congress to provide a suitable remedy, such as an alternative requirement of a bona fide working of the invention in the United States (accompanied, perhaps, by a prohibition of importation) or the granting of a license to others on reasonable terms. If this is not done there will be a number of industries developed by purely artificial means in other countries and never seeing the light of day in this country.

New York City. Domingo A. Usina.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Design of Electrical Machinery.—Hunt.—A paper read before the Liverpool Engineering Society. The author first discusses direct-current machines. Since commutation becomes more difficult the higher the voltage it is advisable that in order to reduce the number of designs as much as possible, at least for small machines up to say 100 hp, the armatures should be designed for 500 to 550 volts; it will then be quite easy to obtain excellent commutating qualities for all lower voltages. To determine the commutating qualities of a machine, the author thinks that it is only necessary to consider the armature ampere-turns per pole, and the length of the armature core, to arrive at a satisfactory basis for calculation. The e.m.f. induced in a short-circuited coil opposing commutation may then be said to be proportional to the armature ampere-turns per pole, the number of turns per commutator part, the speed of the machine in revolutions per minute and the length of the core. The author gives some numerical data on this subject, especially in connection with a special machine, the details of which are given. Concerning commutator losses he says that consulting engineers often specify a maximum value for the current density at the contacts of carbon brushes and commutator, irrespective of the voltage and speed at which the machine may be operated. This often results in the commutator losses being greater than need be. He points out that for any given peripheral speed at which a commutator may be running, there will be a certain current density at the contacts of the brushes which will give a minimum value of the commutator losses. To make these losses a minimum, the contact surface of the brushes should be so chosen that the loss due to friction is half that due to the C^2R loss at the contacts. He then discusses alternating-current machines and says that the value of the power factor and the overload capacity of a motor is almost entirely governed by the demagnetizing component of the rotor current. At no load this is practically nil, but as the torque is increased, it grows with it, slowly at first, until the load is reached at which the power factor of the machine has its highest value. After this load has been passed, the rotor magnetizing component increases more rapidly until, when the motor is developing its maximum torque, it attains the same value as the component of the rotor current with which it is in quadrature. This demagnetizing current depends upon three things: First, the coefficient of leakage of the stator winding; second, the coefficient leakage of the rotor winding; third, the ohmic resistance of the stator winding. Instead of using the coefficients of leakage, the author finds it simpler to work out the coefficient of mutual induction between stator and rotor windings and then to estimate the coefficients of self-induction of the stator and rotor windings. In order to show the effect of the demagnetizing component of the rotor current upon the performance of a motor, details are given of the tests of a 20-hp machine.—Lond. *Elec.*, April 29.

Regulation of Alternating-Current Motors.—A note on a method of Lahmeyer & Co. for the regulation of non-synchronous alternating or three-phase current electric motors, and rotary converters. It is proposed to regulate the speed by inserting choking coils into the rotor circuit, instead of wasteful resistances, and to regulate the choking effect by varying the reluctance of the magnetic path of the choking coil. This may be done by more or less saturating this magnetic path by a variable number of continuous-current ampere-turns. The amount of these may be regulated either by hand or by automatic means, so as to maintain a constant speed of the motor. A purely electric method of automatically regulating the speed is as follows: The choking coil, besides being wound with the leads from the rotor, is also wound with two auxiliary coils, which oppose one another. One is permanently fed by continuous current from a constant-pressure supply, while the other receives its current from a small continuous-current generator (or from the generator proper in the case of a motor-generator) driven by the motor. If, now, the motor exceeds its normal speed, the voltage of the auxiliary continuous-current generator driven by it will rise, and the magnetizing effect of the bobbin, which is permanently excited, will be opposed to a greater degree than before. The permeability of the magnetic circuit of the choking coil will increase in consequence, and the choking effect will become more pronounced—i. e., the motor speed will decrease, and, if the arrangement be properly adjusted, the speed will be brought back to its proper value. If the motor speed decreases, the reverse actions take place.—Lond. *Elec.*, April 29.

References.

Equipotential Connections.—Müller.—The conclusion of his article. He has found in practice that machines which, without the use of equipotential connections, offer great difficulties as to sparkless commutation, would work absolutely satisfactory as soon as such equipotential connections were introduced. He gives algebraical rules how to calculate and introduce these connections.—*Zeit. f. Elek.* (Vienna), April 24.

Output Coefficient.—Pensabene.—A communication on the output coefficient of induction motors. He thinks that the only useful and suggestive formula is the old $D^2L\,R\,\phi$, which is not an empirical one. To determine the nature of the coefficient, ϕ, he gives its expression by an analytical explanation of the fundamental formulæ used in induction motor designs.—Lond. *Elec.*, April 29.

Tests of Direct-Current Machines.—Smith.—A paper illustrated by diagrams giving a review of convenient tests of direct-current dynamos and motors.—Lond. *Elec. Rev.*, April 22, 29.

Lights and Lighting.

Mercury Arc Lamp.—Paweck.—A description of a mercury arc lamp which seems to be mainly of historical interest since it is claimed to have been the first lamp of this type with an automatic starting device. The lamp is shown in Fig. 1. *a* is the tube in which the arc is formed, connections being made by the platinum wires, *c*, at the two terminals, *b*. This horizontal tube can be revolved around the vertical axis, *mm*, connection to the source of current being made by the method clearly indicated in the illustration. *h, i* and *d, g* are platinum wires dipping in mercury. When the circuit is closed, the current passes through the mercury in the middle part of the glass tube, *a*, but at the same time a small electromotor begins to revolve the glass tube, *a*, and the mercury in it is then driven by the centrifugal force to the ends of the tube, *a*, and the arc is started. The operation is stated to be quiet and noiseless, the revolving arc giving the impression of a horizontal lighted disc. The speed of rotation appears to have been small. This lamp was built at a suggestion of Kellner, who has later used amalgams instead of pure mercury in order to improve the color of the light. For instance,

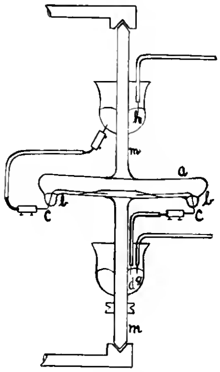


FIG. 1.—MERCURY ARC LAMP.

potassium amalgam gives a red tint. At the same time the use of an amalgam represents a new method of starting the lamp, since when the lamp is not lighted a thin film of amalgam is formed along the internal wall of the tube, which acts as a conducting bridge between the two electrodes, when the lamp is started. Afterwards this film is vaporized and the arc is formed. In another type of Kellner lamps, a plunger is used for starting. Credit is briefly given to the work of Hewitt.—*Zeit. f. Elektrochemie*, April 29.

Miner's Lamp.—A description of the Neu Catrice portable electric lamp for miners. The base of the lamp consists of a box of sheet lead containing two accumulator cells made of transparent celluloid or semi-plastic India rubber. Each cell contains one positive and two negative plates. The united elements constitute a battery of a mean voltage of 3.9, sufficient to supply, for 15 consecutive hours, a small incandescent lamp with a constant illuminating power of about one candle. In order to avoid the spilling of the liquid, the electrolyte of the accumulators is "fixed by a special process," in such a way that the lamp may be used without risk in any position whatever. The protecting globe is painted to one-half with a semi-translucent white varnish which acts as a reflector, while allowing a certain amount of light to be diffused backward. A lamp giving 1 cp for 15 hours weighs five pounds. It consumes 3.5 watts per candle-power. To recharge the lamps a charging table, consisting of 20 or 40 compartments is used, according as the available e.m.f. is 110 or 220 volts.—Lond. *Elec. Rev.*, April 22.

REFERENCE.

Three-Phase Arcs.—An illustrated account of the experiments of Mercanton on this subject.—*Scientific American*, May 7.

POWER.

Power Station Design.—MERZ AND MCCLELLAN.—The first part of a paper read before the British Institute of Electrical Engineers. The authors think that since the early days of the distribution of electrical energy, an amount of attention has been directed to the power station as compared with the distribution system which is hardly warranted by its importance from either an engineering or commercial standpoint. The expenditure upon the distribution system is probably, in the majority of cases, more than 50 per cent. of that on the whole scheme, especially if the consumer's installation be taken into account. The distribution system has a comparatively high efficiency, probably not less than 75 per cent. On the other hand, the power station has a comparatively low efficiency, not more than 10 per cent.; there is thus room for large improvements in the generation of power. For this reason the depreciation accounts must necessarily form a much higher percentage of the capital cost than in the cost of the distribution system. A power station is capable of easy extension without effecting in a very marked degree the ultimate cost; it can, therefore, be begun on a smaller scale. It may pay in future to change even the location of the station. The authors suggest that 10 per cent. per year should be considered as sinking fund in deciding whether to spend more money than is absolutely necessary on any particular section of the plant in a power station in order to secure lower running costs. The relative importance of capital costs and running cost may be seen at a glance for any particular values of either load factor, capital cost or running cost from the curves shown in Fig. 2. It will be seen that a reduction of the capital outlay by £1 (about $5) per kw has a greater effect on the running cost than has a reduction of the coal bill by 6 per cent. This applies with a load factor as high as 30 per cent.; it is, therefore, evident that for lower load factors the question of limiting capital expenditure becomes of overwhelming importance as compared with that of reducing running cost. The authors emphasize the importance of simplicity of design and recommend to subdivide all parts of the plant and apparatus, from the boiler house to the switchboard, into a series of units each complete in itself. Labor-saving devices are becoming more and more desirable, but their installation should be carefully considered. On the one side should be put capital charges, taken at not less than 15 per cent. of the capital cost and repairs, the latter to be estimated. On the other side should be put the saving in labor. Provision should always be made for extensions. The authors then discuss the actual design of a plant generating three-phase, high-tension currents at 5,000 volts or more. They first deal with the type of generating plant. High-speed reciprocating engines cost for the same power less than those of low speed, and will take up less room. On the other hand, the advocates of low-speed engines claim that the repair bill of a high-speed engine is higher and the economy not so good. The authors speak very favorably of steam turbines and give the results of tests of a 2,000-kw Parsons steam turbine which was installed at Wallsend in 1901. This turbine was run 7,500 hours without ever having been opened up, and only on two occasions have the bearings needed any resetting in order to keep the clearance correct, although

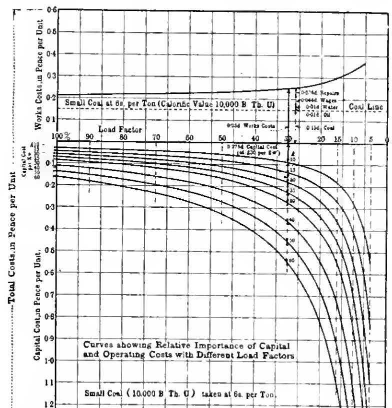


FIG. 2.—CURVES SHOWING COSTS.

they were three times examined and the clearance tested. The only faults of any kind which it has been necessary to repair have been the relining of one of the governor throttle valve chests and the renewal of an oil disc. "Steam turbines seem in every respect to be specially suitable for power scheme purposes, and, although they have taken many years to develop, it is probable that, had there been a demand 10 years ago for 2,000-kw generating sets, turbo-alternators would have been the only large-size generating units in extensive use at the present day." The authors prefer steam turbines to gas engines and draw the balance sheet as follows: Gas engines—Low coal bill, high oil cost, high labor cost, high repair cost; and, most important of all, high capital cost. Steam turbines—Low oil cost, low labor cost, low repair cost; and, most important of all, low capital cost. In the coal bill there is a slight difference in favor of the gas engine. The authors then discuss the general arrangement of a central station. They recommend that the auxiliary buildings, repair shops, stores and all sidings should be put down before the buildings are started. With regard to the general layout of the main buildings, the modern station is tending towards what may be called the complete unit system. For a large power station this tendency might with advantage be carried further than is the general practice at present, so that the only junction between the various units will be: First, at the railway siding or other source of coal supply; second, at the river or other source of circulating water supply; third, at the main bus-bars. In fact, a large power station might with advantage be so designed that the boiler house plant, the steam piping system, the generating system and the switchboard may all be entirely subdivided into different units.—Lond. *Elec.*, April 29.

Belgian Colliery.—A description of the electric installation of a Belgian colliery. A 250-kw generator furnishes three-phase currents at 1,000 volts. More than 75 per cent. of the output of the machine is used for running a winding engine installed underground at a depth of 525 meters. The motor runs at 415 r.p.m. with a normal output of 125 hp, the maximum torque developed under certain working conditions corresponding to 300 hp. It is an induction motor with the slip rings placed outside o fthe bearings in a gas-tight box and is fitted with power and electric brakes, and can also be braked by means of a counter weight, which cuts the motor circuit. The machine is also equipped with an electric device to keep the cage clear of the sheaves, and a side indicator. The balance of the energy is used for pumping and lighting.—*Mines & Minerals*, May; from *Colliery Guardian*, January 29.

Coal Mining.—HARRIS.—An illustrated description of the Ernest plant of the Jefferson and Clearfield Coal & Iron Company, at Ernest, Pa. The electric equipment consists of two multiphase 300-kw, 575-volt generators. Electric power is used mainly for haulage. There are provided ten 10-ton and one 20-ton, 500-volt mining locomotives. Each of the 10-ton locomotives has a cable extended so that two may be coupled together electrically. This arrangement gives many of the advantages of the 20-ton locomotive and permits a 10-ton locomotive to be used separately when one of them will do the work. Traction advantages are also claimed for the combination over the single 20-ton locomotive.—*Mines & Minerals*, May.

TRACTION.

Direct-Current Versus Single-Phase for Traction.—HOBART.—The first part of an article in which the author points out that it is unreasonable to disregard the undeveloped possibilities of the direct-current motor, especially in the matter of operation at higher voltages, in connection with traction. The author does not deny the possibilities of a single-phase system for main line work, but points out that, contrary to expectations, it is not so much for main line work, but more especially for urban, suburban and interurban work that the single-phase motor is at present strongly advocated. Compared with the direct-current motor, the single-phase motor has a larger commutator, greater commutator losses, no better commutation, a higher voltage per turn in the field spools (with increased danger due to a break-down in the insulation), larger internal losses and smaller efficiency; moreover, the power factor of the single-phase commutator motor falls considerably short of unity for all excepting a very narrow range of loads; and with this system considerable auxiliary apparatus is required on the car. The author then criticises Lincoln's comparison of alternating versus direct current for interurban traction systems (ELECTRICAL WORLD AND ENGINEER, December 3, 1903), and points out that in this comparison for a 60-mile interurban line, 600 volts is taken for the direct-current system and the cost for the secondary network amounting to 30 per cent. of the total cost of the electrical system is deduced. "In fact, it is only by comparing a 3,000-volt secondary network for the single-phase system with a 600-volt network for the continuous-current system that an advantage appears to be obtained for the single-phase system." The author offers the following criticisms of Lincoln's estimate: that it is overlooked that single-phase generators cost some 30 per cent. more than polyphase generators for the same rating and guarantees; that the increased cost of low frequency transformers is overlooked; that there is no reason to use many small and expensive single-phase transformers for the polyphase central and sub-stations (although this has been formerly the practice in the United States); that the single-phase generating plant is not sufficiently liberally proportioned, in view of the average power factor; that since the chief handicap of the direct-current system is the low-tension, the voltage should have been increased, as this is a perfectly sound proposition in the present state of the art; that large transformers are artificially cooled and some attendance is advisable even for single-phase sub-stations. The high voltage per turn in the field spools of the alternating-current systems, the less satisfactory commutation and the more complex auxiliary apparatus will inevitably result in a higher percentage depreciation than for the direct-current equipment; nevertheless, Lincoln takes 10 per cent. for the former and 12 per cent. for the latter. The article is to be concluded.—Lond. *Elec. Rev.*, April 29.

Tramcar Control.—An illustrated description of a regenerating system of tramcar control, devised by Raworth. The article is based on two recent English patents. The first patent refers to the regulation of shunt-wound motors by means of controlling both the field circuit so that the armature circuit cannot be made or broken until the field is excited to a maximum. The second patent refers to the return of energy to the line when the car descends a gradient. The motors are compound-wound and the series windings are arranged to strengthen the field when the armatures are returning energy, and, therefore, to weaken the field when the motors are receiving energy from the line. In starting the car, the series field winding is short-circuited and has no effect on the field. To increase the speed the driver pushes the speed lever and the braking handle moves with it, the shunt field being reduced by the insertion of resistance. If the speed increases too much, he draws back the speed lever, thereby removing resistance and strengthening the field. In descending steep hills, the driver first draws back the speed lever until the increased strength of the field returns a strong current to the line, and then, if more retarding effort is required, he pulls back the braking lever, the effect of which is to remove the short-circuit of the series winding and to still further strengthen the field. The controller may be so arranged that in case of emergency, for instance, the trolley leaving the line, further motion of the lever and handle will short-circuit the armature through the series winding, thus bringing the car to a stop or nearly so. No other brakes are necessary than the hand brake to hold the vehicle when stopped; but should the trolley leave the trolley wire, then, unless additional braking means are provided, there is great liability of a serious accident taking place. Means are, therefore, provided to let the motor then act as generators and also as a very powerful brake. All the arrangements are described in detail and illustrated.—Lond. *Elec.*, April 29.

Germany.—An article on the financial results of electric railway operation in Germany. Electric traction has proved there much more costly than was anticipated when electrification was inaugurated, this increase being due chiefly to the higher charges for power, maintenance of track and rolling stock, wages, accident costs and pavement repairs. The only favorable factor which has enabled most of the companies to continue on a paying basis has been the unexpected increase in traffic. The fever for municipalization has abated in view of the results attained on most of the municipal lines as compared with private ones under similar conditions.—*St. R'y Jour.*, May 7.

REFERENCES.

Three-Phase Traction.—KANDO.—In the continuation of his polemics with Lalino he emphasizes that the operation of the Valtellina road has completely proven the practicability of braking with the cascade system and the possibility of winning back energy when running down hill, so that with a road for which saving of energy is of important value reliance can be placed on the above two factors.—*Elek. Zeit.*, April 28.

Noiseless Fuse.—An editorial on the use of a noiseless fuse on large cars, especially elevated railway cars, where a panic may be produced by the burning of the ordinary fuse. It is thought that the fuse could be encased in a porcelain enameled steel shell with a muffler at each end.—*St. R'y Jour.*, April 23.

WIRES, WIRING AND CONDUITS.

Inductive Voltage Drop in Three-Phase Lines.—LICHTENSTEIN.—The first part of an illustrated article referring to some errors which may occur in connection with voltage measurements of a three-phase line. He has found in practice that in an auxiliary wire used for measuring purposes, voltages may be induced even if the distance of this auxiliary wire from the three main wires is relatively very large. He also found that the formula for calculating the inductive voltage drop of parallel alternating-current conductors is no longer valid for three-phase lines, and that the inductive voltage drop must be specially calculated in each case. He gives the mathematical theory of the subject and shows conclusively that in the auxiliary wire voltages are induced of such magnitude that they may influence the result considerably. If the three wires for the three-phase system are in one plane (as is generally the case in three-phase traction installations) he shows that in the auxiliary wire voltages are always induced whatever may be the distance from the three main wires, for instance if this distance is even greater than 8 meters. The article is to be concluded.—*Zeit. f. Elek.* (Vienna), April 24.

REFERENCE.

Eddy Currents in Cable Sheaths.—FIELD.—Two mathematical supplements to his paper abstracted recently in the Digest. In the first he discusses the distribution of induction and eddy currents in a long iron pipe, enclosing an alternating current. In the second the magnetic fields due to various systems of straight parallel conductors are considered, it being assumed that the conductors are circular in section and that the distribution of current over the cross-section of each conductor is a function of the distance from the axis of the conductor only.—Lond. *Elec.,* April 29.

ELECTRO-PHYSICS AND MAGNETISM.

Electric Origin of Rigidity.—SUTHERLAND.—A highly theoretical paper on "the electric origin of rigidity and consequences." The author endeavors to substitute the "doublet theory" for the electron theory, a doublet being a combination of two oppositely charged electrons. The chief difference which the doublet theory of valency makes when substituted for the electron theory is that for over doublet which the electron theory would require on account of the attraction of opposite electrons the doublet introduced an inner doublet whose electrons are very close together. In his theory the most important characteristic of the molecules in metals is that each atom contains in itself both a positive and negative electron. Rigidity at absolute zero is a purely electrostatic affair, but its variation with temperature is a simple kinetic phenomenon. The electric doublet forces the material atom to vibrate. The combined existence of electrostatic and electrokinetic energies in the same pair of electrons is conceived by imagining the electrons to travel over the surface of the atom in curves similar to screws having a small pitch, so that the motion parallel to the axis of the screw negligible in comparison with that around it. The average distance along the axis of the screw between the two electrons is the distance, s, which gives the pair of electrons the electric moment, $e\,s$. The electrokinetic energy of motion round the axis and the electrostatic energy due to separation of charges along the axis, may both be regarded as a store of energy. Since the pair of electrons in an atom of metal possesses electrokinetic energy by virtue of the rotation of the electrons around an electric axis it must have gyrostatic properties. Each atom is equipped with an electrostatic doublet and an electrical gyrostat, both having the same axis. In the metallic conductor all the gyrostats vibrate in a field of electric force, like a number of spinning tops in the field of gravity. The monatomic atom of a metal with its doublet he calls a stion. Metallic conduction is due to the dissociation of stions, electrolytic conduction to the dissociation of molecules. In metallic conduction there is a breaking of molecular gyrostats and the flying together of the broken pieces. The author discusses at some length the consequences to which his theory leads concerning electrical and thermal conductivity in metals. He then deals with the contact difference of potential and the mechanism of the storage of potential chemical energy in the ether. He finally uses the neutron structure of the ether for the calculation of its density and rigidity and the deduction of the velocity of light. The author distinguishes three distinct ways in which kinetic energy can exist in the ether; first by rotation of an electron round its center, connected with magnetic permeability of the ether; second, by rotation of neutron, which is the same as translation of electron; and third by motion impressed on the doublets of matter by the atoms, this being the origin of radiation.—*Phil. Mag.,* May.

N-Rays.—COLSON AND MEYER.—Two French Academy papers on this subject. Colson is of the opinion that the N-rays are capable of being utilized as a delicate chemical reagent of considerable value. Some chemical reactions are the source of N-rays, while other and very similar ones are not. In preparing zinc hydrate the result is the same whether zinc sulphate is added to caustic potash solution or the latter is added to the former. But in the latter case, the reaction gives rise to N-rays, which diminish the brightness of a phosphorescent screen, whereas the reverse process does not give rise to the rays. This evolution of rays is accompanied by the formation of a basic salt which is only formed as long as the zinc sulphate is in large excess. Calorimetric tests show that the formation of this basic salt gives rise to a greater quantity of heat than the formation of the zinc hydrate without such an intermediary stage. Meyer has discovered some new sources of the extinguishing rays called by Blondlot N-rays, and has obtained rays of a higher penetrating power than heretofore. If a screen with patches of phosphorescent calcium sulphide is placed in the receiver of an air pump and the pump is worked, the prosphorescence decreases, being restored as soon as the pressure is restored. The same thing happens if the screen is placed outside instead of inside the receiver. An incandescent lamp through which no current passes, or a vacuum tube, are powerful sources of N-rays, the strain of the glass under atmospheric pressure being sufficient to account for their production. —*Comptes Rendus,* April 11; Lond. *Elec.,* April 29.

ELECTRO-CHEMISTRY AND BATTERIES.

Formation of Hydrogen and Oxygen Gases by Alternating Currents.—VAN NAME AND GRAEFENBERG.—An account of an experimental investigation in which the output of formation of hydrogen and oxygen gases by alternating currents and the voltages applied were measured with platinum and gold electrodes in sulphuric acid and with silver, nickel and copper electrodes, in potassium hydrate. The frequency was held constant at 55 periods per second and the current density was varied. The largest efficiencies obtained were only about one-half of that which can be obtained with direct current. Moreover, these efficiencies could be maintained only for a limited time on account of the electrodes being attacked. Concerning their suitability as electrodes, a number of substances were examined, but no entirely satisfactory substance was found.—*Zeit. f. Elektrochemie,* April 29.

REFERENCES.

Calomel Electrode.—LEY AND HEIMBUCHER.—An account of an experimental investigation on the concentration of the mercury ions in the calomel electrode and on the solubility of calomel. For the concentration of the mercury ions in the 0.1 calomel electrode, and in the .1 normal calomel electrode they find the values 2×10^{-16} and 3.5×10^{-18}, respectively.—*Zeit. f. Elektrochemie,* April 29.

Influence of Light upon the Formation of Lead Accumulators.—SCHOOP.—A note with reference to a recent article of Tommasi, whose results he confirms. He describes the following experiments: A peroxide lead plate, formed according to Planté, was cut into three parts, of which one was left in the dark, the second in the daylight, and the third was placed in the direct rays of the sun. The color of the latter two changed appreciably after some hours.—*L'Eclairage Elec.,* April 30.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Small Inductances and Capacities.—FLEMING.—A description of a convenient method for measuring small inductances. The arrangement is illustrated in Fig. 3. The inductance, L, is

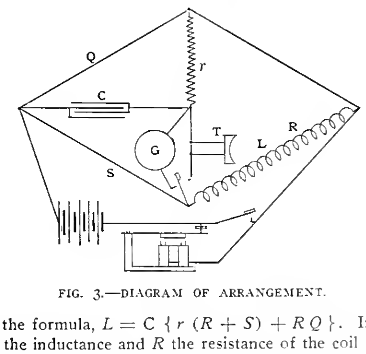


FIG. 3.—DIAGRAM OF ARRANGEMENT.

given by the formula, $L = C \{ r (R + S) + R Q \}$. In this equation L is the inductance and R the resistance of the coil being measured, C the capacity of the condenser consisting of one or more Leyden jars (or a mica condenser), S and Q are the resistances of the adjacent and opposite bridge arms, and r is the resistance inserted in series with the telephone in the bridge circuit, a resistance box being used for r. The steady balance is first obtained in the usual way with the galvanometer and steady current. If the telephone, T, is substituted for the galvanometer and an ordinary buzzer is used in the battery circuit to interrupt the current at the rate of about 100 per second, and when r is adjusted to produce silence in the telephone it was found that variations to the extent of about one per cent. either way and sometimes much less caused the sound to reappear in the telephone. The author has found that solenoid coils constructed by winding silk-covered copper wires in one layer and in closely adjacent turns on a glass rod, have an inductance which is very nearly equal to the length of wire per unit length of solenoid multiplied by the total length of wire used to form the solenoid. This rule is correct as long as the length of the solenoid is at least 50 times that of the diameter. The above arrangement may also be used to determine the capacity in the bridge, assuming the value of the inductance calculated from this formula. On the basis of this formula he describes a method for the calibration of a variable inductance for use for certain resonance experiments.—*Phil. Mag.*, May.

REFERENCES.

Measuring Conductivity of Wires.—Appleyard.—A description of his conductometer, which is a direct-reading instrument intended for the comparison for electric conductivity of copper and other wires, for a range within, say, 5 per cent. above and 5 per cent. below 100.—*Phil. Mag.*, March.

Rymer-Jones.—The first part of an article in which the author doubts the advantages of the conductometer over the simple meter bridge.—Lond. *Elec. Rev.*, April 29.

Meters.—A description of the following meters which have been accepted for calibration by the German Reichsanstalt: A direct-current motor meter, a single-phase induction meter and a three-phase induction meter, all made by the Union Electric Company, of Berlin. The construction and method of calibration of the instruments are described in detail and exact drawings are given.—*Elek. Zeit.*, April 28.

Hot-Wire Ammeter.—Fleming.—An illustrated description of a hot-wire ammeter for the measurement of very small alternating currents. Currents as small as two milliamperes can be measured and the instrument can essily be calibrated at the time of using it. As an instance of the application of the instrument he gives the measurement of the magnetizing currents of small transformers.—*Phil. Mag.*, May.

MISCELLANEOUS.

Lightning Rods.—Kirstein.—An article urging the erection of lightning rods on buildings in rural districts. Care should be taken to examine them regularly concerning their efficiency.—*Elek. Anz.*, April 28.

Asbestos.—An illustrated article on the equipment of the works of the United Asbestos Company with a general description of the methods of mining and treating asbestos and of its various uses.—Lond. *Elec. Rev.*, April 29.

New Books.

Congres de la Houille Blanche. Grenoble, France: Syndicat des Forces Hydrauliques, Chambre de Commerce. 2 vols. 1,270 pages, illustrated. Price, 30 francs; with foreign postage, 31 francs 50 centimes.

These massive and handsome volumes are devoted to a record of the remarkable Congress held at Grenoble in September, 1902, to develop the subject of the utilization of water powers in general, of those of France particularly, and peculiarly those of the region in which the congress was held. As the readers of this paper know, the French describe water power in a happy phrase as "white coal," or "houille blanche," and it will also be remembered that at the time of the meeting a large amount of space was devoted in these pages to a report of the work done. We find here, however, all the papers in full and a verbatim record of the discussions. Even this does not convey the full meaning and importance of the affair, for the men who participated while not all of them known personally or by name in America, were Frenchmen of distinction, of talent and genius; and their work in this convention was done with a skill and thoroughness that must evoke intense admiration wherever it is studied.

The first volume is devoted to the papers and discussions, all, as we have intimated, of an admirable quality and high order of merit, dealing not alone with engineering aspects of the question, but with legal, industrial, commercial, social, each handling its topic with characteristic French sanity and lucidity and compelling one to stop and read at almost every page. The second volume takes the theory of the first volume and shows how it has all actually been worked out in practice in that splendid water power region of Haute Savoie, which, running south from Bellegarde, finds Grenoble as its center. What has been done there is exemplified in hundreds of cuts, accompanying the description of the trips which were undertaken by members of the Congress. In short, the student of water power development who has these volumes at his elbow is fortunate, and without them he is far from being fully acquainted with his subject. It may be added that the utilizations are quite largely electric—lighting, trolleys, power service, electrochemistry, etc.

Electrical Engineering Experiments and Tests on Direct-Current Machinery. By George F. Sever. New York: D. Van Nostrand Company. 64 pages, 22 illustrations. Price, $1.00.

This is a compilation of tests on direct-current machinery, primarily adapted for the direction of third-year students in the shorter laboratory courses of electrical engineering at Columbia University; and secondarily for those who may, in the practice of electrical engineering, desire a synopsis of the simpler tests on direct-current dynamo machinery.

A series of experiments is detailed in the book. These are: (1) The measurement of fall of potential along a wire. (2) The measurement of resistance by fall of potential. (3) The measurement of higher resistances by Wheatstone bridge. (4) The operation and tests of a shunt-wound constant-potential dynamo. (5) The operation and tests of a compound-wound dynamo. (6) The operation and tests of a shunt motor. (7) The operation and tests of a series motor. (8) Tests of a dynamo or motor by the stray-power method. (9) Operation of shunt dynamos in parallel. (10) Operation of compound dynamos in parallel. (11) The operation of a constant-current dynamo, and of arc lamps.

These experiments are clearly defined and described. The diagrams of connections are given, and also tabular forms for recording the observations.

The pamphlet will be of distinct value to students of electrical engineering not only in college, but also wherever direct-current machines have to be operated and tested. The treatment is in conformity with the standardization rules of the American Institute of Electrical Engineers and the notation is in the international system.

A Self-Cohering Receiver.

By Edward Van Winkle.

It is doubtless true that no one at present engaged in the wireless business is entirely satisfied with the results obtained; and the indifferent success has been charged, by a great majority of the wireless people, to the inefficiency of the initial spark as employed in the past, and they have looked for the solution of this fault in the stepping up of the initial spark, with the hope of improving the signal received. In analyzing, however, the defects of instruments as they become apparent through application and use, a radically different view of the remedy required to produce clear signals, has been proposed, the position being that the initial energy of the spark was sufficient, but that the energy contained in the impulse was lost in the faulty construction of every known wireless receiver; that the imperfect signals received were due to the fact that all wireless receivers had their local circuits legged off the antenna and ground wire, thus bridging across the fluctuating point in the receiving instrument and providing a circuit around the fluctuating point instead of through it; and as these local circuits carried less resistance than any known coherer, or anything else used as a fluctuating point in wireless receivers, a great proportion of the impulse assembled on the antenna passed around the fluctuating point while passing to the earth and was lost. Here lay the reason for the indifferent success, and a solution was, not to step-up the initial spark, but to insulate the wave circuit from the local circuit and prevent a loss of the wave energy after contact with the vertical wire.

This principal is applied on the Peters self-cohering receiver, to which the accompanying illustrations refer. In this the local circuits are entirely insulated from the wave circuit, and yet be capable of duplicating in the local circuit the electrical phenomena constantly taking place in the wave circuit as the impulses pass through it to the earth. On several occasions controllable signals have been received over a distance of three miles using only the spark of a single "Mesco" dry cell.

Referring to the illustrations, Fig. 1 is a diagramatic sketch of the receiver, Figs. 2 and 3 sections of the coherer, and Fig. 4 is a photographic view of the coherer, motor-driven, with a regular Morse sounder on the right; the ground wire is shown in foreground.

The coherer includes two electromagnets 1, placed in reverse with

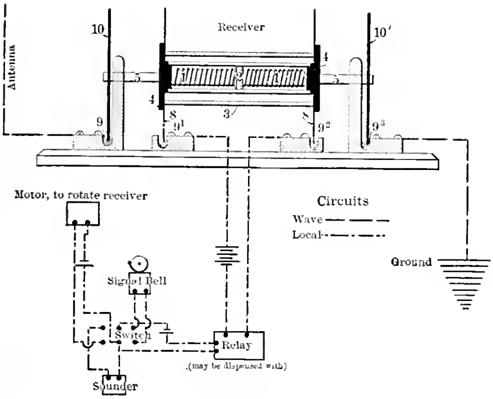
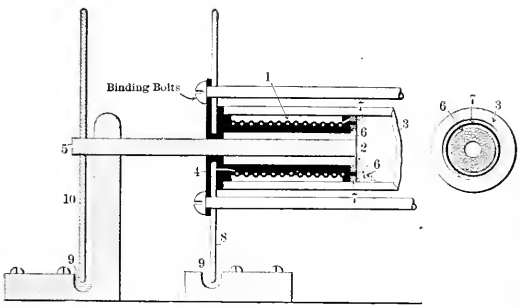


FIG. 1.—DIAGRAM OF CIRCUITS.

the filing-gap 2, between their ends in a glass tube 3, sealed by insulating end plates 4. Both electromagnets have for a core the shaft 5, around which are placed a number of soft iron wires secured at the gap end by a ring of soft iron 6, which is insulated from the soft iron ring 7. This latter ring is the terminal of the coil at the gap end, the other terminal of the coil being the discs 8. The wall of the filing gap is formed of the ends of the core and the insulated terminal ring of the coil, all of which is clearly shown in the illustration.

The coherer is rotated by the motor shown diagramatically. The shaft of the coherer on the left is connected to the antenna, or vertical wire, through the mercury well 9, and the disc 10. The other shaft is connected to the earth through the mercury well 9^3 and the disc 10^1. The coils of the electromagnet are in relay or local circuit through the discs 8 and 8^1.

The bell is in circuit when the switch is thrown to the right, and



FIGS. 2 AND 3.—SECTIONS OF COHERER.

is used only to notify the operator that a message is about to be received. As soon as the filings are magnetized the bell circuit is closed through the batteries and relay, and the bell rings. The operator then throws the switch to the left, which throws both the sounder and the coherer motor in circuit; the coherer then revolves and is ready for message. The iron filings in the gap between the ends of the electromagnet should fill about one-third of the gap, or sufficient to lap the core and coil terminals at all times. When the receivers is in motion the filings as a mass are carried around with the tube, until raised above the angle of repose, when they break away at the top and falling over themselves, reform again at the bottom to be carried up again in endless repetition; this being the decohering process constantly maintained by the rotation of the tube. It will also be noticed that between the top of the mass where the filings break away, and the bottom where they reform, is an area of filings never disturbed with respect to their contact with the walls of the gap (coil terminals); this mass of undisturbed filings is always ready to be cohered when a wave of very high potential passes through, notwithstanding their continuous rotation.

No other type of coherer gives as clear a signal as a filings coherer, and its defect of lack of speed owing to the filings requiring to be tapped is overcome by decohesion secured through rotation. The sensitiveness of this coherer is evident from the fact with the usual filing mixture, 90 per cent. of nickel and 10 per cent. of silver filings it would cohere toó thoroughly to permit of decohesion under the influence of the electromagnetic coils; this compels the use of ordinary iron filings mixed with 40 per cent. of brass filings in order to introduce in the mass a non-magnetizable metallic weight as a roving element in the mass, to break down the perfect state of cohesion maintained by the coils.

The fluctuating point in the local circuit is established by placing sufficient filings in the gap. The wave or impulses entering through the core of the electromagnet coheres the particles and closes the local circuit, the effect of which is to assist or increase the cohering action by energizing the cores.

The cores of the electromagnets constitute the wave circuit and the coils the local circuit, thus completely insulating them, and leaving the local circuit free to energize the cores of the coils when the impulses cause the local battery to flow, by magnetizing the filings that lay between the terminals of the two coils. In this way the local battery is utilized to assist in perfecting cohesion, the wave in the instrument being utilized only as a trigger to start the local batteries to flow, which by their local action complete the act of cohesion.

The mercury wells shown in the diagram, and the wheels rotating therein, are for the purpose of making continuous contact between the movable and stationary parts of the instrument; commutator contacts will be employed in the future construction of the instrument to accomplish this purpose.

The change of potential in this receiver is equal to the actual opening and closing of a circuit, thus giving variation of current sufficient to operate an ordinary set of Morse telegraph instruments giving audible signals, clear enough to be received and copied while operating a typewriter.

The advantages claimed for this device over all others are:

1. Its absolute simplicity. 2. It requires no adjusting after being correctly constructed. 3. Any number of instruments can be operated on the same antenna. 4. It will enable a receiving station to break a sending station. 5. An operator can read the message that he is sending off his receiving instrument. 6. The instrument will receive a wireless message and repeat it to a telegraph line, and vice versa. 7. The filings being always in position for action, and no time being lost waiting for their recovery, a much greater speed can be secured than with a coherer in which the filings are scattered

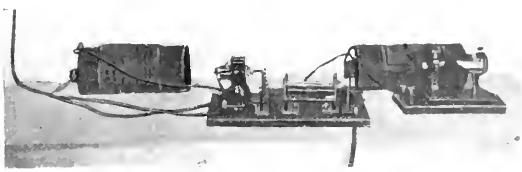


FIG. 4.—VIEW OF MOTOR-DRIVEN COHERER.

by tapping or dumping. 8. Owing to the assistance given the waves by the electromagnetic coils in cohering the filings, a message can be received at greater distances and from weaker signals than by other instruments. 9. The wave and the local circuits being insulated from each other, no part of the impulse is lost through the legged or local circuits. 10. As the entire mass of filings is decohered by one-tenth of a revolution of the tube, and as the tube decoherer is safely under eight revolutions per second, the make and break of the circuit can occur eighty times per second. 11. This coherer is capable of changing the resistance in its gap practically equal to the absolute opening and closing of the circuit.

High-Voltage Oil Switches.

The oil switches shown in the accompanying illustrations, made by the Stanley Electric Manufacturing Company, are so designed that the circuit is broken simultaneously at several points, thus distributing the resulting disturbance over a considerable area. Moreover, for potentials above 6,600 the various contacts are arranged in the same horizontal plane, so that the disturbances resulting from the rupturing of the arc are distributed, rather than concentrated, as is the case where the contacts are one below the other. Another advantage of opening the contacts in a horizontal plane is that the arc tends to flare upwards, increasing its length and thereby securing a longer break than in the vertical type, with the same separation of contacts. The contacts are located comparatively near the surface of the oil, so that the gases resulting from the explosion are readily dissipated, and, by using comparatively large tanks and long breaks, the switch may be opened and closed many times before the oil is carbonized appreciably.

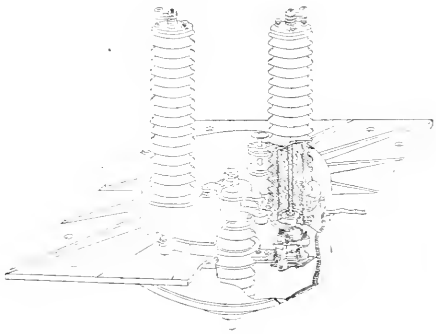


FIG. 1.—60,000-VOLT OIL SWITCH.

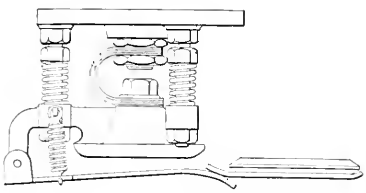


FIG. 2.—CONTACT OF 60,000-VOLT OIL SWITCH.

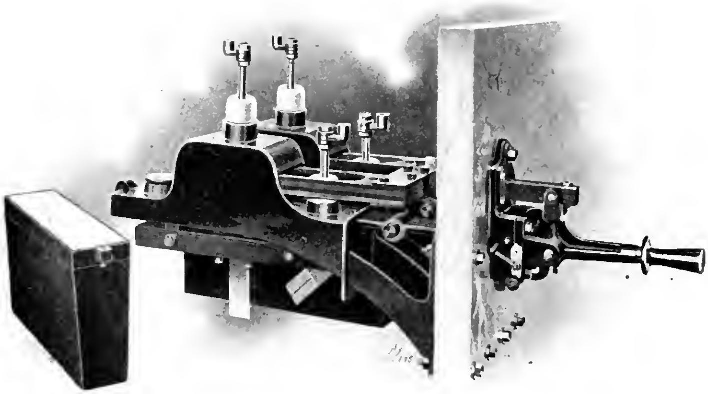


FIG. 3.—3,500-VOLT OIL SWITCH.

The principles of construction above outlined are embodied in a 300-amp., 60,000-volt switch, a number of which have been installed as a part of the equipment of the high-voltage transmission systems in the West. Fig. 1 gives an idea of the general construction of the switch. Each pole consists of, first, a cast-iron top or mounting plate, on which are mounted the two terminal contact insulators, a bearing of liberal length for the driving shaft, and a combined gas vent and automatic oil level indicator; and, secondly, a tank filled with oil in which are immersed the contacts suitably insulated. The insulators are of porcelain made in the form of corrugated cylinders. The center insulator carrying the contact blades is entirely immersed in oil. The two terminal insulators are partly filled with and have their lower ends immersed in oil. These two insulators are held in position by means of hollow clamp rings, which are fastened to the insulators with set-screws and cement. The contact blades are fastened to the central insulator in a similar fashion.

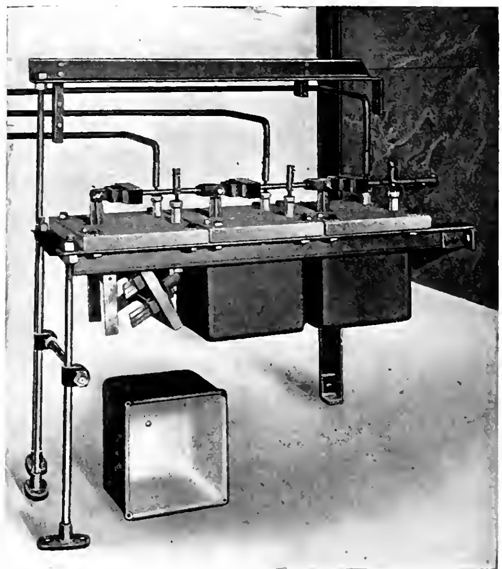


FIG. 4.—6,600-VOLT, THREE-POLE SWITCH.

Fig. 2 shows the details of a contact. The contact arms are of hard-drawn flat copper strips. Each fixed contact is forced downward by three coiled springs which are carried on the studs on which the fixed contacts slide, and which are screwed on the battom of the insulator. These fixed contacts, as well as the blades, have ground surfaces. On closing the switch, each contact blade slides under the corresponding fixed contact, and, owing to the arrangement of the springs, a perfect self-aligned contact results.

The shape and position of the shunt or arc-rupturing contacts are such as to prevent any possibility of the arc being taken by the main contacts. These auxiliary contacts are readily replaceable. In the illustration, the oil level indicator can be seen on the left of the insulator, the construction of which is exposed. Should the oil leak out, or, for any other reason, recede below a safe level, the indicator closes the pilot circuit and warns the attendant by ringing a bell or lighting a lamp, as may be desired.

Each switch is tested at 120,000 volts and, in installing, the iron top and tanks are grounded, making it perfectly safe for the operator to handle the controlling device. The three-pole switch is made up of three of the units described above, connected by rods and the crank on each operating shaft to either a motor, magnet or hand-operated controlling device, and the operation of either of these devices may be controlled by plain overload, time delay overload or reversed current relays. Each pole of the switch may be mounted in either soapstone or brick compartment or upon iron framework.

Fig. 4 shows a three-pole oil switch for voltages up to 6,600, and for currents up to 100 amp. Each pole is in a separate tank, as is the standing practice for oil switches for potentials exceeding 3,000 volts. The tanks are mounted in a strong, yet light framework consisting of angle irons and rods. This switch is made with circuit-breaker attachment, if so desired, and either single or double-throw. One tank can be used as a double-pole switch with a capacity of 100 amp. at 2,400 volts, by connecting one blade to each pole. By connecting the blades in parallel, instead of in series, the switch may be used for 200 amp. at 4,000 volts. It is thus evident that this type of switch is readily adapted to meet a wide range of conditions.

Fig. 3 shows an oil switch designed for installations of not over 3,500 volts. It is made either single or double-throw and for any number of poles desired. The normal three-phase capacity of the switch is 400 kw and the emergency three-phase capacity is 1,200 kw: in other words, these switches should not be installed on circuits which have more than 400 kw normal capacity back of them.

The switch is also made with an automatic overload opening device When so furnished, the handle for closing the switch is not connected rigidly to the parts making contact, but is latched thereto, the arrangement being such that it is impossible to close the switch when there is an overload or short-circuit on the line. With this overload feature, series transformers are used, but one being necessary for either a single-pole or two-pole switch and two for either a three-pole or four-pole switch. As in the switches for higher voltages, there is a separate tank for each pole.

Silvered Mica Condensers.

For the benefit of those familiar with the construction of ordinary condensers it may be well to say a word about these before explaining the silvered mica condenser. In the ordinary condensers made of mica and tin-foil, the air between the surface of the tin-foil and the dielectric causes a variation in the capacity of the condenser, and if

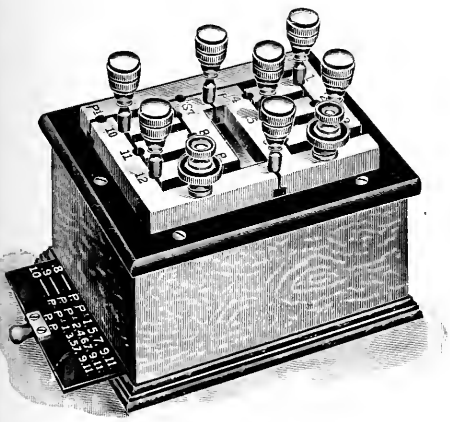


FIG. 1.—ADJUSTABLE CONDENSER.

they are used on alternating-current circuits or subjected to inductive discharges, what might be called electrostatic bombardment will heat them to such an extent that they are liable to break down.

In the silvered mica condenser, these conditions as well as many others are overcome in a most marked degree. This condenser is made by depositing silver on mica. Figs. 1, 2 and 3 show forms of these condensers as manufactured by Messrs. Glifford H. Brown & Co., of New York City. Fig. 1 shows diagram of a 1-m.f. series-multiple and multiple-series standard condenser. It consists of ten 1/10 of a m.f. condensers. It will be seen from the diagram that these condensers may be used singly, in series, multiple, series-multiple and multiple-series, making many combinations possible. In the position in which the plugs are shown, two condensers are in

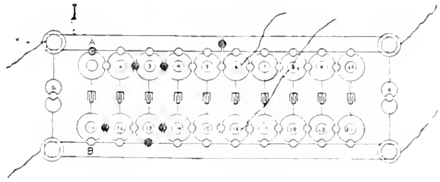


FIG. 2.—DIAGRAM OF CONDENSER CONNECTIONS.

series with two in multiple giving a capacity of .04 m.f. The range of this condenser is from 1 m.f. to 1/100 of a m.f.

Fig. 1 shows an adjustable 1-m.f. standard condenser, the minimum capacity being .025 m.f. This condenser is provided with a printed card, which slides in and out of the bottom of the box. On this card are marked the numbers of the plug holes to obtain the desired capacity. This card will be found of great convenience as well as a time saver.

Fig. 3 shows a non-adjustable standard condenser designed for high potential work. We are informed that Dr. Pupin is using a

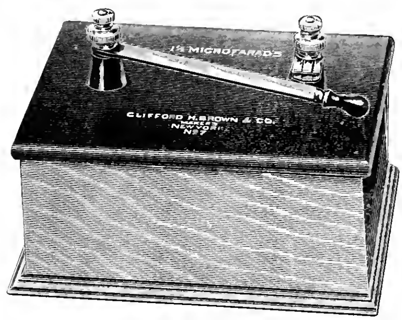


FIG. 3.—NON-ADJUSTABLE CONDENSER.

number of these condensers in connection with multiple telegraphy. These condensers are not only of value as standard, as above indicated, but may be used on high-potential alternating circuits without heating or changing capacity.

Water Power in France.

Mr. H. S. Brunot, United States Consul at St. Etienne, France, in a recently communicated report, says: "Besides the new water supply from the Lignon and electric power works belonging to the municipality of St. Etienne, which are now being constructed, there is another project being studied as a private enterprise which concerns the distribution of electric power and light not only to St. Etienne, but to all the principal towns of the Department of the Loire. M. Mallet, civil engineer at St. Etienne, is the promoter of this scheme and has great hopes of seeing it realized. The water will be taken from high up in the Department of the Ardèche, the source being a small lake 1½ miles in diameter. Certain dams and embankments will be constructed to increase the reservoir capacity of this lake, so as to guarantee a constant supply. The energy expected to be derived is calculated at 20,000 hp. All the industries of the region will benefit by these undertakings. Authorization to commence operations has been applied for from the French Chamber, and if the necessary sanction is given the use of electricity will be largely substituted for steam in this part of the country."

Western Electric Company's New Plant.

The Falkenau Construction Company has been awarded the contract for the erection of some more new buildings at the Western Electric Company's plant at Hawthorne, near Chicago. The principal building will be for the insulating plant and will be 401 x 200 ft. The total cost, with other lesser structures, will be about $142,000.

Lighting by Cooper Hewitt Lamps.

One of the novel fields of electric lighting which has seen the most rapid development since the National Electric Light Association met a year ago is that of vacuum tube work. A great deal more has been done in this department that is realized by the electrical public, while some of the installations are of a character to excite surprise even on the part of those who are well informed. As an example of the extent to which the mercury vapor lamp has been introduced, we illustrate herewith the battery room of the New York Transportation Company, on Forty-ninth Street and Eighth Avenue, New York City. This corporation operates the hundreds of electric hansoms and cabs to be seen in circulation on the streets of Manhattan Island, for the energizing of which a large battery room is required. The room is in fact slightly over 300 ft. long by 42 ft. wide, and 26 ft. high and, as can readily be imagined, it is a difficult place to light, not only on account of the darkness at almost all times, but because of the dense blackness of the storage battery boxes and the general absence of light-reflecting surfaces. Moreover, the frequent emission of fumes from the sulphuric electrolyte militates against the permanence of the ordinary electric light fixtures and appliances, so that from the first it has been found a difficult problem to light the space properly. The room was at one time lighted by fourteen 5-amp. arcs, taking, say, 60 to 70 amp. at 115 volts. It was necessary, however, to remove the mechanism of the arcs from the hood and to place it under a separate cover on account of the acid fumes from the batteries. There was, moreover, considerable difficulty in getting the arcs to work, and the results were never wholly satisfactory. Under all these circumstances, it was thought worth while to make a trial of the Cooper Hewitt mercury vapor lamp and 10 of these at 3 amp. each on the same 115-volt circuit have now been in use for about three months. The New York Transportation Company is very much pleased with the installation, and the current consumption is cut down about one-half. The lamps are run practically twenty-four hours a day. The general effect of the illumination can be seen from our half-tone cut, which, however, does not bring out the fact that the light given is so strong and penetrating that an examination of the batteries can now be made by the attendants with much greater ease and exactitude than ever was possible before.

While this may appear to be a large room for such illumination, we are able to give the data with regard to three other large spaces which the Cooper Hewitt Company has lit successfully. The table includes also the current consumption, the area lighted per lamp, and the area lighted per ampere consumed. Cooper Hewitt lamps are also being used very successfully in photography for taking this way as the tubes can easily be arranged in the regular solar blue print frame.

Character of work.	Area of Room.	No. of lamps.	Current Consumed. Amps.	Current Consumed. Volts.	Area lighted per lamp.	Area lighted per amp.
Draughting room	2,140 sq. ft.	8	3 1/3	110	265 sq. ft.	80 sq. ft.
Business office	1,100 sq. ft.	3	3.3	110	366 sq. ft.	110 sq. ft.
Leather factory	12,000 sq. ft.	30	3.3	55	400 sq. ft.	121 sq. ft.

For general illuminating purposes three types of lamp have now been developed. Two of these are of 700 cp. and the third is of 300

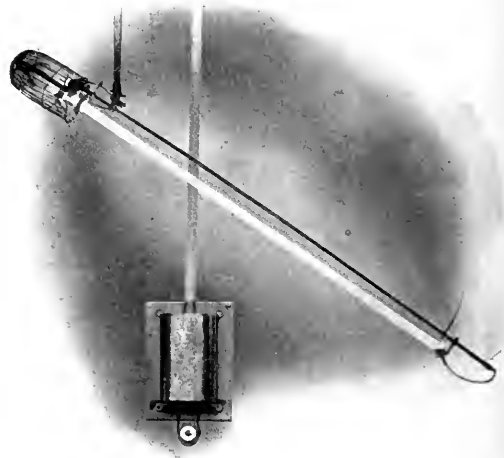


FIG. 2.—MERCURY VAPOR LAMP.

cp. One of these, known as the V-5 type, shown in Fig. 2, is the tube employed in the New York Transportation Company's battery room, and is started with a tilting method. The new type is of half size and can be operated two in series on 110-volt direct current.

FIG. 1.—BATTERY ROOM OF NEW YORK TRANSPORTATION COMPANY, LIGHTED BY VAPOR LAMPS.

pictures, for printing, for enlarging and for reducing. The photo-engraver also finds the lamp more economical of current, securing a more even illumination of the copy and faster printing on sensitized copper. A large amount of blue printing has also been done in

It is the type employed in business offices and for such places as the leather factory enumerated above. It is intended for general illumination and can be run in a horizontal position, whereas its predecessor, of the same candle-power, had to be run vertically or at an inclined angle of 30° from the horizontal. These lamps are started by the tilting method, which as a general thing appears to find preference over that involving the use of a kicking coil. Amongst recent orders for such lamps has been one of fourteen for James A. Hearn & Son, for their large dry goods store on Fourteenth Street, New York City. These tubes have been installed in their shipping and packing departments. It will be gathered from the above data that the Cooper Hewitt mercury vapor lamp has already made a distinct place for itself in the art and is rapidly gaining ground, not only in competition with older illuminants, but under circumstances which renders it peculiarly and sometimes exclusively available.

General Electric Oil Switches.

The extensive use of high-potential distribution systems and the widespread introduction of alternating-current motors and other devices introducing inductance have necessarily required radical changes in switches. The opening of circuits of considerable current value with inductive loads is not possible with old types of switches which were quite adequate for the service for which they were designed. These circuits are controlled with great facility and certainty by the oil switch, and this device is essential for the sure control of most modern alternating-current systems. Though of comparatively recent introduction, it has already been differentiated for many classes of service.

The accompanying illustrations show four types of such switches made by the General Electric Company. That of Figs. 1, 2 and 3, known as "Type F Form I," is designed to rupture loads which under emergency conditions cannot exceed 850 to 1,200 kw, three-phase, at potentials not exceeding 2,500 volts. Fig. 4 shows "Type F Form F" switch, designed to rupture loads which under emergency conditions cannot exceed 3,500 kw, three-phase, at potentials not exceeding 6,600 volts. In Figs. 5 and 6 are shown "Type F Form K" oil switch, designed to rupture loads which under emergency conditions cannot exceed 7,000 kw, three-phase at potentials not exceeding 13,000 volts. Finally, Fig. 7 shows "Type F Form H" switch. used for the interruption of circuits carrying power in excess of that which may be regarded as the limit of the switch of the other types.

The switches of Figs. 1, 2 and 3 are manufactured double, triple and four-pole, both single-throw and double-throw, and are designed in two forms: First, for mounting on switchboard panel, as shown in Figs. 1 and 3; and second, for mounting on separate base or wall, as shown in Fig. 2. This switch is adapted for use independently of a switchboard for the operation of induction motors, etc.

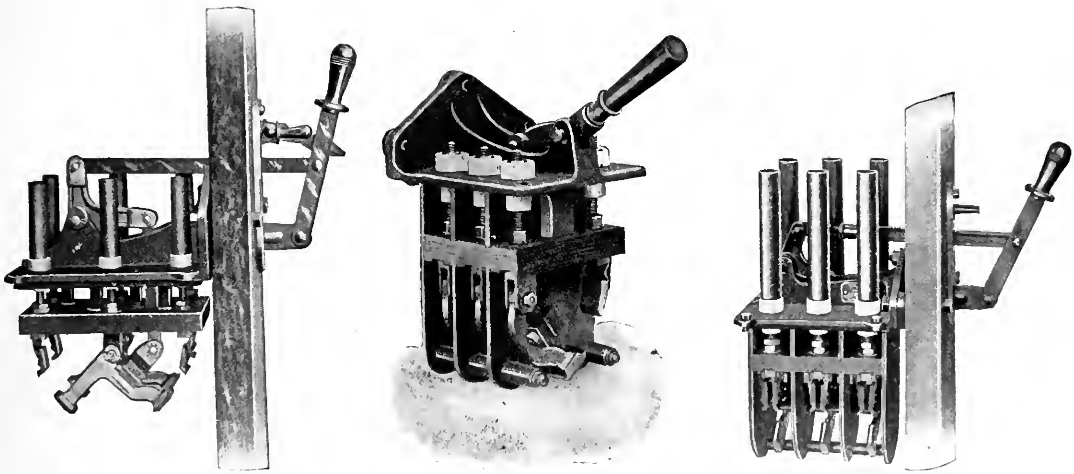
The cast-iron frame is designed to carry the mechanism, insulators and all live parts of the switch. Projecting lugs, from the under side of the frame, hold in position the base to which are attached the contacts and barriers. The switch is single-break—one end of the blade being clamped in a hinge clip by means of spring washers. The blades are joined together by means of a cross-bar, to which is attached the link for operating the switch. The stationary contacts are of the finger type, similar to those used in the General Electric street car controller. The oil vessel is supported from the frame and may be removed without disturbing any part of the switch. A red line indicates the proper oil level when the vessel is removed.

When in position on the switch all live parts and the base supporting the contacts are submerged in oil. The mechanism for working the switch mounted on the panel consists of an operating lever on the front of the board, which is connected by a link to a bell crank on the frame casting. The bell crank is connected to the cross bar of the switch by a second link. For the double-throw switches a lock is provided which prevents the switch from being thrown from one set of contacts to the other unless desired by the operator. This lock consists of two steel links pivoted on the escutcheon which locks the handle lever in the off position. When the oil switch is open it can be thrown on either set of contacts by lifting the locking handle which releases the catch. The switches, designed for mounting on separate base or wall, are equipped with a similar lock which is attached to the frame casting.

The use of this type of oil switch is recommended in connection with circuits which have to be opened under inductive load at voltages of 2,500 or less. The maximum load the switch will safely open is 700 kw single-phase, 1,200 kw three-phase, or 1,400 kw quarter-phase. It is designed in three current-carrying capacities, namely, 150, 200 and 300 amp.

The oil switch of Fig. 4 is manufactured especially for use on systems which require double-throw switches in connection with circuits of greater kilowatt capacity than that for which the above-mentioned switches are designed. It is designed for mounting on back of panel or for remote control, and is operated by means of a handle lever mounted on the face of the board. Double-throw switches are supplied with a locking catch which is released by means of a pull-rod passing through the panel. This lock has the same function as the locking catch o fthe oil switch described above and illustrated in Fig. 2.

The contact blades are carried upon a pivoted block of specially treated wood, and with the clips are supported from above by a cast-iron frame, forming a single element for mounting directly upon the switchboard panel or support. The oil vessel is supported from the frame casting as shown, and when in the operating condition the blades, blocks and all exposed live parts are completely submerged in oil. The oil vessel may be removed without disconnecting the switch or disturbing any other parts. The use of this switch should generally be limited to circuits where the double-throw arrangement is unavoidable. When single-throw switches of these



FIGS. 1, 2 AND 3.—OIL SWITCHES.

capacities are required the oil switch to be described later is preferable. The switch is made for voltages from 600 to 6,600 and currents from 125 to 300 amp.

The oil switch of Figs. 5 and 6 are designed single, double, triple and four-pole, and in two general forms, namely, the back of panel form for mounting directly upon the switchboard. This switch may be mounted upon a separate base equally well, and supported on an auxiliary framework. The second form is for remote control for operation in fire-proof cells or at points remote from the switchboard. Either form is arranged for hand-operation, being opened and closed by hand, and may be equipped with tripping devices which open the switches automatically on overload.

A cast-iron frame constitutes the body of the switch to which are attached all live parts and necessary operating links. The stationary contacts to which the leads are fastened are supported by insulators thoroughly insulating them from the frame casting. Controller finger contacts, which are readily replaced, are used instead of clips. A contact bar which moves in a vertical plane is carried by a rod of specially treated wood. In this manner a hinge contact is obviated and the switch made double-break. In case of double, triple or four-pole switches, the wooden rods carrying the contact bars are joined to a common cross-head which is lifted vertically in closing the switch. On the single-pole switches the rod is lifted directly by a lever, which is pivoted in the rear of the frame casting.

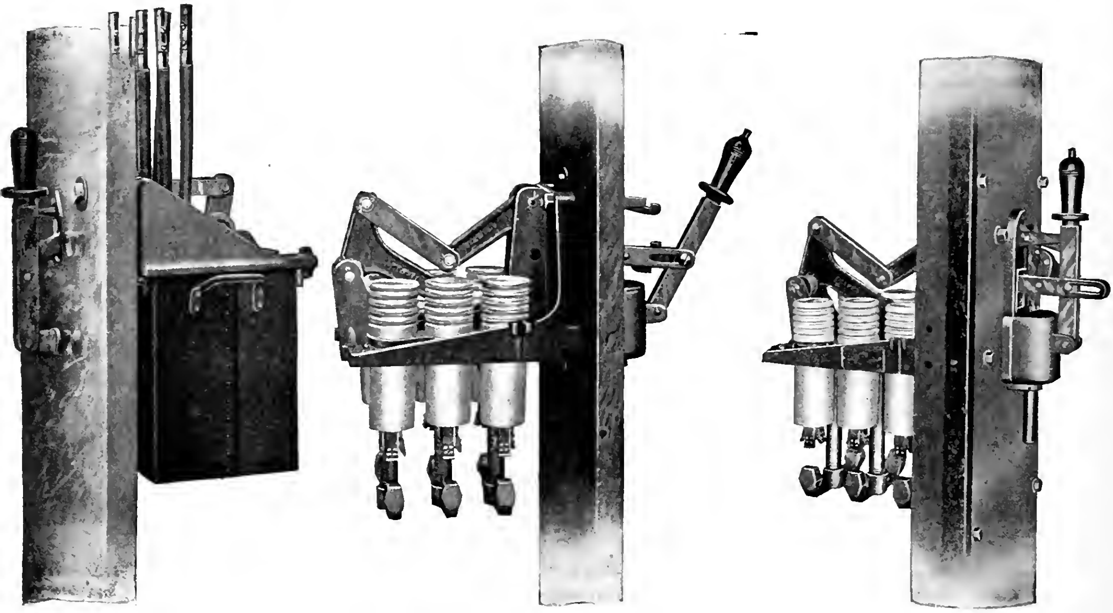
The links and levers forming the switch mechanism proper are so designed that a toggle enables the operator to close the switch with great ease. When the switch is equipped with an automatic trip the topple is set below center, so as to bring more or less pressure upon the tripping link, which, when buckled, allows the switch to open. If the switch is not arranged for an overload release the toggle lever is thrown past the center and the switch is locked in. The oil vessels for the double, triple and four-pole switches are lined and divided into individual compartments by means of wooden barriers.

The oil switch mechanism is connected by a link with the operating lever on the front of the board. When the switch is non-automatic the lever with the escutcheon and fulcrum are the only exposed parts on the front of the panel.

When the switch is electrically tripped the coil and tripping links are located on the front, and in plain view of the operator. A single coil is enclosed in a cast-iron magnet frame forming a part of the escutcheon. The double link connecting the switch mechanism and the operating lever is slotted and held in position by means of a tripping toggle. The core of the solenoid buckles the toggle links and allows the switch to open free from the hand lever. The handle remains in the closed position where it is held by a catch and may be released by means of a thumb push-button. The links projecting out beyond the hand lever indicate that the switch has opened automatically. The tripping link is so designed that it will immediately trip out when contact is first made if the switch is closed on overload or short circuit. This makes it impossible to damage apparatus due to short-circuit conditions.

When this form of oil switch is located at a remote point from the operating stand or switchboard, or placed in fire-proof cells, the operating lever is connected to the switch mechanism through a series of rods and bell cranks. The double, triple and four-pole switches are operated directly from the switch mechanism proper and may be located either straight back from the operating handle or at an angle with the face of the switchboard. The single-pole switches are connected up in groups of two, three and four elements to a common shaft, which is connected in a similar manner to the operating lever. If the operating lever is not located directly in front of a point on the shaft, an angular mechanism will be required.

The remote controlled triple-pole switches are made electrically tripped in the same manner as the switches mounted on the panel. For the single-pole switches the trip coil is mounted at the shaft. When the magnet is energized, the switch is released from the operating mechanism which remains in a closed position. A small switch is provided which closes a lamp circuit, indicating that the oil switch has been electrically tripped. When the switch is opened by hand the lamp does not light and the handle lever indicates that the oil switch is open.



Figs. 4, 5 and 6.—Oil Switches.

The 13,000-volt, triple-pole switch, mounted on the panel, is rated to rupture 6,000 kw, three-phase: and the triple-pole or three single-pole remote control switches are rated to rupture 7,000 kw, three-phase. It is not, however, recommended that the switches, when mounted on panels, be used up to the limiting capacities. If the emergency load will exceed 4,000 kw, three-phase, the remote control, triple-pole switch, mounted in the cell, is recommended.

The use of single-pole switches is recommended, for they permit a complete isolation of each phase, practically eliminating the possibility of a short-circuit between the buses in the station. The increased expense of the use of single-pole switches will usually be justified on account of the additional safety when the emergency load can exceed 5,000 kw, three-phase.

The frames of the single-pole switches should not be grounded or connected together by a metal framework or other electrical connection. This type of switch is made in capacities from 600 to 1,300 volts and 100 to 1,200 amp.

The cellular switch shown in Fig. 7 is manufactured single-throw only and is designed for exceptionally heavy work where the kilowatt rupture capacity is greater than that for which the other switches described are suitable.

These switches are motor-operated, thus allowing them to be located at the most convenient point to suit the general station arrangement. The operation of the oil switch is accomplished by a small hand-controlling switch, generally mounted on the panel, with the

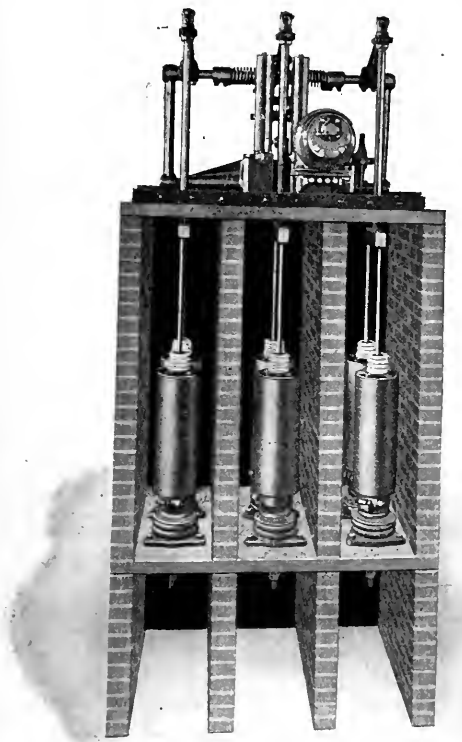


FIG. 7.—CELLULAR SWITCH.

instruments which are in the circuit controlled by the oil switch.

The switch can be made automatic by using a relay, operated by current transformers, which closes the direct current operating motor circuit. The standard voltage for the operating motors is 125, but they may be wound for other voltages when desired. In some cases the switches have been arranged for hand operation, but this method of operation should be considered special. All of this type of switch, however, can be operated by hand with a ratchet wrench, which is specially designed for this purpose and to protect the operator against injury when the crank shaft passes over center.

The switch has six breaks for a triple-pole, each break being in a separate oil receptacle, thus securing a device of great efficiency with a small amount of oil. In addition to this isolation of the breaks, each phase is enclosed in a fire-proof brick compartment, making it impossible for trouble in one phase to be communicated to another. The cells are constructed of brick with top and bottom slabs of slate. The following capacities have been developed: 60,000 volts, 100 amp.; 30,000 volts, 200 amp.; 13,000 volts, 300 amp.; 13,000 volts, 500 amp.; 2,500 volts, 1,000 amp.

This cellular type of switch has been successfully employed in the plants of the Metropolitan and Manhattan Railway Companies, the New York Gas, Light, Heat & Power Company, and the New York Edison Company, of New York City; the Niagara Falls Power Company and the Aurora, Elgin & Chicago Railway Company.

Blake-Knowles Multicurrent Feedwater Heater.

We illustrate herewith a vertical multicurrent feed water heater of Blake-Knowles type introduced by the International Steam Pump Company. In this heater the tubes are arranged in six segmental groups, and the water passes simultaneously through the tubes of each group and successively through the groups. At the top and bottom the tubes terminate in headers, which are divided by partitions which connect adjacent sets. The water entering the water inlet at the side of the heater near the bottom passes up through the first nest of pipes, through the header into the second and down to the lower header into the third, and so on until it issues from the sixth nest through the water outlet. The course of the steam is

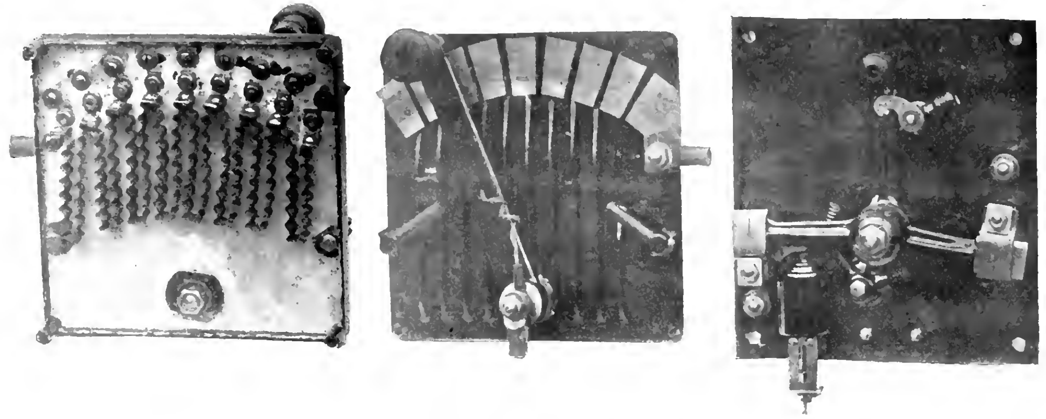
MULTICURRENT HEATER, VERTICAL TYPE.

through a path gradually decreasing in cross section. Entering at the steam inlet near the top of the heater it passes down over three sets of the water tubes, the cross section in this chamber being half the total circular area. The diametrical baffle plate extends from the top of the heater nearly to the bottom and causes the steam to pass up through the two adjacent chambers, each having one-sixth of the cross sectional area of the heater. The baffle plates dividing these chambers from the remaining chamber extend from the bottom of the heater nearly to the top, and the steam next passes downward through a cross sectional area equal to one-sixth of the heater and is finally discharged from the steam outlet at the bottom. In this way the path of the steam at each change of direction is cut down one-third and compensates for the reduction in volume due to condensation, with the effect of producing a nearly constant velocity.

The engraving shows an exterior view of a vertical heater of 800 hp size, in which the parts are disposed as just described. A horizontal form is also made, the theory of operation of which is practically the same though the construction is somewhat modified. In both forms the tubes are of composition giving a high efficiency in the absorption of heat, as well as long life. They are easily accessible for cleaning and allow for expansion and contraction, thus making it possible to use copper or brass tubes if the occasion requires. At the ends the tubes are expanded and secured into two heads, one of which is rigid and part of the main casing, while the other is bolted to a steel plate or diaphragm, the periphery of which is attached to the flange of the heater shell. This arrangement takes care of unequal expansion between the tubes and the shell. Another excellent feature is the absence of stuffing boxes or packings of any kind, doing away with the liability of leakage of feed water. The cross sectional area between the tubes is greater than the area of the exhaust pipe, so as not to cause unnecessary obstruction to the flow of steam, and avoids excessive back pressure. The condensation of the steam accumulating in the steam passages is removed through drip pipes. Blow-offs are also provided to keep the heater clean and free from sediment. Access to the heater is had by removing the heads. The tubes of the vertical heaters can be cleaned from the top, and those of the horizontal heaters from either end. The heaters are made in sizes up to 500 hp.

Rheostatic Combination for Electroplating.

The Ward Leonard Electric Company, of Bronxville, N. Y., has just brought out a rheostat for electroplating work. Fig. 1 shows the back of the electroplating rheostat used for control at the tank and Fig. 2 shows the front view of this rheostat and a special circuit-breaker. The working is as follows: A piece of apparatus which is to be silver-plated—with a certain specified thickness of plate—is suspended in the tank on a balanced beam. Current is turned on and when the exact amount of silver has been deposited, the added weight causes the balanced beam to fall and an auxiliary circuit



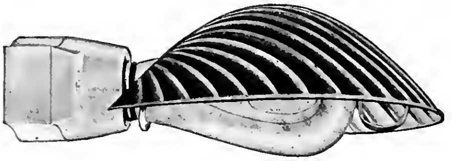
Figs. 1, 2 and 3.—Electroplating Rheostat.

through the overload coil of the circuit-breaker shown is automatically closed. The opening of the circuit-breaker breaks the main line and the current causing deposition is shut off. The rheostat shown is 11 by 11 by 4 in. in dimensions, has a resistance of .015 ohms, and a normal carrying capacity of 150 amp. It is equipped with self-aligning renewable shoes, renewable segments and a flexible connecting strip between the shoe contact and the line terminal preventing any drop of potential in the lever of the rheostat.

Aluminum Reflectors.

A novel and simple addition to electric lighting appliances and to the resources of the store window illuminator has just been brought out by the progressive firm of R. A. Schoenberg & Co., 1906 Sixth Avenue, New York City. The Sarco parabolic aluminum reflector, which is here illustrated, can be applied to the lamp without regard to socket or receptacle, or fielding receptable, the lamp fitting onto either. This enables a window to be wired with regular fielding receptacles, and by having the Sarco reflector applied direct to the lamp an even better reflecting power is acquired than by using an expensive mirror trough reflector. By its peculiar shell shape it gains at once in reflecting power, as shown by actual photometer test. The lamp setting closer to the reflector's surface reflects considerably more light than it would at a greater distance.

The Sarco parabolic aluminum reflector, owing to its simple and peculiar construction, is also an admirable reflector for the purpose of a desk illuminator, as when the reflector is clamped to the lamp, the bottom of the lamp is nearly submerged by the reflector (or covered, according to the position of the reflector), thus permitting no possibility of the light striking the eye. Being also of aluminum, it has the advantage of being so light in weight and adapts itself readily to the purposes of almost any kind of a desk lamp or portable.



Aluminum Reflector.

The finish of the Sarco reflectors is a solid smooth green enamel and the parabolic reflector in position resembles a green sea shell. Owing to its construction, it is possible to use the appliance without screws or clips. One of the chief uses to which the Sarco reflector can be applied is existing cluster lighting, as where a cluster is fitted with a porcelain shade the Parabolic reflector can be clamped direct on the lamp, thus giving the cluster the appearance of an elegant fixture, while at the same time doubling the quantity of the light. The Sarco deep cone reflector brings the polished surface of the reflector so close to the lamp that an actual test with it an 8-cp lamp will give as much light as an ordinary 16-cp light without the reflector. By the simple arrangement in the neck of the deep cone reflector, it can be applied without shade holder wherever desired, as in factory lighting, show rooms, etc.

Engine Builders' Association Council Meeting.

A meeting of the council of the Engine Builders' Association of the United States was held May 10 at the Astor House, New York. Among those present were Mr. C. A. Gates, of the Russell Engine Company, of Massillon, Ohio, who is president of the Association; Mr. J. I. Lyle, manager of the New York offices of the Buffalo Forge Company, the recently appointed secretary; Mr. N. B. Payne, of the Payne Engineering Company, 26 Cortlandt Street, who is chairman of the council; Mr. S. F. Bagg, of the Watertown, N. Y., Engine Company, and Mr. Walter C. Kerr, of the Westinghouse Machine Company.

The meeting was called for the purpose of considering ways and means of procuring more uniform methods in the commercial end of the engine business. Preliminary arrangements were also made regarding the next regular meeting of the Association, which will be held in New York in December. Practically all the members of the Association are identified with firms which make a specialty of building engines for direct connection to generators.

Reaction Brush Holder.

The brush holder is an important part of the great majority of dynamo electric machines and is a feature which in direct-current apparatus has very often been neglected, while other parts of the design were excellent. The type of brush holder shown herewith, and now improved, has been familiar to the public for somewhat over ten years and embodies a number of qualities which have commended it to the users of dynamos and motors. The qualities aimed at in the device are all vital to successful and smooth running, namely, efficiency of contact between brush and holder, freedom or flexibility of the brush in following the commutator contour, absolute parallelism as to plane and motion, slight inertia of the moving parts, a minimum low resistance path, ease and simplicity of handling, and absence of complication in the device.

It will be seen from Fig. 1 herewith that the reaction brush holder includes but six parts. The castings for the body portion and the

FIG. 1.—PARTS OF BRUSH HOLDER.

pressure arm are made from a special composition containing about 90 per cent. of copper and of high conductivity. The contact surface, against which the brush presses in the holder, is subjected to a milling operation that produces a perfectly flat surface. The set-screws have special truncated cone points adapting them equally for a round, flat or v-grooved stud. The spring is simple with no adjusting screws or lock nuts, the pressure on the brush being regulated by changing from one notch to another, as shown in Fig. 2, where, as will be seen, one spring is in one position of the notches

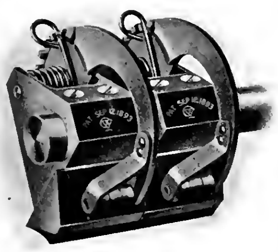


FIG. 2.—SPRINGS.

and another spring is in a different position. The end of the pressure arm is finely serrated, checking any possible tendency that might develop to side movement.

In operation the brush, which is preferably beveled at each end, is placed against the inclined contact plate and is kept always in positive contact therewith by the combined action of the pressure arm at one end and the reaction of the commutator at the other end. Hence, the brush is always maintained in intimate contact with the body of the holder, but so lightly or freely that the condition has been termed a "floating contact," as it leaves the brush entirely free to move away from or toward the commutator. The pressure arm performs the double function of pressing the brush constantly along the smooth contact plate against the commutator and in conjunction with the commutator reaction keeping it always in efficient contact.

The pressure arm is not associated with any box or frame and hence can follow the brush as it wears until it is practically used up. Moreover, the design of the holder permits it to be placed very close to the commutator, furnishing a minimum short path for the current. Owing also to the absence of any box surrounding the brush, all that is necessary to detach it for inspection or cleaning is to lift the pressure arm and simply take the brush away from the contact plate, in place of having to withdraw it from a clamp or box. This can be done even when the machine is in operation. Another feature is that a number of such brushes can be set side by side with no lost space between them, while the use of a flat contact plate without retaining sides makes it possible to use brushes of varying width, embracing the whole range of generator and motor sizes with three or four standard forms of holder. The brush is very quiet in operation and the successive refinements and

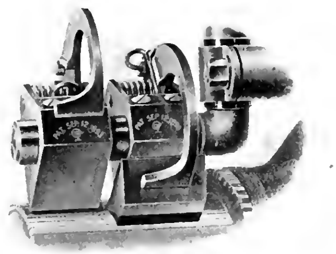


FIG. 3.—BRUSH HOLDER IN POSITION.

improvements have made it standard and satisfactory. The device is made by the Baylis Company, of 140 Washington Street, New York City.

"Dreamland" Lighting System of Coney Island.

The Brooklyn Edison Company has installed a 2,200-kw sub-station in the grounds of "Dreamland" for lighting and general power purposes in that new huge Coney Island amusement resort. There are two General Electric units of 1,000 kw each and two of 100 kw each. The power is taken from the union station of the company. It is transmitted at 3,600 volts, three-phase and is transformed at the sub-station to 170 volts alternating current. There are upwards of 150,000 lights, large and small, wired up in the resort. More than 50,000 decorative lights, it is claimed, are used to illuminate a massive tower in the grounds.

The tower is illuminated by thirty-six different circuits. On the apex 2,500 lights are used. The lighting of the tower is controlled by special remote control designed by Mr. C. C. Harley, the chief engineer for the Wonderland Company, which owns "Dreamland," and of which ex-State Senator Reynolds is president. About 600 hp of General Electric motors varying in capacity from 5 hp to 75 hp are used for operating the mechanism in the side shows, chutes, etc. There are more than 300 miles of special slow-burning fire and weather-proof cable used. The size of the cable varies from one to 1,400 cm. The National Conduit & Cable Company secured the contract for the bulk of the work. The switchboard has five panels. There are thirty 1,500-amp. switches which were manufactured by the F. A. La Roche Company.

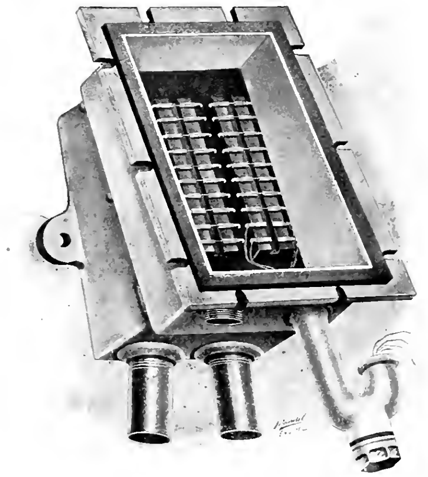
In the event of a break-down in the system, quick connection can be made with the Coney Island plant of the Brooklyn Edison Company, which will enable a 500-lamp control circuit in the grounds to light the resort to that extent.

It is almost needless to add that most of the features of this really wonderful pleasure resort depend largely upon electricity for their attractiveness, either in lighting effects, in spectacular displays or in the movement of mechanism. It is believed that quite a stimulus to such electrical work will be given by the creation of similar shows elsewhere.

Underground Distribution Box.

An excellent form of underground distribution box for telephone, telegraph, fire and police alarm service has been brought out by the Julius Andrae & Sons Co., of Milwaukee, Wis., and is herewith illustrated. It is known as the "Andrae O. K." Its aim is to avoid the usual dead investment in unused wires run from the ground to adjacent pole tops awaiting service, which perhaps never occurs. The box is of cast metal and the front side has a removable cover with brass bolts and screw connections, and is provided with a rubber gasket to keep out the moisture. The bottom of the box has two or more tapped openings for screw-threaded brass nipples, engaged by the cables, and these brass nipples and cables are united by soldering joints.

Inside the box is an insulating base of hard rubber and by means of screws this insulating base is fastened to a ledge projecting from



DISTRIBUTION BOX.

sides and ends of the box. The insulating base is provided with brass contacts mounted on hard rubber ribs, to which wires leading from the cables are attached, being first put through small individual openings, bringing them to the front, so that each connection is in plain view and work can be performed with rapidity.

The insulating compound is poured into the rear of the box—back of diaphragm, through an opening provided on top of the box and when completely filled is closed by a screw plug.

Each box is provided with two goose necks which can be attached whenever necessary under the front of the box through which wires are brought out to the pole or to the fire and police boxes, after which these goose necks are filled with compound. Thus this appliance affords easy and quick access to each conductor in a cable, for connection, test, disconnection, etc., and permits quick adjustment of the system to any emergency.

New Types of Attachment Plugs.

H. T. Paiste & Co., of Philadelphia, have brought out for 1904 a new P-K line of attachment plugs for both brass-capped and porcelain. The new "Pushin" style operates on an entirely new principle, as it is inserted and attached by simply pushing it into the socket, without any twisting of the cord. The two side springs, formed in exact shape to fit the Edison screw shell, hold the plug securely in place, while a third spring at the end completes the circuit. These springs are all of special phosphor-bronze. No. 430 is the standard P-K attachment plug and is made in Edison, T-H and Westinghouse styles. The brass caps are fibre-lined with a fibre bushing already in place in the cord opening. These caps are securely held to the base by two side screws which enter recesses in the porcelain base. All styles of P-K attachment plugs have cord openings

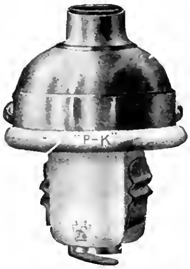


FIG. 1.—BRASS CAP.

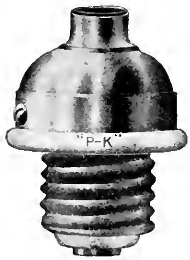


FIG. 2.—"PUSHIN."

FIG. 3.—PORCELAIN PLU

at least 13/32 in. diameter, so that they are easily wired with reinforced show window cord.

Desk Stand Telephones.

The Connecticut Telephone & Electric Company, of Meriden, Conn., has placed upon the market a new type of desk stand. All the working parts of this stand are entirely enclosed, making it free from handling and absolutely dust-proof. The hook switch is simple

DESK TELEPHONE.

and durable. The construction of this instrument is noteworthy for its high class of manufacture, both for finish and mechanical details. The instrument is equipped with the company's new solid-back transmitter and self-contained receiver, making the instrument one of the most powerful yet placed upon the market.

Big Telephone Consolidation.

Mr. J. G. Splane, president of the Pittsburg and Allegheny Telephone Company, says that within three months a consolidation of all the independent telephone companies between New York and Kansas will be perfected. It is said the enterprise is backed by Standard Oil interests. The headquarters will be in Chicago and the new combination will, it is claimed, have 1,000,000 telephones connected.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a complete lack of speculative interest, and extreme dullness prevailed. The renewed weakness in Steel stocks was the chief feature, common making a new low-record price by selling at 9. Otherwise price movements were unimportant, although there was some firmness in the standard railroad stocks in the face of the reactionary movement in the specialties referred to. The news regarding steel and iron trade conditions was the probable cause of the weakness of the Steel stocks. Some manipulative activity developed in Amalgamated Copper, which hardened slightly, on reports that a compromise with the Heinze interests was possible. The industrial and traction stocks as a class were rather neglected, Metropolitan Street Railway being the only one to display any irregularity. Allis-Chalmers common closed at 6, and preferred at 39½, the latter being a net loss of 1 point. General Electric ranged between 152 and 158, closing at 157, and Westinghouse closed at 155 after having reached 154. Brooklyn Rapid Transit closed at 45¾, a gain of ⅛ point, and Metropolitan Street Railway made a net gain of 2⅛ points, closing at 110¾. Bell Telephone ruled steady throughout the week, the closing price being 126⅜, a net gain of ⅜ point. Western Union lost 1⅛, closing at 88. The curb market was featureless, the general list being a little lower in price in sympathy with the reactionary tendency of the Stock Exchange list. The volume of business was very light. Interborough Rapid Transit lost 1½ points in the week's transactions, closing at 10½. Following are the closing quotations of May 17:

NEW YORK.

	May10	May17		May10	May 17
Allis-Chalmers Co.	6¼	6¼	Electric Vehicle	5⅝	4¾
Allis-Chalmers Co. pfd.	41	40	Electric Vehicle pfd.	9	9
American Tel. & Cable	86	86¼	General Electric	157	154
American Tel. & Tel.	126	123	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	109	110
Brooklyn Rapid Transit	45⅝	45⅜	N. Y. & N. J. Tel.	..	..
Commercial Cable	189	180	Marconi Tel.	..	..
Electric Boat	26	26	Western Union Tel.	89	87
Electric Boat pfd.	60	60	Westinghouse com.	155	153¼
Electric Lead Reduction	⅝	⅝	Westinghouse pfd.	175	175

BOSTON.

	May10	May17		May10	May 17
American Tel. & Tel	126¼	124	Western Tel. & Tel. pfd.	77	77
Cumberland Telephone	113¼	113¼	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	*235	234	New England Telephone	*122½	*123
General Electric	157	152	Mass. Elec. Ry.	18½	17½
Western Tel. & Tel	8	8	Mass. Elec. Ry. pfd.	71⅛	69½

PHILADELPHIA.

	May10	May17		May10	May 17
American Railways	44	44⅛	Phila. Traction	96	96
Elec. Storage Battery	56	55	Phila. Electric	5¼	5⅛
Elec. Storage Battery pfd.	56	55	Phila. Rapid Trans.	13¼	*13½
Elec. Co. of America	8	8			

CHICAGO

	May10	May17		May10	May 17
Central Union Tel.	..	..	National Carbon pfd.	101¾	102
Chicago Edison	..	..	Metropolitan Elev. com.	15	15
Chicago City Ry.	155	155	Union Traction	5¼	5¼
Chicago Tel. Co.	..	..	Union Traction pfd.	30	29
National Carbon	28	29			

*Asked

MONEY FOR GOOD INVESTMENTS.—The *Wall Street Journal* states that between January 1, 1904, and May 14, 1904, 135 days, there have been underwritten and sold in the United States securities aggregating over $600,000,000. It has compiled a list showing the principal items that make up this total and the companies that have issued and sold the securities. From this list it has in most cases omitted all issues under $1,000,000, and has not attempted to list securities of small companies or in fact any other securities than those which are well known to the investing public of Wall Street. If the count included all companies the aggregate would probably run over $700,000,000 of securities. From this list it appears that new securities have been sold to the investing public since January 1 at the rate of about $4,450,000 a day. The capitalization of the citizens of the United States has been increased about $8.00 per capita in 135 days. It is impossible, of course, to say how much of the money raised on these securities came from abroad. Probably something over one-sixth of the entire amount was subscribed by foreigners. It says: "The sale of this aggregate of securities in so short a time, coupled with the fact that money can be borrowed to-day in Wall Street at 2 per cent., is suggestive of the tremendous capacity of the United States for the creation and maintenance of legitimate industrial and railroad enterprises." The list includes the following items: General Electric, $3,525,000; Westinghouse, $2,000,000; the following tractions: Metropolitan, N. Y., $2,300,000; Third Avenue, $2,000,000; Central Crosstown, $2,250,000; B. R. T., $4,000,000; Twin City, $3,500,000; Detroit United, $500,000; St. Louis Transit, $8,000,000, and the following telephone securities or notes: Am. Tel. & Tel., $20,000,000; N. Y. & N. J. T. & T., $2,252,000; Bell, of Canada, $2,000,000; K. C. Home Tel., $1,500,000; Keystone Tel., $3,500,000; Northwestern, $1,500,000.

UNITED GAS IMPROVEMENT.—The United Gas Improvement Company shows as follows for the year ending December 31, 1903, and preceding years:

	1903.	1902.	1901.	1900.
Net earnings	$4,027,529	$3,473,643	$2,535,288	$1,714,347
Sale of securities	....	....	....	1,672,424
Total net	$4,027,529	$3,473,643	$2,535,288	$3,386,771
Dividends	2,569,349	2,018,238	1,797,728	1,553,768
Surplus	$1,458,180	$1,455,405	$737,560	$1,833,003

President Dolan says: "It will be noted that the capital stock of this company has been increased to $36,674,955. During 1903 the gas companies in which this company is interested increased their sales 16.6 per cent. in volume over the sales of 1902. The business of the electric light and trolley companies, in which we are interested, increased 11.3 per cent. and 5.3 per cent. respectively. The net profits for the year of $4,027,529 is equivalent to 12.4 per cent. upon the capital actually invested, as the new capital was not paid in until July 1, 1903. Out of these net profits $2,569,349 was paid in dividends and the balance, $1,458,180, invested in the business."

CONSOLIDATED GAS.—The directors of the New York Consolidated Gas Company have adopted a resolution that the capital stock be increased from $80,000,000 par value to $100,000,000 par value. A special meeting of stockholders will be held on June 2 to vote on a proposition to issue $20,000,000 6 per cent. debentures convertible into stock after three years. The stock will be issued to provide for "additional improvements and betterments, the acquisition of additional property, the payment of any indebtedness of the company, whether now existing or hereafter contracted." The stock will be issued to stockholders at par, payable in 3 installments, of 30 per cent., 30 per cent. and 40 per cent., temporary receipts will be issued for each installment, convertible into debentures at the option of the holder.

DIVIDENDS.—The General Electric Company has declared a regular quarterly dividend of $2, payable July 15. The directors of the General Electric Company have voted to offer stockholders of record June 15 the right to subscribe for the new stock at par on the basis of one new share for each ten of the old stock. Subscriptions will be closed July 15 and payments must be made on or before July 20. Subscriptions will be received only for full shares. The directors of the Barney & Smith Car Company have declared the regular quarterly dividend of 2 per cent. on the preferred stock, payable June 1. American Railways Company directors have declared a dividend of 1½ per cent. (75 cents) per share, payable June 15, to stock of record May 31. The Philadelphia Electric Company directors have declared the regular semi-annual dividend of 2½ per cent. (18¾ cents) on the stock $7.50 paid, payable June 15.

INTERNATIONAL STEAM PUMP.—The profits of the International Steam Pump Company for the fiscal year ended March 31, 1904, were, it is officially stated, nearly as large as they were in the preceding fiscal year, when they amounted to $2,113,365, and after deducting interest amounting to $585,709, preferred dividends of $531,000 and common dividends of $590,400, there was a surplus of $506,156. The preferred dividend is cumulative, and the declaration of the usual rate of 1½ per cent. quarterly is expected. With respect to the common stock, however, at the present time, it is not so certain that the rate of 4 per cent. per annum, which has been maintained during the past two years and paid in quarterly installments of 1 per cent. each, will be paid, during the ensuing year.

JERSEY TROLLEYS.—The forthcoming annual report of the New Jersey State Board of Taxation will show Trenton to be the leading trolley centre of the East, with eighteen separate systems and subsidiary lines. It will also show that during the last year of all these lines only one of them paid any dividends. Of the more than sixty such companies in New Jersey only eight of them paid dividends. Their total capital stock is $85,061,880, and they have a total of 980,563 miles of track.

MEXICAN TELEPHONE.—The following is the report, in Mexican currency, of the Mexican Telephone Company, for the year ended February 29, 1904:

	1904.	1903.	Changes.
Telephones in service	4,904	4,478	Inc. 426
Gross	$274,876	$246,368	Inc. $28,508
Net	134,885	111,997	Inc. 12,888
Net revenue U. S. currency	52,523	37,745	Inc. 14,778

Commercial Intelligence.

THE WEEK IN TRADE.—The more favorable weather conditions have stimulated retail trade and farmers have been able to do considerable planting. The improvement in some lines of trade has extended to reorders from jobbers. Reports of industry in general, however, are of slackness, particularly in cotton, woolen and shoe manufacturing. A quieter feeling and easier prices prevail in the iron trade, as a whole. Production is on a large scale, but stocks are not increasing as yet. Sales of 40,000 tons of steel rails, 5,000 tons of bars, and of good quantities of structural material are reported from Chicago. The hardware trade is good, but lumber is not quite up to expectations. A strike of teamsters at Chicago interferes with building activity at that point. In Chicago warmer weather has helped trade in general; in the Northwest farmers are actively employed and this tends to keep down retail trade. On the Pacific coast trade is below the average at San Francisco, while at other places in that section fair business conditions are reported. At the East there is more doing among the jobbers. There was a decrease of 5 per cent. in railway earnings in April as compared with the corresponding month last year. Copper prices are still firm, but the demand for consumption is dull. Quotations are unchanged, at 13⅜c. to 13⅝c. for Lake, 13⅛c, to 13¼c. for electrolytic, and 12⅞c. to 13⅛c. for casting stock. The exports for the month, so far, have been light, amounting to 4,300 tons. The business failures during the week ending May 12 numbered 201, as reported by *Bradstreet's*, against 176 the previous week and 182 the corresponding week in 1903.

SHANGHAI MUNICIPAL TRAMWAYS.—The firm of Fearon, Daniel & Co., of China, and of 90-96 Wall St., New York City, are advertising again for bids on the tramway concession for the Shanghai Municipal Council. It may be remembered that this was originally brought to the attention of the public as far back as 1898, when a contract was entered into between the municipality and the Brush Electrical Engineering Company of England. Due probably to the serious Boxer troubles which broke out in the Chinese Empire, the Brush Company did not proceed with the contract, so that the matter is again open for competition, and should receive the attention of American engineers. The firm in question have the full details of the concession, the main point of which is the deposit of $25,000 upon signing the contract. The road proposed is a fairly extensive one, comprising in the five specific sections, about 5¾ miles of double track, and 10¾ miles of single track to be equipped with span wire construction for double track, bracket for the single, and with iron or steel poles. The conditions laid down in the original tramway agreement must be complied with, but the agents state that a fair and reasonable proposal will have favorable attention on the part of the Municipal Council. The company putting in the road is permitted to collect from each first-class passenger 6 cents for a maximum distance of 1½ miles, and from second-class passengers 2½ cents. The company is to pay the council a yearly rental of $500 per mile of single track, and $750 per mile of double track. These and many other details are given in the papers in the hands of the firm named.

MOVING PLATFORMS.—It is stated that as an alternative to the proposition of the New York City Railway to give free transfers between their surface lines and the next rapid transit subway, if built by the Metropolitan, the Interborough Rapid Transit Company has formed a combination with the Schmidt & Gallatin moving platform syndicate to interchange transfers from the elevated or subway lines to a platform subway under Thirty-fourth Street. This proposition was laid before the Rapid Transit Commission last week by F. Kinsbury Curtis, lawyer for the syndicate. According to the plan of the combination, the Thirty-fourth Street crosstown connection from Ninth to Second Avenues, if made possible of construction, will be followed by like moving platform subways through Grand, Twenty-third, Fourteenth and Fifty-ninth Streets, to connect the elevated and subway lines. The proposition of Mr. Curtis covers the original route suggested by the moving platform people—over the Williamsburg Bridge, with a loop to the Battery—and a second route across Thirty-fourth Street.

EQUIPMENT FOR GRAND HOTEL EXTENSION.—Contracts have just been awarded through James Robert Moore, consulting engineer, 156 Fifth Avenue, New York, for the electrical equipment to be installed in the extension of the Grand Hotel, Thirty-fifth Street. The Construction Realty Company, 112 West Forty-second Street, has the contract for the construction and equipment of the building. The Buffalo Forge Company, through its New York City office, 39-41 Cortlandt Street, of which J. J. Lyle is manager, secured the engine contract. There will be three 90-hp and two 40-hp horizontal centre crank direct-connected to 50-kw. and 25 kw. generators respectively. The generators will be built by the Crocker-Wheeler Company. The equipment is intended for both light and power use.

ELECTRICAL SUPPLIES, ETC., FOR VENEZUELA.—The La Guayra Electric Light Company, of La Guayra, Venezuela, is placing considerable orders for electrical supplies, etc., through the export commission house of Kates & Bok, Orient Building. Mr. Carlos G. Palacios, chief engineer of the Caracas Electric Light & Power Company, is consulting engineer of the La Guayra Company. Mr. Palacios was recently on an extended visit here. At one time he was associated with the United States Electric Company, of Newark, N. J., and to his efforts is largely due the steadily increasing influx of Yankee electrical equipment, etc., into Venezuela.

CROSSLEY GAS ENGINE FOR LEXINGTON PLANT.—The Lexington (Ky.) Steel Ry. Co. has placed a contract with the Power & Mining Machinery Company (formerly Loomis-Pettibone Gas Machinery Company, of New York, successor to the Holthoff Machinery Company, of Milwaukee, Wis.), 52-54 William Street, New York, for a 500-hp Crossley gas engine to be direct-connected to a direct current, 550-volt generator of 300-kw capacity. The equipment will be installed in the existing steam power plant of the Lexington concern, whose capacity is about 2000-hp.

ELECTRIC CRANES FOR CANADIAN LOCOMOTIVE SHOPS.—Manning, Maxwell & Moore, 85 Liberty Street, have been allotted a contract for three electric traveling cranes for the Locomotive Machine Works, Montreal, which are now controlled by the American Locomotive Company. There will be two cranes of 10 tons' capacity each and one of 15 tons. The cranes will be built by the Shaw Electric Crane Company, of Muskegon, Mich.

ELECTRIC TRACTION OF MAZATLAN, MEXICO.—A concession has been granted to Janier Maxenim for the construction of an electric traction system in Mazatlan, a flourishing seaport town located in the State of Sinaloa, Pacific Coast, Mexico. There is at present a two-mile mule line. The new system will be about five miles long. Mr. Maxenim is expected to arrive here very shortly to place contracts for equipment.

ADIRONDACK ACTIVITIES.—The Paul Smith Hotel Company, Paul Smith's, Adirondacks, N. Y., will develop its water power on the Saranac River at Franklin Falls, N. Y., and build a power plant, from which will run transmission lines to Paul Smith's, Saranac Lake and Lake Placid, to operate an electric railway between the points named. The work will be done by the day, by its own men. Mr. A. C. Rice, State Mutual Buildings, Worcester, Mass., is the consulting engineer.

HOTEL TELEPHONES.—The hotels in Washington are "catching on" to the idea of a telephone in every room. The Chesapeake & Potomac Telephone Company, licensee for the Bell system, has secured contracts recently for the following hotels, all in Washington: Hotel Raleigh, 300 stations; Cairo Hotel, 80 stations; Hotel Rochambeau, 85 stations. The work of installing these telephones will begin at once.

EQUIPMENT FOR ASTOR ESTATE.—Col. John Jacob Astor has contracted through Mr. C. O. Mailloux, consulting engineer, for considerable electrical equipment to be installed for light and power purposes on his Rhinebeck estate. The De Laval Steam Turbine Company secured a contract for steam turbines. The Electric Storage Battery Company, of Philadelphia, has also been allotted a good-sized contract.

EXPORT TRADE.—The exports for the ten months including April amount to $1,277,859,235 or $54,000,000 more than last year; and the imports to $829,002,914 or about $35,000,000 less than last year. The excess of exports for the ten months is $448,856,321. For the month of April merchandise exports were $109,995,160, and imports $83,496,521, an export excess of $26,498,639.

ALLIS-CHALMERS-BULLOCK.—The Canadian business of the Allis-Chalmers Company, which recently acquired the Bullock Electric Manufacturing Company, of Cincinnati, will hereafter be conducted by a new organization bearing the name Allis-Chalmers-Bullock, Ltd. The works and principal offices of this important new Canadian company are in Montreal.

LIGHTING EQUIPMENT FOR HOTEL AMERICA.—The American Engine Company, of Bound Brook, N. J., has secured a third contract for lighting equipment to be installed in the Hotel America, Fifteenth Street and Union Square, New York. The outfit will include a 60-hp American Ball single engine to be direct-connected to a 35-kw. generator.

GORHAM MFG. COMPANY'S NEW PLANT.—Mr. C. O. Mailloux, 76 William Street, is consulting engineer for the electric plant which is to be installed in the new premises of the Gorham Manufacturing Company, silversmiths, at Thirty-sixth Street and Fifth Avenue, New York.

General News.

THE TELEPHONE.

JUNEAU, ALASKA.—All the mines in this vicinity within a radius of 40 miles will be connected by telephone during this summer. President Webster of the Juneau Light & Power Company is interested in the project.

LOS ANGELES, CAL.—The Home Telephone Company has decided to extend its system to San Diego in the near future. Material has been purchased and is now being delivered at San Diego.

LOS ANGELES, CAL.—The San Fernando Valley and Home Telephone Company is installing a system with a central office at Burbank, and lines will run to Toluca, Glendale, Eagle Rock and other suburban towns.

BOULDER, COL.—The city government of Boulder, Col., has granted an independent telephone franchise to Charles C. Townsend, of Greeley, Col., vice-president of the Morgan County Independent Telephone Company of that State. Mr. Townsend states that he and his associates intend to build a $100,000 plant in Boulder as soon as the work can be done, and that the rates will be $1 per month for residence telephones and $2 for business telephones on absolutely single party lines. It is understood that two per cent. of the gross receipts will be paid to the city of Boulder.

MOSCOW, IDA.—The Interstate Co-operative Telephone Company, of Moscow, has been absorbed by the Lookout Telephone Company of Lewiston, Ida.

LIBERTY CENTER, IND.—The Liberty Center Telephone Company is establishing an exchange and service in this town and county.

BLOOMFIELD, IND.—The New Home Telephone Company, of this city, will issue preferred stock to the amount of $100,000, to be disposed of for the purpose of securing funds to extend the lines and improve the plant.

STENDAL, IND.—The Stendal Home Telephone Company, has organized and incorporated. The capital stock is $10,000. John W. Stilwell, F. W. H. Schumaker, Wm. H. Eibert are among the incorporators.

EVANSVILLE, IND.—The Cooperative Telephone Company which advanced its rates a few weeks ago, was forced to readjust them on account of the wholesale "ordering out" of its telephones by the patrons. The old rates will be restored.

TERRE HAUTE, IND.—The stockholders of the Citizens Telephone Company have decided to install 32,000 feet of new cable and two sections will be added to the main switchboard at the central exchange. Another section will be added to the board at the North exchange. The cost of these improvements will be about $26,000.

ELKHART, IND.—The Central Union Telephone Company has been granted permission to lay conduits on all the streets asked except Franklin. It will expend about $75,000 in this city, greatly improving its present service and adding new equipment. It is said that the company will also improve and extend its plant to Goshen and between Goshen and Elkhart, the change to cost about $50,000.

EVANSVILLE, IND.—The Board of Public Works has granted a 30-year franchise to the Citizens' Telephone Company. The rental for business telephones shall not be more than $4 a month on full copper metallic circuit and $2 a month for residence instruments on metallic circuits. The Evansville Home Telephone Company is also seeking a franchise in this city. It is said that J. O. Parker, a banker, and other influential business men are back of the new company. In many respects the franchise submitted is the same as the one passed by the board to the Citizens' Telephone Company. The rules are to be $3.50 for business, $2 for residence and $1 for party line service. The Citizens Telephone Company has filed articles of incorporation. The capital stock is $100,000. A. F. Karges, M. L. Johnson, M. S. Sontag and others are the incorporators.

WAUKON, IA.—The Paint Creek Farmers' Telephone Company has been incorporated with a capital stock of $15,000. Wm. Rood is president.

OTTUMWA, IA.—The Iowa Telephone Company contemplates building a new exchange in this city, plans for which are being prepared by architect G. M. Kerns.

SUMNER, IA.—The stockholders of the Sumner Telephone Company have voted to sell, at public sale, its property, consisting of toll lines, exchanges, instruments, franchies, etc. The sale will take place at Sumner on May 25.

ALBANY, IA.—At the annual meeting of the stockholders of the Albany Home Telephone Company the following-named officers were elected: Howard Hendrickson, president; Irving H. Griswold, vice-president; George C. Lee, Jr., treasurer, and H. J. Price, Jr., secretary. The annual report shows an increase of 1159 in the number of telephones during the year with about 200 contracts on file waiting for installation. After operating for 15 months the company has earned 9 per cent. on the stock, after paying all expenses and fixed charges.

BOWLING GREEN, KY.—A company has been formed at Woodbourne, this county, to establish an independent telephone service at that place.

DANVILLE, KY.—The citizens of Junction City have organized a company at that place for the purpose of installing a telephone exchange. Dr. J. R. Steele was elected president.

CENTER LINCOLNVILLE, ME.—The Center Lincolnville Telephone Company has been organized to establish an exchange at this place. It has a capital of $1500. The officers are: President, J. S. Mullin; treasurer, W. D. Ross, both of Center Lincolnville.

BANGOR, ME.—The People's Telephone Company has been organized at Mercer for the purpose of building a line from New Sharon to Norridgewock. The capital stock is $27,000, and the officers are: President, C. K. Allen; treasurer, N. E. True, both of Mercer.

MECHANICSVILLE, MD.—The Southern Maryland Telephone Company has been organized with J. F. Coad as president.

ASHLAND, NEB.—The Ashland Telephone Company has filed articles of incorporation, with the Secretary of State, the capital stock being $50,000. It is the intention of this company to re-organize the old independent company at Ashland and to make a number of improvements in the service. The incorporators are Herbert H. Harndon, president; W. R. Shankland, secretary, and E. J. Rose, treasurer.

BATH, N. Y.—A new telephone company has been organized here with Isaac Rising as president.

COOPERSTOWN, N. Y.—The Cooperstown Telephone Company has increased its capital stock from $7000 to $10,000.

NORTH COLLINS, N. Y.—The North Collins Telephone Company has been incorporated with a capital stock of $5000. The directors are W. M. Ward, D. A. Dillingham and H. G. Parker, of North Collins.

WALTON, N. Y.—The Delevan Telephone Company, of Walton, has been incorporated with a capital stock of $3000. The directors are Grant Wilson, I. L. Brayman, Walton, and Thomas Carey, of Hancock.

BUCYRUS, OHIO.—The Bucyrus Telephone Company has increased its capital stock from $30,000 to $65,000. Mr. John A. Chesney is president and J. C. F. Hull, secretary.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has been ordered by the Board of Public Service to take down two miles of poles in the center of the city and place the wires underground.

ASHTABULA, OHIO.—At the annual meeting of the Ashtabula Telephone Company the following officers were elected: President, P. C. Remick; vice-president, W. R. Flower; secretary, S. W. Crosby; treasurer, D. B. Seymour. The company has added over 200 new telephones to its service during the past year.

MT. VERNON, OHIO.—At the annual meeting of the Mt. Vernon Telephone Company it was decided to re-incorporate the company under the laws of Ohio and to increase the capital stock from $100,000 to $150,000. The original company was incorporated under the laws of West Virginia. The company controls exchanges in Mt. Vernon, Fredericktown, Gambier, Centerburg, Twin City and Brandon, representing a total of 1603 telephones. The following-named gentlemen were elected directors: Frank L. Beam, Harry C. Devin, W. P. Bogardus, P. S. Kelser, E. O. Arnold, B. D. Herron, R. G. McClelland, H. G. Beam and J. W. Kelser.

CROWE, ORE.—The Crowe Telephone Company has been incorporated with a capital stock of $1000 to build a line between Crowe and Elmira, Ore.

ALBANY, ORE.—An independent telephone exchange is to be installed here. Messrs. W. R. Bilyue, L. C. Stratton, G. A. McCart and others have been appointed a committee to take action in the matter.

EUGENE, ORE.—The R. B. Electric & Manufacturing Company, of Kansas City, has asked the city council through W. D. DeVarney for a telephone franchise. Mr. DeVarney has opened an office at Portland, Ore.

PITTSBURG, PA.—The Wheeling & Pittsburg Telephone Company is to extend its lines.

PHOENIXVILLE, PA.—The Mutual Telephone Company has just formed here with R. K. Allsbach as president.

CANTON, S. D.—The Mutual Telephone Company has been incorporated with a capital stock of $20,000.

PIERRE, S. D.—The Eldon Home Telephone Company has been incorporated with a capital stock of $50,000.

LINWOOD, TENN.—The Linwood Telephone Company has been incorporated by H. D. Beadle, W. W. Young and others. It is capitalized at $1000.

EL PASO, TEX.—The contract for the construction of the new telephone exchange building for the Southwestern Telegraph & Telephone Company in this city has been let to C. W. Mackenzie for $11,000.

EL PASO, TEX.—The city council of El Paso has granted a telephone franchise to R. V. Bowden, attorney for the Southern Independent Telephone Company. The scale of rates provides that the minimum charge shall be $3 per month for business telephones and $2.17 per month for residence. This rate is to be charged when the company has from 1000 to 1500 telephones in use. The maximum rate shall be $4.70 for business and $3 for residence, to be charged when the number of telephones in use is between 4000 and 4500.

WHATCOM, WASH.—The Sunset Telephone Company will erect an exchange and general office building here.

TRINIDAD, WASH.—The Farmers' Telephone Company and the Bell Telephone Company offer to build a line from Trinidad to Wenatchee and Euphrata if $600 worth of stock is taken.

SPOKANE, WASH.—The Cheney & Spangle Mutual Telephone Company has been granted a franchise by the Spokane County Commissioners. The officers of the company are M. Ludwig, president; E. Thompson, secretary, and Saul Lind, treasurer.

SPOKANE, WASH.—The city council has granted to the Interstate Telephone Company a franchise to operate its system in this city. This will give Spokane patrons connection with numerous cities in what is known as the Panhandle district. The company has commenced the construction of a line from Spokane to Harrison, Ida. It will be 200 miles in length.

UTICA, WIS.—The Utica Telephone Company has filed articles of incorporation with a capital stock of $5000. The incorporators are Jasper Pickett, president, and Albert Parks, Robert Mackie and W. E. Munsil.

MINERAL POINT, WIS.—The Duke's Prairie Telephone Company, of Mineral Point, has been incorporated with a capital stock of $5000. The names of the incorporators are Charles Collicutt, James M. Pile, Joseph Whitford and William Harford.

Electric Light and Power.

BIRMINGHAM, ALA.—Saml. H. Lea, Chief Engineer, 305 Title Guarantee Building, this city, states that a power plant is proposed, but plans are not matured concerning size and details of construction.

ANNISTON, ALA.—The Clear Creek Mining Company has placed a contract with the Crocker-Wheeler Company for a 100-kw engine-type generator to be direct-connected to a new Ball & Wood engine in the company's plant at Arbacoochee. The new machinery will represent an outlay of $60,000.

CLARKESVILLE, ARK.—Col. E. T. McConnell has secured a franchise for lighting this city by electricity.

FAYETTEVILLE, ARK.—Bids are wanted for a 2-phase 120-kw alternator to be operated either by steam turbine or direct connected engine. It is understood that a day circuit will be maintained both for light and power. Other improvements are also being considered . F. W. Fratt, owner, 1001 North Broadway, Oklahoma City, O. T.

TEMPE, ARIZ.—The Tempe Pumping Company has been organized to develop water power for the production of electrical energy. The electric power will be transmitted to five sub-stations and will also be used for industrial purposes and lighting. Irrigation will also form a part of the company's work.

ALAMEDA, CAL.—A resolution has been passed by the council authorizing the electric light committee to install a day service in the municipal electric light works for power.

QUINCY, CAL.—The Quincy Water & Power Company has been incorporated by J. D. Goodwin witb a capital of $50,000. It is the intention of the company to improve the water works and to install an electric power plant.

BUENA VISTA, COL.—Articles of incorporation of the Chaffee County Electric Line, Power & Railway Company have been filed with the Secretary of State by Senator Wm. E. Mason, of Illinois, and associates. The company contemplates the erection of several water power stations at various points in the county.

NORFOLK, CONN.—The town authorities are considering the question of installing a new electric light plant.

SAND POINT, IDA.—The Sand Point Electric Company is now operating the city arc lights on the multiple system, but expects to install the series alternating current system during the coming fall. The company will also install a new 150-hp engine.

TABLE GROVE, ILL.—The citizens have voted to issue $4000 bonds to take over the electric light plant or install a new plant.

PERU, IND.—The Indiana Hydraulic Company is about ready to receive bids for the construction of a dam, electric power plant and electric railway between Vincennes and West Baden. J. Herff is president.

GREENSBURG, IND.—The Greensburg Gas Light Company has changed its name to Greensburg Gas & Electric Company and increased its capital stock $30,000. The purpose is to equip a plant and furnish electric light and power to the citizens of Greensburg.

MARION, IA.—The Marion Light, Heat & Power Company proposes to install new generators for street lights.

NEW ORLEANS, LA.—Bids will be received June 11 by Mordecai T. Endicott, Chief of Bureau Yards and Docks, Navy Department, Washington, D. C., for installing boilers, turbines, condensers, generators, etc., at the New Orleans Naval Station.

PITTSFIELD, ME.—The plant of the Pittsfield Electric Light & Power Company was completely destroyed by fire May 3. The loss was partially covered by insurance. A temporary plant is to be constructed.

CUMBERLAND, MD.—The following-named gentlemen have been elected officers of the Piedmont Electric Light & Power Company: President, H. B. Carroll; vice-president, Timothy Kenny; secretary, Norris Bruce; and treasurer, W. W. Shultice.

HOOSICK FALLS, MASS.—At the annual meeting of the Hoosick Falls Electric Light Company the following-named officers were elected: Frank H. Viele, president; D. L. Hall, vice-president; W. H. Tylee, secretary and treasurer, and Ralph D. Smith, general manager.

BOYNE CITY, MICH.—The Boyne City Electric Company proposes to develop a water power of 300-hp and will install a three-phase generator.

GRAND LEDGE, MICH.—Engineer H. A. Sprague, of Corunna, is stated to be interested in the Grand River Power Company, which is said to have secured an option on land along the river to be used for electrical purposes.

OTSEGO, MICH.—The Kalamazoo River recently formed a new channel around the Southern end of the big dam at the power plant of the Kalamazoo River Electric Company, depriving the plant of its supply of water. Most of the cities between Kalamazoo and Jackson, as well as the Jackson, Battle Creek Interurban road, depend upon this plant for power, and business was suspended temporarily while the Otsego dam was being disconnected from the others. The company has sufficient power to meet all demands. It will take about ten days to repair the damage.

FORT SNELLING, MINN.—It is proposed to increase the boiler, engine and generator capacity in the electric light plant at this post. Information can be obtained by addressing the quarter-master's department, Fort Snelling.

HANNIBAL, MO.—The Board of Public Works has closed several contracts for machinery, etc., for the new $100,000 municipal electric light plant.

PORTSMOUTH, N. H.—The board of tax assessors has decided to assess taxes upon the entire light and power plant of the Rockingham County Electric Light & Power Company of this city. This is the largest plant in the State and when it was built the city voted to exempt all new work of the company from taxation for a period of ten years. Since then the plant has been developed at a cost of $500,000. The supreme court decided that all votes of cities and towns exempting light and power plants from taxation are illegal and void.

NEWARK, N. J.—The following-named gentlemen have been elected officers of the Woodbourne Electric Light, Heat & Power Company of Sussex Borough: President, Charles A. Wilson; vice-president, C. H. Chrisman; secretary, A. W. Deldell; treasurer, Dr. H. D. Van Gassbeek.

SALISBURY, N. C.—The Salisbury Gas & Electric Light Company proposes to build a street railway five miles in length, install two new boilers, and new generators.

SANFORD, N. C.—The Sanford Electric Light & Power Company is extending its lines to Jonesboro, a distance of two miles, and will install about 500 additional lamps.

KENTVILLE, N. C.—The Kentville Electric Lighting & Power Company will probably install a small steam and electric unit for late night service. Judge Chipman, of Kent, is president of the company.

LEXINGTON, N. C.—The plant of the Lexington Water & Light Company was destroyed by fire on the night of April 30. Mr. F. W. Siebert is manager and G. W. Montcastle is president. The plant will be rebuilt.

DICKENSON, N. D.—Hughes & Dieters, proprietors of the electric light plant here, will install a new tubular boiler some time during the coming summer.

CINCINNATI, OHIO.—A number of local interests are forming a company to undertake the work of utilizing for power and commercial purposes the Ohio River from Pittsburg to Cairo. The object is to construct a system of reservoirs at the head waters of all the rivers and streams emptying into the Ohio along its entire length, thereby controlling the waters of the Ohio River. Another meeting of the projectors is to be held soon to decide whether the government shall be requested to conduct the enterprise, or whether it shall be carried out by private capital.

STAYTON, ORE.—The Stayton Electric Light Company expects to install a 250-volt booster in its plant here.

ROSEBURG, ORE.—The Umpqua Water, Light & Power Company was organized March 1 last by consolidating the Douglass Electric & Water Company and the Roseburg Water & Light Company. The capitalization of the company is $50,000. The officers are: President, Fred J. Blakeley; secretary, Dexter Rice; treasurer and manager, T. R. Sheridan; superintendent, F. H. Farrer.

BROOKSVILLE, PA.—The Solar Electric Company contemplates installing an additional dynamo and one 150-hp engine.

TARENTUM, PA.—Some improvements are contemplated in the municipal electric light plant at this place at a cost of between $10,000 and $12,000. The plant will be operated on the meter basis.

JEFFERSON CITY, TENN.—The Jefferson City Electric Company proposes to add some steam equipment to its plant.

CARTHAGE, TEX.—Mr. John C. Whitney, owner of the electric light plant here, proposes to give the plant a general overhauling and will probably install a more economical prime mover.

FOUNTAIN GREEN, UTAH.—The Big Springs Electric Company is considering the advisability of extending its electric lighting service to Ephraim, 12 miles from here.

LOGAN, UTAH.—Garff & Sons are making negotiations with the city council to establish and equip an electric lighting plant here, which is to be sold to the city after four years.

BURLINGTON, VT.—Bonds for $58,000 will be issued for a municipal electric light plant here. The city attorney is now looking into the legal questions connected with such an enterprise.

RUTLAND, VT.—The Rutland City Electric Company recently installed a new modern switchboard at its station. The board contains 11 panels of Vermont blue marble, each panel being 7 ft. high.

TAZEWELL, VA.—The Tazewell Electric Light & Power Company has been incorporated at Tazewell with a capital stock of $15,000. Joseph S. Moss is president.

HOOSACK, WASH.—The Washington Mining & Development Company in the Mt. Baker District is preparing to install an electric plant.

NORTHPORT, WASH.—The Northport Electric Company's plant was destroyed by fire May 4, entailing a loss of $4000. Mr. Robt. Morrell is manager and owner.

GLIDDEN, WIS.—There is an opening for an electric light plant in this place.

NEENAH, WIS.—In January last the city council awarded to the Fox River Valley Gas & Electric Company a franchise to light the city for a term of 20 years. Later this contract was annulled, and a similar one was let to the Wisconsin Light, Heat & Power Company, of which John I. Beggs, of Milwaukee, is the head. The Fox River Company has entered court to contest the annullment of its contract, and the Beggs company has agreed to indemnify the city against any damages or costs that may arise from the legal action.

NELSON CITY, B. C.—Bonds have been issued for the erection and equipment of a 3000-hp plant for power and lighting purposes.

BATHURST, N. B.—A contract was signed at Bathurst for putting in an electric light plant for lighting the town and village. The plant will be run by water power, which will be obtained from the Tamagouche River, two and one-half miles from Bathurst.

ACTON, ONT.—The electric light plant here, which is operated by the town, proposes to install a day power service.

CARLTON PLACE, ONT.—The Carlton Place Electric Light Company proposes to increase the capacity of its plant during the present season. Messrs. H. Brown & Sons are the proprietors.

The Electric Railway.

PRESCOTT, ARIZ.—Frank Wright, manager of the Prescott electric lighting system, of the local telephone system and of the new electric street railway, has a plan for penetrating the nearby mining districts with electric railways for hauling freight and ores.

MT. HERSEY, ARK.—The North Arkansas Electric Railway Company has filed articles of incorporation. The capital stock is $150,000, of which $30,000 has been subscribed. The officers are Griff Glover, of Bloomfield, Mo., president; E. K. Eby, of Jasper, Ark., vice-president; S. J. Norman, of Jasper, Ark., secretary and treasurer.

VISALIA, CAL.—The Visalia Electric Railway Company has been incorporated with a capital stock of $1,000,000 to build a 24-mile electric railway to run easterly from Visalia to Exeter, Lemon Cove and Lime Kiln Point. The directors are W. H. Hammond, Ben M. Maddox, Susman Mitchell, C. J. Giddings, all of this city, and Harold Wheeler, of New York.

DENVER, COL.—The Denver-Boulder Interurban Railway Company has been incorporated with a capital stock of $1,000,000. The directors of the road are: Ex-Mayor Henry V. Johnson, of Denver; Charles F. Potter, Judge Sterling B. Toney, of Denver; John R. McKinnie and L. L. Aitken, of Colorado Springs, and John H. Simpson and Percival Moore, the latter of Louisville, Ky. The company will be bonded for $500,000.

DANIELSON, CONN.—The Worcester & Eastern Railway Company, which is controlled by the New York, New Haven & Hartford Railroad, has made application to the Superior Court for New Haven County for a change of its name to "The Consolidated Railway Company."

GRANITE CITY, ILL.—At the annual meeting of the Venice, Madison & Granite City Railway Company, by unanimous vote the corporation was dissolved and the charter surrendered. The company sold out to the Granite City & St. Louis Railway Company, in which Governor D. R. Francis, of Missouri; Fred E. Allen and E. J. Spencer are the principal stockholders.

GENEVA, IND.—The Geneva Traction Company has filed articles of incorporation. The company is capitalized at $20,000. The purpose of the company is to construct an electric railway in Geneva and to Montpelier, Ind., and one also to Celina, Ohio, and will furnish electric light and power to various people and manufactories along the route. The company's office will be at Geneva and the concern will be managed by a board of seven directors, including A. G. Briggs, Charles Parks, E. F. Welch, J. H. Hardison, S. W. Hale, D. M. Shirley and W. J. Huter.

FOREST CITY, IA.—D. B. Lyons, of Des Moines, and an engineer, will survey for the proposed electric railway from Forest City to Cresco. It is now proposed to build to the Mississippi River, and a company with $1,000,000 capital will be organized.

LOUISVILLE, KY.—The Lebanon & Columbia Electric Railway has incorporated with a capital of $1,000,000. The line will be 42 miles in length. The incorporators are prominent business men of Lebanon, and W. K. Azbil, of Lebanon, is president. Arrangements for financing the project are said to have been made.

HENDERSON, KY.—The Henderson Street Railway, in which Joseph E. Bohannon and H. W. Richardson, of Louisville, and A. L. Rich, of Cincinnati, are large holders, will be rebuilt and extended. The work is in the hands of the Tennis Construction Company. It is contemplated by the owners of the property to extend the road to Evansville.

BOSTON, MASS.—The National Exchange Bank, of Providence, has filed two bills in the United States Circuit Court against the Lowell & Boston Street Railway Company and the Concord & Boston Street Railway Company, seeking appointment of receivers for each company. The bank alleged that the Lowell & Boston Company is indebted to it for $9,000, and the Concord & Boston Company for $10,000.

ST. LOUIS, MO.—On April 30, the first day of the World's Fair, the St. Louis Transit Company carried 927,000 passengers. Average daily volume of traffic since then has been from 350,000 to 400,000.

KANSAS CITY, MO.—The Metropolitan Street Railway Company has secured a permit to erect a power house sub-station at the southwest corner of Twelfth Street and Cleveland Avenue. It will be completed in about sixty days. The cost is estimated at $20,000.

KANSAS CITY, MO.—A charter has been granted for another electric railway between Kansas City and Topeka by way of Lawrence, Olathe and Rosedale. It is known as the Kansas City, Lawrence & Topeka Railway, and its capital stock is $1,000,000. The following-named officers have been elected: Henry G. Pert, president; George Leis, of Lawrence, vice-president; W. A. Bunker, Kansas City, Mo., treasurer, and J. G. Hughes, of Kansas City, Kan., secretary.

KANSAS CITY, MO.—The Kansas City, Burlingame & Western Electric Railway has filed articles of incorporation in Topeka. The capital stock is given as $2,000,000. The officers are: President, Hugh A. Holmes; vice-president, J. T. Pringle, Burlingame, Kan.; second vice-president, E. J. Hilky, Overbrook, Kan.; third vice-president, J. O. Southard, Allen, Kan.; treasurer, J. P. Slaughter, Burlingame, Kan.; secretary, Charles G. Taylor, Burlingame, Kan. The road incorporated will connect with the Kansas City & Olathe line at Olathe. It will run through Baldwin, Overbrook and Burlingame to Council Grove, a distance of 100 miles. Much of the right of way of the Burlingame line has already been secured. The road is to be in operation in eight or nine months. Cars may be running to Baldwin in five months. The line chartered is part of the system which includes the Kansas City & Olathe line, and the Kansas City, Lawrence & Topeka road. The Olathe line is to be in operation this summer. Electric cars may be running into Topeka by next spring.

RENO, NEV.—Money has been provided for the commencement at once of work on the proposed railway between this city and Sparks. California capitalists are the promoters, who are represented here by S. N. Griffith.

NEWARK, N. J.—The Public Service Corporation has announced the schedule of the passenger service between Jersey City and Philadelphia, which went into effect Friday, May 13. The first car leaves Jersey City at 8.35 A. M., and will leave Broad and Market Streets, this city, at 9.28 A. M., arriving at Trenton at 1.50 P. M. At Trenton close connections will be made with a boat of the Delaware Navigation Company for Philadelphia. The sail down the river will take about four hours. Three other cars will leave New York at 11.20 A. M., 2.20 P. M., and 5.20 P. M., and returning cars will leave Trenton at 8 and 11 A. M., and 2 and 5 P. M., arriving at Newark at 12.30, 3.32, 6.32 and 9.32 P. M. The cars will pass through Elizabeth, Westfield, Plainfield, Bound Brook and New Bruswick.

MIDDLETOWN, N. Y.—The sale of the Middletown-Goshen Electric Railway will be held May 26. The date of the sale was originally set for April 28.

ROCHESTER, N. Y.—The highway commissioners of the town of Wheatland have granted permission to the promoters of the Rochester, Scottsville & Caledonia Electric Railway Company to pass through that town. The road will be capitalized at $250,000. Articles of incorporation have been forwarded to Albany.

HUNTINGTON, N. Y.—The Huntington Railroad Company, owned and operated by the Long Island Railroad Company, has signed a contract with the Huntington Light & Power Company, whereby the last named is to furnish power to operate the road. The plant of the Light & Power Company will be about doubled in size. New engines will be installed at once. The power used at present is furnished by gas engines.

ELIZABETH CITY, N. C.—David E. Evans, president of the Elizabeth City Electric Light Company, is planning to organize a company to build an electric railway here.

COLUMBUS, OHIO.—The bill passed by the Legislature giving electric railways practical power of eminent domain in municipalities is now the law in Ohio, as the Governor has allowed ten days to elapse without either signing or vetoing it.

NORWALK, OHIO.—Citizens of Norwalk have subscribed nearly all the $100,000 in bonds to secure the building of the Sandusky, Norwalk & Mansfield Railway between Norwalk and Plymouth. Construction work on the road will probably start in the near future.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is closing a contract with the Electric Storage Battery Company, of Philadelphia, for a storage battery outfit to have a capacity of 1600 amperes for one hour. The battery will operate in connection with a booster set, and will be located on Detroit Street to assist with the loads on the west side lines of the company.

CLEVELAND, OHIO.—The Mansfield & Eastern Traction Company has placed a contract with the Reisinger-Proctor Company, of Pittsburg, for the construction of 17½ miles of road from Mansfield to Ashland by way of Mifflin, with a spur to Petersburg Lake. Plans for the road have been prepared by the General Engineering Company, of Cleveland, and it is stated that construction work will start before June 1. The bonded indebtedness of the company will be $450,000, and one-third of the amount has been underwritten. David Morrison, of Cleveland, is at the head of the company.

INDIANA, PA.—The Town Council has granted the necessary franchises to the Indiana Street Railway Company to enable it to construct its proposed lines.

WASHINGTON, PA.—The Wheeling & Elm Grove Railway Company, which operates from Wheeling to West Alexander, will extend its lines to Washington and form a link in the line from Pittsburg to Wheeling.

HARRISBURG, PA.—The Valley Traction Company has bought the Baltimore, Westminster & Gettysburg Electric Railway Company. The Valley Traction Company has also acquired the Hampden Street Railway and the South Middletown Electric Railway, their respective rights and franchises.

STROUDSBURG, PA.—The Northampton & Monroe Electric Railway Company, shortly to commence operations between Stroudsburg and Bangor, is to be extended to Mount Pocono, Tobyhanna and thence to Scranton. It is believed that the line will be constructed and in operation within two years.

UNION, S. C.—T. C. Duncan has organized a company to build an electric railway between Roebuck and a point on the Georgia Central & Northern Railroad, via Neal Shoals.

CHATTANOOGA, TENN.—At a meeting of the Rapid Transit Company stockholders it was decided to issue bonds to the extent of $1,000,000, of which $250,000 will be spent in improvements. The present officers of the company were re-elected.

SEATTLE, WASH.—The Seattle, Renton & Tolt Electric Railway Company has been incorporated with a capital stock of $750,000. The trustees are W. H. Goldson, P. J. Farley and Edwin S. Gill.

SEATTLE, WASH.—Articles of incorporation of the Snohomish & Cherry Valley Electric Railway are ready for filing. The capital stock of the company is to be $1,250,000. The road will connect Snohomish and Tolt by way of Monroe and Cherry Valley.

HALIFAX, N. S.—G. Martin Brill, of the J. G. Brill Company, of Philadelphia, Pa., is president of a company organized to construct an electric railway in Nova Scotia. The corporation will take over 50 miles of roadway that has already been surveyed.

TORONTO, ONT.—The Toronto Street Railway Company is increasing its power capacity by installing a plant which will bring the total output up to 10,000-hp, with a reserve storage battery capacity of 3000-hp in addition. The company has also secured an additional 200-hp from the old Metropolitan power house at Eglington, a suburban line recently secured by the company.

New Industrial Companies.

THE TURBINE ELECTRIC TRUCK COMPANY, of New York, has filed a certificate of increase of capital stock from $100,000 to $300,000.

THE INTERNATIONAL RAILWAY SIGNAL COMPANY, of Winston, N. C., has been chartered with a capital stock of $250,000. A. H. Eller and others are the stockholders. The purpose of the company is to equip railways with a new signal system and sell rights to use the same.

THE CLINTON STAMPING & ELECTRIC COMPANY will establish a plant at Clinton, Ia., for the manufacture of a combined lightning arrester, ground switch, fuse and lever cut-off for telephones. The company will also manufacture knife switches and engage in electroplating.

THE BLACK HAWK ELECTRIC COMPANY has been incorporated at Davenport, Ia., for the purpose of dealing, besides its present business, in electrical appliances, repairing automobiles, etc. The capital stock is $10,000. The officers of the company are W. A. Fuller, president; James E. Bayles, vice-president; John H. Eagel, secretary and treasurer.

THE MARTIN-REYNOLDS ELECTRIC COMPANY, of Little Rock, Ark., has been incorporated with a capital stock of $15,000, of which $4000 has been subscribed. The incorporators are Ed. Cornish, Robert E. Wait, M. B. Sanders, T. B. Martin, Jr., E. T. Reynolds, C. E. Robinson, Ed. M. Pennington, A. D. Reynolds, E. T. McConnell, R. D. Dunlap and D. T. Reynolds.

THE AKRON INSULATOR & MARBLE COMPANY and the Colonial Sign Company, both of Akron, Ohio, have consolidated under the title Colonial Sign Company. The plant of the Insulator Company will be removed to that of the Colonial Sign Company in South Akron and the new concern will continue to manufacture the same line of articles produced heretofore by the separate companies. The capital stock has been increased to $50,000. Mr. H. B. Camp is president of the new company; G. D. Chapman, vice-president; C. R. Quine, secretary; W. H. Motz, treasurer, and J. R. Hemphill, general manager.

Obituary.

MR. NELSON PERIN.—Mr. Nelson Perin, one of the leading financiers of Baltimore, Md., after a long illness, aged fifty-one years, died on May 12. He was one of the pioneers of rapid transit in Baltimore, and was the first president of the United Railways and Electric Company, which combined all the street railways of the city. He retired from the presidency of the company three years ago. Mr. Perin also was a promoter of the present system of electric lighting.

GEN. A. HICKENLOOPER.—The death is announced at Cincinnati, Ohio, of Gen. Andrew Hickenlooper. He rose from captain to brigadier in the Civil War, and was a famous commander of artillery in the Union Army. After the war he was civil engineer of Cincinnati, and for the past thirty years president of the Cincinnati Gas & Electric Company. He was Lieutenant-Governor of Ohio from 1880 to 1882. Gen. Hickenlooper was sixty-seven years old. He was long noted for his prominent connection with gas interests in Cincinnati and for the virulence of his opposition to electric lighting.

Personal.

MANAGER SCOTT, of the Cutter Company of Philadelphia, has returned from a short trip to Europe.

MR. H. A. RHODES, chief engineer of the Colorado Telephone Company, has gone from Denver to St. Louis on a combined business and pleasure trip.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, of Ampere, N. J., has just returned to New York from a brief trip to Europe.

MR. ERNEST F. LARNED, of Boston, formerly with Stone & Webster, has arrived in Tacoma, Wash., on a tour of inspection of engineering propositions in the Far West.

MR. JOSEPH H. THOMPSON, JR., has opened an office at 11 Broadway, New York City, for the purchase, sale or exchange of new and second-band electrical and steam machinery.

MR. D. MAZENET, managing director of the Mexican General Electric Company, which represents the interests of the General Electric Company, will pay a visit to the United States headquarters early next week.

MR. AUGUSTA WITZIG, of the Societe l'Eclairage Electrique de Paris is now on this side. The French concern is represented in the United States by the Goudey-McLean Company, 120 Liberty Street, New York.

MR. J. H. HALLBERG has opened an office at 45 Broadway, New York City, as consulting expert in electrical distribution and illumination, a branch of work for which his training and experience qualify him admirably.

MR. JAMES H. McGRAW, president of the McGraw Publishing Company, has been elected a delegate for New Jersey to the Republican National Convention which will meet in Chicago in June to choose a presidential candidate.

MR. J. C. McQUISTON, formerly secretary of the Publishing Department of the Westinghouse companies, has been made its superintendent and responsible head. He will be charged with matters of advertising, preparation of technical articles, etc.

MR. J. C. BOYNTON, toll traffic manager of the Colorado Telephone Company at Denver, has resigned his position with that company and gone to Newcastle, Pa., where he will probably continue his work in connection with telephone traffic problems.

MR. LOUIS F. PHILO, who for the past six years has been connected with the Wesco Supply Company, in the capacity of manager of the supply department, has become assistant manager of sales with the Ewing-Merkle Electric Company of St. Louis.

MR. J. G. WHITE, president of the electrical engineering and contracting firm of J. G. White & Company, Inc., New York, will sail for Europe May 24 on the North German Lloyd liner *Kaiser Wilhelm der Grosse*. He expects to be absent about three months.

MR. FRED A. GEIER, secretary and treasurer of the Cincinnati Milling Machine Company, who has been abroad some time, has just returned home from Europe, having greatly enjoyed the change and seen a good deal of industrial conditions on the other side.

MR. W. OWEN THOMAS, electrical engineer of the Michigan Lake Superior Power Company at Sault Ste Marie, Mich., has severed his connection with that large undertaking to become assistant to the mechanical engineer of the Chicago & Northwestern Railway Company, at Chicago.

MR. CHARLES H. HASWELL, known to all engineers the world over, celebrates his ninety-fifth birthday Sunday, May 22, and his friends in this city where he was born in 1809 are giving him a dinner at the Engineers' Club on Monday next. The veteran will enjoy a story and a cigar with the liveliest of them.

MR. JAS. R. CRAVATH recently addressed the Armour Institute of Technology branch of the A. I. E. E. on the subject of "Illumination," taking up first the general subject of how to secure the best results for a given expenditure of money for electric light, and following with some specific examples and practical suggestions.

ARTHUR FRANTZEN & COMPANY.—The electrical engineering and contracting firm of Arthur Frantzen & Company, Chicago and Baltimore, has entered the Mexican field. Branch offices have been opened in the Mexican capital under the management of Mr. A. B. Boynton. Mr. A. W. Maulsly will be assistant manager.

MR. H. M. DIEFFENBACH, who recently resigned as general manager of the Mexican end of the American Smelting & Refining Company, has beeen appointed general manager of the Compania de Minelales y Metales of Mexico City. This concern controls the Penobles Mining Company, which will be in the market for a big lot of electrical equipment very shortly.

MESSRS. J. CICERON CASTILLO and F. Mendoza Alvirez have recently established themselves in Morelia, State of Michoacan, Mexico, under the firm name of Castillo y Compania. They will inaugurate a department to be devoted to the installation of hydro-electric machinery, etc., for operating mines, etc., and have already obtained some fair-sized contracts.

MR. HERMANN RUETE, until recently associated with the export commission house of G. Amsinck & Company, Hanover Square, New York, is about to leave for Germany, where he will enter his father's firm, Ruete & Schutte, of Hamburg, which is one of the largest commission houses in that part of the world. A new department is to be created for the purpose of handling American electrical equipment, supplies, etc. Mr. Ruete's address is 128 Water Street, New York.

MR. CHARLES J. GLIDDEN, the chairman of the Boston touring committee of the American Automobile Association, who at present is abroad, will return in June and take up the active work of organizing the New England Division. Mr. Glidden will start his grand tour of the world by going from New York to St. Louis with the run from there to San Francisco. Before leaving New York, Mr. Glidden stated that he expected to bring Mr. Edge of Gordon-Bennett fame back with him to drive a Napier in the tour.

MR. H. WARD LEONARD, president of the company bearing his name, has resumed work, and we are very glad to state that he is entirely restored to health. He had to go into hospital on account of his eyes. He had considerable trouble with an attack of iritis, due to the results caused by arcing, and consequent upon tests he made in connection with making and breaking the circuit of several large motor starters built under his supervision at the Bronxville works. He is quite cured of this trouble and his eyes are in good condition.

MR. HERBERT LAWS WEBB has an interesting article in the London *Daily Mail* on the manner in which the telephone as a necessity in New York becomes a luxury in London. "British bankers will not use the telephone service. In America bankers are wholesale users of the telephone. In London there is not a hotel having telephone service in all the rooms. In New York the hotel which does not have the city telephone service in every room is the exception. The Metropolitan police refuse to use the telephone. The New York police have an elaborate system of their own and connection with the general system at every station. In New York for years past the police have managed all large processions by telephone. In London the police and the military manage processions by flag signalling! The broad difference between the American and the British public, and their respective authorities, is that the former welcome all devices aiming at saving time and increasing efficiency, while the latter resist them to the last ditch."

Educational.

HARVARD AND "TECH."—Advices from Boston of May 14 say: "Negotiations between the Institute of Technology and Harvard University looking toward their union have been formally opened by the Institute. It was announced to-day at the office of President Pritchett that a resolution of the corporation of the Institute had been formally transmitted to the corporation of Harvard. This resolution is as follows: "Voted, that the executive committee be required to ascertain whether any arrangement can be made with Harvard University for a combination of effort in technical education such as will substantially preserve the organization control, traditions and name of the Massachusetts Institute of Technology."

Trade Notes.

THE HAZARD MFG. COMPANY, of Wilkes Barre, Pa., has opened its own office and warehouse at 71 and 73 West Adams Street, Chicago, Ill.

MR. W. S. BROWN, New York representative of the Chase-Shawmut Company, Boston, has moved his offices to the Bancroft Building, 3 West Twenty-ninth street.

THE PERKINS MACHINE COMPANY, maker of power presses, has removed its main office from South Boston to its Warren plant at Warren, Mass. The company is receiving large orders for its machine from its German agents, Messrs. Schuchardt & Schutte, of Berlin.

THE F. BISSELL COMPANY, of Toledo, Ohio, has issued Bulletin No. 31 devoted to tape, solder, screws, insulating materials and carbon brushes. This bulletin becomes part of its new illustrated catalogue, and will be sent on request to any user of electrical goods.

GARTON-DANIELS COMPANY, Keokuk, Ia., has issued No. 40 catalogue, which embraces all details as to its full line of lightning arresters. This catalogue has already run in to more than one edition. It deserves the general circulation and demand it is enjoying. Businesss in these arresters for the first three months of 1904 shows a large increase over any previous period and the demand continues progressively.

H. T. PAISTE COMPANY, Philadelphia, Pa., is pushing its new P. K. "Pushin" attachment plug, and calls attention to its new principle of inserting without any backward or forward twisting of the cord. The inquiries and orders for it have already been most gratifying, beyond anything that was expected. This device is described and illustrated on page 1004 of this issue.

SELF-SOLDERING HEAT COILS.—Mr. Frank B. Cook, 240 W. Lake Street, Chicago, has an exclusive license to manufacture and sell all self-soldering heat-coils and other circuit protecting devices and apparatus covered by patents and applications for patents, as well as any devices of that kind, which may hereafter be invented by Charles A. Rolfe, or owned and controlled by the Rolfe Electric Company. All other licenses have been withdrawn.

HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., has just issued a new bulletin on motor generators, No. 302. It is somewhat larger and more comprehensive than the old bulletin, and covers its subject and its field most completely. An appendix of several pages has been added, which treats of the various forms of the telephone machinery of this class, showing the latest apparatus in this line. In fact, it is a most interesting catalogue and should be in great demand.

JAMES LEFFEL & COMPANY, Springfield, Ohio, have just issued a catalogue of 40 pages devoted to their steam engines, boilers and turbine water wheels. The engines and boilers are illustrated in full detail and descriptions are given of both classes of apparatus. Dimensions, sizes, etc., are also furnished, and from this catalogue the intending purchaser can obtain an excellent idea as to the best manner of satisfying his wants. The catalogue also illustrates the well known turbines made by this firm and the Leffel portable vertical engines, as well as Leffel upright engines and submerged tube boilers..

SIDE CUTTING PLIERS.—Mathias Klein & Sons, 87 and 89 West Van Buren Street, Chicago, are now making side cutting pliers in 6, 7 and 8 inch sizes, the 6-inch being a recent addition made to the line by general request. They make also a full line of climbers, splicing clamps, pliers, wire grips, pulley blocks, etc., and carry a general assortment of linemen's and construction men's requisites in such particulars. They also distribute "a good rule" which they will be pleased to send gratis to interested people.

ADAMS-BAGNALL ELECTRIC COMPANY, of Cleveland, Ohio, in its recent bulletins gives a number of illustrations and a variety of details as to its well-known arc lamps, for all classes of service. These lamps have been on the market for a number of years, and are standard features of the art. The company has paid special attention lately to the alternating current series type of lamp, with all the necessary parts and accessories, and its literature on the subject shows both the apparatus and the manner of connecting up the circuits, with particular attention to the regulator for the alternating constant current.

POP CONCERT AT THE ELECTRIC LIGHT CONVENTION.—A pop concert will be held at Symphony Hall, Boston, on the evening of May 25, during the convention of the National Electric Light Association. Mr. Geo. C. Ewing, Nernst Lamp Company, 501 Atlantic Ave., Boston, informs us that delegates may obtain free tickets by addressing him by mail or applying to him personally on their arrival at Boston. There will be approximately 600 seats at tables of 4 or 5 each, and it is proposed to make the evening a very enjoyable one for the delegates.

NEW BOILER FEED SYSTEM.—Frank E. Keyes, manager of the Refined Wood Company, of 20 Broad St., New York, has devised and patented an improved and very effective boiler feed system by which the water is purified, then put into the boiler under any pressure at a boiling point, without the use of pumps, injectors or inspirators, namely by gravity. It is claimed that the simplicity and the low cost of installation will appeal to all steam users. As the water is purified before going into the boiler, it is possible to run the boiler much longer without cleaning. A steady supply of clean hot water is insured, giving the greatest efficiency with the least amount of fuel.

KEYSTONE ELECTRIC COMPANY, Erie, Pa., has issued a handsome quarto catalogue devoted to its generators, motors, switchboards, panel boards, etc. It is a pamphlet of 40 pages, and is profusely illustrated, showing complete and in detail a large variety of excellent apparatus in these lines of production. A valuable part of the catalogue is that which gives detailed diagrams and dimensions of the machinery. We note a new type of brush holder, and the switchboards are also admirable types of that class of work. A section is devoted to the application of Keystone motors to machine tools, ventilating fans, etc., exemplifying a wide range of use for their power apparatus.

SLOTTING MACHINES.—The Newton Machine Tool Works, Philadelphia, Pa., in a recent catalogue, illustrate and describe a very complete line of slotting machines particularly adapted for use on electrical machinery and large engine work. These machines are made to he belt driven or motor driven, and range from 6 in. to 18 in. stroke. Each illustration is accompanied hy dimension tables. Other machines illustrated are a 40-in. gear cutting machine; an armor plate slotting machine; milling machine; cold saw cutting-off machines, etc. The illustrations are very clear and the machines have a very massive and substantial appearance.

THE STUART-HOWLAND COMPANY, Boston, Mass., reports a decided improvement in business with the opening of spring. It has recently secured several large orders, three of which are for shipment abroad. These, in addition to the ordinary business will keep its force very busy for some time to come. This company is located in the very heart of Boston, within one hundred feet of Summer Street and within four minutes' walk of the new terminal station. Its offices and warerooms are large, light, airy and especially convenient for handling goods at a minimum cost. It carries one of the largest and most complete lines of electrical goods to be found in the United States. The push, energy and up-to-date methods of this concern are too well known to the trade to require further comment.

CARBORUNDUM IN BUTTON MAKING.—Hitherto pearl buttons have been cut and drilled with steeled tools. An inventor named Louis W. Holub has devised a means of grinding them out of the raw mother-of-pearl by means of carborundum. The firm of Holub-Dusha Co., 1801-3 First Ave., New York, is now doing this. A little girl sits in front of the machine, feeding it, and just as fast as her little fingers can go the machine finishes the work, whether the button is 1/4 inch or three inches in diameter, whether the surface is to be straight, concave, convex, or the form of the button be that of round, oval, square, hexagon, triangular, or of any other form. The machine consists of a flat, slowly revolving, round, horizontal turn-table of about two feet in diameter. Near to its outer periphery is mounted a plurality of vertical button chucks, revolving rapidly around their own axes while slowly moving the turn-table. These chucks describe a circle of about 22 inches in diameter. Into this circle is mounted, eccentrically in relation to the chucks, a horizontally revolving carborundum wheel mounted on a vertical shaft. The diameter of the wheel is about 20 inches. As the carborundum wheel is 2 inches smaller in diameter than the circle described by the chucks, it comes in contact with but few of the buttons at a time, and thus leaves the rest of the chucks free for manipulation, such as placing the button therein, gripping it, taking out the finished product, and freeing it of dust, etc. When this so-called "merry-go-round" is in motion the carborundum wheel makes 5000 revolutions per minute, the chucks about 600, and the turn-table about 15 revolutions. When the chucks arrive before the little girl they are open and do not revolve around their own axes, but move with the turn-table. A button blank is placed therein. The chuck automatically grips it, begins to revolve with it, and brings it in contact with the lower side of the carborundum wheel. Terrific grinding takes place and in less than a second the top of the button is ground. When it has passed the grinding wheel the chuck ceases to revolve, it opens automatically, and the button is now under a suction tube that lifts it out of the chuck, taking with it every particle of dust, and the now clean and open chuck is once more before the little girl to receive a new blank to be ground. If the button should be convex or half round, then the lower or outer end of the carborundum wheel is dressed concave with a diamond. The wheel being intensely hard, it holds its shape for days, and it is re-dressed at a trifling cost.

ZINC.—In a very neat and illustrated pamphlet, recently issued by the Lanyon Zinc Company, "Two Stories of Zinc" are told, the first being the story of spelter. The various steps in the reduction of zinc from the ores are clearly described and a sketch is given of a day's work in a zinc smelter plant. The ore is first crushed and then treated in the calcining kilns where it is desulphurized, the zinc sulphide being changed into oxide and the sulphur passing off as sulphur dioxide. The temperature in these kilns is in the average 1700 degrees F., but is gradually increased as the period of calcination progresses. The zinc oxide is then mixed with finely ground coal and fairly coarse coke or coal in order to be reduced in the distillation furnace. In this step of the process zinc is treated in quite a different way from other metals. Zinc ore cannot be melted nor can any zinc be extracted by the usual methods of treating ores. Gold, for example, is placed in the furnace in company with the metals known as fluxes, which collect in the bottom of the furnace and late in the process are drawn off in the form of bullion containing the gold which is afterward refined and the metals separated. Zinc, when placed in contact with intense heat, is transformed into a vapor, and then recovered in condensers. This is done in the distillation furnace. The presence of any fluxing material in the smelting of zinc would be a positive detriment. On account of this method of distillation the losses of zinc during the treatment are high compared with other metals and average from 10 to 30 per cent. of the metallic contents of the ore. The Story of Sheet Zinc is next told in the pamphlet. The operation is one requiring skilled help and constant watching. The choicest of spelter is used. It is first melted in a huge pot and then poured into moulds and billets are cast. The billets are annealed and treated in the first or "roughing" rolls. They are then again annealed and treated in the finishing rolls. The last operation is the most delicate one of the process. The applications of sheet zinc have rapidly increased during the last 30 years. Among the more common uses of sheet zinc are the manufacture of metallic ceilings, stove boards, linings of refrigerators, and it is largely used in the zinc process for the extracting of gold from its ores. The use of small galvanic cells takes quite a large tonnage of this metal in the course of a year, since it has been demonstrated that batteries and rods made from sheet zinc are of a more satisfactory character than those which are cast. In recent years, the manufacture of nickel, copper and brass plated sheet zincs has grown rapidly, and they have entered into formidable competition with sheet brass and sheet copper.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 10, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

759,237. CIRCUIT CHANGER; Charles C. Cadded, Cleveland, Ohio. App. filed June 15, 1903. Strip metal, spring contacts are actuated by a spreader carried by a lever and which moves in the space between the contacts.

759,276. INSULATOR FOR TELEGRAPH WIRES; Clayton Hobert, Philadelphia, Pa. App. filed April 10, 1903. A knob having grooves in the top arranged at various angles and a second knob or cover screwing down upon the first to hold a wire in one of the grooves.

759,280. TELEPHONE ATTACHMENT; Stephen C. Houghton, San Fancisco, Cal., and Frank M. Potter, Jr., Syracuse, N. Y. App. filed Dec. 30, 1903. (See page 987.)

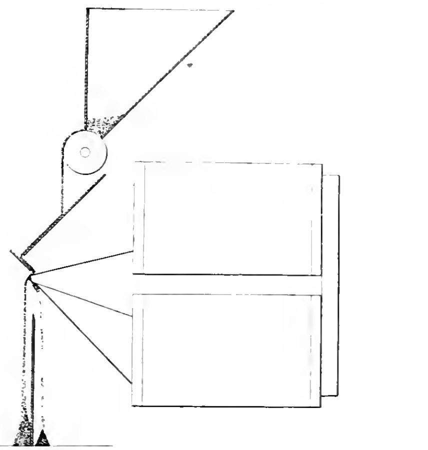
759,281. SIGNALING; Gustav A. Huber, Mounthope, N. Y. App. filed Jan. 9, 1904. General improvements in a magneto generator and selector.

759,286. ELECTRICITY METER; Martin Kallman, Berlin, Germany. App. filed Sept. 28, 1901. An armature deflected by the current has a to-and-fro motion which rotates a wheel in one direction giving it sufficient momentum at each impulse to keep the motion continuous between impulses.

759,316. TELEPHONE-RECEIVER; Walter C. Runge, London, Eng. App. filed Dec. 6, 1902. (See page 987.)

759,327. RAILWAY SWITCHING AND SIGNALING APPARATUS; John D. Taylor, Buffalo, N. Y. App. filed Oct. 25, 1901. Devices for preventing crosses on the wires of the system.

759,346. RAILWAY BLOCK SIGNAL SYSTEM; Winthrop M. Chapman, Newton, Mass. App. filed May 12, 1902. Various details of construction.



759,358.—Magnetic Separating Apparatus.

759,352. METER FOR MEASURING ELECTRICAL ENERGY; Louis P. Decombe, Paris, France. App. filed Nov. 26, 1901. The fine wire spool forms part of a system arranged in such a manner that the number of oscillations of a spool on a suitable axis is proportional to the energy consumed in the distribution.

759,358. MAGNETIC SEPARATING APPARATUS; Thomas A. Edison, Llewellyn Park, N. J. App. filed June 21, 1900. The separator consists essentially of an electro-magnet having extended tapering poles, one of which slightly overlaps the other to form a narrow gap between them whereby the magnetic particles will be attracted by the lines of force towards one of the poles and caused to fall into a compartment separate from that which receives the non-magnetic particles.

759,383. COMBINED SWITCH-SOCKET AND RESTORING-ANNUNCIATOR; Anton M. Knudson, Chicago, Ill. App. filed Oct. 13, 1900. (See page 987.)

759,385. RAILWAY SWITCH AND OPERATING MEANS THEREFOR; Lucius A. Lindsay, Strubbe McConnell and Clifford C. Hudson, Atlanta, Ga. App. filed Nov. 23, 1903. A circuit closing device actuated from the platform to energize magnets in the road bed for moving the switch tongue.

759,414. GROUND WIRE ATTACHMENT; Wilbert J. Bishop, Buffalo, N. Y. App. filed Sept. 4, 1902. A strap to embrace a pipe and carrying a roughened plate which bites into the pipe to make good contact.

759,426. ELECTRIC SOLDERING IRON; Sydney Evershed, London, Eng. App. filed Dec. 8, 1903. Details.

759,428. TELEPHONE-TRANSMITTER HOOD; Robert D. Fannon, Chicago, Ill. App. filed Oct. 29, 1901. (See page 987.)

759,431. ELECTRIC ACCUMULATOR; Ricardo Fortun and Eduardo Semprun, Madrid, Spain. App. filed Sept. 30, 1901. (See page 986.)

759,433. TROLLEY; Elmer E. Gillingham and Delancy E. Huntley, Wellston, Ohio. App. filed April 27, 1903. Two wheels mounted on a two-part frame, the members of which are hinged together, permitting the wheels to assume different vertical planes.

759,441. TELEPHONE TRANSMITTER; Alfred W. Hill, West Hoboken, N. J. App. filed Oct. 9, 1902. (See page 987.)

759,453. ELECTRIC RAILWAY; Timothy Mahoney, San Francisco, Cal. App. filed July 1, 1903. The two ends of the third rail are directly connected to the dynamo and means are provided for shunting the current from the rail through the car and back to the rail again.

759,464. ALARM SYSTEM; Felix McGloin, New York, N. Y. App. filed Dec 31, 1902. Improvements in non-interfering mechanism for alarm circuits.

759,492. TELEPHONE EXCHANGE; Clarence A. Anderson, Salina, Kan. App. filed Dec. 5, 1901. (See page 987.)

759,506. MEANS FOR AND METHOD OF SECURING LEAD-IN WIRES IN ELECTRIC LAMPS; John C. Entriken and Wm. S. Everett, Malvern, Pa. App. filed Jan. 21, 1904. That portion of the leading-in wires embedded in the glass is of platinum, as usual, but the remainder of the leading-in wire is of another and cheaper metal.

759,511. LIGHTING SYSTEM FOR LOCOMOTIVES; Ethelbert T. Ford, St. Louis, Mo. App. filed Dec. 21, 1903. A system of circuits and apparatus for operating the headlight and incandescent lights in the cab from the same dynamo and means whereby either circuit can be used alone.

759,543. ELECTRIC RAILWAY SIGNAL; Elwood W. McGuire, Richmond, Ind. App. filed Aug. 15, 1902. Details.

759,550. SECONDARY-BATTERY ELECTRODE; Charles J. Reed, Philadelphia, Pa. App. filed Jan. 16, 1901. (See page 986.)

759,586. ELECTRIC SWITCH; Henry C. Baer, New York, N. Y. App. filed Nov. 9, 1903. Details of a fixture switch.

759,600. ELECTRICAL SWITCH; Fay L. Faurote, Ann Arbor, Mich. App. filed March 14, 1903. A switch having a "combination" attachment which must first be properly set before the circuits can be closed.

759,615. BURGLAR ALARM; Arthur J. Kercher, Minneapolis, Minn. App. filed Oct. 9, 1903. An electro-static circuit closer which normally holds the circuit in an open condition by the attraction between two sets of electrically opposite plates.

759,632. SWITCH FOR INCANDESCENT LAMP SOCKETS; John D. Raymond, Chicago, Ill. App. filed Feb. 1, 1904. Details.

759,641. SIGNALING APPARATUS FOR TELEPHONE-SWITCHBOARDS; Edwin H. Smythe, Freeport, Ill. App. filed Jan. 26, 1903. (See page 987.)

759,650. MANUFACTURE OF SMALL INCANDESCENT LAMPS; Allen D. Whipple, Chicago, Ill. App. filed Dec. 5, 1903. (See page 988.)

759,652. RAILWAY SIGNAL; John W. Anderson, Jr., Woodland, Ill. App. filed Feb. 20, 1903. Details.

759,697. TELEPHONIC APPARATUS; Alfred Graham, London, Eng. App. filed Feb. 4, 1903. (See page 987.)

759,701. FACSIMILE TELEGRAPH APPARATUS; Ernst Karl Gruhn, Dresden, Germany. App. filed Nov. 21, 1902. An arrangement for preventing erroneous variations of the resistance, comprising a peculiar arrangement of a curved contact piece, bearing upon the resistance and having a certain relation to the motion of the controlling fulcrumed lever.

759,722. ELECTRIC HEATER OR RHEOSTAT; Max C. Krusger, Chicago, Ill. App. filed Oct. 6, 1902. A series of resistance plates superposed upon each other and with insulating material between them, all being clamped together.

759,740. BATTERY; Jay Noble and Edward L. Anderson, St. Louis, Mo. App. filed June 1, 1903. (See page 986.)

759,741. ELECTRIC BLOCK-SIGNALING AND TELEPHONING SYSTEM FOR RAILWAYS; Charles Goodman Otwell, and Ira Howard Melvin, Laurel, Del. App. filed Feb. 11, 1904. (See page 987.)

759,762. SIGNALING APPARATUS FOR TELEPHONE-SWITCHBOARDS; Edwin H. Smythe, Freeport, Ill. App. filed Sept. 14, 1903. (See page 987.)

759,767. RAIL SUPPORT; Louis Steinberger, New York, N. Y. App. filed Jan. 7, 1904. The rail chair is constructed to rock on its support to permit the rail to conform to pressures applied to it.

759,771. SIGNAL APPARATUS FOR TELEPHONE-SWITCHBOARDS; DeWitt C. Tanner, Chicago, Ill. App. filed March 27, 1902. (See page 987.)

759,787. CABLE HANGER; Frank E. Wey, Wheeling, W. Va. App. filed May 16, 1903. A special kind of strap.

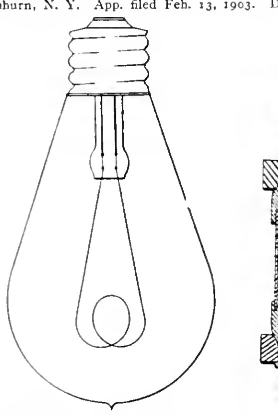
759,796. LIGHTNING ARRESTER; John C. Barclay, New York, N. Y. App. filed Sept. 9, 1903. A lightning arrester of special construction is combined with an inclosed fuse.

759,797. RHEOSTAT; John C. Barclay, New York, N. Y. App. filed Nov. 18, 1903. A telegraph rheostat comprising a variable resistance for insertion in an artificial line and a separate terminal connected to an intermediate point in such resistance and adapted for connection to a main line to compensate for battery resistance.

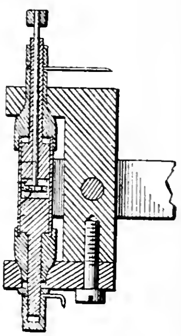
759,798. ELECTROLYTIC APPARATUS; Henry Spencer Blackmore, Mount Vernon, N. Y. App. filed July 22, 1903. (See page 986.)

759,799. ELECTROLYTIC APPARATUS; Henry Spencer Blackmore, Mount Vernon, N. Y. App. filed July 22, 1903. (See page 986.)

759,814. DOOR-LOCK-ACTUATED CIRCUIT BREAKER; Grayson G. Knapp, Auburn, N. Y. App. filed Feb. 13, 1903. Details.



759,506.—Means for and Method of Securing Lead-in Wires in Electric Lamps.



759,835.—Coherer.

759,825. WIRELESS TELEGRAPH APPARATUS; Joseph Murgas, Wilkesbarre, Pa. App. filed Oct. 2, 1903. In this system the message depends upon the character of the impulses, as the frequency, intensity, etc., rather than their time relation.

759,826. METHOD OF COMMUNICATING INTELLIGENCE BY WIRELESS TELEGRAPHY; Joseph Murgas, Wilkesbarre, Pa. App. filed Feb. 24, 1904. A modification of the preceding invention.

759,835. COHERER; Austin H. Stewart, Nashville, Tenn. App. filed Oct. 20, 1903. The agitator is within the tube and is actuated by a rod passing to the outside.

759,836. GENERATOR FOR TELEPHONE-CALLS; Ernest Hugo Strauss, Chicago, Ill. App. filed Nov. 17, 1902. (See page 987.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, MAY 28, 1904. No. 22.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
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NEW YORK, SATURDAY, MAY 28, 1904.

CONTENTS.

SCOPE OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

It is probable that the range of topics touched upon by President Edgar this week at the Boston convention of the National Electric Light Association will surprise many who read his address. A great many important plans and topics are touched upon in a suggestive way, and a little thought will show that all of them fall legitimately within the scope of the body, whether regarded as a congress of large public service corporations or as the technical exponent of a great modern engineering industry. In fact, the opportunities and the responsibilities of the Association have grown, *pari passu*, with the wonderful expansion depicted by Mr. Edgar so briefly but so graphically; and if the Association does not go forward to larger usefulness, it must necessarily go back. This latter it will not do, if Mr. Edgar's fine address be any indication, or if we know aright the temper and quality of the men now administering the affairs of the Association and determining and shaping its policy.

Particularly do we like the broad gauge of Mr. Edgar's reference to the desirability of enjoying the hospitality of the Union Engineering Building in New York City, as headquarters for the Association; and his proposal to form a new class of members. In both respects this is an indication of that largeness of policy to which the growth and prosperity of such a body must always be due. It is well that the Association should thus put itself in touch with the other national engineering societies of the country, with consequent uplifting of its aims and motives. It is equally well that it should provide against the process of dessication and shriveling up that would inevitably attend a decline in even the mere numbers of membership. The drawing together of small lighting companies into a limited number of larger corporations is a fact and a sign of the times, and powerful associations have suffered from such a change, to the hurt of the public and to their own injury. Mr. Edgar's plan for keeping the membership full and alive with active men commends itself to our judgment, as doing what is needed to maintain the Association as a forum of lighting discussion and as an authoritative mouthpiece of the distribution art in general.

Such admirable papers and discussions as were presented this week are in themselves an argument for the wider membership that President Edgar advocates, and while we are glad to note the continuing share in the proceedings of many of the veterans, the happiest augury after all is the participation of new men so numerously. It is to them that the Association must look for its development and vigor in the years that are to come. Indeed, Mr. Edgar and the officers are to be heartily congratulated upon the attendance of the younger men in such numbers, and their keen interest in all that went on. It was notable that they read a large proportion of the papers and took a large part in the discussions—and hence in no slight degree was the brilliant success of a memorable convention achieved.

THE CONVENTION PAPERS.

The programme placed before the Boston National Electric Light Convention this week contained no fewer than 27 entries of papers and reports, including a "Question Box" which for full consideration would alone have taken up no small part of the entire time set for the disposal of the programme. By far the most valuable contributions to the proceedings are this "Question Box," and the hundred odd pages of "Wrinkles" which the indefatigable editor of this new department of the Association's work, Mr. Charles H. Williams, had gathered through correspondence with central station men. The amount of live information of direct practical value to central station men contained in the "Question Box" and "Wrinkles" should alone give a money value to the printed *Transactions* much in excess of the annual dues for membership in the Association. We believe, however, that somewhat more discrimination in the admittance of queries to the Question Box would conduce greatly to the permanent success of this valuable feature. At present too large a proportion of the questions are of a kind to which the querist could have found answer by reference to books which every electrical man worthy of serious consideration should have at hand, or relate to matters that from their scope or importance call for the services of a consulting engineer rather than free advice through this channel. Unless a change is made in this respect, we fear that those who would otherwise be glad to continue to supply answers to questions, will in time find their interest slackening. Of the other items on the programme, the report by Mr. Arthur Williams on "Sign and Decorative Lighting," and that by Mr. La Rue Vredenburgh on "Advertising Methods," will doubtless be found of keen interest by the more enterprising class of central station men. The time has certainly arrived when further considerable extension in central station supply will only come through the introduction of methods for extending business such as prevail in other branches of affairs; that is to say, every increase of business must depend largely upon methods for awakening the interest of possible customers and in subsequent solicitation of their trade in an intelligent manner.

To be properly prepared, however, to take full advantage of the possibilities of a campaign of publicity and individual solicitation, the central station man should know exactly every item which affects the price at which he can sell current profitably. Mr. Frank W. Frueauff, in a paper on "Office Methods and Accounting," has, in a well-written paper, set forth one aspect of this side of the situation, namely, that relating to a system of accounts whereby the central station manager may determine exactly the cost of electrical energy under any condition of service; and Mr. C. W. Humphrey, in an admirable report on "Lost and Unaccounted-for Current," pointed out the manner in which distribution losses may be segregated, thus enabling savings in this direction to be made, which in turn may permit of reductions in rates with consequent increase of business. It is notable that both of these eminently useful papers were written by members of the staff of the Denver (Col.) central station, where Mr. H. L. Doherty has, by the introduction of new methods, been enabled to increase enormously the output, following progressive reductions of rates doubtless fixed by analyses such as those described in the papers referred to, coupled with broadly conceived methods of publicity and personal solicitation of custom. Of the other papers, only two stand out with any prominence, namely, that of Mr. Eastman, upon which we comment below, and that of Messrs. Andrew and Wells, giving the result of an economy test of one of the 5,500-hp generating units in the New York Waterside Station. Indeed, the programme would have been very much strengthened by the absence of quite a third of the papers which it carries.

EFFECTS OF GROUNDING HIGH POTENTIAL LINES.

Mr. Eastman's N. E. L. A. paper upon this topic is singularly timely. So many high-potential polyphase systems with more or less underground conductor are now in use that questions of capacity, rarely serious on the older circuits, become of the first importance. How important they may be under common practical conditions Mr. Eastman's paper clearly shows. It must be remembered first, last and always, that the sources of trouble on high-voltage circuits are abnormal and not normal conditions. In the purely academic discussion of alternating currents the student, and even the average well-trained engineer, is too apt to get a fixed idea that the capacity and inductance of the line as such is of the first order of importance. On the contrary, the line is often of relatively small importance compared with the apparatus connected thereto. A modern high-voltage generator or transformer can furnish, when grounded, pretty high values of inductance, resistance and capacity according to the particular way in which it is constructed or misconnected. Accidents of a very simple kind are, moreover, capable of starting vicious surging, so that abnormal potentials are, as experience shows, rather common upon high-voltage alternating circuits. Every accident, every change of load even, produces disturbance of the potentials, generally trivial, but sometimes of serious magnitude. And where as in the admirable four-wire, three-phase system there is a neutral conductor, its potential relations may be seriously disturbed even while the voltages of the system remain in fairly close accordance.

This case is the one particularly investigated by Mr. Eastman, who has worked out the potential relations between ground and neutral under various hypotheses as to the resistance, reactance and condensance of grounds on one phase wire. The upshot of the matter is that under certain conditions which may occur in practice, the voltage between neutral and earth may rise to dangerously large figures, which, particularly in underground distributions, would be likely to lead to serious trouble. It is, we believe, the common experience of those operating high-voltage alternating circuits that at times there become evident potentials altogether greater than any which normally belong to the system. At an earlier stage of the game these were charged up to "static," which meant anything and everything from lightning to a leaky switch base. Later there was a disposition to lay everything to resonance, which was nearer the mark, but somewhat vague. Resonance in the form of resonance with the fundamental frequency is fortunately exceedingly rare. In its minor varieties it is, of course, common, but it is well to remember that all abnormal potentials are not due to resonance. At all events, large disturbances of potential may, on polyphase systems, result from so simple a thing as a ground, and when these are averted their serious secondary effects are eliminated also. It therefore is of no small importance to understand the conditions under which abnormal potentials are liable to be encountered.

It is certain at least that some unpleasant contingencies may be escaped by so simple a device as grounding the neutral conductor in a three-phase system. The effect of such grounding is to give a stable relation between the working voltages involved so far as accidental rise of potential is concerned. Once grounded, the neutral holds at earth potential and one knows exactly what he is dealing with. Of course, a low-resistance ground on the neutral means the possibility of a ferocious short-circuit if there should occur a bad ground on one of the phase wires. On aerial circuits this possibility may sometimes outweigh the advantage to be gained by a grounded neutral, but on underground circuits where any sort of an active ground is likely to put a cable out of commission, the severity of a short-circuit is of small account compared with an increased chance of averting one entirely. It would be interesting to figure out all the various sorts of abnormal potentials that can result from the grounding of lines and apparatus, but it would be a formidable task, and Mr. Eastman should certainly be heartily thanked for bringing to notice a single important case. Obviously, the same conditions which he discusses may exist in the case of secondary mains, causing serious danger of breakdowns in inside fixtures and connections, and the same remedy will prove effective. It is the old question of grounding the neutral in a three-wire system over again. So far as alternating distributions are concerned, there can be but one answer on the score merely of safety. A grounded secondary system is so essential to safety that it may perhaps be unnecessary to recommend it on other grounds. The best evidence of the success of the policy of grounding the primary neutral is the comparative immunity of the great Chicago system from troubles which have not infrequently been serious elsewhere.

Alternating-Current Wave-Forms.

At the annual meeting of the American Institute of Electrical Engineers, an interesting paper was presented by Mr. G. H. Rowe on the variations of wave form of e.m.f. on a long-distance transmission system. The system was that of the Standard Electric Company in California, extending from the power house in the hills at Electra to San Francisco, 153 miles away, with taps at a number of stations en route, and with shorter parallel lines and branches. The system was supplied with power at Electra by a plurality of Stanley inductor three-phase, 2-kilovolt, 60-cycle generators in parallel. The e.m.f. was supplied not only by these machines, but also by a number of synchronous motors operating at various places on the system. The voltage on the long-distance lines was in the neighborhood of 40 kilovolts. A Blondel oscillograph was arranged to take photographic oscillograms of the voltage on the system, at successive intervals of about half an hour, for ten or twelve hours together. The oscillograph records were not taken simultaneously over the system, or on the same day at the different stations. The oscillograph seems to have been sent from station to station, and to have been used at different dates, during a period of ten weeks. The oscillograms were taken at the Electra power house and also at San José, Stanford and San Francisco, three stations near the distant end of the system. An additional three-phase—two-phase transformer was in circuit at Stanford, which may have had some special influence there. Omitting Stanford, the wave forms at San José, 113 miles from Electra, and at San Francisco, 153 miles from Electra, fairly resemble each other; so that the discussion is advantageously narrowed, without much loss of generality, by considering only the e.m.f. waves at Electra, the generating end, and at San Francisco, the extreme terminal of the system.

Although the oscillograms were not taken on the same day, yet the evidence favors the belief that there exists a considerable difference in wave form between these two ends of the system at certain times of the day, particularly during the times of heavier load. The e.m.f. waves at Electra may be described as being approximations to sine waves, with a hump or dissymmetry, sometimes on one side of the maximum and sometimes on the other. At San Francisco, the e.m.f. wave is shown to have varied from a nearly sinusoidal form, at 1:30 A.M., when there may have been relatively little load, to almost a double-peaked wave at 6:20 P.M., when the local load may have been relatively heavy. Assuming, however, that the oscillograms, actually taken on different days, are fairly indicative of what occurred simultaneously at the ends of the system on either occasion, it would seem that a distortion in e.m.f. occurred at the distant end of the system, which might almost amount to the production of a double-peaked wave, or a camel-backed wave; while at the same time a slight dissymmetry occurred in the dromedary-backed wave at the generating end. In other words, it seems possible to have dromedary waves of e.m.f. at the generating end of an extended transmission system, and to have camel waves, at the same time, at the other end of the system.

The analysis of the waves, as given in the paper, indicate 10 per cent. harmonics of triple-frequency, and 8 per cent. harmonics of quintuple frequency. Such magnitudes of harmonics are readily capable of producing either camel waves or sharply-peaked dromedary waves, according to their respective phase displacements relatively to the fundamental. It seems evident that if the load on the system were simply incandescent lighting—supplied through transformers—that is to say, if there were no motors connected with the system, the e.m.f. wave form would be substantially the same all over the system, for any reasonable approximation to a sine wave delivered by the alternator. A very kinky wave at the generator, bristling with harmonics, might set up resonant effects at the distant end, with some harmonics, while other less favored harmonics might be smoothed out; but a sine wave at the sending end would establish a sine wave to the last lamp on the system, through the last transformer, except for the small influence of drop of pressure in conductors. The current waves, however, might be very much distorted at light loads, owing to hysteresis in the transformers. At full load this disturbance would be reduced. The variations in current wave form between generator and distant ends would tend to be more marked than the variations in the e.m.f. waves, owing to the influence of charging currents. With capacities at work current waves are always more liable to vary than e.m.f. waves from a single source.

Every motor, and particularly every synchronous motor, connected with a system, is virtually a new generator with its own e.m.f. waves and ripples, added to the system. If the system of transmission conductors had no appreciable resistance, the e.m.f. wave would be the same all over the system. The presence of distributed resistance, inductance and capacity in the transmission lines favors the existence of local ripples due to the various separate generators, whether those generators are supplying power in bulk or are absorbing power in bulk. It is common to find a synchronous motor under load absorbing a large amount of power from the system at its fundamental frequency of 60 cycles per second, and yet generating, and delivering in return, a small amount of power to the system at harmonic frequencies, such as 180 or 300 cycles per second. It seems that this Institute paper contains valuable evidence as to the influence of motor e.m.f's in locally modifying the voltage wave form in a transmission system containing considerable distributed resistance and capacity, as well as some inductance.

Alternating-Current Wave-Form Analysis.

In fitting sequel to the preceding topic is an article in this issue on page 1023, by Prof. S. M. Kintner, giving the details of one of the most popular methods of harmonic analysis, or the decomposition of an irregular wave form into its component fundamental sine wave and multiple frequency sine ripples. There are a number of methods of effecting such analysis, and there are also, in fact, several kinds of machines for effecting the analysis mechanically. Prof. Kintner supplies a number of convenient tables, of three-digit accuracy, for effecting the analysis up to the seventeenth frequency harmonic inclusive. He suggests that these can be kept on manifolded or mimiographed forms, with the blank columns ready for their figures. A yet simpler equivalent plan would, of course, be to retain the tables on single columns of paper, or celluloid, for use in juxtaposition with the sheets used in computation, so that one and the same column might serve for an indefinite number of successive analyses. It seems likely that the directions and tables given in the article may be useful to many engineers who may have wave forms they wish to analyze and yet have no mechanical analyzers, such machines being rare and expensive.

Cost of Steam Electrical Generating Plants.

At the recent Washington meeting of the American Cotton Manufacturers' Association, Prof. R. C. Carpenter, of Cornell University, presented a paper entitled "The Cost of Power," from which we extract the portion giving data as to the cost of steam plants.

Table I gives current prices on the basis of a 1,000-hp plant, of various types of steam boilers. The tables following give, on the same basis, the cost of steam engines and electrical generators, together with data as to depreciation, etc.

TABLE I.—COST PER HORSE-POWER OF 1,000-HP BOILER PLANT.

Kind of boiler.	Price per B. H. P. erected.	Depreciation. Per cent.	Cost of brick work.	Total cost of boiler plant and building.	Annual charges, interest and depreciation.
A Horizontal Water Tube Forged Steel Headers	$14.00	5	$2.00	$24.25	$2.42
B Horizontal Water Tube Cast Steel Headers	13.00	8	2.50	23.25	2.59
C Horizontal Water Tube Cast Iron Headers	12.00	10	2.50	22.25	2.72
D Horizontal Water Tube Flat Stayed Head	12.00	10	2.50	22.25	2.82
E Horizontal Water Tube Curved Steel Tubes	9.00	15	3.00	19.75	2.91
F Vertical Water Tube Straight Steel Tubes	9.00	12	3.00	19.75	2.43
G Horizontal Fire Tube Plain Tubular	9.00	15	4.00	18.75	2.46
H Vertical Fire Tube	6.50	20	1.50	16.75	2.64

TABLE II.—COST PER HORSE-POWER OF 1,000-HP ENGINE PLANT.

Kind of engine.	No. of cylinders.	Price per H. P.	Price of condensers.	Price of piping and foundations.	Total cost per engine horse-power.
A Simple Slide Valve, Non-cond.	1	$5.00	....	$5.00	$10.00
B Comp. Slide Valve, Non-cond.	2	8.00	....	7.00	15.00
C Comp. Slide Valve, Cond.	2	8.00	$2.00	8.00	18.00
D Simple Corliss, Non-cond.	1	8.00	....	6.50	14.50
E Compound Corliss, Cond.	2	12.00	2.00	7.00	27.00
F Triple Corliss, Cond.	3	16.00	2.00	7.00	25.00
Electric Generator for D, E and F.		12.00	....	....	....
Steam Turbine with Elec. Generator		30.00	3.00	5.00	38.00

TABLE III.—TOTAL COST OF 1,000-HP PLANT.

Kind of Engine.	Total cost of engines and boilers. F type.	Annual cost of both engines and boilers dep. & in.	Tons of coal per year for one engine H.P., 3000 H.P.	Lubricants.	Labor engine and boiler.	Total cost of power, coal, at $2.00 per ton. Per engine H.P. 1 year.
A Simple Slide Valve, Non-cond.	$29.75	$4.03	6,750	$1.02	$5.00	$23.53
B Comp. Slide Valve, Non-cond.	31.50	4.38	5,660	1.25	4.50	21.45
C Comp. Slide Calve, Cond.	29.80	4.26	4,050	1.25	3.80	17.41
D Simple Corliss, Non-cond.	32.25	3.84	6,075	1.00	4.70	21.00
E Comp. Corliss, Cond.	30.87	3.76	3,375	1.25	3.50	16.25
F Triple Corliss, Comp.	34.25	4.28	3,110	1.50	4.00	16.00
Elec. Gen. for D, E or F.						
St'm Turb. with Elec. Gen. C.	47.87	5.91	3.375	.50	3.50	16.45

TABLE IV.—DEPRECIATION AND OTHER ENGINE PLANT DATA.

Kind of Engine.	Depreciation. Per cent.	Steam per H. P. Ordinary engine.	Steam per H. P. Best record.	Boiler H. P. required per 1000 engine H. P.	Annual charges dep. and int., engine only.
A Simple Slide Valve, Non-cond.	15	33	30	1,000	$1.60
B Compound Slide Valve, Non-cond.	15	25	22	840	2.20
C Compound Slide Valve, Cond.	15	16	14	600	2.80
D Simple Corliss, Non-cond.	10	30	27	900	1.65
E Compound Corliss, Cond.	10	15	12	500	2.55
F Triple Corliss, Cond.	10	14	10	466	3.15
Electric Generator for D, E or F.	10				1.80
Steam Turbine with Elec. Generator	10	15		500	4.70

The final results in Table III show the total cost of power per year, including labor, lubricants and coal at $2 per ton. The cost of steam power for several classes of machinery are taken into consideration as varying from $16 per year with the compound Corliss engine, to $24 per year when the simple slide-valve non-condensing engine is used. The table shows that best results are obtained commercially with the compound Corliss engine, although the steam turbine with electric generator is a close second when the results are based upon the cost per engine horse-power per year.

Interest is assumed at 5 per cent., and the cost of buildings not included. In calculating coal it has been assumed that one boiler horse-power required 4.5 pounds per hour, giving an evaporation of 6.66 pounds of water per pound of coal. In computing labor it is assuming that one man is needed in the boiler house for each 200 boiler hp and that the cost in engine room is $2 per hp-year.

Economizers are not considered. The present cost, allowing 5 sq. ft. of surface per horse-power, is about $6 per hp erected. To obtain the total cost, there should be added for feed pumps, heaters and boiler house piping $1.25; for brick chimney $3.50; for boiler house $4; except for G and H add $5. Mechanical stokers are not considered. The present cost of these is $3.50 to $4.50 per boiler hp. One year is assumed to include 3,000 hours. No charge is made for coal used in banking fires.

Census Report on U. S. Telegraph Systems.

The Director of the Census has issued a preliminary report on the commercial telegraph systems of the United States for the year ending December 31, 1902. The report includes only commercial telegraph companies owned and operated within the United States, which were in operation during any portion of the year, no statistics being given for foreign telegraph companies operating in the United States.

Number of companies	21
Common stock: (1)	
Authorized, par value	$104,383,075
Issued, par value	99,870,225
Gross income	37,552,450
Total expense	28,490,219
Dividends and interest on bonds	6,084,919
Net surplus	2,977,312
Miles of wire operated	1,248,602
Number of messages sent during 1902	90,844,789
Number of telegraph offices	27,352
Batteries in offices:	
Primary—Number of cells	634,491
Storage—Number of cells	19,639

(1) Exclusive of the capitalization of the Postal-Telegraph Cable Company, which was reported as $100,000.

The final report will contain an analysis of the above totals and present statistics for other phases of the industry.

Anniversary of the Telegraph.

The sixtieth anniversary of the sending of the first telegraph message (from Baltimore to Washington) was celebrated by the Postal Telegraph Company at its building in New York City, on May 24. This date also was the tenth anniversary of the opening of the company's building at 253 Broadway. In commemoration of these two events Mr. Clarence H. Mackay, president of the Postal Company, entertained at dinner at the Hardware Club the company's general and assistant superintendents from all sections of the country, including California and Texas. There were 100 at the dinner, the other guests being the officers of the company, including Col. A. B. Chandler, chairman of the directors; George G. Ward, general manager of the Commercial Cable Company; Charles R. Hosmer, vice-president of the Commercial Cable Company; W. H. Baker, general manager of the Postal Telegraph Cable Company; E. C. Bradley and C. C. Adams, vice-presidents; E. C. Platt, treasurer; Ford Huntington, treasurer of the New York Telephone Company.

President Mackay welcomed his guests in a speech in which he said that Prof. Morse lit the torch which now flashes the sparks of intelligence, progress and civilization over the continents and under the seas.

Speeches were also made by Col. A. B. Chandler, Vice-President George G. Ward, of the Commercial Cable Company, and Vice-President Baker, of the Postal Telegraph Company.

Handsome menus were presented as souvenirs. The cover had a picture of the Postal Telegraph Building on the front and the Commercial Cable Building on the back. Inside was a picture of Prof. Morse and the playbill of "The County Chairman," which the party saw on Monday night as the guests of Mr. Mackay.

The Largest Electric Water Power Station in New Hampshire.—I.

MOSES G. FARMER said that Garvin's Falls would one day supply light and power in Manchester, N. H., fourteen miles distant, when he was in that city many years ago. This prophecy has now come true. During 1902 an electric station was built at Garvin's Falls, and energy from the falling water began to be transmitted to Manchester at about 12,000 volts pressure, as described in the ELECTRICAL WORLD AND ENGINEER of January 17, 1903. At that time the capacity of the electric station was 1,300 kw, and the water was made available at the station by a previously existing dam and canal.

This dam is decades, and the canal perhaps a century, old. In that portion of its bed opposite to the canal, the Merrimac River passes over a series of rapids or low falls, and the old canal appears to have been built at first as an aid to navigation between Concord, New Hampshire and Boston. In 1793 a charter was granted for the construction of a canal between the Charles River and Lowell, on the Merrimac River. About the same time the Bow Lake and Canal Company secured a charter with the right to perfect navigation south of Concord on the Merrimac River. This stream passes over a number of falls and rapids between Concord and Lowell and the remains of an old canal can be traced at a number of such points along the river. Just when the canal through which boats passed around Garvin's Falls came into use cannot now be stated, but Hayward's *New England Gazetteer,* published by John Hayward at Boston, in 1839, mentions the canal as an important waterway for boats coming south from Concord.

The railways having put an end to water traffic on the Merrimac, attention was turned to Garvin's Falls as a source of power, and a stone dam was completed there near the upper end of the old canal, on September 5, 1859. The final builder of this dam, being in a hurry to complete it, dumped a large amount of loose rock in to form the central portion, after the builder of the end sections had been called to Washington to superintend work on a new government building there. As might have been expected, the dam failed in the freshets of the following year, about 200 ft. of the central portion going out on March 5, 1860. The dam remained in this partly

FIG. 1.—OLD DAM AND CANAL, GARVIN'S FALLS.

ruined condition for nearly a score of years, or until 1879, when its owners filled up the central gap with a timber crib and stone section just in time to prevent the lapse of their flowage rights.

At the time when a location was being sought for some of the large cotton mills now at Lowell, the site at Garvin's Falls was considered, but finally rejected. Thus the small tower of Bow, where the falls are located, escaped the fate of being a large city. From the rebuilding of the dam in 1879 down to about 1890 the water power at Garvin's Falls appears to have been used to some extent and during a portion of the time for local manufacturing purposes. Some time after the latter date an electric lighting station of small capacity was built there for comparatively nearby service, and this lighting plant remained until after the property passed into the hands of the Manchester Traction, Light & Power Company, near the close of the century. From all this it appears that although these falls had been close to places of considerable population for a hundred years, and a dam and canal had been maintained for power purposes during forty years, yet most of the energy of the water had run to waste during these long periods. It remained for electrical transmission, answering the demands of the largest city in the State, to bring Garvin's Falls effectively into the service of men.

Shortly after the purchase of the Garvin's Falls property by the Manchester company, the new electric station of 1,300-kw capacity, above named, was built, and the transmission at 12,000 volts to that city begun. This new station relied for power on the patched dam of 1859, and on the transportation canal that ran back into the eighteenth century for its origin. Though the Manchester company had

FIG. 2.—OLD AND NEW CANAL IN USE TOGETHER, GARVIN'S FALLS.

the right to utilize the entire flow of the Merrimac it was impossible to do so, because the ancient canal originally dug for small boats could not carry the whole river. Furthermore, the composite dam was of uncertain strength. The plan of the Manchester company was, therefore, from the start to build a new dam and dig a canal that would carry all the available water at times of moderate flow. Meantime, as the demands for light and power in Manchester were pressing, an incomplete station was built at the falls and as much generating equipment was installed as the water coming down the old canal would operate. For half a year work has been under way on the new dam and canal, and on the extension of the power house. This work has now reached a stage that gives promise of the early delivery in Manchester of all the power that a 28-ft. fall in the Merrimac will yield.

The construction now under way at Garvin's Falls contemplates an ultimate station capacity of 3,900 kw or 5,200 hp in electric generators. This capacity is to be made up of six three-phase, 60-cycle alternators, each rated at 650 kw and 12,000 volts. Three 39-in. turbine wheels mounted on the same horizontal shaft are direct-connected to each generator and drive it at 180 r.p.m. The rating of each group of three wheels is 1,000 hp. As the station at Garvin's Falls now stands, with 1,300-kw capacity in electric generators, it is the largest electric water power plant in New Hampshire. When the extensions now under way are completed and the station capacity is raised to 3,900 kw, it seems improbable that any electric water power plant in the State will equal it for at least many years to come. This conclusion is supported by the fact that the Merrimac is much the largest river in New Hampshire, and that the fall at Garvin is greater that that at any other point on the river in that State, save the one at Manchester, which is utilized by a great manufacturing corporation located there.

The Merrimac is not a great river, being only 110 miles long from its head, at Franklin, N. H., to its mouth at Newburyport, Mass., neither is its elevation exceptional, for the head waters at Franklin are only 269 ft. above sea level. Nevertheless, this comparatively small river probably turns more spindles than any other stream in the United States or even in the world. This is due to the fact that three of the four largest powers on the river, those at Manchester, Lowell and Lawrence, are mainly devoted to the manufacture of cotton goods. Considering its length, the drainage area of the Merrimac is exceptional, being 4,864 square miles. At Lawrence, 28 miles from the mouth of the river, the drainage area is 4,553 square miles, and the mean annual discharge of water from 1890 to 1897, inclusive, ranged between 4,850 and 9,373 ft. per second. Above

Garvin's Falls, which is 83 miles from the mouth of the Merrimac, the drainage area is 2,400 square miles, and it is estimated that the head of 28 ft. there will yield at least 5,000 hp during nine months of each year. During the great freshet of March 2, 1896, the largest in the history of the river, it is estimated that the discharge at Garvin's Falls rose to 72,000 cu. ft. per second. At Lawrence the fall of the Merrimac is 29 ft., and at Manchester it is 52 ft., and these are the only other two points on the river where the height of the fall at Garvin's is approached.

The old dam at Garvin's Falls is located about 1,240 ft. up stream from the power station, and water formerly came down to the station through the old canal of that length. Between abutments the old dam, built in 1859, and partially rebuilt in 1879, has a length of 454 ft. The old canal is a rough excavation of irregular cross section, and has an overflow wall of timber and stone for a part of its length on the side next to the river. The new dam is being built across the river at a point approximately 500 ft. up stream from the power station, and something more than 700 ft. below the old dam. In length the new dam is about 550 ft. between the abutments and these latter, together with their core walls and the head gate wall, extend up into the banks about 160 ft. on the canal side and 80 ft. on the opposite side of the river, beyond the central portion of the dam. On the right-hand side of the river, at one end of the new dam, the new canal begins and in its course to the power house it

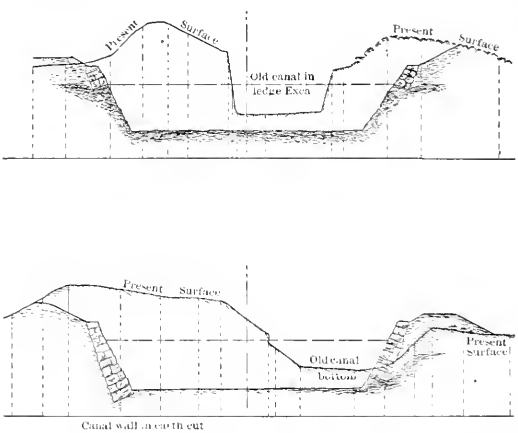


FIG. 3.—CANAL PROFILES.

overlaps substantially the entire site of the lower 500 ft. in the length of the old canal. The new site selected for the dam not only afforded a natural rock foundation with comparatively little excavation, but also shortened the required length of canal by more than 700 ft.

Of the total length of about 550 ft. in the central portion of the dam, 70 ft. at the left-hand end has a crest 2 ft. above that of the remainder in elevation. For its entire length the dam rests on the natural ledge in the bed and banks of the river. In general outline the dam is straight and its height above the bedrock varies from about 10 to as much as 25 ft. between the elevations of heel and crest. A notable feature of the dam is its width up and down stream, which amounts to as much as 31 ft. from heel to toe in the part that is 25 ft. in elevation from heel to crest. The portion of the dam between the abutments is of stone masonry laid in mortar of Portland cement and sand. Ashlar masonry is used on the crest and down-stream face of the dam, and rubble masonry for its up-stream face and core. Of that portion of the dam between the abutments three sections have been completed, one section adjoining each abutment and one about mid stream, and if the weather is favorable it is expected that the entire dam will be completed during the winter. Both of the dam abutments, including the head gate wall at the entrance to the canal on the right-hand bank, are practically finished. The right and left bank abutments are formed of concrete and faced with ashlar masonry, and the head gate walls are built entirely of concrete.

When the new canal is considered, the importance of the change made in the water power development at Garvin's Falls becomes evident. The striking feature of the new canal is its great increase in area of cross-section over that of the old. It is hard to state accurately just what is the cross-section of the old canal, since this varies materially in the course of its length, but it may be put at approximately 264 sq. ft. for at least a part of its course, up to the

FIG. 4.—HEAD GATES, NEW CANAL, GARVIN'S FALLS.

top of its banks. Compared with this, the area of cross-section for the new canal to the top of its banks is 1,260 sq. ft. at the entrance to the forebay. Up to its flow line the canal has a cross-section of 750 sq. ft. before it widens into the forebay. The new canal has been excavated partly in earth and partly in ledge, and some filling has been necessary along its banks. In all cases where the canal wall or any part of it is in earth, this wall is of concrete or stone masonry. Before entering the forebay the canal at its flow line, which corresponds in elevation with the top of the dam in its mid-stream section, has a width of 74 ft., and this flow line is 13 ft. above the canal floor. In its course of about 500 ft. between the head gates and the forebay the level of the canal floor drops one foot.

The floor of the forebay gradually drops to a level four feet below that of the canal at the point of entry. This gives the water in the forebay, when just up to the level of the top of the dam at its

FIG. 5.—CANAL FROM HEAD GATES, GARVIN'S FALLS.

middle section, a depth of 17 ft. At the river side of the forebay is an overflow wall 90 ft. long with a crest that is 2 ft. above that of the river section of the dam. At the rack the width of the forebay is increased to 134.5 ft., and 80 ft. of this rack length represents the new addition. In vertical height the rack is 20 ft., and its top is 3 ft. above the crest of the river section of the dam. In the forebay wall near the river end of the rack are the waste and flush gates. The entire floor of the forebay was excavated in the ledge of the river bank.

The head wall of the forebay forms also one side of the wheel room at the power station. This station thus sets directly across the lower end of the canal, and is connected with the river by a short tail race. On the top of this head wall of the forebay, which is of stone masonry and rises to an elevation 8.5 ft. above the crest of the river section of the dam, there is a pent house containing electric motors that operate the gates of the several wheels. When completed the power station will have an outside width including the head forebay wall of 67 ft., and an outside length of 149.75 ft., at the foundation level. Of this total length that part of the station built in 1901 forms 65.5 ft. The wheel room from the outside of the head wall of the forebay to the wall that separates the wheel and generator rooms is 33.5 ft. wide, has less elevation than the remainder of the power station, and is covered by a nearly flat roof. Inside of the generator room the width is 30 ft. and the length about 146 ft. Above the stone foundations the station walls are of brick and the parallel walls on the two longer sides are each 24 in. thick to an elevation of 20 ft. above the floor of the generator room, at which elevation their thickness shrinks to 9 in., giving a shelf 15 in. wide to support the traveling crane. Beneath the generator room there is a stone foundation resting on bedrock and consisting of arches, and this foundation is pierced by seven arched openings, which connect an open space beneath the entire wheel room with the tail race.

The floor of the wheel room is of spruce plank laid on steel I-beams that rest on the head wall of the forebay at one end, and on the arches beneath the generator room at the other end. These I-beams also support the wheel cases, which are hung between them. Seven steel wheel cases pierce the forebay wall and extend into the wheel room. Each of six of these cases is 12 ft. in diameter and contains three 39-in. horizontal turbine wheels. The seventh case is 5 ft. in diameter and contains two turbines of 12 in. diameter each. From

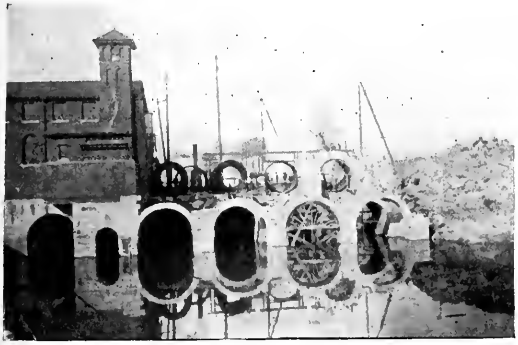


FIG. 6.—NEW FOUNDATIONS FOR ADDITION TO GARVIN'S FALLS POWER STATION.

each wheel case two draft tubes extend down to a level below that of the tail water. From each set of wheels the horizontal shaft extends through a water-tight bearing set in the wall that separates the wheel room from the generator room, and is direct-coupled to that of a generator or exciter. The center of the shaft of each set of main wheels and of their generator is 10.5 ft. below the crest of the dam at its river section, and 17.5 ft. above the ordinary level of the tail water.

In the generator room the concrete floor is supported by the stone arches beneath, and rests in part on I-beams that span the spaces between them. The floor is finished with a layer of Portland cement mortar 2 in. thick. As the floor level in the generator room is 15 ft below the crest of the dam at its river section, and 5.24 ft. below the level reached by the back water in the great freshet of March 2, 1896, the highest on record, both the floor and the walls were made watertight up to a level 2 ft. higher than that reached by the back water during the freshet just named. With this construction the power station may continue in operation when high water backs up about its outside walls and in the wheel room to an elevation more than 7 ft. above that of the floor in the generator room. As the entrance to the station, at the end more distant from the river, has an elevation as great as that of the dam crest, and about 10 ft. above the freshet level no water can enter there.

Beneath each of the 650-kw alternators in the generator room there is a pit 12 ft. long, 6 ft. 2 in. wide and 2.5 ft. deep beneath the floor level. Each of these pits is connected by iron pipe with a drain tank set beneath the floor level, and water is removed from this tank by means of a small centrifugal pump driven by a motor. From each or the pits beneath the main generators and also from each of the two exciters, conduits are laid to the switchboard bay. This bay is located about midway on that side of the generator room opposite to the wheel room. Exclusive of the switchboard bay the total width of the generator room is only 30 ft., and of this width the row of generators takes up 17.5 ft., leaving only 12.5 ft. between

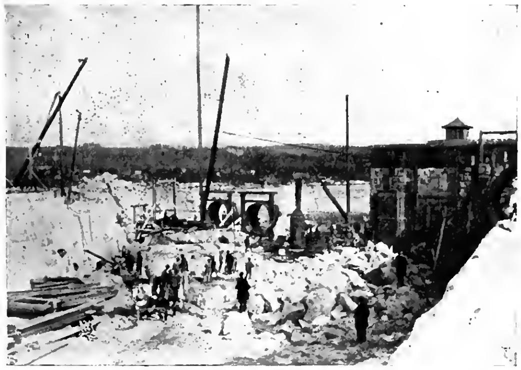


FIG. 7.—LAYING FOUNDATIONS FOR ADDITION TO POWER HOUSE.

the outer end of a generator bearing and the wall. The switchboard bay juts out on the tail race side of the generator room with a length of 33 ft. and a depth of 6.5 ft., above the foundations. Inside the switchboard bay measures 7.5 ft. wide and 26 ft. long at the floor level, and the lowest point on the inside of its slanting roof is 16.5 ft. above the floor. The switchboard sets in this bay so that its face is nearly in line with the inside surface of the main wall of the generator room, and this location leaves ample room for access to the rear of the board, which is reached through a door at one end. Beneath the switchboard and running its entire length is a trench in the concrete floor 10 in. wide and 12 in. deep, where the conduits carrying cables from the generators and exciters terminate. In the side wall of the switchboard bay at an elevation above the top of the board a row of slate slabs are set in the brickwork, and these slabs are pierced by circular openings through which the bare conductors pass that transmit the energy of the water power plant to the substation in Manchester, 14 miles away.

As matters stood at Garvin's Falls early in 1903, before construc-

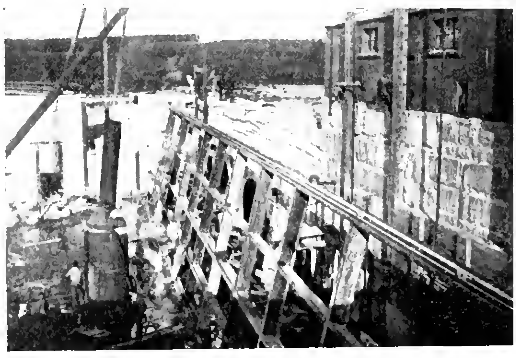


FIG. 8—RACK AND FOUNDATION FOR ADDITION TO GARVIN'S FALLS POWER STATION.

tion on the extension of the power plant was started, it was necessary to discontinue the operation of the station altogether, while the new canal and the foundation for the addition to the station were being built. The 1,300 kw of generator capacity in the incomplete station could be shut down with the least loss during the summer months, and the general contract for the new dam, canal and extension of the power station was accordingly closed on June 5, 1903, with the provision that the new canal, station foundations and the deepening of the tail race were to be first completed. This plan has been carried out, water was let into the new canal in November of the present year, and the older portion of the power station with its two 650-kw generators is now in regular operation. It remains to complete the new dam and the addition to the station above the foundations, and to remove a portion at least of the old dam of 1859. This old dam and the upper section of the old canal are still in use to divert and deliver water to the new canal. The upper 700 ft. in the length of the old canal brings water down to the head gates of the new canal, and will continue to do so until the new dam is completed. By this use of the old canal it is possible to maintain a dry river bed for work on the new dam, while the new canal is in use. The work of construction can now go on without interfering with the operation of the older part of the power station, and it is expected that the entire development will be completed during the first half of 1904.

The Manchester Traction, Light & Power Company, the owner of the electric light, power and traction systems in that city, owns also the entire water power rights and developments at Garvin's Falls. Hollis French and Allen Hubbard, consulting engineers, of Boston, are the engineers for the Manchester company on all of the work above described, being represented at the work by Mr. George G. Shedd, resident engineer. The general contractors for the work are Holbrook, Cabot and Rollins, and their superintendent at Garvin's Falls is Mr. J. B. Haviland. The other contractors on the plant are, for steel work, the Boston Bridge Works; for the station building, Waymire & Penniman; for the electrical machinery, the General Electric Company; for the switchboard, S. B. Condit, Jr. & Co.; for the water wheels, the Rodney Hunt Machine Company.

Especial thanks are due to Mr. J. Brodie Smith, general manager of the Manchester Traction, Light & Power Company, and to the engineers, Hollis French and Allen Hubbard, for aid in the collection of the above facts.

Rise of Electric Lighting in New England.

By Alton D. Adams.

BEGINNING OF ELECTRICAL SUPPLY.

CHARLES FRANCIS BRUSH exhibited a four-lamp arc dynamo at the Mechanics' Fair in Boston during October, 1878. On November 9, after the Fair, this dynamo and lamps began to operate in a building occupied by the Continental Clothing House, at the corner of Howard and Washington Streets. This was the first electric light plant installed for regular service in Boston, and probably in New England.

Much light is thrown on the state of the art at that time by the construction of this dynamo and lamps, which Mr. Brush thought of sufficient importance to warrant their exhibition by him in person. The armature core was a cast-iron ring with wide slots to receive the coils in radial directions on its two sides. There were eight of these slots on each side of the ring, and it was wound eight coils or bobbins as they were called. Diametrically opposite coils were connected in series, and the four pairs of coils thus formed had the two free ends of each brought out to a two-part commutator ring. Each of the four commutator rings was electrically independent of the others, and from each ring two bare No. 6 wires were carried to a single arc lamp. Independent commutators were necessary on this dynamo because the arc lamps had no automatic cut-outs, and when the carbons in any lamp had burned out its circuit was completed through only the fine shunt winding. Bare square carbon rods were used in these lamps, and their cost was 25 cents each.

The electric arc thus brought to public attention in Boston was soon seen at other points in New England. Isolated plants naturally come first, and then central stations for general lighting. One of the earliest, if ot the first public lighting system in New England, was that using the United States series dynamo and arc lamps in New Haven, Conn., which began to operate on July 4, 1881. The next year was one of much activity in the promotion of lighting from central stations, and equipments were installed for this service at Portland, Me.: Manchester, N. H., and Lowell, Lawrence, Lynn, Salem, Taunton and Springfield, Mass., in 1882. At Manchesser the first plant comprised 10 Weston arc dynamos with a capacity of ten lamps each, and was operated with rented power in one of the mills of the Amoskeag Maufacturing Company.

The Portland Electric Light Company had one small arc dynamo driven by a simple engine, and began to supply light in that city during February, 1882. In Lowell the first public lighting system was preceded by a plant of a Brush dynamo and ten arc lamps in the clothing store of Putnam & Son, on Central Street, which was started in operation about May 1, 1882. Later in the same year a company was formed for general lighting service, and three Weston arc dynamos with a capacity of ten lamps each were installed in the basement of Davis & Sargent's mill for this purpose. Circuits from these dynamos were run along Middlesex and Central Streets, where 30 arc lamps were hung, and the plant went into operation on the day before Christmas, in the year just named. The Middlesex Electric Light Company was formed and installed a public system of arc lighting with Thomson-Houston dynamos and lamps at Lowell in 1883, and this company was soon consolidated with the one that had preceded it. Sometime after this consolidation the capacity of the lighting system was increased by the addition of a 600-lamp, 110-volt Thomson-Houston dynamo for incandescent service.

Lawrence was the site of the first Edison three-wire system in the State, and probably in New England, the company for the installation of the Edison system there having been formed in 1882. In the same year the Lawrence Electric Light Company was formed for the operation of the Thomson-Houston system of arc lighting there, and both of the companies began their service before the end of the year. Some years later both of the electric companies sold their systems to the Lawrence Gas Company.

The Salem Electric Lighting Company began operations, in 1882, with the Thomson-Houston arc light apparatus. In the same year the Lynn Electric Lighting Company began service in that city from a Thomson-Houston dynamo that was driven by rented power in a shoe factory on Market Street, nearly opposite the station of the Boston, Revere Beach & Lynn Railway. A little later the plant of the Lynn company was moved to Stewart Street and provided with its own steam plant. In 1888 the gas and electric company at Lynn were consolidated under an act of Legislature. Electric lighting was begun at Springfield, in 1882, by the Blair Manufacturing Company with Thomson-Houston arc dynamos and lamps. The plant thus started was subsequently secured and operated by the Springfield Electric Light Company, and, in 1887, the entire system passed into the hands of the United Electric Light Company.

Every one of the first electric lighting systems just mentioned, with the single exception of the Edison at Lawrence, had been equipped at the start with only arc dynamos and lamps. In the following years incandescent lighting claimed a large share of attention. The Pearl Street Edison station in New York had been started in September, 1882, and was a striking example of what could be done in the multiple operation of incandescent lamps.

In May, 1883, the original Fall River Electric Light Company started its plant of one Thomson-Houston arc dynamo with power rented in a machine shop in that city. October of the same year saw an Edison station equipped in Fall River with its three-wire circuits entirely in underground tubes. In 1896 these two companies were consolidated under the name of th- former. An Edison company was also incorporated for operation in Brockton during 1883, and subsequently absorbed an arc lighting system operated there by another company.

This year of 1883 marks the beginning of electric lighting from central stations in Boston, and two companies then started their plants. One of these plants operated with the Brush arc dynamos and lamps, and its first machines were located in Ham's Iron Works on Portland Street. From this plant the first arc street lamps in Boston were operated. After a few months the dynamos of the Brush system were moved to a station on Lancaster Street, and still later to the well-known Ferdinand Street station. In the same year that the Brush company began operations, the Merchants' Light, Heat & Power Company rented a space in the basement of the Mechanics' Building on Huntington Avenue, and installed a 10-lamp Thomson-Houston arc dynamo driven by a small high-speed engine for general commercial lighting. This plant was soon made larger, and in 1885 was moved to 197 Congress Street.

The Massachusetts Electric Power Company was formed in the year last named, and installed at the Congress Street station of the Merchants' Company the first dynamo ever used in Boston for the distribution of current exclusively to electric motors. This dynamo was of the Daft make and rated at 50 hp and about 110 volts. Steam power was rented from the engine of the Merchants' Company to operate this Daft dynamo, and it is related that the engineer of this company would watch for the greatest loads on the Daft machine and then take cards from his engine to determine the basis on which the power used was to be computed. The power company operated only motors with their Daft dynamo, as it was thought impracticable at that time to supply both incandescent lamps and motors from the same machine. In this 50-hp, 110-volt Daft dynamo of 1885, with its two-wire circuits to nearby motors, might have been read the prophecy of the great electric motor load in Boston at the present day, but those most interested saw it not.

In 1884 another company, the New England Weston, entered the arc lighting field at Boston with dynamos and lamps of the Weston make. These three arc lighting companies, the Brush, the Merchants' and the Weston, operated in competition until about 1887, and were then consolidated in the Boston Electric Light Company, which was formed for the purpose. In this consolidation there was also included the power company that had started with the Daft dynamo.

During these hard, early years of competition capital did not flow to electrical enterprises as readily as it does now, and some amusing incidents are related of the financial straits to which the companies were sometimes put. Its contract for street lighting gave the Brush Company a degree of opulence not enjoyed by the others, which had to rely solely on their commercial business, and this led to a prodigal rejection of rather long carbon stubs by the trimmers of the street lamps. Knowing of this habit and also of the limited resources of their own employer, the trimmers of the Merchants' Company were wont to go about under the Brush street lamps and gather the rejected carbon stubs for their own use. It is even said that there were times when the operators at the Merchants' station were obliged to go out and buy oil with their own money to prevent shutting down the machinery. This company had a contract with the Hotel Brunswick to supply an arc lamp outside during the evening and also a contract with the Adams House to operate an arc lamp inside during a part of each day. Having only one arc lamp that could be devoted to both of these hotels, the employees of the Merchants' Company were obliged to carry this lamp back and forth every day. Sometimes when a day was darker than usual it required no small degree of strategy to get this lamp to the Brunswick early enough and yet not take it away from the Adams House too soon.

On December 31, 1888, the station bounded by Summer Street, Gilman Place and the water front, which had been built by the Boston Electric Light Company to care for the consolidated business of the earlier companies was started. The station of the Weston Company, on Stanhope Street, was continued in operation as part of the Boston system until 1893, and was then abandoned. The Ferdinand Street station was also continued in operation, and though burned down in 1893 was at once rebuilt. From 1898, when the L Street station was started, to 1902, when the Boston Electric system passed into the hands of the Boston Edison Company, the Ferdinand Street station did duty in the distribution of current from L Street, and was abandoned in the latter year. In 1894 the Boston Electric Light Company equipped its station on Boston Street with apparatus that had been exhibited at the World's Fair in the previous year. After 1898 the energy for the Boston Electric Light system was mainly generated at its last, best and largest station on L Street.

Combination of Independent Telephone Interests.

A number of representatives of independent telephone companies throughout the country arrived in St. Louis May 13 and held two business meetings. It is reported that it is the preliminary to a combination of interests in the near future. There was an executive session in the offices of the Kinloch Telephone Company, and another meeting was held in the afternoon. The entire party went to the World's Fair in the evening and was entertained at the "Tyrolean Alps."

Among the visiting representatives was a delegation from Pittsburg, Pa., whose members are believed to be leading the others in an effort to perfect a combine of the independent companies. The Pittsburg delegation has already visited Cleveland, Ohio; Toledo, Ohio; Grand Rapids, Mich.; Chicago, Ill., and Kansas City, Mo. Before returning to Pittsburg its members will visit Louisville, Ky.; Indianapolis, Ind., Dayton and Columbus, Ohio.

The following attended the executive session: James B. Hoge, of Cleveland, Ohio; J. A. Armstrong, A. L. Tetu and Col. J. D. Powers, of Louisville, Ky.; B. B. Sale, Indianapolis, Ind.; James S. Brailey, Jr., of Toledo, Ohio, director of the Home Telephone Company, of Kansas City, Mo.; J. G. Splane, president, and R. C. Hall, D. P. Reighard, William Flinn, John S. Weller, J. T. Braden, D. R. Williams, J. V. Wibbs, T. T. Misslin, John A. Howard, H. M. Nichols, H. B. Beatty, directors, and S. H. Browne, manager, Pittsburg and Allegheny Telephone Company; A. O. Stromberg, Chicago; C. Marquard Forster, president, W. Roy McCanne, secretary, and W. Linton Reber, general manager, Kinloch Telephone Company, St. Louis, and the following directors: Rolla Wells, Breckenridge Jones, William S. Nolker, E. H. Benoist, W. L. Benoist, Philip Scanlan and M. H. Clapp.

The Nature of Patents and Inventions.

Mr. Samuel G. McMeen delivered recently an address to the engineering student body of Lewis Institute, Chicago, on the above subject. He said that a patent issued by our government is a memorandum of a bargain between the inventor as one individual and the people of the country as another. This bargain is to the effect that because the inventor furnishes to the people a more or less useful product of his brain they in their turn guarantee to pay him for his effort. The payment is not made in a definite sum of money, but in an arrangement whereby he may enjoy for seventeen years all the profits coming from the use of the thing he has produced. Rights to these profits he may sell or rent to others or make such disposition as he likes, but from the time of the making of the bargain the thing belongs to the people. At the end of the seventeen years the inventor has no further claim on his production and it belongs thereafter wholly to the people, having been bought and paid for.

In a sense the price paid by the people is set by the inventor. It may be very large or very small, depending on the excellence of the invention or on the caprice of the people. Examples will come to mind of inventions almost trivial, so far as real usefulness is concerned, but which gave the inventor large financial return. There are other examples of inventions which were epoch-making, but because they were too soon for the minds of the pople, brought no financial return. It may be that if they had been invented later, so that the period of monopoly had coincided with the period of welcome, the reward might have been proportionate to the excellence of the conception.

The industrial greatness of this nation is in large measure due to the existence of good patent law and to the encouragement which has been given to inventors by its operation. The inventive ability of a people lies not alone in its facility in finding ingenious ways of setting things together to achieve results, but also in its wisdom to see clearly industrial and social needs. In the instance of the inventor who produced the cranberry sorter, everyone in the cranberry industry knew the need of sorting so that cranberries for market would contain no soft ones; it required a mental aptitude to see an immediate possibility of invention in the circumstance that when cranberries were spilled down the back steps only the sound ones hopped from step to step, the soft ones stopping early.

It is not true that a patent granted by the United States may be renewed. A reissue is not an arrangement by which an expiring patent may be given new life, but only an arrangement whereby a necessary correction may be accomplished. In other countries there are periods of patent life, which, by proper action, may be extended somewhat as in the case of a copyright in this country, but in each case there is an ultimate time beyond which the term of the patent cannot be extended.

An applicant may not secure a patent in this country if his invention has been in actual public use for two years or more before he makes his application. Interesting questions sometimes arise as to whether the use has been really public or might not have been wholly for the purpose of testing the efficiency of the invention by a continued test: A form of sidewalk which had been in use for two years was held not to vitiate the rights of the applicant because, although distinctly in public use, the excellence of its form could only be proven to the inventor by actual trial and could not be considered to be a final test unless continued for a considerable time. In another instance of an article of wearing apparel distinctly not public in its use, a period of two years was held wholly to vitiate the rights of the applicant because very much less than two years should have sufficed to enable him to decide whether the invention was or was not in a proper form for filing his application.

An Expression for the Torque of a Polyphase Wattmeter.

By F. R. Stowe.

Although the following discussion could apply to any polyphase recording wattmeter, the writer has in mind a standard type of a well-known make.

All recording meters for alternating-current circuits are really induction motors of very small power. The rotor of this meter is an aluminum disc. The stator comprises two sets of windings, each set consisting of two series coils and one potential coil. The potential coils have laminated iron cores, and in series with each, but placed so as not to act on the rotor, is another coil wound to have a high reactance. Each potential coil has a short-circuited secondary for

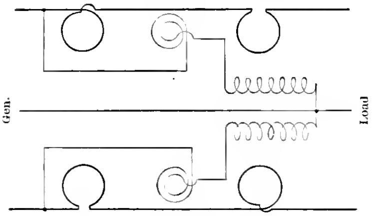
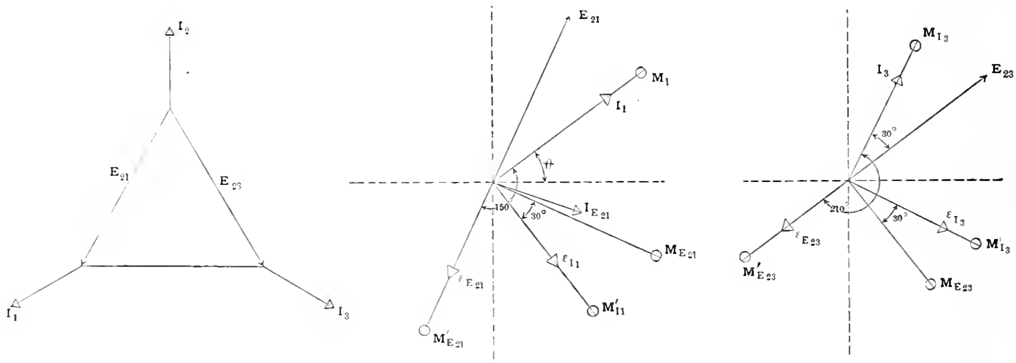


FIG. 1.—METER CONNECTIONS.

the purpose of bringing the lag of the magnetic flux behind the impressed e.m.f. to exactly 90°. By proper adjustment of the resistance through which it is "short-circuited" this can be done.

Fig. 1 shows how the meter is connected to measure the power in a three-phase circuit. It also indicates the direction of winding and the relative position of the coils. Let us take up first the case of a three-phase circuit with unity power factor of which Fig. 2 is the vector diagram. Let I_1 and I_3 be the currents flowing through the series windings and E_{21}, E_{23} be the corresponding e.m.f's. Consider I_1 and E_{21} as in, say, the lower set of coils in Fig. 1. There being no iron in the magnetic circuit of the series coils, the flux, M_I (see Fig. 3), is in phase with I_1, and the eddy currents, E_{I_1}, induced in the disc are 90° behind I_1. M'_I is the flux due to E_{I_1}.

In the potential circuit, however, the current, $I_{E_{21}}$, due to the high reactance, lags about 80° behind E_{21} and the effect of hysteresis and



FIGS. 2, 3 AND 4.—CURRENT DIAGRAMS.

the lag coil is to make the flux, $M_{E_{21}}$ 90° behind E_{21}. We thus have the following reactions to consider: Between M_{I_1} and $M'_{E_{21}}$, 150° behind M_{I_1}; and between $M_{E_{21}}$, 60° behind M_{I_1}, and M'_{I_1} 30° behind $M_{E_{21}}$.

The torque produced by the reaction between M_{I_1} and $M'_{E_{21}}$ is positive when their instantaneous values have opposite signs, and negative when these values have the same sign. Thus, it is not uniform throughout a cycle, but varies from a large positive value to a comparatively small negative value. The same is true of the torque produced by $M_{E_{21}}$ and M'_{I_1}. The sum of these two torques, however, is positive and constant, as may be shown as follows:

The torque due to M_{I_1} and $M'_{E_{21}}$ at any instant is

$$T' = -C M_{I_1} \sin\theta\, M'_{E_{21}} \sin(\theta - 150);$$

that is, the product of their instantaneous values. The minus sign is used because when these values have opposite signs T' is positive. C is a constant depending on the units in which T'_1, M_{I_1} and $M'_{E_{21}}$ are expressed and on the distance between the coils. Or we may write it:

$$T' = C M_{I_1} M'_{E_{21}} \sin\theta \sin(\theta + 30).$$

In the same way we get the torque due to $M_{E_{21}}$ and M'_{I_1}:

$$T'' = -C M_{E_{21}} M_{I_1} \cos\theta \sin(\theta - 60).$$

Then the total torque is:

$$T_1 = T' + T'' = C\,\{ M_{I_1} M'_{E_{21}} \sin\theta \sin(\theta + 30) - M_{E_{21}} M'_{I_1} \cos\theta \sin(\theta - 60) \}.$$

Let $A = \frac{M'_{I_1}}{M_{I_1}} = \frac{M'_{E_{21}}}{M_{E_{21}}}$, as it depends only upon the frequency and the resistance of the disc. Substituting in the above equation for T_1 values of M'_{I_1} and $M'_{E_{21}}$ in terms of M_{I_1} and $M_{E_{21}}$ and simplifying the sine and cosine terms we get

$$T_1 = C A M_{I_1} M_{E_{21}} \cos 30 = \text{constant}.$$

The above result could have been arrived at in a simpler manner, which follows, but it would not have been so clear that the torque is constant throughout a cycle.

The reaction between two fluxes is proportional to the vector product of their effective values, so we have

$$T' = C \frac{1}{\sqrt{2}} M_{I_1} \frac{1}{\sqrt{2}} M'_{E_{21}} \cos 30°$$

$$T'' = C \frac{1}{\sqrt{2}} M_{E_{21}} \frac{1}{\sqrt{2}} M'_{I_1} \cos 30°,$$

substituting as before $A M_{I_1}$ for M'_{I_1}, and $A M_{E_{21}}$ for $M'_{E_{21}}$, we get

$$T' = \frac{CA}{2} M_{I_1} M_{E_{21}} \cos 30° = T''$$

and $T_1 = C A M_{I_1} M_{E_{21}} \cos 30°$.

In the same manner we get the torque produced by the other set of coils (see Fig. 4):

$$T_3 = C' A' M_{I_3} M_{E_{23}} \cos 30°.$$

If we assume now the current to lag $\phi°$, the above expressions would be changed in one respect only, $\cos 30°$ becoming $\cos(30 + \phi)$ and $\cos(30 - \phi)$, and we would get as an expression for the total torque,

$$T = C A M_{I_1} M_{E_{21}} \cos(30 + \phi) + C' A' M_{I_3} M_{E_{23}} \cos(30 - \phi),$$

which corresponds exactly to the expression for the power:

$$P = I_1 E_{21} \cos(30 + \phi) + I_3 E_{23} \cos(30 - \phi),$$

showing that T varies as P.

We have neglected in the above discussion the effect of magnetic leakage, and the rotation of the disc, upon T. Tests made on one meter showed a difference of about 2 per cent. between the starting and the running torques.

Alternating-Current Wave Form Analysis.

BY S. M. KINTNER.

WHILE it is quite generally known that the wave forms of current and voltage of alternating-current machinery can be represented by a series of sine waves varying in frequency, phase and amplitude, it is not so commonly known *how* any given complex wave form can be split up into such a series. It is the purpose of this article to supply such information, in the form of tables of constants which can be used in such analysis, and to discuss briefly the theory of the method, giving such instructions as are needed to carry out the analysis of the ordinary forms of waves encountered in practice. The greater part of the matter presented is not new, but the fact that methods of wave form analysis are not as generally known by active engineers as its importance warrants, may serve as a sufficient reason for presenting the following:

FUNDAMENTAL PRINCIPLES.

Fournier has shown, in a mathematical theorem bearing his name, that wave forms which are single-valued periodic functions, such as those of alternating currents, can be represented by a series, the first term of which is a constant and each of the terms following are sines and cosines of an angle multiplied by a constant. Expressed analytically any wave form can be said to be equal to:

$$A + A_1 \sin \omega t + B_1 \cos \omega t + A_2 \sin 2\omega t + B_2 \cos 2\omega t + A_3 \sin 3\omega t + B_3 \cos 3\omega t + \ldots \ldots + A_n \sin n\omega t + B_n \cos n\omega t. \quad (1)$$

Where the A and B factors are the amplitudes of the various sine and cosine component waves; ω equals a constant angular velocity, and so ωt represents an angle varying with time.

By the proper choice of the X axis along which t is measured, the first constant, A, will reduce to zero while no change will take place in the other factors. The condition for this is that the two halves of the wave, above and below the axis, shall have equal areas. As the alternating-current waves encountered in practice are plotted thus, the discussion following will be based on that assumption.

It will be seen on inspection of equation (1) above that its factors occur in pairs, sines and cosines of the same angles. By a simple trigonometric transformation, these factors in pairs, i. e. $A \sin \omega t + B \cos \omega t$, can be expressed as a single function of the same angle and made to appear as $C \sin (\omega t + \theta)$.

The method of making this transformation and determining the constants, C and θ, is as follows: Looking at Fig. 1, where the three factors are represented on the left-hand side of the figure by the three lines diverging from a common center, o, the relation between them will be seen at once.

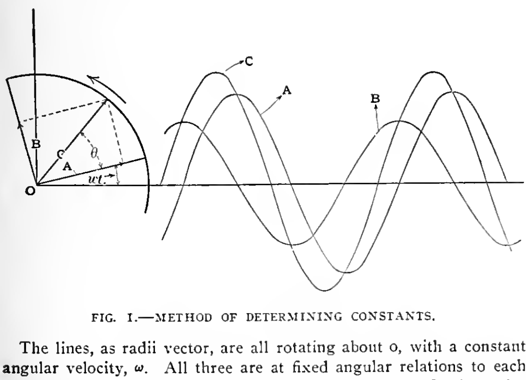


FIG. 1.—METHOD OF DETERMINING CONSTANTS.

The lines, as radii vector, are all rotating about o, with a constant angular velocity, ω. All three are at fixed angular relations to each other, and C is seen to be the resultant of A and B, at a fixed angular position to A, determined by the relative values of A and B. The angle, θ, is seen to be one having a tangent equal to B/A. It is perfectly evident that the numerical values of C is $\sqrt{A^2 + B^2}$.

The right-hand side of Fig. 1 shows the three sine curves that the radii vector, A, B and C, would develop if the sines of the angles are plotted as ordinates and the angles as abscissæ, the angles being measured between the horizontal axis and the respective radii. It will be seen on inspection that the instantaneous value at any point on curve C is equal to the sum of the values of A and B taken at the same point, care being taken to allow for change of sign for all values below the axis; consequently, curve C is a correct representation of the resultant of the two curves, A and B.

The method of performing the transformation, then, for a given expression, $A \sin \omega t + B \cos \omega t$, is indicated thus:

$$\sqrt{A^2 + B^2} \sin (\omega t + \tan^{-1} B/A).$$

The various sine waves into which a complex wave can be subdivided are known as fundamental and harmonics, the fundamental having the same frequency as the complex wave from which it is derived. The harmonics may have any multiple frequency, though in general only the odd frequencies will occur, as will be explained later. Thus a sine wave of a given frequency, such as three times that of the fundamental, representing the sum of a sine and a cosine wave of the same frequency, is known as the third harmonic. The sine and cosine factors from which a particular harmonic is determined are known as the sine and cosine components of that harmonic.

The components of the various harmonics being more readily determined than the harmonics proper, and their phase relations, that method is the one generally used. After the components are determined it is a simple matter to perform the transformation indicated above, and thus get the harmonic and its angle of lead or lag.

The fact that

$$\left.\begin{array}{l} \int_0^\pi \sin x \sin nx\, dx \\ \int_0^\pi \sin x \cos nx\, dx \\ \int_0^\pi \cos x \cos nx\, dx \\ \int_0^\pi \sin x \cos x\, dx \end{array}\right\} = 0.$$

(Where n is any integer other than unity)

is the fundamental principle upon which is based practically all of the methods of harmonic analysis.

With the above in mind, it becomes evident that if any complex wave, expressed as a series of sine and cosine component harmonics, is multiplied by a test wave, such as $\sin nx$, and all these products integrated between the limits indicated above, the result will be zero for each and every term excepting the sine component of the harmonic of frequency n. If the result of the entire operation is zero, it is proof that there is no sine component of that particular harmonic present. It is evident, then, that the components of the various harmonics are picked out, one at a time, by the use of test waves. Thus, to determine if the sine component of the nth harmonic is present, the complex wave series is multiplied by a sine wave of unit amplitude and a frequency n times that of the fundamental, and all products reduce to zero on integration, save the sine component of the nth harmonic, if such is present. Such an operation expressed analytically would, after integration, stand thus:

$$0 + 0 + 0 + 0 + \int_0^\pi \sin nx\, A_n \sin nx\, dx + 0 = \frac{A_n \pi}{2}$$

The indicated integral is the equivalent of the area of a curve formed by the products of all ordinates of the two sine waves of the same frequency, but different amplitudes. This area is seen to equal $\frac{A_n \pi}{2}$, and A_n is the value that is desired. Thus A_n is equal to $\frac{2}{\pi}$ multiplied into the result of the entire operation of multiplication and integration.

What has been said regarding the determination of the sine components is equally true regarding the cosine components, and they are determined in a similar manner, using cosine testing waves in the latter case, of course.

While the above indicates the correctness of principles, it is not enough to enable one to actually analyze a wave such as is determined experimentally, as it would be simply a curve on paper without any analytical series expressed. What is wanted, then, is some way of summing the products of every ordinate of the complex wave into those of the various test waves. For an analytical method, where no recourse is had to any mechanical integrating device which would also allow for the products with the test wave, the best that can be done is to select a definite number of evenly-spaced ordinates of the complex wave form, measure them, multiply them by ordinates in the corresponding angular relations of the test waves, and sum the products. Such a method would be an approximate integration of the products of the test wave and the series, and the result of such an operation must relate only to the sine or cosine component of the harmonic of the same frequency as that of the test wave, according as the test wave is a sine or a cosine function.

The amplitude of the component harmonic is determined from the residue of the last operation by multiplying it by 2 divided by the base of the complex wave, which in numerical value will equal the number of equal parts into which the base is divided.

Todhunter has proven the truth of the above statements in his integral calculus, and expresses the value of the amplitude of the sine, or cosine components of any harmonic, m-, in the following manner:

$$A_m = \frac{2}{n+1}\left[e_1 \sin\left(m\frac{180}{n+1}\right) + e_2 \sin\left(2m\frac{180}{n+1}\right) + e_3 \sin\left(3m\frac{180}{n+1}\right) + \;.\;.\;.\;.\;.\;.\; + e_n \sin\left(nm\frac{180}{n+1}\right)\right]$$

$$B_m = \frac{2}{n+1}\left[e_1 \cos\left(m\frac{180}{n+1}\right) + e_2 \cos\left(2m\frac{180}{n+1}\right) + e_3 \cos\left(3m\frac{180}{n+1}\right) + \;.\;.\;.\;.\;.\;.\; + e_n \cos\left(nm\frac{180}{n+1}\right)\right]$$

Where the symbols have the following meanings:

A_m = amplitude of the sine component of the mth harmonic.
B_m = amplitude of the cosine component of the mth harmonic.
n = number of measured ordinates.
e_1, e_2, e_3, e_n = values of the measured ordinates taken in the regular order of sequence in which they were measured.

Using these formulæ, it is seen how, by dividing the base of one alternation of the complex wave to be analyzed into $n + 1$ equal parts and measuring the n ordinates at the points of division, it is possible to determine the sine, or cosine component of any harmonic desired.

In performing such an operation there is considerable labor involved in determining the various trigonometric values indicated.

TABLE I. WAVE FORM ANALYSIS.

Meas. Ord.	A_1	B_1	A_3	B_3
	.087	.996	.259	.966
	.174	.985	.50	.866
	.259	.966	.707	.707
	.342	.94	.866	.5
	.423	.906	.966	.259
	.5	.866	1.0	.0
	.574	.819	.966	—.259
	.643	.766	.866	—.5
	.707	.707	.707	—.707
	.766	.643	.5	—.866
	.819	.574	.259	—.966
	.866	.5	.0	—1.0
	.906	.423	—.259	—.966
	.94	.342	—.5	—.866
	.966	.259	—.707	—.707
	.985	.174	—.866	—.50
	.996	.087	—.966	—.259
	1.0	.0	—1.0	.0
	.996	—.087	—.966	.259
	.985	—.174	—.866	.5
	.966	—.259	—.707	.707
	.94	—.342	—.5	.866
	.906	—.423	—.259	.966
	.866	—.5	.0	1.0
	.819	—.574	.259	.966
	.766	—.643	.5	.866
	.707	—.707	.707	.707
	.643	—.766	.866	.5
	.574	—.819	.966	.259
	.5	—.866	1.0	.0
	.423	—.906	.966	—.259
	.342	—.94	.866	—.5
	.259	—.966	.707	—.707
	.174	—.985	.50	—.866
	.087	—.996	.259	—.966
	A_1=.0555×	B_1=.0555×	A_3=.0555×	B_3=.0555×

TABLE II. WAVE FORM ANALYSIS.

Meas. Ord.	A_5	B_5	A_7	B_7
	.423	.906	.574	.819
	.766	.643	.94	.342
	.966	.259	.966	—.259
	.985	—.174	.643	—.766
	.819	—.574	.087	—.996
	.50	—.866	—.5	—.866
	.087	—.996	—.906	—.423
	—.342	—.94	—.985	.174
	—.707	—.707	—.707	.707
	—.94	—.342	—.174	.985
	—.906	.087	.423	.906
	—.866	.5	.866	.5
	—.574	.819	.996	—.087
	—.174	.985	.766	—.643
	.250	.966	.259	—.966
	.643	.766	—.342	—.94
	.906	.423	—.819	—.574
	1.0	.0	—1.0	.0
	.906	—.423	—.819	.574
	.643	—.766	—.342	.94
	.259	—.966	.259	.966
	—.174	—.985	.766	.643
	—.574	—.819	.996	.087
	—.866	—.5	.866	—.5
	—.996	—.087	.423	—.906
	—.94	.342	—.174	—.985
	—.707	.707	—.707	—.707
	—.342	.94	—.985	—.174
	.087	.996	—.906	.423
	.5	.866	—.5	.866
	.819	.574	.087	.996
	.985	.174	.643	.766
	.966	—.259	.966	.259
	.766	—.643	.94	—.342
	.423	—.906	.574	—.819

TABLE III. WAVE FORM ANALYSIS.

Meas. Ord.	A_9	B_9	A_{11}	B_{11}
	.707	.707	.819	.574
	1.0	.0	.94	—.342
	.707	—.707	.259	—.966
	.0	—1.0	—.643	—.766
	—.707	—.707	—.996	.087
	—1.0	.0	—.5	.866
	—.707	.707	.423	.906
	.0	1.0	.985	.174
	.707	.707	.707	—.707
	1.0	.0	—.174	—.985
	.707	—.707	—.906	—.423
	.0	—1.0	—.866	.5
	—.707	—.707	—.087	.996
	—1.0	.0	.766	.643
	—.707	.707	.966	—.259
	.0	1.0	.342	—.94
	.707	.707	—.574	—.819
	1.0	.0	—1.0	.0
	.707	—.707	—.574	.819
	.0	—1.0	.342	.94
	—.707	—.707	.966	.259
	—1.0	.0	.766	—.643
	—.707	.707	—.087	—.996
	.0	1.0	—.866	—.5
	.707	.707	—.906	.423
	1.0	.0	—.174	.985
	.707	—.707	.707	.707
	.0	—1.0	.985	—.174
	—.707	—.707	.423	—.906
	—1.0	.0	—.5	—.866
	—.707	.707	—.996	—.087
	.0	1.0	—.643	.766
	.707	.707	.259	.966
	1.0	.0	.94	.342
	.707	—.707	.819	—.574

As these values are in no way dependent upon the wave under investigation, but depend only on the number of equal divisions into which the base is divided, it is evident that a table of constants can be determined for use with a particular number of base line divisions. Such a table has been devised and is submitted in the following form as one that is convenient to use. It is based on the assumption of a base line division of thirty-six equal parts—an ordinate every five degrees of the fundamental—and can be used for that, or for an eighteen-part base line division, where so great accuracy is not required. To obviate the labor and liability of error in transcribing these constants every time it is desired to use them, it is suggested that copies of the tables be made on some duplicating machine such as a mimeograph, leaving blank columns for calculations as in the arrangement of the tables I to V.

It will be noticed that the constants are calculated for the odd harmonics only. This is for the reason that all wave forms that are symmetrical about the X axis contain only the odd harmonics; the even harmonics always produce a lack of symmetry between the alternations above and below it. As most of the wave forms encountered in practice are of that type, it was not considered advisable to in-

TABLE IV. WAVE FORM ANALYSIS.

Meas. Ord.	A_{13}			B_{13}			A_{15}			B_{15}		
	.906			.423			.966			.259		
	.766			-.643			.5			-.866		
	-.259			-.966			-.707			-.707		
	-.985			-.174			-.866			.5		
	-.574			.819			.259			.966		
	.5			.866			1.0			.0		
	.996			-.087			.259			-.966		
	.342			-.94			-.866			-.5		
	-.707			-.707			-.707			.707		
	-.94			.342			.5			.866		
	-.087			.996			.966			-.259		
	.866			.5			.0			-1.0		
	.819			-.574			-.966			-.259		
	-.174			-.985			-.5			.866		
	-.966			-.259			.707			.707		
	-.643			.766			.866			-.5		
	.423			.906			-.259			-.966		
	1.0			.0			-1.0			.0		
	.423			-.906			-2.59			.966		
	-.643			-.766			.866			.5		
	-.966			.259			.707			-.707		
	-.174			.985			-.5			-.866		
	.819			.574			-.966			.259		
	.866			-.5			.0			1.0		
	-.087			-.996			.966			.259		
	-.94			-.342			.5			-.866		
	-.707			.707			-.707			-.707		
	.342			.94			-.866			.5		
	.996			.087			.259			.966		
	.5			-.866			1.0			.0		
	-.574			-.819			.259			-.966		
	-.985			.174			-.866			-.5		
	-.259			.966			-.707			.707		
	.766			.643			.5			.866		
	.906			-.423			.966			-.259		

TABLE V. WAVE FORM ANALYSIS.

Meas. Ord.	A_{17}			B_{17}					
	.966			.087					
	.174			-.985					
	-.966			-.259					
	-.342			.94					
	.906			.423					
	.5			-.866					
	-.819			-.574					
	-.643			.766					
	.707			.707					
	.766			-.643					
	-.574			-.819					
	-.866			.5					
	.423			.906					
	.94			-.342					
	-.259			-.966					
	-.985			.174					
	.087			.996					
	1.0			.0					
	.087			-.996					
	-.985			-.174					
	-.259			.966					
	.94			.342					
	.423			-.906					
	-.866			-.5					
	-.574			.819					
	.766			.643					
	.707			-.707					
	-.643			-.766					
	-.819			.574					
	.5			.866					
	.906			-.423					
	-.342			-.94					
	-.966			.259					
	.174			.985					
	.996			-.087					

clude the even harmonics in the table above. Any one desiring to determine the value of the even harmonics, in a case where such is necessary, can do so by calculating the values required from the Todhunter formulæ given above.

Another characteristic of wave forms is worthy of note in passing. That is, all wave forms symmetrical about both the X axis and the middle ordinates of each alternation have zero as the value of the cosine component of all harmonics. The truth of this is readily seen from the relations of the constants under the various B's; they are all symmetrical, but of opposite sign, about their middle value. The cosine components all reducing to zero, shows that all harmonics pass through one of their zero values at the same time that the fundamental does.

It is seldom one has an opportunity of utilizing this last characteristic in investigating wave forms determined experimentally, but it can be used in studying assumed wave forms of that type.

INSTRUCTIONS FOR USING THE TABLES OF CONSTANTS.

It is intended that the following instructions shall be complete enough, so that any one can perform the operations of the analysis without having read over all the preceding discussion of the principles.

First, take the wave to be analyzed and divide the base line into thirty-six equal parts, starting at the zero value of the wave. Erect ordinates at each point of division and measure their values. Place the values of these measured ordinates in the left-hand column of the table, marked "Measured Ordinates." Next, multiply each measured ordinate by the constants in the various columns opposite; this is quite readily done by means of a slide rule. The two blank columns are left to the right of each column of constants in order that the positive and negative products can be placed in separate columns and thus render the addition of the columns more certain. All the columns of products should be added and the difference between the positive and negative values determined for each set of pairs of columns. This difference for each is then multiplied by the constant .0555, care being taken to preserve the sign of each oper-

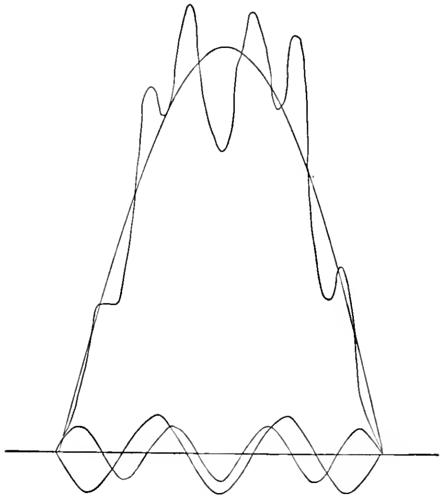


FIG. 2.—FIFTH HARMONIC OF THE CURVE.

ation. The products resulting from the constant .0555 into the various differences are values of the amplitudes of the respective component harmonics, the number of the harmonic being indicated by the subscript of the letter A, heading the columns of the constants in the table, for the sine components and the letter B, for the cosine components.

Having determined the components of the various harmonics, as described above, the harmonic is determined thus: Its amplitude is $\sqrt{A^2 + B^2}$, and the harmonic goes through its nearest zero value to the zero value of the fundamental, at an angle whose tangent is B/A, ahead, or behind the fundamental as determined by the signs of A and B. The rule for determining angles between the fundamental zero and the nearest harmonic zero to it, is as follows: If A and B are both positive, the harmonic is ahead of the fundamental less than 90°, by an angle whose tangent is B/A; if A is negative and B positive, the harmonic is ahead, an angle less than 180°, but greater than 90°, whose tangent is B/A; if A is negative and B negative the harmonic is lagging at its zero nearest the fundamental zero by an angle less than 180° and greater than 90°, whose tangent is B/A; if A is positive and B negative, the angle of lag is less than 90° and is the angle having a tangent equal to B/A.

As an illustration of the above instructions, the fifth harmonic of the curve, of which one alternation is shown in Fig. 2, will be determined.

The thirty-five measured ordinates are placed in the left-hand column of the table of constants for the two component curves of the fifth harmonic, the multiplications and summations made, as will be seen in the following tabular form:

$A_5 = .0555 \times - 14.737 = - .817,$
$B_5 = .0555 \times - 1.531 = - .084.$

The two components of the fifth harmonic can now be written as

$$- .817 \; sin \; 5 \omega t - .084 \; cos \; 5 \omega t.$$

Resolving the two component waves into the resultant harmonic, thus:

$$\sqrt{(- .817)^2 + (- .084)^2} = .822,$$

the value of the amplitude; the angular relation is gotten as the angle whose tangent is $\dfrac{- .084}{- .817} = 5^\circ \; 52'$. The rule given above, for determining the sign of the angles as well as their size, states that when both components are negative, the angle is a lagging one, greater than 90° and less than 180°: this case reduces to an angle then of 174° 8′. The harmonic as finally determined is written thus:

$$.822 \; sin \; (5 \omega t - 174^\circ \; 8').$$

TABLE VI. WAVE FORM ANALYSIS.

Meas. Ord.	A_5			B_5		
.79	.423	.334		.906	.715	
1.24	.766	.95		.643	.797	
2.23	.966	2.15		.259	.578	
3.32	.985	3.27		—.174		.577
3.35	.819	2.74		—.574		1.92
3.32	.50	1.66		—.866		2.87
4.06	.087	.353		—.996		4.04
5.695	.342		1.945	—.94		5.35
8.05	—.707		5.69	—.707		5.69
8.12	—.94		7.63	—.342		2.77
7.44	—.996		7.41	.087	.646	
7.95	—.866		6.87	.50	3.97	
9.58	—.574		5.50	.819	7.85	
10.00	—.174		1.74	.985	9.85	
8.40	.259	2.175		.966	8.12	
7.66	.643	4.93		.766	5.87	
6.87	.906	6.22		.423	2.91	
6.73	1.00	6.73		.00		
8.15	.906	7.38		—.423		3.45
9.13	.643	5.87		—.766		7.00
9.82	.259	2.545		—.966		9.48
9.40	—.174		1.634	—.985		9.26
8.20	—.574		4.71	—.819		6.71
7.63	—.866		6.60	—.50		3.815
8.81	—.996		8.77	—.087		.766
9.30	—.94		8.74	.342	3.18	
6.68	—.707		4.72	.707	4.72	
4.65	—.342		1.59	.94	4.37	
3.64	.087	.316		.996	3.625	
3.44	.50	1.72		.866	2.975	
4.20	.819	3.44		.574	2.41	
3.41	.985	3.36		.174	5.27	
1.775	.966	1.715		—.259		4.60
.98	.766	.75		—.643		.63
.507	.423	.214		—.906		.459
		58.822	73.549		67.856	69.387
			58.822			67.856
			—14.737			—1.531

A complete analysis, up to the 17th harmonic, of the wave above, Fig. 2, gives the following:

$$9.02 \; sin \; (\omega t + 0^\circ \; 23') + .0825 \; sin \; (3 \omega t + 57^\circ \; 26')$$
$$+ .822 \; sin \; (5 \omega t - 174^\circ \; 8') + .607 \; sin \; (7 \omega t + 10^\circ \; 40')$$
$$+ .433 \; sin \; (9 \omega t + 158^\circ \; 36') + .482 \; sin \; (11 \omega t + 93^\circ \; 3')$$
$$+ .029 \; sin \; (13 \omega t - 37^\circ \; 12') + .196 \; sin \; (15 \omega t + 137^\circ \; 33')$$
$$+ .435 \; sin \; (17 \omega t + 51^\circ \; 20').$$

The fifth, seventh and thirteenth harmonics are particularly prominent and have amplitudes of about ten per cent. of that of the fundamental. The fundamental, fifth and seventh harmonics are drawn in Fig. 2.

Radium and Terrestrial Heat

Prof. Rutherford, of McGill University, Montreal, in a lecture before the Royal Institution in London, has advanced the striking theory that the earth's heat is not attributable to a molten mass which has been slowly cooling for a million years, which has been the generally accepted theory, but to the presence of radium. Prof. Rutherford's address was listened to by a distinguished audience, including Lord Kelvin, Lord Rayleigh, Prof. Dewar and other great scientists. Prof. Rutherford was the first to measure the mass and velocity of the electrons of radium. He announced the probability of radium being contained in all matter.

Glimpses of Steinmetz.

In the June *World's Work* Arthur Goodrich tells some interesting stories about Mr. Charles P. Steinmetz, chief engineer of the General Electric Company at Schenectady. "One of his ablest assistants spent a number of days of hard work in solving an intricate mathematical problem. When he had finished it he asked Steinmetz to work it out. The inventor grasped the problem at once, counted on his fingers a few times, and gave the correct answer without touching pencil or paper. Yet he remarked recently: 'Mathematics is valuable only to obtain results. Mathematics for mathematics' sake is foolishness.'

"Some years ago Steinmetz went into the Adirondacks with a hunting party of friends. Not caring to hunt, he was often left alone at a little lodge that was made the party's headquarters. One night before the camp fire a mathematical question came into his head. To settle it he needed a table of logarithms which could not have been found within miles of the camp. He remembered a few figures, and in a short time had worked out an entire table of logarithms for himself, and from it solved the problem. This mathematical sense, which was originally trained by hard study at Breslau, makes it possible for him to answer quickly the rapid fire of questions his aids hurl at him daily.

"The laboratory workers come to him constantly for advice and direction. Eighteen thousand employees stand ready to work out his ideas. With the men he is always genial and democratic. When any business matter needs settling he does it in determined fashion. He is as independent as he is good-natured. When the heads of the works made a rule against smoking in the factory, Mr. Steinmetz said he would smoke or leave. He did not leave. 'He can accomplish more in an hour,' said one of his assistants, 'than I can do in a week.' If some difficult problem needs solution at the works, it is nearly always taken to Steinmetz.

"Not long ago there was an explosion in a manhole in New York City, which made great trouble for an electric railroad. Many local engineers tried to find the cause of the trouble, and gave various unsatisfactory explanations. The matter was brought to Mr. Steinmetz's attention. In a few moments he asked how certain adjacent wires in the manhole were covered. Here, indeed, was the trouble. It was simple, but no one else had thought of it. He takes the short cut to the essential thing. It is characteristic of all his work."

Recent Electrochemical Developments.

Two patents granted on May 17 to Mr. Alfred H. Cowles, of Cleveland, refer to methods of manufacturing calcium carbide. There is nothing new of a fundamental nature in his method since the carbide is produced simply by heating a mixture of lime and carbon to a high temperature. The patents refer rather to details of the method. Mr. Cowles intends to make the operation continuous and superheats the carbide so that it may be easily tapped off.

A patent granted to Mr. R. N. Pelton, of Detroit, Mich., refers to an electric furnace for dentists. Its essential part is a muffle with a heating coil of platinum wire in the wall. The outside of the muffle is surrounded by another heating coil.

Mr. P. J. Boucher, of Cleveland, Ohio, patents an apparatus for purifying water by electrolysis with the aid of aluminum electrodes. As well known, a flocculent hydrate is thereby produced which coagulates the various impurities and allows them to be easily removed from the liquid by settling or filtering. If the current always goes in the same direction, deposits form on the electrodes and interfere with their action and the electrodes unequally deteriorate. To counteract this tendency, the inventor automatically reverses the current at predetermined periods of time. He also provides means for automatically relieving the pressure of the gases evolved by electrolysis and for insuring the current being turned on or off whenever the liquid is turned on or off.

A patent granted to Mr. F. Hinz, of Berlin, Germany, refers to a process of manufacturing peroxides of magnesium and zinc in a diaphragm cell. For making magnesium peroxide he uses an aqueous solution of magnesium chloride in the anode compartment and a neutral solution of magnesium chloride and hydrogen peroxide in the cathode compartment. Magnesium deposited on the cathode by the action of the current reacts with the hydrogen peroxide and yields magnesium peroxide.

Discussion of Institute Papers.

The discussion of the papers read before the recent annual meeting of the American Institute of Electrical Engineers was quite extensive, particularly that of the first day. The paper by Mr. W. L. Waters on "Predetermination of Sparking in Direct-Current Machines," and that of Mr. E. H. Anderson on "Effect of Self-Induction on Railway Motor Commutation" were discussed together. Referring to the latter paper, Mr. Waters said that Mr. Gano S. Dunn some ten years ago proposed the method outlined for finding the self-induction of commutation. In reference to the statement that one cannot run with impunity 5, 6 or 7 coils per slot, he pointed out that this is due to the peculiar conditions of a railway motor. An oscillagram shows that the field of the armature is almost constant over quite a considerable distance; and though one may be commutating under different conditions for different coils, yet the field is almost constant. A series current motor with a brush on the neutral point is a special case, having little relation to the ordinary direct-current machine.

Mr. E. R. Douglas pointed out that there are two systems of flux giving rise to self-induction. A great part of the flux goes directly across the slots above the coil and through the wire itself, but a further and larger portion spreads out in all directions and flows parallel to the shaft as well as along the shaft. He gave an account of experiments made by the Crocker-Wheeler Company, in which a sphere of high permeability was used with a circular coil lying on the surface, and discussed at length the results of the experiments. He also discussed other experiments by the same company having a relation to the subject of Mr. Anderson's paper. His conclusions were that there are very many things to be taken into account in a formula for sparking. Mr. Thornburn Reid discussed in detail the paper by Mr. Waters with reference to work that he has been doing on the same problem, which work he states is nearly at a point where he is ready to bring it before the Institute. He has found that for one set of brushes the variation of the current from what might be called perfect resistance commutation depends not on inductance e.m.f. alone, but on the ratio of the reactance and the contact resistances or the brush surfaces. He things that if this factor were used in place of that for reactance voltage there would be an entirely different relation in the variation of the constant. A further factor that affects the question is that of the frequency of the commutation periods. Referring to the calculation of self-inductance of an armature coil, Mr. Reid said that in his method, which differed considerably from that of Mr. Waters, instead of taking the depth of the slot he took only the depth above the winding.

In the discussion of Mr. Winship's paper on "The Calculation of Railway Storage Batteries," Mr. F. J. White said that the method of determining the average running current per car by station wattmeter readings will not give the variation of the current throughout the line, and very often that variation will determine where the central point with respect to the battery is located. In regard to the matter of sub-station storage batteries, he has found that with the average schedule of load, say, half-hour or hourly cars, it has been found economical to install storage batteries. Mr. Lamar Lyndon said that the results of Mr. Winship corresponded in general with those developed by Sarrat, of Brussels, and that he obtained similar results in 1902. In these latter, however, and in the formula of Mr. Sarrat, the internal resistance of the battery was taken into consideration, which factor Dr. Winship has apparently neglected, but which must be reckoned with. The character of the generator from which the load is supplied must also be considered, since it affects some of the factors in the formula offered. He referred to a specific case where, without considering these factors, the booster worked out at 24 kw, whereas when the factors mentioned were taken into consideration, the size came out at 12 kw.

Mr. E. H. Anderson criticised the formula of Mr. Waters as not taking into consideration all of the important factors and went into considerable detail with relation to the principles of sparking. Mr. Winship in replying to Mr. Lyndon, said that in his experience it was not possible to obtain a value of the internal resistance of a battery that could be worked with. In using the calculations as they appear in his paper, he has been able to come out within a very few per cent. of observed results.

President Arnold said that in sub-station work he has in general made it a practice to connect each terminal cell to a line and connect to the bus-bar so as to go in and out of the cells to keep the feeders properly charged and keep track of the batteries. He usually installs 4, 5 or even 10 or more cells than needed in practical operation. Owing to the variable conditions, the best calculation seldom hits the proposition on the start. Mr. F. D. Newbury supplemented the paper by Mr. Lamme on "A 10,000-cycle Experimental Alternator," with notes on the measurement of voltage, iron loss tests, short-circuit tests and effects of high-frequency currents. Mr. J. H. Cuntz referred to a somewhat similar machine designed by Mr. Tesla in 1890 for high-frequency experiments at Columbia College, which was operated at from 10,000 to 12,000 cycles and was designed for 20,000 cycles. In general appearance the machine was similar to that described in the paper.

In the discussion of the paper by Mr. Barnes on fly-wheels, Prof. Franklin went at length into the question of parallel operation. He said that he had worked out a mathematical development, the denominator of which covered two pages and the numerator covered seven pages of paper. Prof. Clarence Feldmann, of Darmstadt, Germany, confirmed Mr. Barnes in a statement that in the case of gas engines driving alternators a lighter fly-wheel and heavy damping are needed. In the case of any prime-mover with small uniformity of speed a light fly-wheel and heavy damping are required. He referred to a formula by Boucherot for the fly-wheel, which he thought was the best that had been offered. He said that in designing he never used a damper, but used steel poles, which act partly as dampers. By the use of heavy fly-wheels and the natural damping produced either by steel poles or by coils short-circuited on top of each pole, trouble from hunting may be avoided. Prof. Feldmann referred to several specific cases of parallel operation in which the difficulties due to damping had been overcome by various arrangements. Prof. Franklin, after concluding the reading of the paper, on "The Induction Motor," supplemented it with some remarks in which he referred to the difference between the theory which he offered and that of Mr. Steinmetz on the same subject.

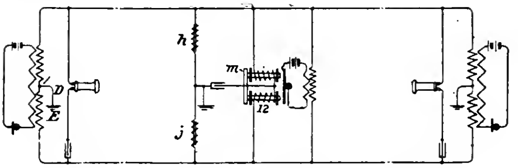
In a further discussion of the paper by Messrs. Waters and Anderson, Prof. Feldmann said that Mr. Waters greatly underestimates the influence of the shape of the pole pieces, and the reactance voltage is only the sole criterion as to sparking for one special type of machine. He believed that Mr. Anderson's statement that a motor of identically the same design will commutate better at 150 than 500 volts, is somewhat misleading or inexact. At the same current and speed and half the field the commutation will be worse. If, however, only half the current is taken at half the volts, the commutation will be better. He agreed with Mr. Reid that not only the self-induction, but also the mutual induction between the adjacent armature coils, should be taken into account in the sparking problem, and that other points should be considered, such as the frequency, and the contact resistance of the brushes. He stated that Prof. Arnold, of Carlsrhue, with the assistance of Prof. Mic, of Kiel, in 1898 completed and solved the differential equation applying in commutation, and in Prof. Arnold's book the formula is given with all the data necessary to figure self and mutual induction for any arrangement of coils in the slot.

Mr. H. Ward Leonard referred to a statement of Mr. Anderson in regard to sparking effects in starting the series motor for railway operation, and he considered that this was inherent in the type. For railway operations the best effects can be obtained by having the field of a motor separately and continually excited. He referred to experiments with an automobile where with series motors separately excited the automobile gave much better service than with self-excited fields. The automobile climbed with the same load and the same grade, with an expenditure of 120 watts in the field instead of 1,100. He referred to the experiments in Switzerland with the Ward Leonard system in connection with heavy railway work, in which difficulty with commutation at the generator was at first experienced, but which difficulty has been entirely overcome. He stated that a 20-km. trial of the railway system would shortly be made in Switzerland. The source of power is 15,000 volts alternating. The locomotive, which is capable of developing about 1,000 hp, has a single-phase motor which drives a direct-current generator, the armature of which is connected in multiple with the armatures of the motor. A separate machine excites the generator field and also excites the motor fields. In the generator field is a rheostat which enables the magnetism of the field to be reversed or given any degree of magnetism desirable, so that the entire control of the locomotive in starting, accelerating, retarding, stopping or reversing is all accomplished by the manipulation of one handle.

New Telephone Patents.

REPEATING SYSTEMS.

If one considers the metallic circuit telephone line in contrast to the grounded line, its predecessor, it seems very natural that early telephone managers were so loth to abandon the latter, for not only does the metallic circuit require double the length of wire, but incidentally the line resistance to be talked through at the same time is approximately doubled. If, however, by some means the two wires of our metallic circuits could be used in parallel, not only would the low-resistance conditions of grounded circuits obtain, but even this resistance would be halved. In a new repeating system just brought out, such a result is approached, in that for at least a considerable portion of the line the two conductors do work in parallel. The system referred to is that described in a patent recently issued to J. J. O'Connell, of Chicago, and assigned to the American Telegraph & Telephone Company. In the figure is shown a diagrammatic view of a completed through connection, at the middle being shown



O'CONNELL APPARATUS FOR AMPLIFYING AND REINFORCING TELEPHONE CURRENTS.

the repeating station and at the ends the two subscriber's stations. The operation may be best made clear by tracing the talking current from one station to the other. Consider the left-hand station. Current in the primary of two induction coils, varying in response to the transmitter, induces currents in the secondaries. These latter are so poled as to impress upon their junction point, *D*, which is grounded, equal currents of like sign, and similarly to send out upon the two sides of the metallic circuit two equal currents of like sign. These currents complete their circuit though the earth to which they pass at the repeating station through the coils of the repeater, *m*. Thus for transmitted or "sent-out" currents, as far as the repeating station the line wires serve in parallel. At the repeating station the incoming currents are cumulative in effect and actuate the diaphragm, thus sending out upon the line a repeated current.

As will be readily understood from the circuit diagram, this repeated current uses the advance line as a metallic circuit. At the receiving station practically all current passes through the telephone as the two induction coil secondaries, which in series form only shunt circuit about it, have in this relation such a high impedance as to be of no effect. Operation in the reversed direction is, of course, exactly similar. It may be well to state that the coils, *h*, *j*, at the repeating station serve to relieve the line of extraneous currents which might affect the repeater. To this end these coils are wound of low resistance, but of high inductance.

The ringing generator patent, issued to E. H. Strauss, describes a separately excited generator, the electromagnetic field being supplied from a battery. The automatic generator switch contains elements to control the field current so that the circuit will be closed only during the time of actual signalling.

CURRENT NEWS AND NOTES.

CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—The twenty-third annual meeting of the Association of Railway Telegraph Superintendents will be held at Hotel English, Indianapolis, Ind., June 15 and 16 next. Papers on topics relative to telegraphs and telephones will be read, and there is promise of a meeting of unusual interest. The members will probably proceed to St. Louis in a body to visit the Exposition. Mr. P. W. Drew, Milwaukee, Wis., is secretary of the Association.

INVESTIGATING RUBBER SUPPLY.—The United States Government is making investigations and has already issued a bulletin upon the subject of rubber gathering in the Philippines. It is known that in some of the southern islands the Hevea or Para rubber tree grows as perfectly as it does upon the Amazon and its tributaries, and in all of the islands the Castilloa or Mexican rubber tree can be made to grow. This is a matter of extreme importance to the Philippines and of the utmost interest to the American trade in general.

WHERE NEPTUNE DROWSES.—In the *Booklovers' Magazine* for June, Mr. P. T. McGrath has a very interesting article on life at St. Pierre Miquelon, the last Atlantic stepping stone for Europe. Water pipes running from reservoirs in the hills, and electric lights replacing the quaint oil lamps whose ornamental iron brackets still adorn the street corners, are the sole evidences of modern progress. There are no trams, street cars, telephones, newspapers, theatres, laundries or other accessories of advanced existence. Everything is sleepy, restful, and old-fashioned. Save for the Atlantic cable which touches there, it is as isolated from the world as Greenland.

DEPRECIATING THE STEAM ENGINE.—Writing under the title of "The Superseding of Steam Power," in the June *World's Work*, Lewis Nixon says: "I have been led, lately, to think the whole development of the steam engine, to the exclusion of the gas engine, has been a mistake, and that we are now at the beginning of a new era in the use of power. Engineers could to-day gain better and more economical results by abandoning steam and using internal combustion engines, even in large establishments. The gain in economy of fuel will advance with the size of the establishment. With the internal combustion engine, a brake horse-power can be produced on a pound of coal. This could not be done with steam under any conditions.

LETTERS TO THE EDITORS.

Reduction of Titanic Chloride.

To the Editors of Electrical World and Engineer:

SIRS:—We read on page 525, Vol. XLI of the ELECTRICAL WORLD AND ENGINEER (No. 13, of March 28, 1903), a note of Mr. Townsend, according to which a patent has been granted to Mr. Howard Spence, of Manchester, for the electric reduction of titanic chloride to titanous chloride. This conveys an impression that Mr. Spence had alone a right of carrying out this reduction.

We take the liberty of pointing out to you that the electric reduction of titanic chloride to titanous chloride has been put at everybody's free disposal through a publication of E. Polidori, which appeared in the beginning of the year 1899. (See *Zeitschrift für Anorganische Chemie*, Vol. XIX, page 306, and *Chemisches Zentralblatt*, 1899, Vol. I, page 518.)

NÜRNBERG, GERMANY. PAUL ASKENASY.

Italian Transmission Line Construction.

To the Editors of Electrical World and Engineer:

SIRS:—I have in hand the issue of your journal of March 12 and I tender my very best thanks for the lengthy editorial notice of my paper on "High-Tension Construction." I desire, however, to clear up some points which, it would appear, were not made thoroughly plain in the paper.

A system of land expropriation at so much per pole is extensively in use all over Europe. Of course, there are cases in which the full right of way is purchased, but even in these cases distinction is made between right of way and occupation of land; the first is paid at so much per meter of line, while the second is paid at so much per pole.

Referring to climatic difficulties, the writer of the editorial seems to consider the climate all over Italy as the climate of Naples and Rome, thus forgetting that most of the important lines run from the Alps, where snow, wind and variations of temperature are very severe. On the other hand, I do not very well understand how severe climatic conditions may be an objection to long spans and iron poles. If such conditions are to be met, it is purely a matter of introducing suitable data in the calculations, and to give the wires such a sag that the strain will not reach the limit of elastic deformation in the coldest weather and with the maximum overload put on by the wind and the snow, and to proportion the poles in accordance. Only by suitable calculations can one be sure of arriving at a solid construction, and where difficulties are great, the recourse to sound engineering, which does not halt at severe conditions, is justified.

As to wooden poles, I quite agree that, if in any country they can have a considerable life, this would be an argument in their favor. The life of wooden poles differs very much according to locality; on mountains they will last very long, in cultivated plains they will have a very short life. The fact that the average life of wooden poles is longer in America than in Europe, may perhaps depend on the fact that in America the most important transmission lines run through mountainous country, while in Europe a large number of such lines, after passing through valleys, come out on cultivated plains where irrigation is extensively practiced.

On the other hand, I do not think there is any danger from rusting of iron poles. Rusting is prevented by repainting, and it may be observed that no bridge has ever been known to break down through the action of rust.

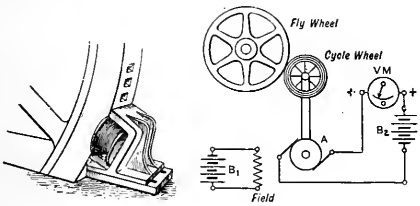
The editorial emphasizes the use of cross arms to prevent trouble from insulators breaking, and I may say that by the use of good modern insulators, the occurrence of such inconveniences is quite insignificant; and the use of cross arms as suggested in order to prevent the consequences of accidents which in practice very seldom occurs, detracts from the many mechanical advantages of metallic construction.

MILAN, ITALY. GUIDO SEMENZA.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

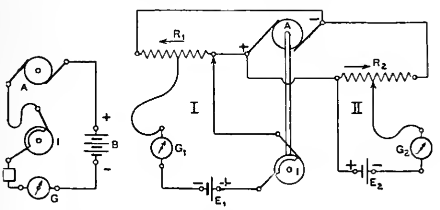
DYNAMOS, MOTORS AND TRANSFORMERS.

Alternators in Parallel and the Coefficient of Speed Variation.—BOHLE.—The conclusion of his long paper on this subject. He deals with the operation of a synchronous generator in parallel with a non-synchronous generator and then discusses the connection in parallel of alternators driven by gas engines. The difficulties are here great on account of the great speed variation and because the coefficient of speed variation varies according to the load. The latter difficulty may be overcome by loading an incoming machine artificially. Dettmar uses for this purpose a Foucalt brake which acts on the fly-wheel as shown in Fig. 1. The magnet is excited by direct



FIGS. 1 AND 2.—ALTERNATORS IN PARALLEL.

current, the load being regulated by means of a regulating resistance. The heat produced by these currents is kept low by the air currents, especially as the proceedings last only a short time. On account of the artificial load, the regulator of the engine has a position which corresponds to the load, so that the machine will take over part of the load of the other machine immediately. The faucault brake acts at the same time as a damper, diminishing the mechanical fluctuations. The author then discusses the various methods for determining the coefficient of speed variation. Electrical methods are the only accurate ones and even these cannot be relied upon, when the coefficient of speed variation is less than 1/200. Fig. 2 represents a method of the General Electric Company. A cycle wheel is fixed on the shaft of the small direct-current generator. The rubber tire is braced against the fly-wheel of the engine and the excitation of this generator is such that its e.m.f., corresponding to the mean speed, is equal and opposed to the pressure of a battery, B_2. Between the armature of the generator, A, and the battery, B_2, is joined a Weston voltmeter with a low-reading scale. It will be evident that, if the fly-wheel rotated at a uniform speed, equal to the mean, the voltmeter would show no reading; but as the fly-wheel is rotating with a varying speed within a revolution, the voltmeter needle will oscillate, the amplitudes from the zero position being a measure of the variation of speed. A modification of this method by Franke is shown in Fig. 3. The armature, A, and the indicator, I, are coupled to the engine, the indicator closing the circuit once in a revolution at a definite crank position, causing a deflection on the galvanometer, G, which is proportional to the instantaneous pressure at this instant, hence also to the corresponding annular velocity. By bringing the brushes of the indicator into different positions the circuit will be closed at a different time. This method would be very accurate, if the time of a revolution would not change, but on account of this the instantaneous velocity changes with each revolution, so that the pressures for the same brush position are not constant at different times. To avoid this fault, the arrangement of Fig. 4 may be employed, in which the influence of the changeable time is considered. Here the pressure of the armature, A, is closed by the high resistances, R_1 and R_2. There are thus two circuits. On account of the drop in R_1 the back pressure, E_1 (at the instant the circuit is closed) is compensated, say, by means of the galvanometer, G_1. The pressure, E_2, is compensated similarly by G_2, which should possess a periodic damping and a fairly large periodic time. Galvanometer G_2 shows, therefore, only changes in the number of revolutions, or, in other words, the changes in the time of a revolution. Observations must be made in circuit I at the time when the galvanometer, G_2, shows no deflection, all observations will then correspond to the same time. It is seen that two persons are required for the experiment, which requires a great deal of time and patience. Irregularities in the pressure due to the construction of the experimental generator, must, of course, also be eliminated beforehand. Very small coefficients, that is to say, those below 1/200, cannot be determined. The author describes briefly the use of phase lamps, etc., and finally describes an



FIGS. 3 AND 4.—ALTERNATORS IN PARALLEL.

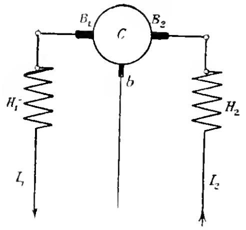


FIG. 5.—COMPOUNDING DIRECT-CURRENT MACHINES.

apparatus of Goerges for demonstrating the oscillations of parallel running alternators.—Lond. *Elec.*, May 6.

Compounding of Single Machines Supplying a Three-Wire System.—ROSENBERG.—If a single direct-current machine for supplying a three-wire network is to be compounded, the series winding is generally placed in the two outers, I_1 and I_2, as indicated in Fig. 5 by the coils, H_1 and H_2. But this division of the series winding is not always possible. The author shows that the arrangement of Fig. 6 is equivalent. Here the coil, H, is inserted in one outer, and the coil, h, in the neutral, while the second outer has no excitater winding. Fig. 6 shows the arrangement of Debrowolsky, where the neutral wire is connected to the central point of an induction coil, T, the two

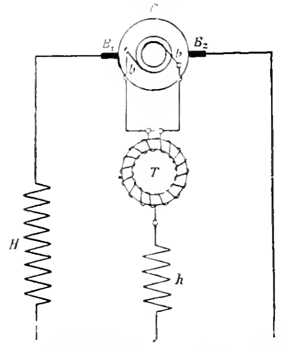


FIG. 6.—COMPOUNDING DIRECT-CURRENT MACHINES.

terminals of which are connected to two slip rings on two diametrically opposite points of the armature. The number of turns of h must be one-half of H. The cross-section of the winding, h, is to be determined according to to the value of the differential current, which it has to carry.—*Zeit. f. Elek.* (Vienna), May 1.

REFERENCES.

Alternators.—Atchison.—The first part of an illustrated paper, read before the Birmingham Section of the British Institute of Electrical Engineers, on some properties of alternators under various conditions of loads. After some brief remarks on the e.m.f. on open circuit, he discusses the e.m.f. induced with the machine loaded, both for non-inductive and inductive load, diagrams being given.—Lond. *Elec.*, May 6.

Alternators.—Hay.—In a continuation of a serial on the theory of alternators he gives, with the aid of diagrams, the analytical and graphical theory of the "ideal alternator."—Lond. *Elec. Mag.*, April 26.

Single-Phase Commutator Motors.—Sumec.—A conclusion of his serial illustrated by diagrams. He deals with the repulsion motor and the shunt motor.—*Zeit. f. Elek.* (Vienna), May 8.

Lights and Lighting.

Illumination of Incandescent Bodies and Temperature.—Jablonski.—A communication referring to a recent article of Eisler. He points out that his results are in agreement with a former law of Rasch, according to which the total illumination, Φ, increases with the temperature, T, according to the differential equation, $d\Phi/\Phi = Kd\ T/T^2$.—*Elek. Zeit.*, May 5.

Power.

Power Station Design.—Merz and McLellan.—A continuation of their British Institute paper, the first part of which was abstracted in the Digest last week. The authors say that the question of spare plant and its proportion to the output of the station is an important one in design, as also is that of securing the correct relative capacity of the various pieces of apparatus making up a complete unit: the boiler, engine, generator and switch gear. They emphasize that the steam turbine lends itself admirably to dealing with large overloads. They discuss eight different methods in which the station may be rated. In a plant where the load factor over a year may be expected not to exceed 25 or 30 per cent., low cost of production will be facilitated by the engineer considering capital expenditure rather from the point of view of the most economical way of dealing with a peak load. In other words, in estimating the capital cost, he considers that the rating of the station should be based on the maximum possible output which the station is capable of dealing with for one or two hours, making no allowances for spare plant. The authors consider that by proper attention to spares and overload capacity the cost per kilowatt of maximum output of a power station can be reduced from 20 to 40 per cent., depending, of course, on the load factor to be dealt with. They then deal with auxiliary machinery, and recommend electric driving for the machinery in the boiler house and for the circulating and air pumps. For the feed pumps they recommend to install at first steam-driven feed pumps and to use electrically-driven feed pumps for extensions. Concerning the method of electric driving the auxiliary machinery, they recommend to have in view the ultimate adoption of driving from separate generating sets, with the addition of a connection to the main bus-bars to meet emergency conditions. But for the first installment they recommend the use of polyphase auxiliaries operated through stationary transformers from the main bus-bars, without, for the time being, providing any alternative source of supply. They also offer the following possible method as being quite attractive. It consists in driving the whole of the auxiliaries from the particular main unit which they serve by connecting stationary transformers direct to the alternator terminals, these transformers being of sufficient capacity to operate air pumps, centrifugal pumps, stoker, induced-draft fan, and even, if desired, feed pumps—all in permanent connection through a switch with the main unit. In starting up, the switches controlling air pumps and centrifugal pumps may be left in and the field of the main generator excited. These auxiliaries would then start up with the main machine just as if they were mechanically coupled or geared to it. Flexible connections would be provided so that motors, feed pumps or induced draft fans could be used as spares for other sets, but normally each main unit would deal with its own auxiliaries and would be independent of all others. In an editorial discussion of the paper emphasis is laid on the point brought out by the authors that economy in capital expenditure is as important as economy in works cost.—Lond. *Elec.*, May 6.

REFERENCES.

Steam Turbines.—London.—An article illustrated by diagrams on steam turbines for electric generating stations, with some comparisons with the reciprocating engine.—Lond. *Elec.*, April 26.

Emmet.—A paper on new steam turbine developments, illustrated by various diagrams. He deals with the development of the Curtis turbine and gives some notes on the 5,000-kw turbine installed in the new plant of the Chicago Edison Company and of a 2,000-kw machine of the new four-stage type recently tested under the conditions of vacuum and superheat afforded by the Schenectady power station. He thinks that the four-stage machine will hold its own against all competing engines for some time to come, and that it will be extensively used.—*Proc. Engineers' Club, Philadelphia*, April.

Lifting Apparatus.—Reichwald.—An illustrated description of electrical lifting apparatus for iron and steel works, especially of block charging cranes, and loading cranes.—Lond. *Elec. Mag.*, April 26.

Blast Furnace Gas Engines.—Allen.—In a continuation of a serial on the application of electricity to mining and metallurgy he deals with the utilization of the blast furnace gases for driving gas engines.—Lond. *Elec. Mag.*, April 26.

Traction.

Double-Current Generators for French Traction System.—A fully illustrated description of the electric tramway line from Aix to Marseilles. The length of the line is 30 km. and each train consists of a motor car and a trailer and makes the return trip five times per day. Each motor car is equipped with two 36-kw motors. The power plant contains three double-current generators supplying both direct current direct to the line and three-phase currents to step-up transformers, which send high-tension three-phase currents to sub-stations in which the current is changed to direct current by step-down transformers and synchronous converters. The converters are in parallel with the direct-current side of the double-current generators, so that there is a very close interrelation between the different machines in the power plant and the sub-stations. There is a good distribution of the load and the generators supply more or less direct current or three-phase current, according to whether motor cars are nearer or farther away from the power plant. The following advantages are claimed for this system over that of the generation of three-phase currents to converter sub-stations: one sub-station at the power plant itself is avoided; there is no loss at the power plant itself in the conversion of three-phase currents to direct currents; the only high-tension apparatus used are transformers. The main difficulty to be overcome in this system was that the same voltage must exist at the commutators of the double-current generators and of the converters, whatever may be the load. It was, therefore, necessary to compensate for the loss of voltage in the transformers, the line and the converters. Such an automatic compensation was obtained by special construction of the transformers with high self-induction and by compounding the converters. The power house contains three double-current generators, two of 200 kw and one of 100 kw. They furnish direct current at 650 volts and three-phase currents at 400 volts. The voltage of transmission of the three-phase currents is 10,000. There are two sub-stations, one containing one transformer and a 120-kilovoltamp. converter, while the other one contains two sets of the same kind.—*L'Ind. Elec.,* April 25.

Direct-Current Versus Single-Phase Traction.—HOBART.—The conclusion of his article. The author continues to discuss Lincoln's comparison of the single-phase and direct-current system for a 60-mile road. He introduces such corrections for Lincoln's single-phase figures as he considers to be justifiable, and he substitutes, moreover, for the 600-volt, direct-current system with sub-stations a system with two direct-current generating stations, located respectively 15 miles from each end of the system and 30 miles from one another. These stations he assumes to be equipped with slow-speed 1,350-volt direct-current generators, and the cars are fed at an average voltage of 1,300. Each car carries two 650-volt motors connected in series and operated as a 1,300-volt unit. The acceleration is rheostatic. He gives a table of comparative costs and arrives at the result that the single-phase system is 12 per cent. higher in first cost and 7 per cent. higher in operating expenses than the direct-current system for the items which he takes into consideration. He assumes two power houses for the direct-current system, since this arrangement is fairly suitable for Lincoln's line and for 1,350 volts at the generators; but for extensive lines polyphase generation from a single station would often be preferable. He concludes that his comparison affords ground for the opinion that the superiority of the single-phase motor for other than main line work is as yet by no means a foregone conclusion. Nevertheless, the single-phase commutator motor represents a very important advance. It is beyond all comparison superior to the single-phase motor without commutator, and is already not greatly inferior to polyphase motors and direct-current motors. This is an excellent record for such a brief period of development.—Lond. *Elec. Rev.,* May 6.

Electric Headlight.—CARNEY.—An abstract of a paper on the electric headlight as an adjunct to modern railway practice. It acts as a safety device by giving a warning to the public that a high-speed train is approaching. But an electric headlight burning in a switch-yard is a nuisance. One main disease of it is the effect of the diverging rays on the vision of the engineman during snow, rain or mist. To overcome this difficulty a cylindrical extension about 15 in. long has been fitted to the ordinary headlight. This gives a sharper pencil of light and seems to illuminate the track better than the standard one.—*Eng. News,* May 19.

Traction Motor for Small Gauge Roads.—BOEHM AND RAFFAY.—An illustrated review of the development of traction motors by the Oerlikon Company with special reference to a 900-volt, 110-hp motor for small gauge roads. It weighs 1,700 kg., when tested for one hour with a load of 105 hp, the increase of temperature in the field coils was 70° C. over the temperature of the surroundings, while the commutator and the armature had a smaller temperature. The insulation of the windings was tested with 3,000 volts alternating currents. —*Elek. Neu. Anz.,* April 15.

Egypt.—A description of the first Egyptian steam line to be converted to electric traction. The combined system comprises the Alexandria Traction Company and the Alexandria & Ramleh Railway. The main line of the latter is a standard-gauge, double-track road joining Alexandria and Ramleh. The principal features are the use of heavy rails, center-pole construction, high-voltage alternating-current transmission system with rotary converter sub-stations and compound condensing engines in the power plant.—*St. R'y Jour.,* May 7.

Electric Traction in Germany.—JACQUIN.—A description with maps of the tramway systems of Hamburg and Kiel.—*La Revue Elec.,* April 30.

Rail Bonding.—SHEARDOWN.—The first part of a paper read before the Dublin Section of the British Institute of Electrical Engineers, on tramrails and rail bonding. The author states that while there have been many forms of solid or continuous rail joints thought out and patented, yet the only three which have had any amount of use in practice are the Falk cast-welded joint, the electric-welded rail joint of the Lorain Steel Company, and the thermit joint. In the present installment the first two mentioned systems are described.—Lond. *Elec.,* May 6.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

An Apparatus for Making out Bills to Electricity Consumers.—BIERMANN.—A paper read before the Berlin Electrical Society. The author emphasizes the amount of money which is yearly spent by large electric supply companies for rendering the bills to their customers. The meter is read by a man, then at the office the consumption is calculated, multiplied with the constant of the meter, again multiplied with the rate at which the energy is charged for, the bills are made out and the money is collected. Then there is much trouble with customers, who claim that their meter is wrong. He describes a meter in which most of the above work is done in the meter itself and the consumer is always enabled to read at once from the meter how much money he has spent for electric light every day. If there is really something wrong about the meter the consumer will soon find it out and then put in his claim at once, and there will not be any trouble at the end of a longer period. His meter is essentially a combination of an ordinary electricity meter with a calculating apparatus and a printing device. In this way the bill is directly made out by the meter. The instrument is described in detail and illustrated.—*Elek. Zeit.,* May 5.

WIRES, WIRING AND CONDUITS.

Earthing of the Neutral Point in Three-Phase Systems and the Watt Loss in the Dielectrics of Cables.—HUMANN.—An article in which the author calls attention to the advantages in earthing the neutral point in three-phase systems. The safety of the system against accidents is thereby increased. At the same time the watt loss due to dielectric hysteresis in the cable network is considerably diminished. This loss is for high-voltage networks considerably greater than is generally assumed, and this loss exists whether current is consumed in the network or not. The author has made experiments with a three-core, three-phase, high-tension cable of 3×25 sq. mm. copper cross-section, of 890 meters length. The insulating layer of impregnated paper was 6.8 mm. thick between copper and lead, as well as between the different copper conductors. His results are applied to a comparison of the watt loss in the following two cases: In the first case the neutral point is earthed; in the second case one phase is earthed. He remarks that the latter case may easily occur in practice. For 100 km. of his cable, operated at 5,000 volts, the loss amounts to about 23,000 kw-hours per year, if the neutral point is earthed, and to about 35,200 kw-hours, if one phase is earthed. If the cost of 1 kw-hour is assumed to be 2.5 cents, the earthing of the neutral represents a saving of $304.40. For higher tensions this saving is much more considerable; for 10,000 volts it amounts to $1,209. The earthing of the neutral point is preferably carried out in the power house by means of a special conductor of sufficient cross-section.—*Elek. Zeit.,* May 5.

Inductive Voltage Drop in Parallel Three-Phase Lines.—LICHTENSTEIN.—The conclusion of his article. In practice the voltage drop of parallel conductors carrying three-phase currents is often calculated as follows. To determine the voltage drop in the set of conductors 1 and 2 one calculates the voltage drop in conductor 1 and the voltage drop in conductor 2 and forms their geometrical sum. By voltage drop in conductor 1 is meant the geometrical sum of the ohmic voltage drop and the inductive voltage drop per conductor, the latter being calculated by the formula for two parallel single-phase conductors. This method of calculation, if applied to three conductors in one plane (as is often the case in three-phase railways) gives accurate results only for the voltage drop between the two outers of the three wires. For the voltage drop between 1 and 2 and for the voltage drop between 2 and 3 the results are wrong by a few per cent. The author emphasizes, however, that by such a method of calculation the term "voltage drop in a conductor" is introduced, which he endeavors to show has no physical significance. The calculation of the voltage drop is much easier if the three conductors are so arranged that a cross-section through them gives an equilateral triangle.—*Zeit. f. Elek.* (Vienna), May 1.

ELECTRO-PHYSICS AND MAGNETISM.

Revolving Electrostatic Field.—GUYE AND DENSO.—An illustrated description of an arrangement for producing a revolving high-tension electrostatic field, which they use for making experiments on the dielectric hysteresis in revolving fields. The arrangement is shown in Fig. 7, in which A_1 and A_2 are two points connected to a single-phasealternator. R is a non-inductive resistance, C an adjustable capacity and L an induction coil. A_1, B and A_2 are connected to the four plates, 1, 2, 3, 4, as shown. The authors derive the mathe-

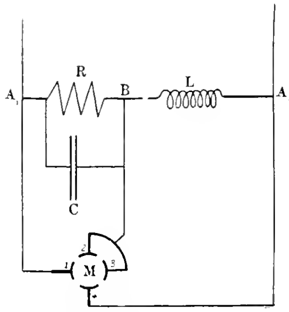


FIG. 7.—REVOLVING ELECTROSTATIC FIELD.

matical relations which must be fulfilled between R, C and L, in order to produce a circular revolving electrostatic field at M.—*L'Eclairage Elec.*, May 7.

Conductivity of Sodium.—BERNINI.—An account of an experimental investigation of the influence of temperature on the electric conductivity of sodium. The main results are that sodium is one of the best conductors of electricity; its conductivity decreases with increasing temperature, and it appears that the law of proportionality is nearly fulfilled within the limits of his investigation; the temperature coefficient is larger for liquid sodium than for solid sodium; the change of resistivity at the melting point is represented by a sudden rise, in the proportion of 1 to 1.337. The specific resistance at 0° C. is 0.050407 and at 120° C. 0.093062. Just below the melting point, at 97.3°, it is 0.0655, and just above the melting point, at 98.5°, it is 0.088. The melting point is, according to his measurements, 97.633° C.—*Phys. Zeit.*, May 1.

REFERENCES.

Hertzian Waves and Phosphorescence.—GUTTON.—An account of experiments in which he found that not only does the induced e.m.f. due to the variation of a magnetic field brighten a calcium sulphide screen, but Hertzian oscillations, producing, as they do, very intense e.m.f's, do the same.—*Comptes Rendus*, April 18; Lond. *Elec.*, May 6.

Flames Between Electrodes.—An account of an experimental investigation of the electric current through flames placed between two nearby electrodes, some experiments being made with calcium oxide electrodes.—*Phys. Zeit.*, May 1

UNITS, MEASUREMENTS AND INSTRUMENTS.

System of Electrical Units.—FOURNIER D'ALBE.—A communication referring to the suggestion of Robertson, whose radical changes could only be justified on the ground of finality, but such a claim cannot be made for them. The advance of the electron theory is gradually reducing the whole of electromagnetic theory to a theory of the electron at rest and in motion. The present author emphasizes that the natural unit of electricity is the electron itself, or, since it is inconveniently small, some multiple of it, preferably a trillion electrons, which might be called the "trelectron." A coulomb would be about five trelectrons. A current of one ampere would be generated by the passage of five trelectrons per second through any cross-section of the conductor. One trelectron would repel another at a distance of one meter in air with a force of 40,000,000 kg. Putting ξ for the new fundamental unit of electric quantity he gives the new dimensions of several electric units; for instance, current $= \xi T^{-1}$. The conductivity comes out as the density of electrons multiplied by mobility, the mobility being the steady velocity acquired by an electron under unit force acting upon it within the conductor.—Lond. *Elec.*, May 6.

Hay.—Another communication on the same subject. He emphasizes the innate conservatism of human nature. "Will any number of resolutions or recommendations passed at international electrical congresses induce the host of designers to abandon their present methods merely in order to satisfy the fastidious taste of their scientific confrères? And if not, what advantage is there in tampering with the existing system, beyond the somewhat imaginary one of eliminating the innocent yet much-abused 4π from certain equations, merely in order to have it reappear in others?" He thinks that "such unfamiliar terms" as abfarads, abcoulombs, gausses, gilberts, abstatvolts are "certainly more remarkable on the score of originality than on that of euphony." He thinks there is the danger with any attempt to alter the existing system that it would create two distinct systems, one for use by theorists and the more enlightened engineers, the other by those who are merely concerned with the more or less mechanical application of general principles to practical problems. The only result would be to make the language of the scientific investigator much less intelligible to the practical man than it is at present.—Lond. *Elec.*, May 6.

Measuring the Energy of Short and Rapidly Decreasing Electric Currents.—WEICHSEL.—A mathematical article on the measurement of the energy of very short and very rapidly decreasing electric currents; thus problem is of importance for telegraphy and electric clocks. He shows that if a dynamometer is used with a period of oscillation which is very large compared with the duration of the current to be measured, the reading of the first deviation of the needle gives the time integral of the squares of the instantaneous currents. On the other hand, a ballistic galvanometer gives the time integral of the instantaneous currents. If the current, the energy of which is to be measured, is sent through the fixed coil, while the movable coil, in series with a very high non-inductive résistance, is shunted across the terminals of the apparatus in which the current is consumed, the energy of the short and rapidly decreasing current is proportional to the first deviation of the needle of the instrument. He gives rules of the application of Thomson's quadrant electrometer and of the Curie electrometer. His equations are valid for undamped instruments only. He finally introduces the corrections which must be made on account of the damping.—*Zeit. f. Elek.* (Vienna), May 8.

REFERENCES.

Pyrometry.—GHEURY.—The first part of a paper on the various methods used in pyrometry. He dwells specially on the three standard methods which have actually left the experimental stage and are of current use in practice, that is the gas thermometer, the resistance thermometer and the thermo-electric thermometer.—Lond. *Eng'ing*, May 6.

Barbed Damping Device.—FAVÉ AND CARPENTIER.—A description of a new device for damping oscillations which combines a very small moment of inertia with a high damping coefficient. It consists of a stellar arrangement of very thin glass fibres or natural hairs, fastened to the oscillating needle with its plain horizontal and its center in the axle of oscillation. The fibres used have a diameter of about 1/10 mm.—*Comptes Rendus*, April 18; Lond. *Elec.*, May 6.

MISCELLANEOUS.

Comet Tails.—An editorial summary of the hypotheses which have been proposed for the explanation of comet tails. Fitz Gerald has suggested that the Maxwellian light pressure exerted by solar radiation on the molecules of a gaseous cometary envelope might be the cause of the observed curvatures of the appendages. A difficulty, however, arises from the small absorption of radiation by gases, and Arrhenius has suggested that condensed particles of matter should replace the molecules of Fitz Gerald's hypothesis. On the basis of this hypothesis Schwarzchild has calculated the repulsion exercised by the sun's total radiation on a single particle and compared that force with the sun's gravitational attraction. He estimated that, on particles of the most favorable size, the radiation pressure might reach a magnitude about 20 times the gravitational attraction. As a matter of fact, astronomical measurements indicate a solar repulsive force about 40 times the attraction of gravitation. Thus, with the most favorable postulates, the Maxwellian light pressure theory has not yet afforded a complete explanation of the main phenomena. Perhaps it is a complex effect, however, some other distinct self-contained theories have been suggested. Fessenden thinks the tail may consist of particles carrying negative electricity which move under solar gravitation, nuclear electrostatic attraction and the electric repulsion of a negatively-charged sun. J. J. Thomson has suggested that the sun's ultra-violet radiation disengages from the nucleus negative ions which are repelled by radiation pressure. This supposition seems to require the existence in solar radiation of Hertzian waves. Lastly, Bois has suggested that radioactive substances in the nucleus may give rise to charged atmospheres, which move in the electrostatic field of the sun.—Lond. *Elec.*, May 6.

Radium Rays for the Blind.—London.—An account of experiments in which he attempted to utilize radium rays for the instruction of the blind. Although the rays probably exert some feeble effect upon the optic nerve, they act in a much more pronounced manner upon the retina, and whatever effect can at present be produced is conditional upon the retina, or some small portion of it, having retained its susceptibility for light. If a box containing a radium preparation is approached towards the head of a person whose eyes are bandaged, he perceives a general diffused luminosity which is centered to some extent towards the direction of the box. With some practice the subject can indicate the direction in which the box is situated, and if the operator traces lines and curves in front of his eyes, with the box, he can trace them out after him with a fair amount of accuracy. But the practical value of these observations is annulled by the fact that the rays are very dangerous to the eyes, leading easily to retinitis and blindness. On the other hand, the rays may be usefully employed in conjunction with a platino-cyanide screen. The author encloses such a screen in an opaque frame, which is held in front of the eye in a dark room. Objects are shown as silhouettes on the screen, and the blind subjects are told their shapes as first, with the aid of the sense of touch, and when they acquire some practice they are able to trace them out themselves. In this way the reading of raised letters is greatly facilitated, the vague visual impression strengthening the actual perception. Ordinary screens illuminated with electric light were also tried, but were found to irritate the eye by the heat rays.—*Archives d'Elec. Medicale*, April 25; Lond. *Elec.*, May 6.

REFERENCES.

Electric Separation of Oil from Condensed Feed Water.—A note on experiments made by Davis and Perrett, of London, who found that whereas with untreated condensed water it was practically impossible to remove the oil by mechanical filtration, this can be done if the water is first subjected to electrolytic action. For this purpose some tap water must be added to the mixture in order to increase its conductivity. The water is passed through a wooden tank between iron electrodes, a potential of 50 volts being maintained between adjacent plates, and is subsequently filtred.—*Power*, April.

Electricity in Agriculture.—Guarini.—The first part of a serial on electricity in agriculture. The author emphasizes that experiments and observations have shown that electricity is able to have good effects on the growth of plants. This influence may be either direct by the electrification of the ground, the plant, the atmosphere, or indirect, by means of lighting with the voltaic arc. He begins to give a summary of the results obtained in this direction by various investigators.—*L'Elec.*, May 7.

Radio-Therapeutics.—Bergonié.—An account of a case of cure of a cancroid cancer of the eyelid by Röntgen rays. The patient was a woman of 63 years, suffering from cancer of the eyelid and the orbid of 20 years' standing, but recently accelerated. Röntgen rays of sufficient intensity to penetrate the thorax were applied to the eye through an aperture in a lead screen during 11 sittings of five minutes each, extending over a month. Six weeks after the treatment the cancer had completely disappeard, laving the eye closed, indeed, but covered with a normal skin through which the eyeball could be felt to be in a normal condition.—*Archives d'Elec. Medicale*, April 25; Lond. *Elec.*, May 6.

New Books.

La Telegraphie Sans Fils. By André Broca. 2 ième Édition. Paris: Gauthier-Villars. 234 pages, 52 ills. Price, 4 francs.

André Broca, who is professor of physics in the faculty of medicine in the École Polytechnique, Paris, issued the first edition of "The Telegraph Without Wires" in 1890, and his object at that time in writing the treatise was to present a non-technical account of the electromagnetic theory of light and its relation to wireless telegraphy in as simple a manner as possible.

Since then, as Prof. Broca states, in the preface of the second edition, the art has been very greatly extended and the theory of high frequency currents as well as the relation of electrical resonance to syntonization has become a constituent part of wireless telegraphy, and these subjects have been treated in the latter book. There are twelve chapters in all, the synthetic arrangement following more or less closely the works of other foreign writers on the same subject. There is little or nothing new in Broca's book, but the matter included is, however, presented in a readable manner.

Die Anwendung der Elektrizitat für Militarische Zwecke. By Dr. Friedrich Wachter. Leipzig: A. Hartleben. 212 pages, 66 illustrations. Price, 4 marks.

The author has prepared a small handbook of practical information for those interested in the practical applications of the subject. The book is devoid of algebra or quantitative laws, and is divided into five chapters. The first is introductory and preliminary. The second is on military telegraph apparatus, including wire and wireless telegraphy, telephony and optical telegraphy. The treatment is very brief.

The third chapter relates to mine firing. The fourth refers to electric chronographs for determining the velocity of projectiles. This is probably the best chapter and the most modern. The last chapter is devoted to electric lighting motive power and miscellaneous applications.

In many directions the cuts and descriptions refer to archaic forms of apparatus and the book is not up to date in these respects. The treatment is, however, clear, concise and practical.

Theorie und Anwendung des Elektrischen Bogenlichtes. By H. Birrenbach. Hannover: Gebruder Janecke. 350 pages, 266 illustrations. Price, 9 marks.

This volume is a text-book of arc lamps, written by an engineer for engineering students. The graphical method of representing relative magnitudes is developed throughout and brief algebraic formulæ are used where necessary.

The book is divided into seven chapters. The first chapter contains a brief history of the subject and the general laws connecting current, pressure and arc dimensions. The second chapter gives a comparison between various sources of light, including enclosed and open arc lights, in reference to power, cost, etc. The comparison appears in general as unfavorable to enclosed arc lamps—the condition reverse to that holding in this country. Chapter III deals with arc photometry and the units employed. Chapter IV relates to the construction of arc lamps. The mechanisms of the more common forms of German arc lamps is described at considerable length. Chapter V considers the various methods of connecting arc lamps. Chapter VI is devoted to accessory arc lamp apparatus, such as transformers, resistances, indicators, etc.

Chapter VII relates to the applications of arc lamps. These are classified as follows: A, general applications; B, street lighting; C, interior lighting; D, projectors; E, photographic applications; F, medical applications.

The book concludes with a complete list of German arc light patents and an index of contents. The text is clear and the illustrations are excellent. The book will be valued by those interested in the practice of German arc lighting.

New Electric Organ for Denver.

One of the latest examples of church organ manufacture is now being installed in Denver, Colo., at the First Church of Christ, Scientist, Logan and Fourteenth Avenues. The instrument is of the electro-pneumatic type, and when it is completed will cost about $22,000. It contains about 3,200 separate pipes for tone production, ranging from what is called a "speaking length" of 32 ft. to a length of 3/8 of an inch, giving a range of audible vibration of from about 30 per second to 35,000 from the extreme bass to the extreme treble tones—that is, from the "tibia profundissima" to the "harmonic piccolo." The organ is composed of six separate organs: pedal, solo, swell, great, orchestral and echo. The keys are in four banks, each bank containing five octaves and one note, making a total of 244 keys. Each key sounds its proper note by closing a 5-volt circuit through a small horseshoe magnet about 2 in. long, wound with No. 22 wire. The armature of each magnet is about the size of a five-cent piece and covers small air holes which admit the proper air pressure to the organ pipes. This pressure varies from that which will support a water column 5 in. high to that required to support 15-in. column. The electric contacts which are made by the keys are composed of gold wires and platinum strips. These contacts have an extremely low resistance, and do not oxidize as they are used. Current for the operation of the electro-magnets, which open and close the air valves admitting air to the pipes is supplied by a battery of Edison-Lalande cells, consisting of three parallel groups of five cells in series in each group. One group of five cells will operate the magnets.

The total number of stops in the organ is 48. The stops are operated by keys instead of the usual plugs, the organ being one of the only three in America to have this attachment. It is the second organ in the country to have double touch pistons, there being 28 of these peculiar button contacts on the four banks of keys. The object of these pistons is to enable the organist to bring various sets of stops into service without taking his hands from the key banks. Each piston makes two successive contacts, and each contact throws certain stops into operation, so that the old annoyance of having to pull out a long series of stops in securing various tone combinations is largely done away with, constituting an interesting example of the adaptation of the electric circuit as a time-saver in the complex process of rendering a difficult musical score. The platinum and gold contacts alone are valued at over $400. Some of the pedals have double contacts also; an innovation in organ design.

The echo organ is placed in the roof of the auditorium with a set of chimes. The main organ is placed behind and above the reading platform, and all the pipes and mechanism are concealed behind a wooden lattice of handsome design. The console, or playing desk containing the keys, pedals, stops and contacts, is stationary on the auditorium floor at the right of the platform. Compressed air brought through small lead pipes to the console is the agency for producing tonal effects set in combination by the various stop keys.

The organ receives its air supply from a No. 7 Sturtevant blower belt-driven from a 7½-hp, 500-volt, direct-current, two-pole General Electric shunt motor running at 1,650 r.p.m. This apparatus is located in the basement of the church, and is connected with the organist's switch cabinet by cables running in iron-armored conduit. The motor is run open, its closed capacity being but 5.5 hp. The organist's cabinet is a fire-proof recess lined with galvanized iron and asbestos located beneath the reading platform at the left of the console seat. It contains a double-pole, single-throw knife switch and a rheostat with automatic release, both of General Electric make. The organist thus can easily start the blower motor by simply turning to the left and without leaving his seat. The air supply from the blower is further controlled by a damper valve in the flue which leads from the blower room to the organ loft. Over 22 miles of electric cable are installed in the organ proper, and the various parts are lighted by 108-volt, 16-cp incandescent lamps, to facilitate inspection and repairs. This organ is the first in America to be equipped with "tibia plena" pipes.

The church building is a handsome new structure of lava stone, quarried near Salida, Colo. It is admirably lighted throughout by widely distributed incandescent lamps of the frosted bulb variety. The seating capacity of the building is about 1,000 and the total cost, approximately, $150,000. The organ is the work of the Austin Organ Company, of Hartford, Conn., to whose representative, Mr. Herbert Brown, the writer is indebted for these details.

Exhibits in the Electricity Building, St. Louis.

In the southwest corner of the Electricity Building is a complete exhibition of electric heating appliances made by the American Electrical Heater Company, of Detroit, Mich. The modern housekeeper finds that electricity is first a luxury then a necessity when the many labor-saving electrical appliances are placed at her disposal. With the electric smoothing iron she can laundry her own shirtwaists and neckwear, doilies and lingerie, and save many misgivings about her hand-made lace and embroidery. She simply removes a lamp from a socket, inserts a plug attached to a flexible cord and the iron keeps at a constant heat. The company shows a full line of cooking utensils, including complete ranges with ovens, boilers, etc. Individual appliances such as chafing dishes, coffee and tea pots, egg boilers, hot water urns, curling iron heaters are shown in different styles and sizes. Nearly every manufacturing industry needs some tool or apparatus to be heated, and electricity gives the most perfect heat known, as the heat can be conducted to a certain part of the appliance and kept there continuously at constant temperature, allowing the operator to do more and better work than by any other method. Over sixty different styles of pressing and smoothing, or laundry irons, are shown, ranging in weight from twenty ounces to thirty pounds. House and office heaters are shown as well as ovens, plate warmers, foot warmers, glue pots, griddles, pancake cookers, toasters, small stoves like a stove lid from four inches to

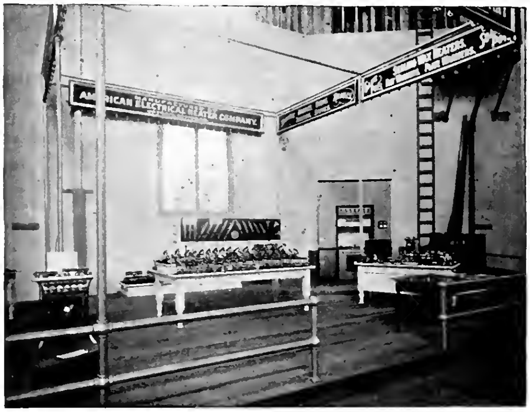


FIG. 1.—EXHIBIT OF AMERICAN ELECTRICAL HEATERS.

sixteen inches in diameter, laboratory plates giving seven heats in different sizes, branding irons for branding cigars and corks, wood-bending forms, soldering irons from ten ounces to four pounds in weight, and numerous other articles. Mr. B. H. Scranton, the president and general manager, was on the grounds for three weeks getting the exhibition in shape, and it was completed when the gates opened on April 30.

The space occupied by the Acheson Graphite Company, near the main entrance of the building, contains miniature electric furnaces which illustrate the processes of Mr. E. G. Acheson of manufactur-

FIG. 2.—ACHESON GRAPHITE EXHIBIT.

ing graphite from anthracite coal or similar raw materials. The different grades of graphite and electrodes of various sizes and forms will be shown, the latter containing practical working samples of different anodes and electrodes as used by the customers of this company for electrolytic work. They illustrate the different methods of machining and assembling the graphite into economical anode forms. For electric furnace work, the electrodes can be joined together end to end and fed into the furnace one after the other as consumed without interruption of the furnace. The graphite bulk products will illustrate the importance of this article in the manufacture of paint, dry batteries, stove polish, motor-generator brushes, etc. Special attention is given to the use of this form of pigment for high-grade protective coatings on structural iron and steel.

The Hutchison Acoustic Company's booth and exhibit were completed at the opening and Mr. M. R. Hutchison gave demonstrations of his acousticon and massacon, electromagnetic instruments for the alleviation of deafness. Two congenital deaf mutes were

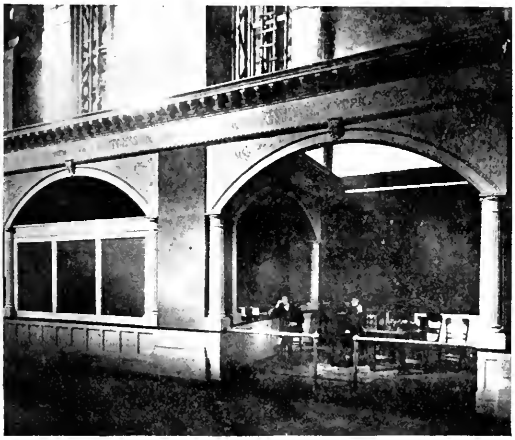


FIG. 3.—EXHIBIT OF HUTCHISON ACOUSTIC COMPANY.

provided by the Educational Department and these boys, who had heard no sound from birth, were made to hear music and the voice by using the acousticon. This instrument consists of a small battery, a specially-designed telephone receiver, and a transmitter which amplifies the sound and imparts the waves to auditory nerves. The massacon is a magnetic instrument which emits sound waves in sharp saw-tooth form and sets the ear drum and auricles in vibration, which stimulates them the same as massage to weakened muscles and restores the ear to normal condition.

The only underground exhibit in the Electricity Building is that of the McRoy Clay Works and the Standard Underground Cable Company near the northwest corner entrance. The installation of the conduit, manholes and cables is just as they are placed beneath the street surface. An excavation is made at one side so that the cross-section of the whole subsurface installation is open to view, as shown in the illustration. The cable reel and capstan are placed at the manholes ready for actual operation. Over the conduit aerial lines and cables are extended between two poles, and these serve to indicate the method of connection and distribution between the

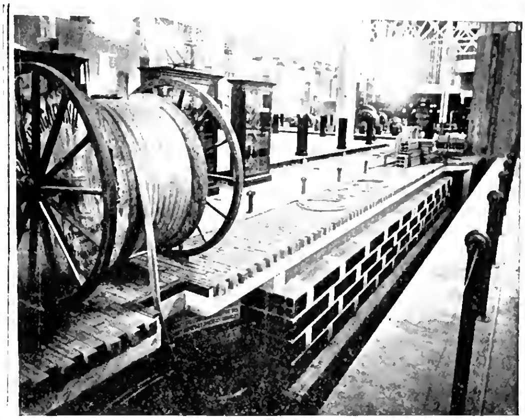


FIG. 4.—EXHIBIT OF M'ROY CLAY WORKS AND STANDARD UNDERGROUND CABLE COMPANY.

overhead and subsurface lines. A number of cabinets contain samples of telephone, lighting and power cables made by the Standard Underground Cable Company.

The Edison historical exhibit, made under the auspices of the Association of Edison Illuminating Companies, contains a collection of early generators, motors and other apparatus constructed under the personal direction of Mr. Edison when electrical engineering was in its infancy. About the walls of the exhibit spaces are hung photographs of the pioneers and their early work. The Jumbo dynamo, made by the Edison Machine Works, direct-connected to a high-speed engine, forms an interesting comparison with the model of the General Electric 10,000-hp Niagara generator, which

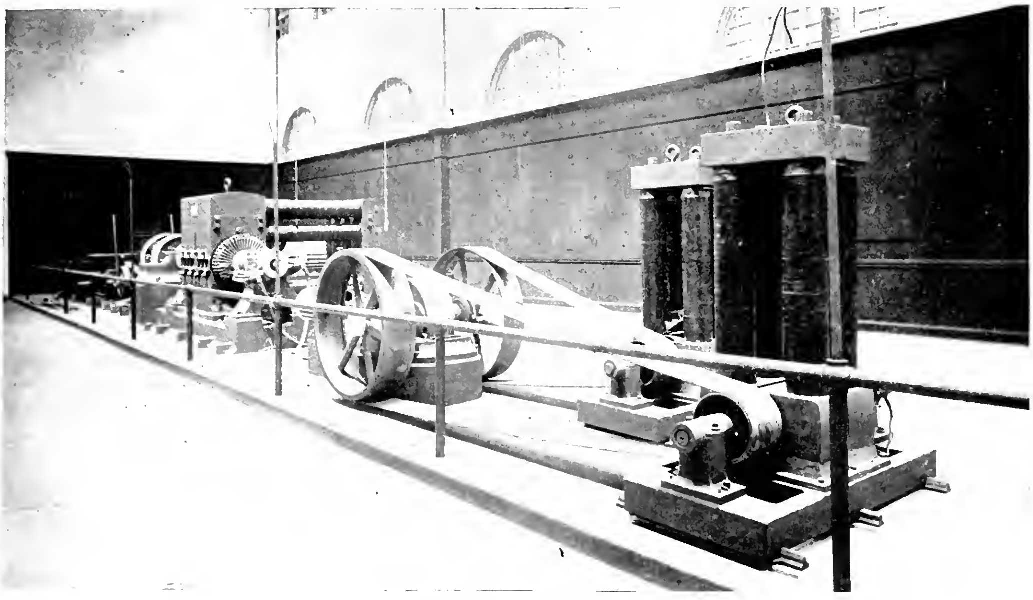


FIG. 5.—EDISON HISTORICAL EXHIBIT.

is across the aisle. The first Edison electric locomotive with its passenger car shows in a graphic way the progress in transportation made since 1880.

The photograph of the British section reveals the splendid display of electrical and scientific instruments made by the English manufacturers. Most of these instruments have been tested and have certificates from Lord Kelvin's laboratory or the National Physical Laboratory. The General Post Office makes an excellent display of the telegraphic apparatus used in Great Britain. Kelvin and

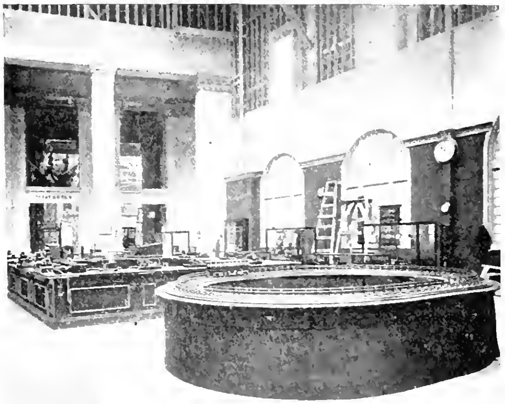


FIG. 6.—ENGLISH EXHIBIT.

James White, of Glasgow, and Muirhead & Co., of Kent, have cases of galvanometers, condensers, standard cells, ammeters, voltmeters and other instruments of precision. In the foreground may be seen a working model of Behr's monorail and high-speed car as authorized by act of Parliament for the railway between Manchester and Liverpool, to be operated at a speed of 110 miles per hour.

The greater part of the space of the Wagner Electric Company, of St. Louis, in Section 6, is occupied by the various applications of single-phase alternating-current motors. This includes the standard form, enclosed, semi-enclosed and back-geared types, from 1/4 to 35 hp. The notable feature of these motors is their starting under

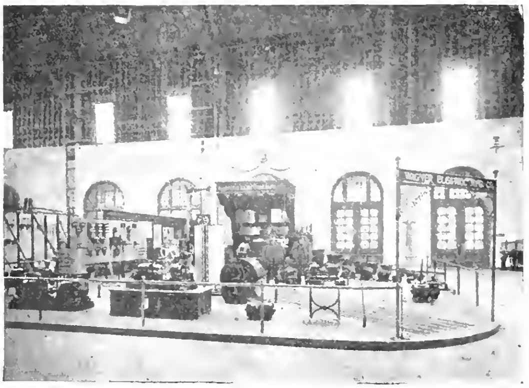


FIG. 7.—EXHIBIT OF WAGNER ELECTRIC MANUFACTURING COMPANY.

load by simply closing a switch. Such a simple starting arrangement makes the motors specially applicable to pumps for different kinds of service, carbonators, as used in drug and confectionery stores, and fans. The noiseless operation of the motors has won them a place for organ-glowing as applied to ordinary bellows in connection with a speed-varying pulley and special centrifugal pressure blower. Other industrial applications are shown in operation, such as machine tools, bakery machinery, etc. In this connection a special speed-changing device is exhibited whereby a machine tool with a single-phase alternating-current motor has all the advantages of control that it would have with a direct-current multivoltage drive. A standard line of transformers from 6/10 kw to 50 kw are shown, in different types of self-cooled, water-cooled and air-blast. A handsome five-panel switchboard is erected at one side, and carries a full equipment of instruments and oil-break switches made by the Wagner Company. Two of the panels are for the operation of the motors and the other apparatus in the exhibit. In the Wagner booth are many interesting photographs and diagrams showing the performance of the various types of machines. There is an office equipment and telephone connection with the down-town office, which are freely and courteously at the disposal of visitors.

The exhibits of electro-therapeutic apparatus are centers of interest to the visitors on account of the high-potential discharges and the X-ray demonstrations. One of the most attractive of these is that of W. Scheidel & Co., which is near the main entrance in Section 4. There is exhibited a complete line of standard X-ray coils, mercury turbine interrupters, Oudin resonators, rheostats, operating and coil tables complete with volt and ammeters, motor and primary rheostats, switches and split-second-stop watches, cab-

FIG. 8.—EXHIBIT OF W. SCHIEDEL & CO.

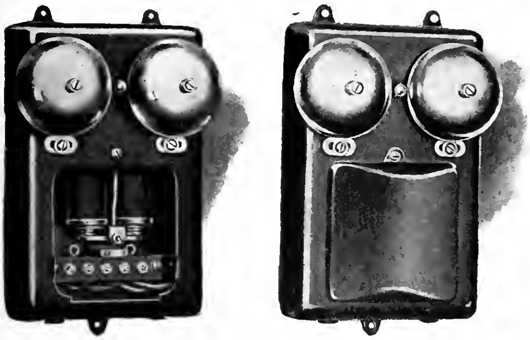
inets containing complete outfits, illuminating cabinets, various tubes, rectifying interrupters for transforming alternating current into direct-curent, fluoroscopes, storage batteries, tube stands, shields and electrodes for local and therapeutics treatments, and a large collection of photographs. Physicians and laymen alike are attracted by the high-potential, high-frequency currents produced by the Oudin resonator, which operates in conjunction with a Leyden jar. The alternating discharge of the jar may be at the rate of a million a second, but by placing a large resistance in the circuit the oscillations are dampened. In order to get from the oscillations of the Leyden jar circuit, currents of high frequency, three different types of machinery are used, namely, the hyperstatic, in which the therapeutic currents are of high potential and are produced by induction; the d'Arsonval spiral or coil, in which currents of low potential are shunted from the Leyden jar circuit by self-induction, and the Oudin resonator.

The resonator consists of a large helix of heavy copper wire, on the lower part of which are passed strong oscillating currents from Leyden jars, which are excited by a coil of sufficient capacity. The upper and longer portion of the helix is not traversed directly by these currents, but is thrown into electric vibration, in harmony with the oscillating currents in the lower part; and these vibrations have a much greater range than the original oscillations. The resonator is regulated by shifting the movable contact near the base of the coil, in front; by varying the rate of interruption of the primary current, and by varying the spark-gap of the resonator. This apparatus can be used as a substitute for static machines, and for Finsen light in the treatment of many forms of disease. All the Scheidel apparatus is connected for operation and a competent demonstrator is in attendance at all times.

Common Battery Telephones.

The Kellogg Switchboard & Supply Company, of Chicago, is constantly adding to and improving its telephonic apparatus, and we now illustrate its latest types of desk telephone and desk set box. In the desk telephone the tubular construction does away entirely with the unsightly wear or tarnish caused by handling the usual nickel-plated standard. The mechanism is dust-proof and cannot be tampered with as it is entirely enclosed.

A tubular standard and a hollow brass base support and contain all the parts of the stand. The transmitter is adjustably hinged to the top of the standard, and two cords, concealed their entire length, lead from it to their proper connections in the base. This base is



FIGS. 1 AND 2.—DESK SET BOX, OPEN AND CLOSED.

covered by a handsome nickel-plated brass shell, and in it are mounted a condenser, the hook switch, a retardation coil and two rubber terminal blocks for the receiver and desk stand cords. The condenser is of a special construction designed to give a comparatively large capacity in a small space. The retardation coil is also of an especially

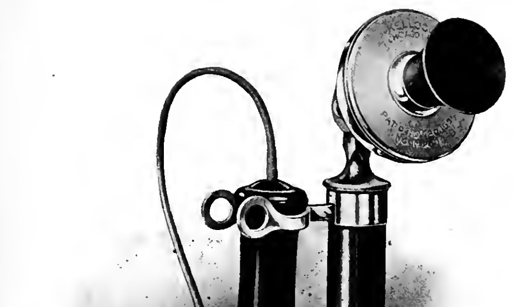


FIG. 3.—DESK TELEPHONE.

compact design. All parts in the base are normally enclosed by an iron plate which fits over the bottom.

The lever of the hook switch is a long L-shaped piece pivoted on the standard, the short arm of which terminates in the fork for the receiver while the long arm extends down through the hollow standard to the base, where its insulated end engages with the hook spring switches. This lever is actuated by a stiff leaf spring.

The new type of Kellogg desk set box is also illustrated herewith open and closed. The compact box is shallow so that it may be mounted in any convenient place about a desk without being in the

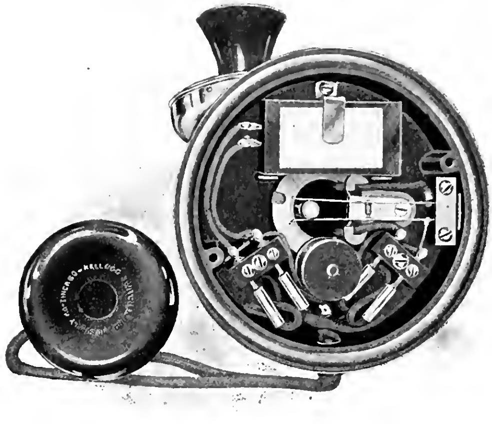


FIG. 4.—VIEW OF INTERIOR OF DESK SET BASE.

way. Standard parts are mounted in a pressed steel case, finished with black enamel. There are enclosing lids front and back, which when removed expose the ringer, condenser and connecting rack. It is intended for either individual or two-party line service and besides being in black is furnished also in white or maroon enamel.

Power and Mining Machinery Contracts.

The Power & Mining Machinery Company (formerly the Loomis-Pettibone Gas Machinery Company, of New York, and successor to the Holthoff Machinery Company, of Cudahy, Wis.), New York, has just been awarded a contract for the equipment of the new power plant of the Wellington Meat Export Company, a British capitalized concern, which operates a large works at Wellington, New Zealand. The value of the contract is almost $125,000. The existing power plant is operated by steam, and owing to the excessive cost of coal in that part of the world the installing of the gas generating equipment and electrical machinery, for which the Power & Mining Machinery Company has the complete contract, is expected to result in a saving of 75 per cent. in fuel.

There will be a 3,000-hp gas generating outfit comprising six generators of 500-hp capacity each, to operate on the Loomis-Pettibone system. Crossley two-cylinder horizontal gas engines will be installed. There will be nine engines aggregating in all 1,415 hp. Three will be of 225-hp capacity each, direct-connected to 150-kw, direct-current, 250-volt electric generators. There will also be two 200-hp Crossley engines, one 160-hp and also a 100-hp engine, which are to be used for driving refrigerating machinery. Gas generated by the same plant will also be used for the large melting and heating kettles. The entire power plant will be in full operation, it is anticipated, in December of this year. Mr. W. H. Morse, one of the Power Company's engineering experts, is now in New Zealand regarding the contract. The electric generators have not yet been purchased.

The Power & Mining Machinery Company will next week complete the installation of the largest power plant of its description in the hemisphere, at Velardena, in the vicinity of Durango, Mexico. The contract was secured from the Velardena Mining & Smelting Company, which concern is controlled by the Guggenheim Exploration Company, New York. The plant will have a capacity of no less than 3,000 hp and consists of five 600-hp Crossley two-cylinder horizontal gas engines to be belted to alternating-current electric generators of 350-kw capacity each. The electric generators were built by the General Electric Company. Power will be generated for transmission to a group of copper, silver and lead mines, including the famous Copper Queen property and the Teneras & Santa Maria mines. The transmission line is about 50 miles long. The voltage is 13,000.

A contract has been secured for the installation of a 300-hp plant for the purpose of lighting Newton, N. J. There will be two American Crossley two-cylinder horizontal gas engines of 200-hp and 100-hp capacity respectively. These machines are to be direct-connected to 150-kw and 75-kw alternating-current electric generators.

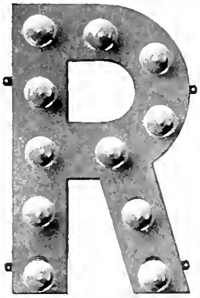
Convention of National Electrical Contractors' Association.

A special train will leave the Grand Central Station, New York, at 1 p.m. September 10, for St. Louis to convey the delegates to the fourth annual convention of the National Electrical Contractors' Association of the United States, which will be held in St. Louis September 14, 15 and 16. The train will arrive at St. Louis next evening at 6.45 o'clock. On account of the exceedingly low rates issued by the several passenger associations between St. Louis and other points it has been unnecessary to secure a special rate on the certificate plan for the benefit of delegates and visitors to the convention. The headquarters for the Eastern delegates will be at the Washington Hotel, which is within easy distance of the fair grounds. Mr. Alex Henderson, 527 West Thirty-fourth Street, New York, is master of transportation, to whom communications should be addressed.

Electrically Illuminated Roof Signs.

The desire to attract customers or to impress a firm's name or the character of a business on the inside of the public cannot be met better than with an electric roof sign, which, while it may cost from 50 cents to $5 an hour in operating expenses, is bound to be read by all the people who pass within a number of blocks, and, possibly, if it be a large sign, within a number of miles of the lôcality where the sign is placed.

The exposed position of such signs calls for solid metal construction. Such signs in all sizes have been designed and are constructed by the Haller Machine Company, of Chicago. The letters they make are indestructible and perfectly water-proof. The company is glad to furnish data as to what the operating expenses of such a sign would be. Any local electrician can connect the sign to service wires, and electric light companies are usually prepared to furnish low special rates for current for this purpose.

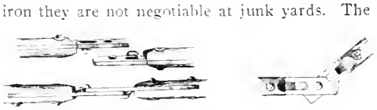


ROOF SIGN.

Underground Conduit Rods.

Since the original appearance of screw joint couplings many designs have been put upon the market and a new one is found in the "Security Conduit Rod."

The design is simple and not likely to get broken in a wagon or in a manhole. This is important, because the handling is severe. Made of iron they are not negotiable at junk yards. The joint with the wood is made by rivets holding large washers; the wood, being hickory, does not split easily, and there is no chance for a break. Coupling and uncoupling is done very quickly, and when in the duct there is no slack between joints, nor can they possibly uncouple, although they will lend themselves to moderate bends.



CONDUIT RODS.

In weight they are light, and long runs can easily be handled by one man. The standard lengths are three and four feet. The rods are easily handled in manholes, quickly jointed and unjointed, and will stand abuse. The couplings lock together rigidly and the rods will not buckle under pressure nor bind against conduit walls. There is no slack between rods. These rods are the product of the Bissell Company, Toledo, Ohio.

A Large Transmission Cable Order.

The Mexican Light & Power Company, Limited, of Montreal, Canada, recently placed with the Ansonia Brass & Copper Company, 99 John Street, New York, an order for copper cable for transmission, which is probably the largest single order for transmission cable ever placed. The order calls for 1,500 miles of cable, equal in carrying capacity to 3/0 B. & S. gauge, and weighing approximately 4,200,000 pounds. The cable is to be used on the Nicaxia-Mexico power transmission line, now under construction, and it will be supported on steel towers in spans of 500 ft. The length of the spans, together with the necessity of reducing the dip as much as possible and the high wind pressure to be withstood, made the matter of cables one of considerable importance. The cable furnished by the Ansonia Brass & Copper Company was designed by Mr. W. G. Clark, of Seattle, Wash., electrical engineer. Mr. Clark found that the cable should have the highest possible elastic limit to withstand the strain; high conductivity to reduce to a minimum the area exposed to wind pressure, high ductility to reduce the possibility of the strands breaking at the ties, and also that each length of cable should be made without splices in the strands to maintain an even temper and elongation; while the cable should be made in lengths as great as could be conveniently handled on the ground, and so designed that the strain should be evenly distributed between the constituent strands—each strand carrying its own portion of the load. A series of experiments demonstrated that while the ordinary concentric laid cable did not meet these requirements, the cable designed by Mr. Clark met the conditions in a satisfactory manner.

FIG. 1.—SHOWING METHOD OF SPLICING.

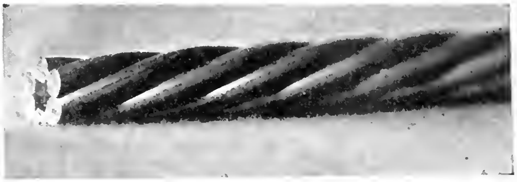


FIG. 2.—ELASTIC CENTERED CABLE.

FIG. 3.—SPLICE OF ELASTIC CENTERED CABLE.

The wires composing the cable receive a special treatment, both while the rod is being rolled and while the wire is being drawn. To secure a high elastic limit without sacrificing ductility and conductivity the cable is laid up of six wires around a soft compressible center, which is compressed as the cable is laid up, and still further compressed when the cable is placed under tension on the line. As all the strands are of equal length, compressing the elastic core, the strain is evenly distributed between the strands. After the cable is stretched in position, the core is no longer of service, and may decay or be removed without affecting the even distribution of the load. The core is so compressed that the space taken up by it is of no importance, but it materially increases the flexibility of the cable, making it more convenient to handle during erection.

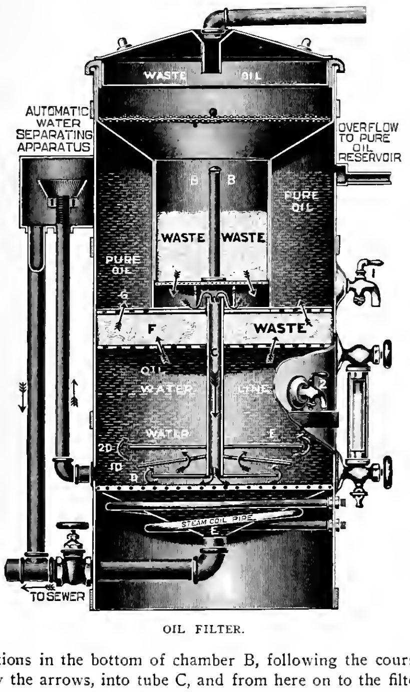
The splices in the line will be made by passing the ends of the cable through a copper tube, driving a taper pin in each end to replace the soft core, and then twisting the sleeve. A joint 12 in. in length made in this way shows one-fourth the resistance of an equal length of cable, and the wires are so firmly compressed into the copper tube that they are not affected by corrosion.

Some idea may be gained of the size of this order when it is considered that the cable, in a single length, would reach half way from New York to Seattle, Washington. The wires composing the cable, each almost as large as an ordinary lead pencil, would, if connected in a continuous length, reach entirely through the earth at the equator, with a thousand miles over; or would reach practically from New York to Manila. The reels required for shipping the cable would, if piled lying flat upon one another, make a pile 7,400 ft. high, or almost a mile and a half.

Oil Filter for Large Plants.

The Burt Manufacturing Company, Akron, Ohio, is the manufacturers of the oil filter shown in the accompanying sectional view, designed to receive the condensation from oil separators or exhaust heads and to automatically separate the oil from the water, while at the same time purifying it. The water is drained to the sewer and the pure oil, rising into a separate chamber, overflows into the pure oil reservoir. The filter is made in twelve different sizes, with filtering capacities of from 300 to 500 gallons per 24 hours.

The mixed oil and water is received through the inlet at the top of the filter and then passes through a layer of waste, which collects all the heavier impurities of the oil. Thence it passes through the



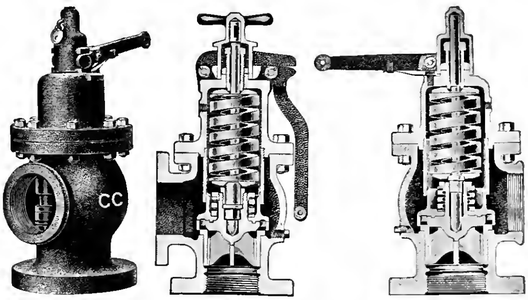
OIL FILTER.

perforations in the bottom of chamber B, following the course indicated by the arrows, into tube C, and from here on to the filter plate D. The increased weight of the water has a tendency to keep the oil back in tube C, but when the pressure of the oil in chamber B becomes sufficient the oil is forced down and spreads over the plate D in a very thin film. This constantly changes surface and grows thinner as it travels from the center to the circumference of plate D, thus exposing every particle of oil to the action of the water. It then flows on to plate 1D and 2D, going through the same process in each case. When the oil leaves the plate 2D it is in a finely divided state and is thoroughly washed by the water. It is separated from the water by gravity, and all the remaining impurities settle in chamber E, from which they can be drained to the sewer by opening the gate valve at the bottom of the filter. From the plate 2D the oil rises and again filters through F, another layer of waste, into the pure oil chamber, where it accumulates until it overflows into the oil reservoir. The water is automatically separated after it passes down the tube C and reaches the bottom plate, on account of its being heavier than the oil, and the surplus water passes into the pipe leading to the automatic water separating device.

Pop Safety Valves.

The constantly increasing demand for Crane patent "pop" safety valves has made it necessary for the Crane Company, Chicago, to increase the capacity of its manufacturing departments on these goods. It has also brought out a number of improved forms of pop valves for stationary, marine, locomotive and portable boilers; also a variety of cylinder reliefs, water reliefs, high-pressure and hydraulic relief valves for all purposes and pressures.

The construction of these valves embodies a self-adjusting feature which automatically regulates the "pop" of the valve or maintains the least waste of steam between the opening and closing points, an improvement which will be readily appreciated, as there is no necessity of re-adjusting to regulate the pop on changes in the set pressure.



POP SAFETY VALVES.

In all pop safety valves it is necessary to have a "pop" or "huddling" chamber into which the steam expands when the main valve opens, thereby creating an additional lifting force proportionate to this increased area and greater than the force of spring, thus holding the valve open until pressure is relieved. Means must also be provided to relieve this "pop" chamber of pressure, in order to allow the valve to close promptly and easily. This is accomplished by the self-adjusting auxiliary valve and spring, which are entirely independent of the main valve and spring. The steam in the "pop" chamber finds a passage through holes or ports into an annular space provided in the auxiliary valve or disc, and by reason of the light auxiliary spring this pressure lifts the auxiliary valve and allows the steam in the "pop" chamber to gradually escape, thus permitting a greater range in setting pressures with the least waste of steam and at the same time supplying a cushion or balancing medium, thereby preventing any chattering or hammering and affording the easiest possible action in closing.

The encased spring valves are constructed with a casing or chamber enclosing both springs, protecting them against the action of the steam, particularly high pressure, which, blowing with great force and velocity throughout all parts of valve before reaching the atmosphere, would otherwise have a tendency to disarrange the springs and other parts operating in connection therewith. This form of valve is also particularly useful where a number of valves may be connected to one main exhaust or discharge pipe. The encased spring chamber, extending over a greater portion of the top surface of the main valve, prevents any retarding action of the steam due to back pressure, which might be caused by one or more valves opening slightly in advance of another, in having any material effect on the free opening of the other valves.

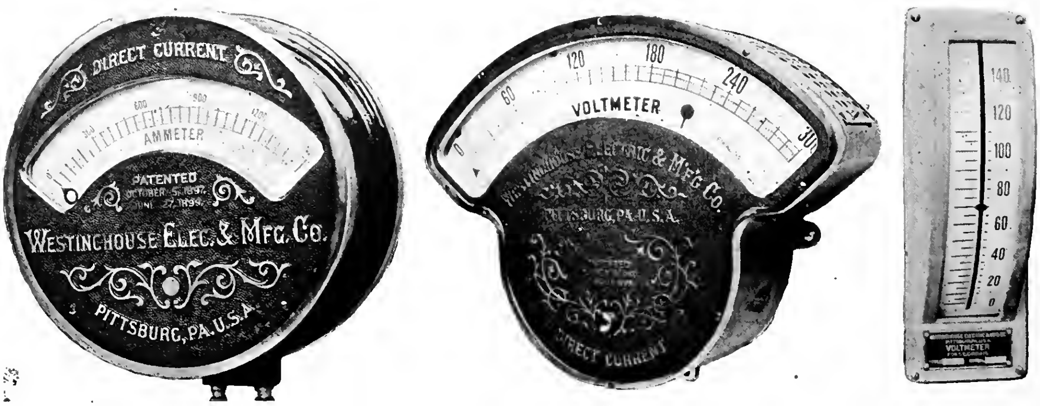
Direct-Current Switchboard Instruments.

The accompanying illustrations show a line of direct-current switchboard instruments, possessing new and novel features in their design, and which have recently been adopted for use in many high-class installations where the best of everything is required.

Three general styles are shown, the principles of operation being the same in all, but the cases and general construction differing to conform to the requirements of service. The type shown in Fig. 2 is furnished with a round case, that of Fig. 2, with an illuminated dial, and Fig. 3 is an edgewise pattern having a narrow case as shown in the illustration. All cases are dust-proof and their appearance is ornamental in effect.

In shape, size and general appearance, the instruments of Fig. 1, known as type D, correspond with the other round pattern switchboard instruments manufactured by Westinghouse Electric & Manufacturing Company. The scale is longer than that of any other similar instrument, and the divisions, which are spaced uniformly throughout, are large and open. The instrument shown in Fig. 2, known as type E, has two tabular lamps, which are so arranged in a separate ventilated compartment as to give a uniform distribution of light over an opal glass scale 20 in. in length.

The width of the cases in the edgewise pattern, known as type H, is only 5¼ in. This permits more instruments to be mounted side by side than is possible with the round pattern, when space is limited. The angle or position of the scale and the large open markings facilitate accurate readings.



Figs. 1, 2 and 3.—Direct-Current Switchboard Instruments.

In construction, these instruments combine a strength which will enable them to withstand rough usage, and a sensitiveness necessary for reliable indications. The magnetic system consists of two permanent horseshoe magnets bolted to a pair of parallel soft-iron pole pieces, the lines of magnetic force passing across the air-gap between the upper and the lower pole pieces. Enclosing the upper pole piece, but not touching it, is a movable coil of fine wire wound around an oblong aluminum bobbin. This coil is attached to the framework of the movement and its weight is just sufficient to counterbalance the weight of the pointer. This construction allows a very long scale and also permits the removal of the movement without taking off the magnets. The indications are dead-beat.

The pole pieces are attached to the permanent magnets before they are magnetized and aged and there is, therefore, no possibility of the magnetic condition being disturbed in assembling or repairing. They are kept in stock for a long time after the treatment is finished and any magnets which upon final test show change of magnetic properties, are rejected.

The controlling springs are not supported by the movement as is usual in other instruments, but are mounted on stationary brass rods in the ends of which the sapphire jewels are set. This arrangement materially reduces the weight on the pivots and in conjunction with the light weight of the moving element (which is made entirely of aluminum) and the excellence of the bearings, in which pointed steel pivots rest in the finest sapphire jewels, free the instruments from any influence by friction.

The ammeters operate from shunts made from resistance metal having a very low temperature coefficient and arranged for connection to the bus-bars. A record of the resistance of each is kept on file as well as sent with each meter, so that when an ammeter is to be calibrated or replaced by a new one, it is not necessary to disturb the bus-bars. In order to calibrate one of these ammeters, it is only necessary to connect a portable millivoltmeter in parallel across the same shunt.

Electric Automobile Charging Panel.

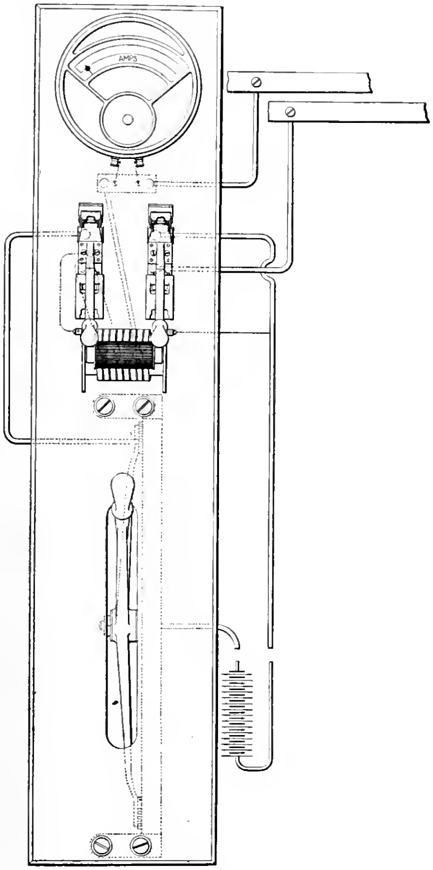
The wide application of storage batteries as a source of power for electric trucks and automobiles, has brought forward the matter of battery protecting devices best suited to the requirements of this class of service. On the manner in which the storage battery is handled, largely depends the successful or economic service of the electric vehicle. If the battery is charged at too high a rate—that is, the charging current is too great—the plates of the battery are destroyed; while a discharge of the battery under abnormal conditions will also cause serious damage to the battery. Careful attendants, guided by suitable measuring instruments, will minimize these dangers, but what is desired is an automatic device which will protect the battery in case of any abnormal condition.

The accompanying illustration is of a standard electric automobile charging panel; on it is mounted an ammeter, a rheostat and an overload and reverse-current circuit-breaker of the "Dublarm" type, which acts as a combined hand switch and circuit-breaker.

The ammeter shows the current flowing into the battery and can be supplemented by a voltmeter which would show the voltage; but, where a number of these panels are used, one voltmeter on a swinging bracket at the end of the board usually serves for all the feeders. The rheostat in series with the line varies the voltage of the charging circuit and in that way allows the charging current to be either increased or diminished as required while the battery is being charged.

The circuit-breaker acts as the main feeder switch, and is so designed that it automatically opens the circuit the instant the charging current exceeds an allowable amount. It is provided with a calibrated scale, which can be adjusted so that the circuit-breaker will open at any desired current, and also automatically open in case the current should flow from the battery into the charging circuit, which would discharge the battery and possibly ruin the plates. Both the overload and the reverse current features are absolutely positive in their operation.

This circuit-breaker is made by the Cutter Company, of Philadelphia, and is one of their "Reversite" types, which have been very largely used by the United States Navy for the protection of storage batteries used in connection with their naval telegraph equipments. They are also used extensively for the protection of



CHARGING PANEL.

storage batteries in telephone exchanges, and are made single, double and triple-pole in any capacity to meet the various requirements.

Measuring Currents in Cables.

A simple apparatus for measuring the current at any point of a cable and thereby determining the load on a feeder or at a point of a distribution network, is shown in the accompanying illustrations, the apparatus being made by the General Electric Company. It consists of a special transformer having a hinged magnetic circuit and a standard Thomson inclined coil ammeter.

The magnetic circuit of the transformer is of specially treated iron thoroughly laminated and accurately machined. Special attention has been given to the hinged and clamping joints so as to insure the best possible magnetic path. The former is provided with a strong and easily manufactured locking device, which insures a uniform and positive contact. The transformer windings, which are placed on either arm of the hinged magnetic circuit, are of 5 amp. capacity and designed to withstand 2,300 volts potential between the windings and core. High insulation is secured by winding the coils on heavy insulation wrapped around the hinged iron core, and is further safeguarded by thoroughly impregnating the windings with a special insulating compound.

In order that the serviceableness of the testing outfit may be further increased, flexible duplex leads 40 ft. in length are supplied with each set. The transformer can thus be clamped in position around the conductor and the ammeter removed to a more convenient place for reading. The ammeter is constructed so as to withstand the hard usage to which portable instruments are subjected. Each instrument is provided with an armature locking device, which, when the instrument is not in service, lifts the pivots from the jewels and prevents damage to these parts. In order that accurate and rapid read-

FIG. 1.—TRANSFORMER WITH PORTABLE AMMETER.

ings may be taken, the instrument is provided with a damping device, which enables the indicating pointer to be brought quickly to rest after each change of current. The scale is satisfactory as to length, legibility and distribution—a fact of much importance in making tests covering wide ranges of current.

When a test is to be conducted the terminals of the duplex leads

FIG. 2.—TRANSFORMER OPEN.

should be inserted in the ammeter binding posts and the transformer jaws firmly clamped in position around the cable. The transformer will maintain within commercial limits its ratio accuracy from one-eighth load to 25 per cent. overload. The combined weight of the transformer and ammeter is about 25 pounds.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was extremely dull with alternating periods of depression and slight rallies on short covering. Trading was narrow, the inactivity of business and the unsettled crop outlook tending to create some bearishness. Features were lacking, the principal trading having been in the Steel shares, Consolidated Gas and Erie, with alternating weakness and strength. Reports were heard that Brooklyn Rapid Transit is likely to show largely increased earnings during the summer, but they had no visible effect on that stock. Amalgamated Copper was the object of a certain amount of trading, but with negative results. Among the industrials, Allis-Chalmers common kept steady at 6 throughout the week, which figure was also the closing price. Preferred closed at 39¾, a net gain of ¼ point. General Electric lost 2 points in the week's trading, the prices ranging between 153 and 156¼, the closing quotation being 155. Westinghouse made a gain of 1⅛ points net, closing at 156⅛. The traction stocks were firmer and all closed with net gains. Brooklyn Rapid Transit closed at 46⅜, a gain of ⅝ point; Metropolitan Street Railway at 111, a gain of ¼ point, and Manhattan Elevated at 142½, a gain of 1 point. Western Union lost ¾ point, closing at 87¼. Outside securities were heavy as to prices and transactions were limited. Interborough Rapid Transit closed at 112, after having declined to and recovered from 106⅜, the closing figure being a net gain of 4½ points. Following are the closing prices of May 24:

NEW YORK.

	May 17	May 24		May 17	May 24
Allis-Chalmers Co.	6¼	6½	Electric Vehicle	4¾	5½
Allis-Chalmers Co. pfd	40	39⅛	Electric Vehicle pfd	9	9
American Tel. & Cable	86¼	87	General Electric	154	156
American Tel. & Tel.	123	125	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	110	110⅛
Brooklyn Rapid Transit	45¾	46⅜	N. Y. & N. J. Tel	..	..
Commercial Cable	180	180	Marconi Tel	..	..
Electric Boat	26	25	Western Union Tel	87	86½
Electric Boat pfd	60	60	Westinghouse com	153¼	155
Electric Lead Reduction	⅝	⅝	Westinghouse pfd	175	180

BOSTON.

	May 17	May 24		May 17	May 24
American Tel. & Tel	124	125	Western Tel. & Tel. pfd	77	77
Cumberland Telephone	113¼	113	Mexican Telephone	1¼	1¼
Edison Elec. Illum	234	234	New England Telephone	*123	*121¾
General Electric	152	155	Mass. Elec. Ry	17½	18
Western Tel. & Tel	8	*7	Mass. Elec. Ry. pfd	69½	70½

PHILADELPHIA.

	May 17	May 24		May 17	May 24
American Railways	44½	44½	Phila. Traction	96	95¾
Elec. Storage Battery	55	55	Phila. Electric	5½	5⅛
Elec. Storage Battery pfd	55	55	Phila. Rapid Trans	*13½	12¾
Elec. Co. of America	8	8			

CHICAGO

	May 17	May 24		May 17	May 24
Central Union Tel	..	.	National Carbon pfd	102	101¾
Chicago Edison			Metropolitan Elev. com	15	16
Chicago City Ry	155	156	Union Traction	5¼	5½
Chicago Tel. Co	..		Union Traction pfd	29	29
National Carbon	29	29			

*Asked

BOSTON EDISON.—A Boston dispatch to the *Wall Street Journal* says: "By the payment May 2 of the final instalment on its new stock, the Edison Company has taken up about $500,000 of its notes, leaving at present $1,000,000 still outstanding. These notes are of various maturities, the longest being for a year, and the latter bearing a 4 per cent. interest rate. Additional notes of about $1,000,000 will be issued between now and next winter, when a 10 per cent new stock issue will be made, which will clean up the entire floating debt. The Edison Company has not yet taken over the electric business of the Woburn Electric Company, owned by interests friendly to the former company. The electric business of the Chelsea and Newton & Watertown gas and electric companies also has not been taken over. These companies are owned by interests representing the Edison Company and Massachusetts Gas Companies. With the Bay State gas suit now settled, it is expected that early action will be taken to assimilate these properties, the gas business in each instance going to the Massachusetts Gas Companies and the electric business to the Edison Company.

KINLOCH TELEPHONE IN ST. LOUIS.—It is stated that financial arrangements have been completed by the Kinloch Long Distance Telephone Company of Missouri with a St. Louis banking syndicate, whereby it, together with other leading independent companies of the country, will be enabled to perfect a trans-continental long-distance system. The Kinloch Co. will shortly file a first mortgage deed of trust to the Mississippi Valley Trust Company, of St. Louis, trustees, covering all of the suburban and interurban properties embraced in the long-distance service. The deed of trust will secure an issue of $5,000,000 first mortgage 5 per cent. 25 year old gold bonds, dated 1904 and maturing in 1929, and the specific purpose of the mortgage is to provide additional capital for extra outlays needed for additions, extensions and other like improvements. It is the intention to eventually gridiron the southwest with lines and with the co-operation of half a dozen of the largest companies not allied with the American Bell Telephone Company, a powerful organization is expected.

COLORADO TELEPHONE.—The Colorado (Bell) Telephone Company reports as follows for the year ending December 31, 1903, and preceding years:

	1903.	1902.	1901.
Gross	$1,294,837	$1,083,037	$858,820
Expenses	977,733	771,231	625,956
Net	$317,104	$311,806	$232,864

The company's capital stock on December 31 was $4,153,000, an increase of $753,550 over 1902. The number of subscribers stations is now 30,226, an increase of 6,753 over 1902. Of the expenditures of $977,733, $289,211 or 29.6 per cent. was charged to maintenance. The American Telephone and Telegraph Company on June 30 last owned $1,744,250 of the $3,400,000 capital stock or 51 per cent.

NEW ENGLAND TELEPHONE.—The New England Telephone and Telegraph Company will in all probability issue additional stock this summer for new construction. It has been the custom of the company for several years to issue additional stock annually, but the rule was broken last year, as the financial conditions were not propitious for a new stock issue and the company was well provided with funds. The growth of the company's business, averaging about 15,000 new subscribers annually, requires about $2,000,000 new capital each year for new construction. For the first three months of this year there were 4,000 new subscribers added, making total subscribers March 31, 130,138. The last new stock was issued in June, 1902, stockholders being offered 36,047 new shares at par on the basis of one new share for each five owned.

THE CALIFORNIA GAS AND ELECTRIC CORPORATION held its annual meeting in San Francisco on April 3. The first monthly dividend of 25 cents per share was declared payable May 16. It was decided to set aside $1,000,000 for betterments and extensions during the coming year. Additional electrical machinery will be installed to operate the Sacramento Electric Gas and Railway Company's system. A large amount will be expended on improving the Standard Electric transmission system, which was recently acquired. An additional 4,000-kw generating unit will be installed this summer at the De Sabla power station.

NIAGARA FALLS POWER REPORT.—The Niagara Falls Power Company reports as follows for the six months ended December 31, 1903: Gross, $579,550; net, $481,060; other income, $37,296; total net, $518,356; surplus after charges, $144,416; improvements, betterments, etc., $42,199; surplus, $102,217. Fixed charges, taxes, etc., include interest for six months on $10,000,000 first mortgage bonds, and on the 6 per cent. debentures issued for the construction of power house No. 2 and one-half of all taxes for the year. Surplus for the six months amounts to about 4 per cent. on the outstanding stock.

NORTH AMERICAN IN ST. LOUIS.—The Laclede Gas Light Company sold recently to N. W. Harris & Co., $4,000,000 5 per cent. 30-year bonds, which has enabled it to pay off the short time notes issued a few months ago, besides giving abundant funds for all purposes. N. W. Harris & Co. sold the entire issue, mostly in the West, before the bonds could be engraved. The North American Company now has its new power plant at St. Louis practically completed, the engines having been installed, and is ready to furnish power to the St. Louis car lines.

CHARLESTON GAS AND ELECTRIC.—The Consolidated Railway Gas and Electric Company, of Charleston, S. C., for year ended February 28, 1904, showed gross $538,173, and surplus after expenses, fixed charges, sinking fund, etc., $22,161.

SOUTHERN ILLINOIS TROLLEYS.—It is stated in Chicago dispatches that the Southern Illinois Electric Traction Company has voted an increase in capital stock from $50,000 to $2,000,000. An extensive system of electric railroad is to be built in the vicinity of Mount Vernon, Ill.

MISSOURI BELL TELEPHONE.—The Bell Telephone Company of Missouri has been given authority to increase its capital from $4,000,000 to $10,000,000 for the extension of its business and system.

BUYING WIRELESS PATENTS ABROAD.—A cable dispatch from London states that a syndicate represented by Charles J. Glidden and E. Bertram Newton, of Boston, have purchased the rights to use the Armstrong-Orling wireless telegraph and telephone patents in the United States and Republic of Mexico. This system has been illustrated and described in our columns. Mr. Glidden is a veteran telephone manager and financier, prominent formerly in the Erie Telephone & Telegraph Company.

BONDS FOR POWER PLANT.—The St. Joseph and Elkhart Power Company has filed a mortgage of $1,750,000 to the New York Security and Trust Company, to secure a bond issue.

Commercial Intelligence.

THE WEEK IN TRADE.—Complaint is still heard of unseasonable weather, trade and the crop situation being affected thereby. According to reports received by the mercantile agencies cool weather is responsible for the slow distribution of spring and summer goods at retail, and the retardation of germination and growth of crops, though permitting good progress in seeding in various sections of the country. In jobbing circles there appears to be a feeling that the spring trade is past, and efforts are now being concentrated on fall business. The industrial situation is somewhat quieter. The strike of masters and pilots of lake vessels continues, with no prospect of settlement. This has had a serious effect on lake transportation. No expansion is indicated by bank clearings, which are considerably behind those of last year. Railway earnings show losses as compared with last year. For the first half of May the decrease in gross is about 4 per cent., and the same percentage of loss is shown for the entire month of April. For the first three months of the year gross earnings are about 1 per cent. less than last year, and net receipts are about 15 per cent less. Money is still easy, but collections are backward. The iron market showed most pronounced weakness, declines ranging from 25 to 50 cents per ton. Among the finished products bar iron is lower at the west, but steady at the east. The other metals are all weaker, copper being dull and heavy at a slight decline. Two hundred and fifteen business failures during the week ended May 16 are reported by *Bradstreet's*, an increase of 14 as compared with the previous week. During the corresponding week last year the number was 155.

BELL TELEPHONE OUTPUT.—The instrument statement of the American Telephone & Telegraph Company for the month ended April 30 and since December 20 is as follows:

	1904.	1903.	1902.	1901.
Gross output	102,907	104,429	108,242	72,396
Returned	42,335	43,491	37,587	33,177
Net output	60,572	60,938	70,655	39,219
Since December 20:				
Gross output	404,475	410,390	387,795	288,505
Returned	151,325	160,137	152,085	122,604
Net output	253,150	250,253	235,710	165,901
Total outstanding	4,032,667	3,400,573	2,761,720	2,118,717

The above statement shows a net output of 60,572, bringing the total number of instruments outstanding for the first time in the company's history above the 4,000,000 mark. The number outstanding on April 30 was 4,032,667, which compares with 3,779,517 outstanding at the close of 1903. The extremely rapid growth of the Bell system apparently shows no signs of let up. The growth in the four months ending April 30, as shown by the net output of 253,150 instruments, is equal to 6½ per cent., or at the rate of 2 per cent. a year. If this rate is continued, the system will have 4,500,000 instruments outstanding by next December. Five years ago the system had 1,125,000 instruments outstanding, and ten years ago it had less than 600,000. The increase in five years has amounted to nearly 300 per cent.; and in ten years to nearly 600 per cent. It will of course be understood that the number of instruments has to be divided by two to get at the actual number of stations.

HUGE PLANT FOR PHILADELPHIA WANAMAKER STORE.—The new Wanamaker department store under construction in Philadelphia is to be equipped with one of the largest, if not the largest, isolated electric lighting plant in this country. While no definite details are available at the moment, it can be said that the capacity will be not less than 3,000 kw. The boilers have already been contracted for with the Babcock & Wilcox Co., New York. The boiler capacity will he 5,300 hp. The Philadelphia store has been designed by D. H. Burnham & Co., of Chicago. Charles Wilks, the Burnham Co.'s chief engineer, is now engaged in drawing up the plans for the electric plant. The contracts for equipment will in all probability be awarded through H. D. Babbit, the electrical engineer of the Thompson-Starrett Co., which concern will construct the building. Mr. Babbit is an old Chicago Edison man. The new Wanamaker store being built between Eighth-street and Broadway, New York, by the same contractors, is to have an 1,800 kw plant, Westinghouse generators and Buckeye engines having been ordered last month. Figures on the Philadelphia plant are expected to be taken in about a fortnight.

INSULATED WIRE FOR JAPAN.—The Safety Insulated Wire and Cable Company, 114 Liberty Street, New York, has received a contract from the Japanese Government contracting firm of Oki & Co., Tokio and Yokohama, for a very large lot of rubber insulated wire. The Artillery Corps, which arm of the United States army has just taken over the submarine mining and coast defense work from the engineering corps, has contracted with the Safety Insulated Wire and Cable Company for a big lot of torpedo cable. The Artillery Corps headquarters are at Willets Point, N. Y. Captains Bailey and Parker are the senior officers. The company has also been awarded the contract for laying the Commercial Cable Company's land cable between Coney Island and 20 Broad Street, New York.

CONTRACT LET FOR 1,000 H. P. MEXICAN HYDRAULIC PLANT.—The electrical engineering and contracting firm of Ugarte & Garcia, Guadalajara, State of Jalisco, Mexico, whose representative, Mr. Ugarte is now in the State, being at the time of writing in St. Louis, has secured a contract for the construction and equipment of a water-power plant of 1,000 hp capacity. The equipment will include three alternating-current generators of 250 kw capacity each for direct connection to water turbines. The transmission line will be about 15 miles long. The equipment, etc., will be manufactured in the United States and the plant is expected to be in running order inside of 12 months.

FEEDER CABLE, ETC., FOR MANILA.—The electrical engineering and contracting firm of J. G. White & Co., New York, which concern has the contract for the construction and equipment of the extensive electric lighting and traction system now being hastened to completion on behalf of an American syndicate at Manila, has awarded contracts for a big lot of triple braid weather-proof feeder cable to the Holmes, Booth & Haydens Co., New York, while the Magnet Wire Company, New York, secured the substantial order for the bare magnet wire.

EQUIPMENT FOR HENRY HEIDE ADDITIONAL PLANT.—An extensive addition is to be made to the candy manufacturing plant of Henry Heide, at Vandam and Hudson streets, New York, which will be equipped with a large-sized electric plant. Mr. C. O. Mailloux, New York, will act as consulting expert regarding the matter while Mr. C. J. Goldmark, of New York, will be the electrical engineer. Plans are now being drawn up and figures will be taken next month.

EQUIPMENT FOR CENTRAL PARK APARTMENTS.—The equipment to be installed in the addition of the Central Park apartment house at Seventh Avenue and Fifty-eighth St., N. Y., has been ordered. There will be a 450-hp outfit. Mackenzie, Quarrier & Ferguson, 114 Liberty Street, secured the contract, which calls for three 150-hp Harrisburg engines direct-connected to General Electric generators of 100-kw. capacity each.

EQUIPMENT FOR NEW BUENOS AYRES THEATRE.—A large electrically operated heating, ventilating and cooling system is to be installed in the $2,000,000 Colon Theatre building now under construction at Buenos Ayres, Argentine Republic. The contracts will be placed in the United States through the export commission house of Kates & Bok, Orient Building, Wall Street, New York.

EQUIPMENT FOR PORTO RICO SUGAR PLANTATION.—M. G. F. Tremain, 135 Broadway, New York, has secured a contract for a Robb-Armstrong engine, built by the Robb Engineering Company, of Amherst, Nova Scotia, for belting to a generator. The outfit will be used for light and power purposes on a large sugar plantation located in the vicinity of Mayaguez, Porto Rico.

EQUIPMENT FOR MICHOACAN MINES.—The Carrizal Gold Mining Company which operates extensive mines in the State of Michoacan, Mexico, will shortly let contracts for the construction and equipment of a fair-sized electric plant. Mr. S. L. Butler, of Salt Lake City, Utah, is president of the company.

BIG STORAGE BATTERY OUTFIT FOR MEXICO.—The Compania Minera de Penoles which Mexican concern operates extensive mines at Mapimi, State of Durango, already equipped with considerable American electrical machinery, is about to install a large storage battery outfit for the smelter plant.

NICARAGUAN POWER TRANSMISSION.—The Siempre Viva Mining Company, of Bluefields, Nicaragua, Central America, is having plans drawn up by Wallace C. Johnson, consulting engineer, Niagara Falls, N. Y., for the construction of an extensive power transmission system.

EQUIPMENT FOR ERIE BASIN IRON WORKS.—The Erie Basin Iron Works, which are controlled by the Krawjenski-Pesant

Co., sugar machinery manufacturers, New York, is to be equipped with considerable electrical equipment, including an alternating-current crane.

THE FIBRE CONDUIT COMPANY, Orangeburg, N. Y., reports that between April 1, 1903, and April 1, 1904, the number of orders received has increased nearly 300 per cent., and the month of April, 1904, is the largest April in the history of the company, including orders from Electrical Commission of Baltimore, Md.; Edison Electric Illuminating Company, of Brooklyn, N. Y.; General Electric Company; Merchants' Heat & Light Company, of Indianapolis, Ind.; Cazenovia Light & Power Company, of Cazenovia, N. Y.; Westinghouse Electric & Manufacturing Company; Suffolk Light, Heat & Power Company, of Southampton, N. Y.; United States Naval Academy, of Annapolis, Md.; Edison Electric Illuminating Company, of Detroit, Mich.; Morton F. Plant, of Groton, Conn.; Citizens' Telephone Company, of Grand Rapids, Mich.; Edison Electric Illuminating Company, of Boston, Mass.; Public Service Corporation, of New Brunswick, N. J.; W. M. Sheehan Company, of New York City; Telluride Power Company, of Provo, Utah. Most of the above companies are old customers, and it certainly speaks well of the product to have them come back every year. The Telluride Power Company at Provo, Utah, is building an underground conduit system for its 60,000-volt circuits and sent its representative East to investigate with the result that its entire order was placed for fibre conduit. The Electrical Commission in Baltimore has used approximately half a million feet and still continues to send orders.

SOME HARRISBURG ENGINE ORDERS.—Mackenzie, Quarrier & Ferguson have secured a contract for a 125-hp Harrisburg standard engine for direct connection to a 75-kw. Crocker-Wheeler generator as additional equipment for light and power purposes in the Philadelphia plant of the Pennsylvania Salt Company. Ten 125-hp Harrisburg standard engines have also been ordered for direct connection to 75-kw. Northern generators. This equipment will be installed in the Twenty-third Regiment Armory, Brooklyn, for lighting purposes. A 75-hp Harrisburg standard engine direct-connected to a Crocker-Wheeler generator has been ordered as an additional unit for the State Normal School at Trenton, N. J. Among foreign contracts in hand is one for a 100-hp Harrisburg engine which is to be belted to a 62½-kw. generator of General Electric build for shipment to Newcastle, Australia.

STERLING ELECTRIC COMPANY, Lafayette, Ind., has just received large orders for telephones from the following cities: Hudson, N. Y.; West Liberty, Iowa; Redkey, Ind.; Ossian, Ind.; and Cedar Rapids, Iowa—the latter for its four party line selective type of telephones. It is installing its latest type of combined distributing boards and protectors at Ames, Iowa; Caro, Mich., and Sully, Iowa. It has also contracted for a 500 tubular drop, bell type switchboard for Eaton, Ohio. It has also received orders for various switchboards and additions for Monticello, Ind.; Brandenburg, Ky.; Mattoon, Ill., and Galena, Kan. In addition to this, it has received large orders for its various types of protectors for Kansas City, Mo.; Peru, Ind.; Pittsburg, Pa.; Hudson, N. Y., and Lyons, Iowa. It has been recently reported that the Sterling Company is receiving orders for condensers of its manufacture at a rate of 5,000 a day.

ELECTRIC POWER FOR DIAMOND MATCH COMPANY.—The Diamond Match Company, which is building several large factories in and near Chico, Cal., has closed contracts through the Wagner-Bullock Electric Company, of California, for three alternating current generators to supply electric power for operating woodworking machinery. There will be three generating units, each consisting of a Bullock generator direct connected to an Allis-Chalmers automatic engine. Sterling boilers will be installed in the power station. The distance of transmission will be short.

THE S. H. COUCH COMPANY, of Boston, Mass., has recently closed several contracts for telephone equipment, among which are the Lafayette Hotel, Portland, Me., which calls for 140 telephones and a 140-line common battery board of its new target type. This replaces a previous equipment recently installed. Also orders for common battery boards for Worcester City Hospital, Worcester, Mass., replacing present system, and Hartford Carpet Corporation, Thompsonville, Conn., and a magneto board for Medfield Insane Hospital, Medfield, Mass.

WALRATH GAS ENGINES FOR PORTUGAL.—The Marinette Gas Electric Company, of Chicago Heights, Ill., has secured a contract for five double cylinders Walrath gas engines for direct connection to generators. This contract came from Portugal. The equipment will be used for lighting purposes. A 75-hp three-cylinder engine direct-connected to generator was recently shipped to Lisbon, Portugal, for installation in the building occupied by the Bank of Portugal where several other Walrath engines are installed.

EQUIPMENT FOR LIMA LIGHTING PLANT.—The Compania Santa Rosa, Limitada, which concern lights Lima, Peru, is to extend considerably its water power plant. The General Electric Company has taken the order for the generator, which is to be of 800-kw capacity. The water wheels will be shipped by the Pelton Water Wheel Company, which has also taken an order for 2,100 ft. of 60-in. pipe. The existing equipment consists of three 400-kw General Electric generators and Pelton wheels.

THE EDISON ELECTRIC COMPANY, of Los Angeles, Cal., has recently placed an order with the Abner Doble Company, of San Francisco, for two 800-hp, 176 r.p.m. impulse water-wheels, two 40-hp exciter wheels, and two type F Lombard governors. These wheels will be installed in the Edison Company's Santa Ana River No. 2 plant near Redlands, and will operate under a 305-foot head. They will be connected to General Electric 750-volt three-phase generators.

LARGE SWITCHBOARD EQUIPMENT.—The H. Krantz Manufacturing Company, of Brooklyn, has secured the contract for the switchboard, etc., to be installed in the electrical plant of the Metropolitan Life Building, Madison Square, New York. There will be no less than 156 Dublarm type circuit-breakers, combination switch and circuit-breakers on the board. It will be the largest installation of its description hitherto contracted for.

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, is now installing 4,000 automatic telephones and complete switching equipment for the Home Telephone Company of Los Angeles, Cal., and 1,200 for the Auburn Telephone Company, Auburn, N. Y. It has received orders for the equipment of San Diego, Cal., with 1,200 automatic telephones, and Lewiston, Me., with 1,500.

WESTERN ELECTRIC COMPANY'S NEW PLANT.—The Falkenau Construction Company has been awarded the contract for the erection of some more new buildings at the Western Electric Company's plant at Hawthorne, near Chicago. The principal building will be for the insulating plant and will be 401 x 200 ft. The total cost, with other lesser structures, will be about $142,000.

THE WIRT ELECTRIC COMPANY, of Philadelphia, has moved into its new factory at 3108 Germantown Ave., the change being rendered necessary by its rapidly increasing business. The new plant is commodious, well planned, and affords the company every facility for turning out high-class work promptly.

EQUIPMENT FOR HOTEL RENAISSANCE.—The Hotel Renaissance, West Forty-third Street, New York City, is to be equipped with two 100-hp Harrisburg standard engines direct-connected to 60-kw, 125-volt General Electric generators. The outfit will be used for both light and power purposes.

NEW HARMONIE CLUB TO TAKE STREET CURRENT.—There will be no plant installed in the first instance in the new Harmonie Club to be built in East Sixtieth Street, New York, as power will be taken from the street. C. O. Mailloux is the consulting engineer.

LIGHTING PLANT FOR BRAZIL.—The export commission house of Agar, Cross & Co., New York offices Bowling Green Building, representing the Westinghouse interests in Brazil, has been awarded a contract for the construction of a plant which is to light Rio VI.

EQUIPMENT FOR MEXICAN CARRIAGE FACTORY.—Electrical equipment is to be installed in a large carriage factory about to be constructed by Noake & De Smeth, Chihuahua, State of Chihuahua, Mexico.

RHODESIAN LIGHTING PROJECT.—A municipal electric lighting system is to be installed in Salisbury, Rhodesia, South Africa. Mr. Crawford Lindsay is the consulting engineer. Salisbury has a population of about 15,000 people.

EQUIPMENT FOR MEXICAN CONCENTRATOR.—Electric power is to be substituted for gas power for generating energy to operate the 450-ton concentrator plant of the Tecoletes Company, at Santa Barbara, Mexico.

HEINE BOILERS FOR WILKESBARRE.—The Wilkesbarre & Wyoming Traction Company, of Wilkesbarre, Pa., has placed a contract for a 1,500-hp boiler outfit with the Heine Safety Boiler Company, New York offices Bowling Green Building.

ELECTRIC DRILL GRINDERS FOR SOUTH AFRICA.—The Wilmarth & Moorman Company, of Grand Rapids, Mich., has secured a substantial contract for electrically-driven drill grinders for export to South Africa.

MORE EQUIPMENT FOR HENDERSON, KY., PLANT.—The plant of the Henderson, Ky., Street Railway is to be enlarged. The boiler order has just been let to the Heine Safety Boiler Company, of St. Louis.

ELECTRICAL SUPPLIES FOR CUBA.—The Robb-Mumford Boiler Company, New York, has two good-sized orders in hand for electrical supplies for shipment to Havana.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—According to a report just issued by the Home Telegraph & Telephone Company, its earnings for the quarter ended April 1 were $74,698.59 and operating expenses $47,881.08, leaving the net earnings for the quarter $31,817.51. This amount, together with $5,029.61, gives a total of $36,847.12 available for dividends or improvements. The number of instruments installed up to April 1, 1904, was 12,026. During the previous six months 3611 were put in and during the last quarter 1551 were reported.

SPRINGFIELD, ILL.—The Calhoun Telephone Company, of Hardin, Ill., has increased its capital stock from $15,000 to $25,000.

WATSEKA, ILL.—The Fountain Creek Telephone Company has been incorporated with a capital stock of $24,000. G. H. Weil is president.

BELLEVILLE, ILL.—A mortgage has been filed in Belleville by the Kinloch Long Distance Telephone Company to the American Trust and Savings Bank, Chicago, and George W. Galbreath, of St. Louis, for $5,000,000.

MONROVIA, IND.—The Monrovia Telephone Company has incorporated to build an exchange and telephone lines in Morgan and Hendricks counties. The capital stock is $2250. W. H. Hubban is president.

DELPHI, IND.—The New Co-operative Telephone Company organized in this (Carroll) county will be known as the Flora and Bringhurst Co-operative Telephone Company. The company will put in an entirely new system. Dr. W. E. Callam is president and A. G. Crosswhite, secretary.

SPENCER, IND.—The Farmers' Mutual Telephone Association has been incorporated to operate in Owen, Monroe, Morgan, Putnam, Clay and Greene counties. The capital stock is $10,000. John S. Snodgrass, John Smith, E. F. White and S. H. Alverson, are the incorporators.

BLOOMINGTON, IND.—The Bloomington Home Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is placed at $150,000. The company will establish an exchange and system of telephones and lines in Bloomington and Monroe County. J. D. Showers, W. D. Bradfute, E. L. Barber and Q. C. Mentieth are the directors.

ELKHART, IA.—The Elkhart Mutual Telephone Company has been incorporated with $10,000 capital stock.

KEOKUK, IA.—The Iowa Telephone Company has secured a lot in this city and will soon erect a building for its exchange.

WEST UNION, IA.—The Rogers Telephone Company has been incorporated with a capital stock of $25,000. The directors are C. H. Talmadge and others.

LOUISVILLE, KY.—The Deatsville & Solitude Telephone Company has been incorporated in Nelson County with a capital stock of $800.

BALTIMORE, MD.—The ordinance granting the Maryland Telephone & Telegraph Company the right to use the streets for electric light and power wires has passed the council and has been signed by the Mayor.

GRAND RAPIDS, MICH.—The Cranmoor Telephone Company has been incorporated with a capital stock of $2000. The directors are J. B. Arpin, M. O. Potter and others.

ROTHSAY, MINN.—The Rothsay Telephone Company has been incorporated with a capital stock of $10,000.

ST. LOUIS, MO.—The Bell Telephone Company, of Missouri, has been granted authority to increase its capital stock from $4,000,000 to $10,000,000. The company will improve and extend its lines throughout the State.

RED LODGE, MONT.—The supreme court of Montana, in a recent decision, held that the city council could not restrain the Rocky Mountain Bell Telephone Company from erecting poles and string wires in the city, provided the company gave the city the privilege of designating where the poles should be placed.

HARDY, NEB.—The Hardy Telephone Company has been incorporated with a capital stock of $10,000.

ARAPAHOE, NEB.—The Arapahoe Independent Telephone Company has been incorporated with a capital stock of $20,000.

RENO, NEV.—Linemen have started from Tonopah on the construction of a telephone and telegraph line to Goldfields. Poles have already been distributed, and no time will be lost in carrying the line to completion.

KEESEVILLE, N. Y.—The Keeseville Telephone Company has been incorporated with a capital stock of $20,000. The directors are J. H. A. Bond, J. B. Mace, and others.

BINGHAMTON, N. Y.—The Whitney's Point and Glen Aubrey Telephone Company has been incorporated with a capital stock of $1000. The home office will be in Glen Aubrey.

LEONARD, N. D.—A telephone company has been organized here with Richard Piper as president.

BEREA, OHIO.—The Citizens' Telephone Company has increased its capital from $40,000 to $50,000. H. E. Bolles is president.

STRYKER, OHIO.—The Stryker Telephone Company has increased its capital stock from $10,000 to $15,000 and is planning improvements to its system.

MT. VERNON, OHIO.—The Mount Vernon Telephone Company, capital $150,000, has been incorporated by J. E. Russell, W. C. Curtis, O. M. Arnold and others.

ROCK CREEK, OHIO.—The Covell Telephone Company, of this place, will build a line to connect with the exchange at Jefferson. The Covell company is building farmers' lines throughout this district.

PERRY, OHIO.—The Perry Telephone Company, capital stock $10,000, has been incorporated by F. E. Morrison, W. R. Child, J. H. Brown, E. W. Orcutt and others to build an exchange at Perry.

SUMMERFIELD, OHIO.—The Summerfield Telephone Company, of Noble County, has been chartered with $10,000 capital stock by Wm. Simmons, E. S. Wilson, H. R. McClintock, C. H. Dew, J. H. Sparling and others.

CLEVELAND, OHIO.—All of the telephone operators employed by the Cuyahoga Telephone Company on May 1 received an advance in salary about 8 per cent. President Dickson, it is stated, had the matter under contemplation for several months and strongly advocated better salaries for the employees.

CLEVELAND, OHIO.—The United States Telephone Company has closed a contract whereby after July 1 it will have an interchange of business with the National Telephone Company, of Wheeling, W. Va. The lines of the Flushing and Belmont telephone companies have been leased and these with about 25 miles of a new line will give the desired connection.

MORRISON, OKLA.—The Perryman Telephone Company has been incorporated with a capital stock of $2000. The directors are J. T. and L. Perryman and others.

ENID, OKLA.—The Garland Mutual Telephone Company has been incorporated with a capital stock of $1000. The directors are H. C. Davis, R. H. Smith and others.

ALTOONA, PA.—The Highland Telephone Company has been formed to establish a telephone line in Summerhill and Cambria townships.

ANDERSON, S. C.—The Anderson Telephone Company, manufacturer of instruments, has increased its capital stock from $16,000 to $30,000. G. W. Evans, W. R. Osborne and others are the directors.

ALPENA, S. D.—The Alpena Telephone Company has been incorporated with a capital stock of $5000.

TAYLORSVILLE, TENN.—The Smith County Telephone Company has been organized in this city and capitalized at $5000.

MEMPHIS, TENN.—The Western Union Telegraph Company has completed plans and specifications for the extension of its underground system in a large section of the up-town district in this city. The cost will be about $20,000.

COVINGTON, TENN.—The Cumberland Telephone Company has withdrawn its service from Covington a tax of $1.50 per pole having been placed on it by the city. The Memphis Telephone Company will install an exchange in place of the Cumberland.

LYTLE, TEX.—The San Antonio & Lytle Independent Telephone Company has completed its telephone line from San Antonio to Lytle.

WEBB, TEX.—The Gertie Webb Telephone Company has been incorporated with a capital stock of $20,000. J. H. Miller, A. M. Fowler and others are the directors.

DEXTER, TEX.—The Dexter & Gainsville Telephone Company has been incorporated with a capital stock of $2000. The directors are J. F. Morris, D. D. Thorn and others.

TYLER, TEX.—D. A. Walker, of Columbus, Ohio, and associates, have purchased the exchanges of the Tyler Telephone Company and the Globe Telephone Company of this place. The exchanges will be enlarged.

SEYMOUR, TEX.—The Proffitt Telephone Company, of this city, has filed letters of incorporation, with a capital stock of $40,000. The incorporators are J. W. Proffitt, John H. Proffitt, of Proffitt, W. E. Hayner and W. E. Bailes, of Seymour.

HOUSTON, TEX.—The Phoenix Telegraph & Telephone Company has been organized with principal office in this city for the purpose of building and operating telephone lines in a large number of counties of the Northern and Eastern parts of the State. The incorporators are J. M. Smith, Lorenzo Hills and A. L. Hills.

FILLMORE, UTAH.—The Millard County Telegraph & Telephone Company has been incorporated with a capital stock of $6000. Mr. Thomas A. Callister is president.

ORFORDSVILLE, WIS.—The Orfordsville Telephone Company has increased its capital from $10,000 to $15,000.

MILWAUKEE, WIS.—The Old Dominion Telephone Company, of Roanoke, Va., has been incorporated in this State.

HALIFAX, N. S.—A combination of the Nova Scotia Telephone Company, the Eastern Telephone Company, and other companies has just completed a telephone system 293 miles long. It runs from Halifax to Cape Porcupine via Truro, New Glasgow and Antigonish. Connection is made over the strait of Canso by a submarine cable, the line then runs to Sydney direct. A branch runs from Aulds Cove to Mulgrave and another from Port Hastings to Hawksbury. Connection has also been made with the Sherbrooke Telephone Company at Antigonish and with lines running to St. Peters and Narricht at Port Hawksbury; at Orangedale with Marble Mountain and Baddock and at Sydney with North Sydney, Synod Mines, Glace Bay and Lewisburg. Over 100,000 pounds of copper wire and between 13,000 and 14,000 cedar poles were used in the construction. The cost of building the line was nearly $100,000 and a rate has been struck at $1.25 for a three-minute conversation between 8 a. m. and 6 p. m., and 65c. for the same time between 6 p. m. and 8 a. m.

ZAMORA, MEX.—A telephone line is being built between this place and Chavinda.

OPICHEN, MEX.—A new telephone line is being constructed between this place and the town of Colentur, in this State (Yucatan).

CULIACAN, MEX.—A company is being organized here for the purpose of installing a new telephone exchange and to build and operate long distance lines throughout the State. Governor Francisco Canedo can give information.

CULIACAN, MEX.—A report has been made by the state Government of Sinaloa showing that there are 1058 miles of telephone lines in operation in the State. A new telephone lines has been constructed between the port of Topolobampo and the town of El Fuerte, along the Kansas City, Mexico and Orient Railroad.

Electric Light and Power.

SYLACAUGA, ALA.—The citizens have voted to issue $20,000 electric light and water bonds.

WYLAM, ALA.—There is some talk of constructing an electric light plant and water works here.

FLAGSTAFF, ARIZ.—The Flagstaff Electric Light Company contemplates installing a 60 or 75-kw generator with engine to correspond.

SEBASTOPOL, CAL.—G. W. Swain has secured a franchise for an electric light plant.

SAN FRANCISCO, CAL.—The Mutual Electric Light Co. has called a meeting of its stockholders for June 21 to vote an issue of $400,000 bonds, $250,000 to be sold for improvements and the remaining $150,000 to be held in treasury until such time as needed.

DENVER, COL.—The Colorado Power & Irrigation Company has secured a location on Grand River and has done some work on the intake and dam site. The company proposes to install two plants, the main plant having a capacity of 15,000-hp and a small auxiliary plant of 5000-hp. No contracts have yet been made for the machinery. Electric energy will be transmitted about 100 miles for mining, lighting, metallurgical processes and irrigating. It will be one year yet before the necessary stone and other construction work at the plant is completed.

WATERBURY, CONN.—The New Milford Power Company, which transmits electric power from its plant at Bulls Bridge on the Housatonic River to Waterbury for consumption by the Connecticut Railway & Lighting Company in this section has had to change all the glass insulators on the double line of aluminum wires and substitute porcelain insulators. Much more satisfactory results are now obtained. The transmission line is being extended to the Cheshire and New Britain districts, where the Connecticut Railway & Lighting Company is erecting distributing stations.

WASHINGTON, D. C.—Bids are wanted May 28 for furnishing and delivering at the Library of Congress incandescent electric lamps, hardware, plumbing and electrical supplies, etc. Address Bernard R. Green, superintendent.

TAMPA, FLA.—A special meeting of the stockholders of the Tampa Electric Company has been called May 30, 1904, to consider the advisability of an increase in the capital stock of the company by the amount of $100,000.

THOMASTON, GA.—The question of constructing water works and an electric light plant is under consideration. Ira E. Farmer is mayor.

POST FALLS, IDA.—The Washington Water Power Company, of Spokane, Wash., has decided to install a power plant here, and Clemens Herschel, of St. Paul, has been engaged to outline plans for developing power both from Spokane and Post Falls. The plant will have a capacity of 10,000 horse-power. The power will be used to operate the Coeur d'Alene electric railways and for the operation of numerous Coeur d'Alene mines.

ST. CHARLES, ILL.—Some improvements are planned for the municipal electric light plant in this city. They will include a 350-hp Corliss engine and one 160-kw generator. These improvements will be made during the summer.

NEW HAVEN, IND.—The town board has rejected all bids received for constructing an electric light plant here. Bids will be readvertised for at once. J. M. Jackson is town clerk.

PERU, IND.—It is proposed to construct a dam, electric power plant and an electric railway between Vincennes and West Baden. Jerome Herff, of Peru, can give further information.

MOORESVILLE, IND.—The Public Service Company is advertising for bids for the construction of the power-house for the water works and electric light plant. The plans and specifications are ready for distribution among applicants.

ELKHART, IND.—A mortgage for $1,750,000 has been filed by the St. Joseph & Elkhart Power Company, covering the immense power plant recently built on Hen Island, in the St. Joe River. The mortgage was filed for the benefit of the New York Securities and Trust Company, and is to take up an old mortgage and to secure enough money to carry out important and extensive improvements. The company has increased its capital stock from $50,000 to $250,000. Ernest A. Sanders is president.

BURLINGTON, IA.—The Merchants' Light & Power Company has been incorporated to construct an electric light plant. The capacity of the new plant at the outset will be 20,000 lights. The work of construction and installation of the plant will be under the supervision of Sweet & Caster, electrical and mechanical engineers, of Burlington.

NEW ORLEANS, LA.—It is stated that contracts are about to be let by the Consumers' Electric Company for its electric plant. It will cost complete about $1,000,000.

GLOUCESTER, MASS.—The Gloucester Electric Company intends to install a 500-kw. steam turbine.

SOUTH STILLWATER, MINN.—Bids are wanted May 28 for an electric light plant. J. J. Flather, Minneapolis, is the engineer, and B. L. Hanks the recorder.

CLARKSDALE, MISS.—A dynamo of 350 or 400-kw capacity, a boiler and a switchboard are to be installed in the municipal electric light plant in this place.

SALISBURY, MO.—A 100-kw alternator and one 200-hp boiler are to be installed in the municipal electric light plant in this place.

JOPLIN, MO.—A proposition will be voted upon June 6 next to appropriate $30,000 for the improvement of the municipal electric light plant in this city. If it carries, a 250-kw generator, engine and boiler will be installed.

LAMAR, MO.—The Lamar Light & Water Company will probably exchange all of its present machinery for larger units or install a duplicate of what apparatus it now has. The present plant is overloaded and there is a large demand for more lights.

VERSAILLES, MO.—Sealed proposals will be received at the office of the mayor until June 3 for furnishing material and equipment for a complete electric lighting plant in this city. Plans, specifications and instructions are on file at the office of A. G. Baker, secretary Board of Public Works, Versailles, Mo., and W. K. Palmer, Consulting Engineer, 402 Lyceum Building, Kansas City, Mo.

FREMONT, NEB.—The question of enlarging the electric light plant is under consideration.

RENO, NEV.—Reno is to have two water and power companies. Work on the opposition plant begins at once and will be completed before the summer is ended. Governor Sparks is the principal owner of the new enterprise and has announced that the people of Reno would have an opportunity to secure water or light from his company not later than next spring. The company owns water rights on Hunter Creek, five miles north of the city.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic Power & Mfg. Company contemplates building a new power house.

SAG HARBOR, L. I., N. Y.—Bonds to the amount of $24,000 have been sold, to be used for building and equipping an electric light plant.

SYRACUSE, N. Y.—Architect A. Russell, 321 Bastable Building, will soon have plans complete, ready for bids for a power plant for the new court house.

NEW YORK, N. Y.—The contract for the electrical apparatus for the New York Navy Yard, for which bids were opened April 23, has been awarded to the General Electric Co., of Schenectady, for $43,500.

SHELBY, N. C.—The electric light plant in this place is to be rebuilt and the system changed to three-phase. Messrs. A. W. McMurray and Hugh G. Miller are the owners.

BAINBRIDGE, OHIO.—A dynamo is to be installed at the electric light and water works.

BELLEFONTAINE, OHIO.—The entire rebuilding of the municipal electric light plant in this city is contemplated.

BELLAIRE, OHIO.—The Bellaire Light & Power Company will expend about $75,000 in improvements.

NAPOLEON, OHIO.—Bids are wanted June 7 for $25,000 electric light and water bonds. Address F. W. Hilgendorff, Village Clerk.

WILLIAMSBURG, OHIO.—Chas. Hoffman, City Clerk, writes that bids for constructing an electric light plant and town hall will be received about June 1.

ZANESVILLE, OHIO.—The city authorities are considering the advisability of installing electrical apparatus in their present water works pumping station and generating their own lighting current. At present the city pays $20,000 per year for lights.

EATON, OHIO.—The Eaton Public Service Co. has been incorporated, with a capital of $200,000. It is to absorb the electric light, power and ice companies and will establish an artificial gas plant and a heating system. H. J. Philips, C. S. Glass and J. R. Cook are among the incorporators.

LA GRANDE, ORE.—J. K. Romig, manager of the Sanger mills, has announced that during the spring his company will install a large power plant at that point.

PORTLAND, ORE.—The Washington Water Power Company is perfecting plans to increase the capacity of its plant fivefold, thus giving the city plants 70,000-hp. The estimated cost of the new work is estimated at $1,500,000.

MAHANOY CITY, PA.—The Economy Light, Heat & Power Company has applied for a charter to furnish electricity for light, heat and power in Mahanoy City, Mahanoy Township and Delano Township. Harrison Ball and John Matthias, of Mahanoy City; P. D. Jones, of Hazleton, and F. P. Spiese, of Tamaqua, are among the incorporators.

CLINTON, S. C.—The City Council is considering the proposition of Washington capitalists to construct an electric light plant and water works.

CHATTANOOGA, TENN.—An electric plant of 200 horse-power has been built to drive the $50,000 addition to the Sheland Machine Works at Chattanooga.

BURLINGTON, VT.—Plans are about to be prepared for the municipal electric light plant to cost about $58,000.

NORFOLK, VA.—R. B. Fentress has petitioned for a franchise for a light, heat and power plant.

OLYMPIA, WASH.—The Olympia Light & Power Company has secured a franchise from the city council for extensive alterations and extensions to its street car lines.

VANCOUVER BARRACKS, WASH.—Bids will be received until June 9 by F. G. Hodgson, Ch. Q. M., Vancouver Barracks, for constructing an electric lighting system at this post.

SEATTLE, WASH.—The Citizens' Light & Power Company has been granted a permit to extend its system in this city at an estimated cost of $50,000. The Seattle Lighting Company is also contemplating extensions of its system in different sections of the city.

RICHWOOD, W. VA.—The Richwood Light & Power Company proposes to purchase a 125-hp engine, one 150-hp boiler and a dynamo.

ANTIGO, WIS.—The station of the Antigo Electric Light & Power Company was destroyed by fire May 5. The loss is reported to have been $20,000.

SUN PRAIRIE, WIS.—The Sun Prairie Electric Lighting Company contemplates the construction of 12 miles of transmission line.

MITCHELL, ONT.—About $10,000 will be expended for improvements to the water works and electric light plant. Jas. Barnett is town clerk.

STAYNER, ONT.—Mr. Joseph Knox, owner of the electric light plant, intends to develop water power for electric lighting and power purposes. The transmission line will be 6 miles in length.

THE ELECTRIC RAILWAY.

JASPER, ALA.—The Jasper Water, Light & Power Company has been granted a franchise to operate an electric railway here. J. M. Crawford is manager of the company.

HARTFORD, CONN.—The contracts for the construction of 39 miles of the proposed electric line between Hartford and Worcester have been awarded. The general contract has been given to James F. Shaw & Company, of Boston; the contract for boilers and similar material to Thayer & Company, of Boston, and the contract for turbines to the General Electric Company. The engineers are Sheaf & Jaastad, of Boston. The present expectation is that the work of construction will be undertaken about July.

AKRON, IND.—The Wabash & Rochester Traction Company has decided to locate the power house in this city. The survey of the line and the work of constructing the power house are to begin soon.

INDIANAPOLIS, IND.—The Chicago & Northern Indiana Railroad Company has been incorporated here to build an electric line from this point to Chicago. Lester Soule, president of the Globe Construction Company, of Des Moines, is promoting the financial arrangements.

FORT WAYNE, IND.—It is said that there is a deal pending for the merger of the Fort Wayne Traction Company, the Fort Wayne & Southwestern Traction Company and the local electric light and power company, which also has the franchise for steam heating in Fort Wayne. The sale is being negotiated through John White. The new company is to construct a monster generating station, using the exhaust steam for heating the downtown districts. Eastern capital is helping to complete the deal.

WATERLOO, IA.—The officers of the Waterloo & Cedar Falls Rapid Transit Company have announced a change of name to the Waterloo, Cedar Falls & Northern Railway.

WASHINGTON, IA.—The Arnold Electric Power Station Company, of Chicago, has reported favorably on the construction of the Iowa City, Kalona & Washington Electric Railway. The report recommends 30 miles of single track and 3 miles of turnouts and switches, with one power house and three sub-stations.

WATERLOO, IA.—It is said that surveys are to be begun at once for the proposed electric railway from Des Moines to Waterloo. The principal promoters are Indiana men, but a local office has been opened here, in charge of W. W. Marsh, Thomas Cascaden, J. E. Sedgwick, Geo. E. Litchy and F. J. Fowler, of this city.

FRANKFORT, KY.—Articles of incorporation have been filed by the Columbia & Lebanon Interurban Railway Company, of Marion County, which has $1,000,000 capital stock. The company will build 46 miles of electric railway, from Lebanon to Columbia. The principal office of the company will be located at Lebanon. The incorporators are W. K. Azbil, of Columbia; R. W. Wathen, J. M. Knott and T. M. Estes, of Lebanon; L. C. Rawlings, of Bradfordsville, and W. W. Bradshaw and C. S. Harris, of Columbia.

SPRINGFIELD, MASS.—The street railway committee of the Legislature has gone over the route of the proposed electric railway from Lee to Westfield, and it is reported will make a favorable report on the project.

HUDSON, MASS.—The Hudson & Northboro Street Railway Company has been given a franchise for the construction of a line that, by connecting Hudson and Northboro, will furnish a short route between Hudson and Worcester.

NORTHBRIDGE, MASS.—The Selectmen of Northbridge have granted a franchise to the Uxbridge & Blackstone Street Railway Company to extend its line from its present terminus at Linwood to Plummer's, there to make connection with the Worcester & Blackstone Valley Street Railway.

ANN ARBOR, MICH.—A company is being organized for the purpose of building an electric railway from Ann Arbor to Lakeland, and possibly to Brighton. Detroit capitalists are interested and are investigating the question as to the right of way. It is proposed to utilize the old mill dam at Hamburg, long unused, for the purpose of securing the necessary power.

GRAND RAPIDS, MICH.—The West Michigan Interurban Railway Company has been incorporated under the laws of Michigan with a capital stock of $1,000,000, for the purpose of building an electric railway from Grand Rapids to Park, Oceana County, by way of Muskegon. F. A. Nims, of Muskegon, and J. K. Flood, of Hart, are among the incorporators. E. H. Christ, of Grand Rapids, is the chief engineer.

SPRINGFIELD, MO.—The Western Traction Company, of Indianapolis, has commenced a survey between Springfield and Carthage for its proposed line.

NEW YORK, N. Y.—The New York & Port Chester Railroad Company has filed with the County Clerk its plans for a 25-mile four-track electric railroad from 132d St. to the State line beyond Port Chester. It is to cost $16,000,000.

SCHENECTADY, N. Y.—The statement is made that the General Electric Company is to equip part of the Schenectady Railway Company's system for experimenting with the single-phase system.

NEW YORK, N. Y.—The Bronx Traction Company has been incorporated with a capital of $585,000. The company is formed as a result of the consolidation of five street surface railroad companies in Bronx Borough, known as the Suburban Traction Company; Van Nest, West Farms and Westchester Traction Co.; Wakefield & Westchester Traction Company; West Farms & Westchester Traction Company and the Williamsbridge and Westchester Traction Company. The directors of the new corporation are Edward A. Maher, of the Union Railway Company; Henry A. Robinson, of the Metropolitan Street Railway Company; Charles E. Warren, D. B. Hasbrouck, D. C. Moorehead, of Brooklyn; Frank S. Gannon, Oren Root, Jr., Reune Martin and M. G. Starrett, of New York City. Edward A. Maher is president of the Consolidated Company and Thomas W. Olcott, secretary and treasurer.

NEW YORK, N. Y.—As an offset to the proposition of the New York City Railway Company to give free transfers between its surface lines and the next rapid transit subway, if built by the Metropolitan, the Interborough Rapid Transit Company has formed a combination with the Schmidt & Gallatin moving platform syndicate to interchange transfers from the elevated or subway lines to a platform subway under Thirty-Fourth Street. According to the plan of the combination, the Thirty-Fourth Street crosstown connection from Ninth to Second Avenues, if made possible of construction, will be followed by like moving platform subways through Grand, Twenty-third, Fourteenth and Fifty-Ninth Streets, to connect the elevated and subway lines. The latter proposition covers the original route suggested by the moving platform people—over the Williamsburg Bridge, with a loop to the Battery—and then urges the second route across Thirty-fourth Street. This, it is argued, will afford relief to the congestion that will be caused when the Pennsylvania Railroad tunnel station is ready for use.

CHARLOTTE, N. C.—The construction of an electric car line from High Point, N. C., to Greensboro is likely to assume definite shape. A. L. Garrell, owner of several lines, is at the head of the movement.

COLUMBUS, OHIO.—Ralph Peters, superintendent of the Pennsylvania lines (steam) in this district, is quoted as saying that the Cincinnati & Muskingum Valley Railway is to be equipped with electricity between Trinway and Lancaster, in order to compete with electric lines that are building and contemplated.

TOLEDO, OHIO.—The Detroit, Monroe & Toledo Short Line has commenced giving regular service between Toledo and Detroit. The through trip can be made in three hours, and the fare is 90 cents. This completes the connection between the interurban roads of northern Ohio and Michigan, and makes possible a continuous trolley trip from Westfield, N. Y., to Port Huron, Mich.

DAYTON, OHIO.—The Inter-State Traction Company, which proposes to build a line from Dayton to Indianapolis by way of Camden and Connorsville, has elected these officers: D. M. Sanger, president; W. H. Heinz, first vice-president; E. R. Beard, second vice-president; C. A Cline, secretary; A. B. Landis, treasurer, and J. D. Boroff, general manager.

MEADVILLE, PA.—Charles W. Davis, of Linesville, one of the promoters of the proposed electric railway from this town to Geneva, Ohio, states that the contract for the building of the line will be let very soon.

GREENVILLE, PA.—A charter has been granted to the Greenville Street Railway Company, the incorporators being William C. Wilbert, Arthur H. Springer, R. H. Washabaugh, Samuel G. Bailey, J. D. Wild, Machael J. Ryan and M. A. Wilson, all of Pittsburg. The company will build an electric railway in Greenville.

PITTSBURG, PA.—The Jeannette, West Newton & Monongahela Railway Company has elected officers, and has arranged to begin construction before the end of the month. The capital is $4,000,000. All rights of way have been secured and the line will extend across country to the river district of Westmoreland County through a territory with a population of 20,000.

PHILADELPHIA, PA.—By the installation of additional equipment at its power plant at Second Street and Wyoming Avenue, the Philadelphia Rapid Transit Company is now enabled to supply power to all the lines south of Washington Avenue from the sub-station at Broad Street and Snyder Avenue. The difference of potential of transmission from the Wyoming plant is 13,500 volts, and the new installation is part of the company's general plan to high-voltage distribution.

NEALS SHOALS, S. C.—It is stated that W. J. Oliver has signed a contract to build an electric railway from Neals Shoals to Union. Work to begin June 1.

ANDERSON, S. C.—The Carolina Development Company, which is to have charge of the building of the electric railway between Anderson and Greenville, has organized as follows: F. G. Brown, J. A. Brock and R. S. Ligon, of Anderson; H. J. Haynsworth, of Greenville; Capt. E. A. Smyth, of Pelzer; Frank M. Faurier, S. S. Rhoads and Dr. Geo. E. Caughlin, of Indianapolis, and D. M. Stewart, of Xenia, Ohio, directors; Dr. Geo. E. Caughlin, president; R. S. Ligon, vice-president, and J. A. Brock, secretary and treasurer.

TEMPLE, TEX.—The Temple-Belton Traction Company, which is building an interurban electric railway between this place and Belton, has been formally organized with a capital stock of $250,000. Its principal office is at Temple. The incorporators are Calvin Green, W. C. Davies, J. C. Horn, A. C. Mayer, of Lewiston, Pa.; Samuel Watts, of Belleville, Pa.; L. F. Treaster, W. R. Barefoot, of Milsay, Pa.; H. E. Ahrens, of Reading, Pa.; A. M. Brown, of Tyrone, Pa.; A. F. Bentley, of Temple, and N. K. Smith, of Belton.

CHELAN, WASH.—Judge W. J. Long, of the Chelan Water Power Company, is promoting an electric railway from Rock Island through the wheat country around Big Bend and down the Columbia River to Chelan. A. Betts, of Spokane, and J. F. Sullivan, of Couer d'Alene, Idaho, are also interested in the project. The company is to be known as the Big Bend Railway Company.

TERREBONNE, QUE.—The Charlemagne Traction & Power Company is seeking incorporation to construct an electric railway connecting Terrebonne, Montcalm, L'Assomption and Berthier.

ST. THOMAS, ONT.—St. Thomas, which operates municipally the local street railway system, may take advantage of its charter to build an electric railway to Port Stanley. The City Council has referred the question to a special committee for consideration.

OTTAWA, ONT.—At the close of the last fiscal year of the Dominion, there were 759 miles of electric railway in Canada completed and in operation, 185 miles being double tracked. The paid up capital amounted to $57,274,853, of which the municipal aid amounted to $173,000. The gross earnings aggregated $7,233,677, an increase of $747,239, and the working expenses $4,472,858, an increase of $670,000, leaving the net earnings $2,760,819. The number of passengers carried was 155,662,812, an increase of nearly 18,000,000, and the freight carried amounted to 371,286 tons. Power was supplied in fifteen cases by water, and in thirty cases by steam. Ontario has 412 miles of electric railways, Quebec, 242; British Columbia, 49; Manitoba, 20; Nova Scotia, 24, and New Brunswick, 12.

New Industrial Companies.

THE PATRICK HIRSCH COMPANY, of New York, has been incorporated at Dover, Del., for the purpose of acquiring steam and electric railways. The capital stock is $10,000.

THE THOS. DEADERICK ELECTRIC COMPANY has been incorporated as the Standard Electric Company of Nashville, Tenn., capital $15,000. Thos. Deaderick, W. W. Page and others, of Nashville, are the incorporators.

Personal.

MR. CHARLES MANTNER, formerly manager for the H. Krantz Manufacturing Company, of Brooklyn, N. Y., is now manager of the Switchboard Manufacturing Co., New York.

MR. W. J. CLARK, manager of the foreign department of the General Electric Company, sailed for Europe May 24 on the North German Lloyd liner *Kaiser Wilhelm der Grosse.*

MR. H. W. RILEY, who superintended the construction of laying the electric lighting conduit in Havana on behalf of the contractors J. G. White & Company, New York, is back from Cuba, after completing the work.

MR. P. T. ACKERSON, formerly in charge of the supply sales department of the Western Electric Company at Chicago, has accepted the position as manager of sales for the American Transformer Company, of Newark, N. J.

PROF. ALBERT W. SMITH, head of the departments of mechanical and electrical engineering at Stanford University, Cal., has resigned in order to accept the post of director of Sibley College of Mechanical and Electrical Engineering at Cornell University.

MR. NORBERT B. KATES, of the expert commission house of Kates & Bok, New York, which concern handled considerable quantities of electrical equipment for the South American markets, is about to leave on an extended trip to Mexico with a view to closing some fair-sized orders for electrical equipment, supplies, etc.

MR. ARTHUR STANLEY RIGGS has returned from Manila, where for several years he was engaged in newspaper work, latterly as city editor of the *Cable Times.* The *Atlantic Monthly* several months ago printed an interesting paper from the pen of Mr. Riggs on the Philippine situation, which was widely noted in American papers.

MR. Y. KINOSITA, of Oki & Company, Yokohama and Tokio, contractors in electrical equipment to the Japanese Government, who has been on a hurried visit to this side, has left for home. It is confidently expected that shortly after his arrival in the Far East some very interesting contracts will be placed as a result of his trip here.

MR. CHUJI AWOYAMA, electrical engineer to the Imperial Japanese Department of Communication and to the Imperial Tokio Telephone Exchange, has sailed for home after a brief sojourn in the States. In a report which he will draw up for submission to the Japanese Government he will recommend the purchasing of a big quantity of electrical apparatus on this side.

PROF. CLARENCE FELDMANN, of the Darmstadt Technischen Hochschule, is on a visit of several months to the United States. Prof. Feldmann is well known to engineers as the designer of the Frankfort central stations the prototype of the great central stations of to-day, and from his writings, the most recent of which is a comprehensive treatise on the arc lamp.

MR. CYRUS ROBINSON, first vice-president and general manager of the Power and Mining Machinery Company, formerly the Loomis-Pettibone Gas Machinery Company and successor to the Holthoff Machinery Company, 52 William Street, New York, will leave for Mexico next week in order to attend the starting up of the Velardena Mining & Smelting Company's power plant, reference to which is made elsewhere in this issue.

MR. JAMES W. LYONS, who has been for many years associated with the Allis-Chalmers Co. in the capacity of engine salesman, has been appointed manager of the newly-created power department of the Allis-Chalmers Co., with headquarters in Chicago, the appointment taking effect Monday, May 16, 1904. This newly-created power department will control the sales of reciprocating steam engines, steam turbines (entire units including turbo-generators), condensers, gas engines, pumping engines, blowing engines, hoisting engines, air compressors. Mr. Lyons' promotion will gratify his many business friends throughout the country.

MR. B. G. WASSERMANN, of J. Wassermann Company, which concern is affiliated with the old established German commission house of J. Wassermann & Company, of Hamburg, and has recently opened offices at 35 South William Street, New York, leaves for South America early next month for the purpose of opening a branch establishment in Buenos Ayres, Argentine Republic, where yankee electrical equipment, supplies, etc., will be handled on an extensive scale for that market. Mr. Wassermann will be accompanied by Mr. Otto E. Glocke, formerly manager of the European department of the mercantile firm of G. Amsinck & Company. Mr. Glocke will have charge of the Buenos Ayres offices.

MR. G. MARCONI sailed back last Saturday to England again on the *Campania* to perfect his arrangements to furnish the Cunard Company with a daily news service. He arrived on the same vessel, and, not finding his contemplated trip to the Cape Breton station necessary, sailed on the steamer to put the finishing touches to his scheme. On his return trip he hopes to have everything in working order. The greater part of the voyage will be spent by Marconi in experimenting as to the most favorable situation on the vessel for the receiving and sending of messages. He says the rooms now in use are too small for the latest instruments, and he does not believe that they are in the best place—one amidships on the main deck and the other just aft of the bridge.

NEW INSTITUTE MEMBERS.—At the May meeting of the American Institute of Electrical Engineers, 64 new associate members were elected as follows: Adam, Fred B., secretary and manager, Frank Adam Electric Co., St. Louis, Mo.; Barclay, George, New Zealand Volunteers, Palmerston, Otago, N. Z.; Bates, Francis Reed, consulting engineer, Bogart-Bates Co., Seattle, Wash.; Beckett, Bergie Barry, student, Cornell University, Ithaca, N. Y.; Blizard, John Walter Frederick, chief draughtsman, Keystone Telephone Co., Philadelphia, Pa.; Bramhall, Charles A., manager, Diehl Mfg. Co., New York City; Brosius, James Simms, engineering apprentice, Westinghouse Electric Mfg. Co., Pittsburg, Pa.; Brown, Alfred Evelyn, partner, Scott and Brown, Christchurch, New Zealand; Byllesby, Henry Marison, president, H. M. Byllesby and Co., Chicago, Ill.; Curtis, Leonard E., vice-president and treasurer, Guanajuato Power and Electric Co., Colorado Springs, Colo.; Dean, George Cooper, member of firm Johnston and Dean, New York City; d'Humy, Fernand Emile, district electrician, Postal Telegraph Cable Co., Boston, Mass.; Dunwoody, Henry H. C., instructor, Commanding Signal Corps Post, Fort Myer, Va.; Edwards, Charles Griffin, assistant engineer, Electrical Commission of Baltimore, Md.; Eveleth, Charles Mirick, assistant engineer, American Telephone and Telegraph Co., New York City; Francisco, Ferris Le Roy, supervising electrician, Consolidated Tobacco Co., New York City; Fridenburg, Henry Leslie, secretary and manager, Electric Utilities Co., New York City; Fries, Jons Elias, engineering department, New York Edison Co.; Gale, Frank Harvey, advertising manager, General Electric Co., Schenectady, N. Y.; Gilliland, Clarence Rey, correspondent, Westinghouse Electric and Mfg. Co., Pittsburg, Pa.; Glenn, Charles Sewall, electrical inspector, Baltimore and Ohio R. R., Newark, Ohio; Goehst, J. Henry, construction superintendent, Chicago Edison Co.; Goldsmith, Leon, Westinghouse Electric and Mfg. Co., Columbus, Ohio; Hicks, De Forest, manager, Western Electric Co., Philadelphia, Pa.; Howell, Cecil Ashbrooke, transformer designing engineer, Wagner Electric Mfg. Co., St. Louis, Mo.; Howell, George D., engineer in charge, Lake Erie Traction Co., Philadelphia, Pa.; Hyman, Wallace Munroe, assistant P. R. Moses, New York City; Joseph, Theodore Harold, member of firm E. J. Electric Installation Co., New York City; Kodjbanoff, Basil George, illuminating engineer, Benjamin Electric Mfg. Co., New York City; Lamme, William Fenner, construction department Westinghouse Electric and Mfg. Co., San Francisco, Cal.; Lea, Edward S., sales manager DeLaval Steam Turbine Co., New York City; Lee, William S., Jr., vice-president and chief engineer, Catawba Power Co., Rock Hill, S. C.; Lombard, Percival Hall, salesman General Electric Co., San Francisco, Cal.; Ludwig, Rudolf Emmanuel, electrical engineer, Ludwig and Co., Atlanta, Ga.; Mansfield, Edward Stacey, Edison Electric Illuminating Co., Boston, Mass.; McKay, Maurice Parker, engineer, Westinghouse, Church, Kerr and Co., New York City; Moody, William Edgar, draughtsman, American Elevator Co., Columbus, Ohio; Moore, Clifford Thompson, electrician U. S. Navy Yard, League Island; Mountain, John Theodore, load despatcher, Chicago Edison Co.; Müller, Henry Nikola, electrician, Allegheny County Light Co., Pittsburg, Pa.; Nicholson, Lloyd Carlton, instructor, University of Missouri, Columbia, Mo.; Norton, William John, agent, Federal Electric Co., Baltimore, Md.; Nurian, Kerson, superintendent of construction, Main Switchboard, Mechanical and Electrical Dept., World's Fair, St. Louis, Mo.; Osthoff, Otto Earnest, electrical engineer, H. M. Byllesby and Co., Chicago, Ill.; Pettit, James Edward, chief operator, Postal Telegraph Cable Co., Chicago, Ill.; Pierson, Henry Gregory, member of firm, Foote, Pierson and Co., New York City; Potter, Herbert Sturgis, electrical engineer and contractor, Boston, Mass.; Roberts, George Clifford, electrical engineer, Philadelphia, Pa.; Schneider, Carl Albert, student, Columbia University, New York City; Schuler, L., electrical engineer, Wagner Electric Mfg. Co., St. Louis, Mo.; Schwabacher, Frank, student, Columbia University, New York City; Skog, Gustaf Emanuel, erecting engineer, Westinghouse Electric Mfg. Co., Wilkinsburg, Pa.; Slemin, Harry C., telephone engineer, Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y.; Smith, Robert James, superintendent, Canadian Electric and Water Power Co., Ltd., Perth, Ont., Can.; Stimpson, Clarence Arney, chief operator, Postal Telegraph Cable Co., Philadelphia, Pa.; Stratton, Samuel W., director of National Bureau of Standards, Washington, D. C.; Streng, Lewis Starr, assistant engineer, Public Service Corporation of New Jersey, Newark, N. J.; Thomas, Stephen A., chief electrical inspector, Department of Education, New York City; Wallace, John Eugene, assistant engineer, L. B. Stillwell, New York City; Weber, Frederick Carl, tester, General Electric Co., Schenectady, N. Y.; Wiswell, Orzo N., Snoqualmie Falls and White River Power Co., Snoqualmie Falls, Wash.; Wolls, William A., chief engineer Peruna Drug Mfg. Co., Columbus, Ohio; Woodmansee, Fay, electrical engineer, Sargent and Lundy, Chicago, Ill.; Youngblood, Frank James, special apprentice, British Westinghouse Electric and Mfg. Co., Manchester, England.

Legal.

BIG COLORADO JUDGMENT.—Judgment for $205,280.65 has been rendered in the district court at Colorado Springs, Col., against the Colorado Electric Company in favor of Eastern bondholders represented by the Union Trust Company, of Pittsburg, Pa. The court has ordered a public sale of the plant at Canon City and all other holdings of the company unless payment is made within five days. The judgment was rendered on a mortgage for $250,000, part of which has been paid. No defense was entered, the case going by default.

TELEPHONE RIGHTS OF WAY.—The law as interpreted by the Pennsylvania courts, defining the rights of telephone and telegraph companies says that a telephone company has no rights on private property except those which are granted by the owners, which is, no doubt, old and good law. As to the highways in the country, they have a restricted right of eminent domain, subject to a reasonable compensation to the abutting property owners, but no compensation can be demanded by abutting property owners in cities where wires are strung on streets with the permission of Councils. In no case has a telephone company the right to make use of house-tops for any purpose without the consent of the owner of the property, and the latter have redress for service and destruction of property where houses have been so used without permission.

MEASURING INSTRUMENT LITIGATION.—Judge Lacombe, of the United States Circuit Court for the Southern District of New York, on May 9, filed an opinion in the case of the Weston Electrical Instrument Company against the Whitney Electrical Instrument Company and Machado & Roller, declining to grant an injunction against the Whitney Company and Machado & Roller upon the Weston patent No. 392,387, which was recently sustained against the Jewell Electrical Instrument Company and the Keystone Electrical Instrument Company. The case was argued at length by Messrs. Kenyon & Kenyon on behalf of the Weston Company and by Mr. C. V. Edwards on behalf of the Whitney Company and submitted upon voluminous papers. Machado & Roller, the general selling agents of the Whitney Electrical Instrument Company, announce that, in addition to this recent emphatic decision another suit brought by the same Weston Company against the Whitney Electrical Instrument Company and themselves on Weston patent No. 446,489, likewise covering Weston instruments, was dismissed upon final hearing by the Court in October last and costs assessed on the Weston Company.

ANNUNCIATOR DROPS.—The U. S. Circuit Court of Appeals of the Sixth District has handed down an opinion sustaining the lower court in its decision declaring that the North Electric Co. had not infringed certain claims in a patent issued to James C. Warner and owned by the Western Electric Co., relating to an electric annunciator drop. The North Electric Co. was represented by Mr. Albert Lynn Lawrence, of Cleveland, and the appellants by Messrs. Rector, Barton and Tanner, of Chicago. One claim of the patent of Warner involved surrounding an annunciator coil with a soft iron shield to minimize induction therefrom as far as possible. The court held that it was not new to surround the magnet coil of an annunciator with a shield or tubing of soft iron, an English patent to Faulkner, issued in 1875, describing this construction. Prof. S. P. Thompson, in his "Elementary Treatise on Electricity in Magnetism," in the edition of 1887, also pointed out the use of a shield to secure the space outside of the coil from magnetic influence. A number of patents were adduced to show that the Warner claim for leading-in device of the wires of the helix through the armature is not new. The court held that if this claim is to be sustained at all, which is a doubtful matter, it can only be sustained by confining Warner to the specific device he has secured, and thus limited the defendant does not infringe. The court affirmed the decree dismissing the bill charging infringement.

Trade Notes.

BULLOCK ELECTRIC MFG. COMPANY announces that its New York offices, of which Mr. E. W. Goldschmidt is the district manager, have been moved to the Empire Building, 71 Broadway.

INCREASE OF SUMTER CAPITAL.—The capital stock of the Sumter Telephone Manufacturing Company, Sumter, S. C., is to be doubled. A new building has been added and new machinery installed, costing nearly $50,000, which has been paid out of the surplus profits.

D. M. STEWART MFG. COMPANY, of Chattanooga, Tenn., finds that Lavite is selling quite largely. It has made recent additions and improvements of its plant which will enable it to fill orders promptly. Lavite insulation is very well known throughout the electrical field.

FUSELESS ROSETTE.—Pass & Seymour, Inc., Solvay, N. Y., report that they are meeting with unqualified success in introducing their new fuseless rosette for concealed work. It is not only easy to install, but makes a finished job, completely concealing wires, tubes, etc. A request addressed to Pass & Seymour, Inc., mentioning their trade number 604, will bring a free sample.

CROCKER-WHEELER COMPANY, Ampere, N. J., has just issued a very tasteful pamphlet entitled "Uncle Sam Printer," giving an illustrated account of its fine installation of generators and hundreds of motors in the Government Printing Office at Washington, D. C. The pamphlet is based upon the series of articles on the subject that appeared in the ELECTRICAL WORLD & ENGINEER at the beginning of the year.

GERMANIA LAMPS.—The Germania Electric Lamp Company, Harrison, N. J., has just issued a very neatly gotten-up price list of its electric lamps. It contains some common sense facts about incandescent lamps, and half-tone illustrations of representative types of Germania lamps. The standard Germania lamps are made in efficiencies of 3.1 watts, 3.6 watts or 4 watts per candle, for voltages of from 75 to 130. The company also makes a complete line of special lamps.

THE INTERNATIONAL TELEPHONE MFG. COMPANY, Chicago, states that it was not affected adversely, either directly or indirectly, by the recent self-restoring drop patent decision. On the other hand it has had a constantly increasing demand for its new "never failing" self-restoring drop for new exchanges as well as for increasing boards of other makes. Its drop and jack can be fitted for any size plug and for mounting on any style of board.

UNDERWRITERS' RULES.—We have received from the Pettingell-Andrews Company, Boston, Mass., a copy of the National Electrical Code for the installation of electric wiring and apparatus, as recommended by the Underwriters' National Electric Association. It is of pocket size, and has a substantial green-leather cover into which it can be slipped and withdrawn. In this form it will be found very serviceable and ready for reference, as it can be easily carried in the pocket.

FLOATING CURRENT MOTOR.—Mr. J. Rauscher, electric push button manufacturer, at St. Paul, Minn., has invented and received a patent for a floating current motor. Mr. Rauscher's factory being located for 12 years on West Third Street, giving him a good view of the Mississippi River, caused him to think of the enormous power being wasted. During his leisure hours he made a few sketches and then a model. The first not being satisfactory he made a second and then a third which he took and tested in the Mississippi River, and which test proved highly satisfactory. He is now building a more highly improved motor, all improvements being covered by patents applied for, which he will give a thorough test on the Mississippi River about July 1. It is claimed that this machine can be built to produce 500-hp.

SPECIAL LIGHTING AT HARTFORD, CONN.—For the encampment and reunion last month at Hartford, Conn., of the Army of the Potomac, some fine special lighting effects were carried out. Nearly 25,000 lights in all were used temporarily on 1½ miles of street, the extra work requiring 15 men 10 days, and then it could not have been done without the aid of the Norbitt sockett. The current was furnished chiefly from the storage battery of the Hartford Electric Light Company. General Electric lamps were used. The construction was superintended by Mr. E. Baldwin, of Rice & Baldwin, local electrical contractors, who carried out all the plans and designs most successfully. All the emblems, stars, etc., were of the new changeable system of the Electric Carriage Call Company, of which Mr. Mortimer Norden is general manager. The local press spoke highly of the whole work.

CURTIS STEAM TURBINE.—The Curtis steam turbine has been very fully described and illustrated in these columns, and our readers are already familiar with this recent type of prime mover and its advantages. It is now classed as a standard product and is the subject of a special trade pamphlet just issued by the General Electric Company. The pamphlet is gotten up in the finished and artistic style which characterizes this company's trade literature. It is printed on fine coated paper, with artistically executed engravings. The machine is very completely and clearly described and the many excellent half-tones and line illustrations show it off to the best advantage. Many illustrations of details are also shown for the first time. The list of illustrations includes turbines of various capacities, ranging from 500-kw to 5000-kw, a particularly interesting feature being those showing the comparative sizes of turbines and steam engines of equivalent capacities. As is well known, the steam engine suffers by comparison. The rapidity with which these turbines have grown in favor forms a unique chapter in the history of industrial development, and engineers will no doubt peruse the pages of this new catalogue with unusual interest and care.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 17, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

759,858. AIR BRAKE MECHANISM; Guss A. Brooks, Covington, Ky. App. filed June 15, 1903. When the car motor is driven by the momentum of the car, it serves as a generator to supply current to an electric motor which actuates an air compressor for the brakes.

759,880. ELECTRIC ARC LAMP; Otto Gross, Manchester, England. App. filed Dec. 11, 1903. Details of a clock-work driving friction wheels which bear directly upon the carbon rod to feed the same.

759,887. PROCESS OF MANUFACTURING PEROXIDS; Friedrich Hinz, Berlin, Germany. App. filed Nov. 23, 1903. (See page 1026.)

759,900. ARMATURE WINDING; Frank A. Merrick, Johnstown, Pa. App. filed Oct. 25, 1900. The end connections of each coil are made with two bends, of offsets, in substantially radial directions, so that each end portion has two parts which lie entirely in different circumferential planes.

759,904. REGULATING APPARATUS FOR THEATRICAL ELECTRIC LIGHTING; Ernst F. Moy and Percy H. Bastie, St. Pancras, London, England. App. filed Dec. 11, 1903. Regulating apparatus enabling the operator to control the dimmers separately or collectively from a distance.

759,909. ELECTRICAL FURNACE; Richard M. Pelton, Detroit, Mich. App. filed Dec. 3, 1902. (See page 1026.)

759,915. ELECTRIC SWITCH; Max Von Recklinghausen, New York, N. Y. App. filed April 22, 1902. Details of a cut-out wherein the circuit is broken by a sudden movement while the contacts are immersed in oil, the device being especially adapted for making a quick rupture of the starting circuit of vapor electric lamps.

759,916. QUICK BREAK OIL SWITCH; Max Von Recklinghausen, New York, N. Y. App. filed April 22, 1902. A modification of the preceding invention.

759,927. COIL CASING; Charles F. Splitdorf, New York, N. Y. App. filed July 24, 1903. Details of a water and dust proof casing for induction coils; also an inclined passage for the wires leading to the binding posts, for shedding rain water.

759,941. PLUG RECEPTACLE FOR ELECTRIC CIRCUITS; John H. Trumbull, Plainville, Conn. App. filed Oct. 9, 1903. Details of a receptacle set flush in the wall and having a cover plate which ordinarily closes the orifice when the lamp is not in position.

759,962. PLURAL LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed Dec. 9, 1901. Details of construction of a cluster socket including the arrangement of the various contacts beneath the finishing cap and their mounting upon the insulating base.

759,963. PLURAL LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed July 18, 1902. Further details of a cluster socket having special reference to a series connection of the lamp.

759,967. ALTERNATING CURRENT MOTOR; Alexander J. Churchward, Brooklyn, N. Y. App. filed March 29, 1897. Means for keeping the armature at synchronous speed in a machine of the ordinary direct current type, when supplied by alternating currents.

759,981. ELECTRIC CABLE; Johannes Frisch, Mulheim-on-the-Rhine, Germany. App. filed May 5, 1902. The cable has a core of insulating material of star-shaped cross-section, the conducting wires being wound spirally about the same, the object being to lessen the electro-static capacity.

759,987. FACSIMILE TELEGRAPH APPARATUS; Ernst K. Gruhn, Dresden, Germany. App. filed Nov. 20, 1902. A stylus, a lever connected therewith and mounted to have a bodily as well as an oscillatory movement, a resistance body whose resistance is varied by the oscillatory movements of the lever, whereby the movement of the stylus is decomposed into orthogonal co-ordinates to effect a variation in the resistance of the line conductors.

760,029. TELEGRAPH SOUNDER; John F. Skirrow, East Orange, N. J. App. filed Jan. 8, 1904. A sounder wherein the electro-magnet may be adjusted toward and from the armature without changing the angular relation of the magnet cores and the armature.

760,057. PROCESS OF ELECTRICALLY SMELTING MATERIALS; Alfred H. Cowles, Cleveland, Ohio. App. filed Oct. 20, 1903. The material is placed in a conductive receptacle, the walls of which are kept cool by circulation of water to prevent short-circuiting of the current through them which would otherwise occur by reason of the heated condition of the material in contact with the walls.

760,065. BASE FOR INCANDESCENT LAMPS; Howard Gilmore, Boston, Mass. App. filed Nov. 22, 1901. The porcelain button in the end of the base is held in place by a shell eyeletted in.

760,075. ELECTRIC HEATER; George I. Leonard, Pasadena, Cal. App. filed Oct. 27, 1902. The resistance is a sheet of asbestos coated with a film of rubber over which a layer of graphite is placed.

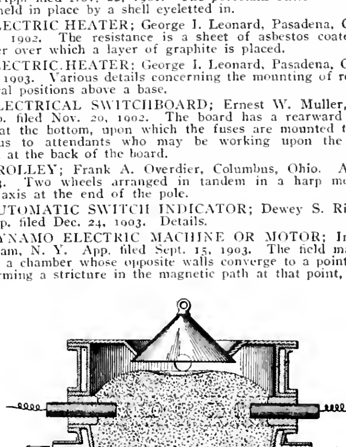
760,076. ELECTRIC HEATER; George I. Leonard, Pasadena, Cal. App. filed Jan. 22, 1903. Various details concerning the mounting of resistance plates in vertical positions above a base.

760,077. ELECTRICAL SWITCHBOARD; Ernest W. Muller, Brooklyn, N. Y. App. filed Nov. 20, 1902. The board has a rearward horizontal extension at the bottom, upon which the fuses are mounted to make it less dangerous to attendants who may be working upon the other devices mounted at the back of the board.

760,079. TROLLEY; Frank A. Overdier, Columbus, Ohio. App. filed June 30, 1903. Two wheels arranged in tandem in a harp mounted upon a vertical axis at the end of the pole.

760,081. AUTOMATIC SWITCH INDICATOR; Dewey S. Rice, Weatherly, Pa. App. filed Dec. 24, 1903. Details.

760,086. DYNAMO ELECTRIC MACHINE OR MOTOR; Imle E. Storey, Amsterdam, N. Y. App. filed Sept. 15, 1903. The field magnet core and pole has a chamber whose opposite walls converge to a point near the pole face, forming a stricture in the magnetic path at that point, to prevent the



760,057.—Process of Electrically Smelting Materials.

lines of force from serging from one-half of the pole into the other by reason of the rotary motion of the armature.

760,091. AUTOMATIC REGULATOR FOR ELECTRIC CIRCUITS; Montgomery Waddell, New York, N. Y. App. filed June 18, 1903. A shunt wound generator, a variable resistance in series with its field magnet winding, electro-magnetic means for controlling the resistance, said means being in series with the working circuit of the generator and also having a coil connected on one side to the working circuit and on the other side to the field magnet winding between the same and the resistance.

760,096. PROTECTING DEVICE FOR VAPOR ELECTRIC APPARATUS; James R. Baker, Arlington, N. J. App. filed Nov. 6, 1903. The pockets for the mercury electrodes contain a cushioning material, preventing the shock which occurs when the mercury forcibly flows into the pocket, from rupturing the lamp.

760,119. MEANS FOR PROTECTING VAPOR ELECTRIC APPARATUS; Peter Cooper Hewitt, New York, N. Y. App. filed Dec. 22, 1903. A modification of the preceding invention.

760,132. CIRCUIT CLOSER; James W. Leech, Staunton, Va. App. filed Oct. 10, 1903. Details.

760,143. APPARATUS FOR AMPLIFYING OR REINFORCING TELEPHONE CURRENTS; Joseph J. O'Connell, Chicago, Ill. App. filed Aug. 22, 1903. (See page 1028.)

760,145. GUARD FOR TROLLEY WHEELS; Charles O. Phillips, Kalamazoo, Mich. App. filed March 2, 1904. Details.

760,159. ELECTRIC BLOCK SIGNAL SYSTEM; Tony Silvene, Victoria, Can. App. filed May 20, 1902. Details.

760,163. TROLLEY CATCHER; Irwin W. Smyth, Dayton, Ohio. App. filed Jan. 25, 1904. A spring drum and pawl and ratchet arrangement for winding up the cord.

760,184. TROLLEY POLE HEAD; Robert I. E. Dunn, Dallas, Tex. App. filed Aug. 29, 1903. Details.

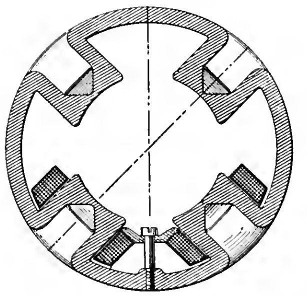
760,209. CIRCUIT CONTROLLER; Paul H. Jaehnig, Newark, N. J. App. filed March 1, 1904. Details of construction of an automatic switch for electric signs.

760,223. ELECTRIC RAILWAY; Thomas D. Lovell, Beverly, Mass. App. filed Jan. 22, 1904. A block system in which the movement of the cars on a single pack road, automatically cuts off the current from adjacent blocks.

760,231. TROLLEY BASE; Peter D. Milloy, Buffalo, N. Y. App. filed Nov. 16, 1903. The object is to produce a low base in which the revolving section surrounds and incloses a greater portion of the fixed section and revolves upon horizontal bearings which are not exposed to the elements.

760,234. ELECTRICAL CAB SIGNAL; Edward McClintock, Merriam Park, Minn. App. filed Sept. 5, 1903. Details of a signal intended to show when the train runs past a danger signal.

760,280. ELECTRIC WATER HEATER; Richard Toennes, Boonville, Mo.



760,086.—Dynamo Electric Machine or Motor.

App. filed Jan. 27, 1904. The water is caused to flow through devious passages, the walls of which form the sides of the circuits.

760,281. ELECTRIC ALARM; Herbert Trull, Fernie, Canada. App. filed Sept. 17, 1903. A fire alarm comprising a tube containing a liquid, the expansion of which moves a plunger to close a circuit.

760,289. ELECTRICAL APPARATUS FOR WORKING RECIPROCATING TOOLS; Alfred D. Williamson and Cecil L. Sumpter, Sheffield, Eng. App. filed Jan. 31, 1903. Apparatus for working planing machines and the like in which provision is made for automatically reversing the direction of the tool and making the return stroke more rapid than the operating stroke.

760,302. PURIFYING APPARATUS; Pierre J. Boucher, Cleveland, Ohio. App. filed March 28, 1903. (See page 1026.)

760,305. COUPLING FOR ELECTRIC WIRES; Ricardo G. Castillo, Mexico, Mex. App. filed Sept. 9, 1903. The coupling comprises a block of insulating material carrying a coupling wire, the conductor wires attached to the block and terminating thereat, are fitted with mercury cups into which the ends of the coupling wire dip to establish a good through connection.

760,312. PROCESS OF MAKING CALCIUM CARBID; Alfred H. Cowles, Cleveland, Ohio. App. filed June 28, 1902. (See page 1026.)

760,315. COMBINED ELECTRIC HEATER AND BATTERY; Jesse R. Davis, Parkersburg, W. Va. App. filed Dec. 8, 1903. Details.

760,325. ELECTRIC RAILWAY; William R. Fearn, Camden, N. J. App. filed Dec. 16, 1903. Details.

760,326. UNIVERSAL FLOOR BOX FOR THE DISTRIBUTION OF ELECTRIC WIRES; John Fountain, Jr., Elizabeth, N. J. App. filed Dec. 16, 1902. The cover of the box is interchangeable and constructed to receive either a supplemental cap flush with the cover, or a nozzle projecting above the cover, both of which have a water-tight connection with the box.

760,330. TROLLEY POLE; James Furgason, Montour Falls, N. Y. App. filed May 28, 1903. Details.

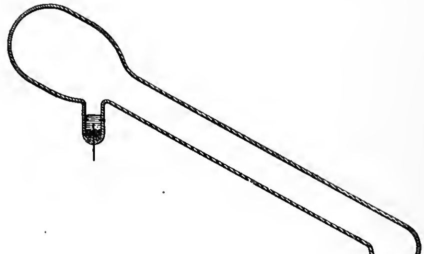
760,361. STEADYING RESISTANCE FOR ARC LAMPS; Louis Wolff, Berlin, Germany. App. filed Dec. 16, 1903. The lamp resistance is coiled around a fireproof layer of insulating material on the outside of the solenoid.

760,375. ELECTRIC LAMP CLUSTER; Reuben B. Benjamin, Chicago, Ill. App. filed March 3, 1902. Details.

760,376. ELECTRIC LAMP CLUSTER; Reuben B. Benjamin, Chicago, Ill. App. filed Nov. 12, 1902. Details.

760,387. ELECTRIC SWITCH; Egbert R. Dull, Chicago, Ill. App. filed Aug. 5, 1901. Details of construction of a switch for operating electric signs.

760,399. SELECTIVE SIGNAL SYSTEM; Fred C. Penfield and Olin Templin, Lawrence, Kan. App. filed March 17, 1902. An improvement upon a pre-



760,119.—Means for Protecting Vapor Electric Apparatus.

vious invention of the same parties, whereby the system is adapted for the common battery method of operating telephone circuits.

760,400. AUTOMATIC OIL SWITCH; Max Von Recklinghausen, New York, N. Y. App. filed Jan. 6, 1904. The invention resides in the construction of a liquid-tight casing for the switch, the latter being operated by a solenoid.

760,408. DYNAMO ELECTRIC MACHINE; Leonard Wilson, Pittsfield, Mass. App. filed June 1, 1903. A construction whereby a wide brush may be used on high speed machines, thus obtaining low current densities and providing ample time for proper reversal and yet wholly avoiding local excess or uneven distribution of current.

Twenty-Seventh Convention of the National Electric Light Association.

THE twenty-seventh convention of the National Electric Light Association was called to order by President C. L. Edgar at the Hotel Vendome, Boston, Mass., at 10.30 A.M., May 24, some 400 delegates being then in attendance in the hall. Secretary E. H. Davis read a number of letters from prominent men as to absence or intention to be present.

PRESIDENT'S ADDRESS.

President Edgar then delivered an able address which was listened to most intently by one of the largest gatherings that ever witnessed the opening exercises of a convention. He referred to the fact that he had been one of the attendants at the former convention in 1887, as the guest of Capt. Brophy, when he visited the old Thomson-Houston works at Lynn, Mass., when the entire number of men employed was not equal to the number now in any one of a dozen departments. At that time the Boston Edison Company was the possessor of one small station, with a total load connected to its overhead system equal to the fortnightly growth of the present year. Referring to the general growth of the central station business, as represented by the members of the Association distributed throughout the United States and Canada, he found that the number of electric light stations has increased during these seventeen years more than nine fold. Naturally the membership of the Association has not grown in proportion, but the fact that there are now upon the rolls 583 members, as compared with only 158 at that time, is a matter for sincere congratulations. "The work done by my two immediate predecessors in getting new members into the Association stands by itself. The growth this year, as the result of their work, has been rather slow. At the same time, the Association has had a healthy and steady increase in membership and I feel satisfied that it will continue in at least as great a ratio as during the past year."

Mr. Edgar then rehearsed the facts with regard to the Union Engineering Building, New York City, the gift of Mr. Carnegie, and announced that the Association would be able to place its offices there, a plan which he heartily recommended, for its many and obvious advantages. He then took up the question of the constitution and said: "The time has come when it seems desirable to make a somewhat desirable change in the by-laws of your Association. When it was organized some nineteen years ago the industry consisted of a large number of small companies, located throughout the country. Almost without exception, these companies were confined each to its own city; in fact, there were a number of cities, especially those of the larger size, that had a number of competing companies. As time went on, consolidations took place, either by the purchase of a local company by a syndicate or holding company or by the actual amalgamation either of competing or of adjoining companies. This has, at the present time, been carried on to such an extent that in some sections of the country all of the small companies have now been obliterated and one large corporation now covers the territory and does the entire work. A most striking example of this kind comes under my own personal observation. The Boston Edison Company has taken the place of fifteen local lighting companies, all of whom were eligible for membership in our Association. Under the regulations of this State it is necessary to actually wind up these local companies, not only in business, but in a corporate sense, and a number of them have, therefore, had to resign from the Association. Within the next year or two there will be only one company left and the actual membership in the Association will be cut down from seven to one. This is going on all over the country and is a matter of serious concern for the future of the Association. The matter has been discussed at considerable length by the Executive Committee and numerous suggestions have been made for overcoming the difficulty. These have been put in concrete form by your secretary and will be submitted to the Association in executive session. Speaking generally, the remedy suggested is to have another class of membership, consisting of individuals called junior active members, to be elected under some sort of supervision of the active member with whom they are connected in business and paying as dues an amount in keeping with their privileges. I trust that this matter will be given serious consideration by the members of the Association within the next two or three days, so that a conclusion can be arrived at the executive session on Thursday."

Mr. Edgar then discussed a number of important Association topics. The electric lighting industry in this country, he said, has in the past, in certain definite directions, been under somewhat serious disadvantages because of a lack of a comprehensive and correct directory of the industry. In most other lines of work it has been possible for manufacturers, investors or inquirers generally to find out something about the industry in which they were interested. This want was brought especially to his attention sometime during the early part of the year. One of the various circulars issued periodically by the assistant secretary was sent out over the President's name and mailed from Boston. The number of letters returned undelivered was astonishing and the conclusion was arrived at that all the existing lists were worse than useless. About this time a prospect appeared of this work being taken up by one of the members of the Association and put on a par with the publications of other industries of like character. President Edgar thought that members should give their earnest support to this enterprise, incidentally because it is carried on by one of the members, but primarily and selfishly because all members are interested in having it a success.

Referring to the International Electrical Congress, he announced that the Association had accepted an invitation from the Congress inviting it to contribute three papers and to send the authors as delegates to the Congress. The work of the Congress is truly international in its character, papers having been promised by some of the most noted scientists in the world, both in this country and abroad, and for this reason it is extremely desirable that the Association's representation at the Congress shall be in keeping with its standing. Mr. Edgar said that until he became president of the Association, he had no suspicion of the vast amount of work carried on at the permanent office in New York. Under the efficient direction of the assistant secretary, a large and varied correspondence is kept up with the member companies, an average of over ten letters daily being written on all sorts of subjects. In addition to this, various compilations have been made during the year and most of these have been forwarded to the members from time to time. The office is now engaged upon various other reports, notices of which will be given at the proper time. In short, the Association has a thorough and business-like organization, capable of taking up and intelligently discussing almost any subject of interest to the members of the Association.

"Sometime during the winter it was suggested by one of the members of the Executive Committee that there must be a vast amount of valuable information in the records of the Association which were practically useless because of the lack of an index. The matter was taken up at once and there has been prepared a complete index of the papers and reports presented to this Association since its organization, indexed and cross-indexed in various ways. It is intended to publish this as a separate volume for distribution with the proceedings of this convention. I think that none who have not specially looked into this subject realize the great amount of information locked up in the proceedings of the conventions, but which will be available at a moment's notice when this index is published."

Mr. Edgar then noted the resignation of Mr. C. O. Baker, Jr., as master of transportation, commending his long and efficient service; and stated that he had appointed Mr. G. F. Porter in his stead. He then referred to items of the programme and suggested the merging of the "Question Box" and "Wrinkles" departments. He also alluded appropriately to the questions of central station advertising and the sudden and large business that developed last winter in electric thawing—a subject calling, he thought, for special report. He enlarged also upon the duties of the Executive Committee, which was a body intended to do some work, for even at the best the position of president of the Association was a hard one. "I think that the Executive Committee should be chosen with some reference to their geographical location and with considerable reference to the size of the companies that they represent. Then, in order to make it easy and possible for them to attend the periodical meetings of the committee, an arrangement should be authorized for meeting the necessary expense of these meetings. This matter has been discussed by the Executive Committee during the past year, and I hope they will have some definite suggestions to offer in a report that they will make at the executive session on Thursday.

"Even if this can be accomplished, I realize that the difficulty is fundamental. We must look to our permanent officers to keep the work of the Association going in the right direction. It devolves upon them to instruct the incoming administration as to the precedents and policy of the past and in general to keep the permanent policy of the organization before the mind of each new executive, leaving the latter the privilege of bringing to the office and to the work the strength of his own personality and thus, by a mixture of the old and the new, build up an organization that shall stand distinct and unique among its compeers."

Mr. E. B. Weeks, of Kansas City, one of the earliest presidents of the Association, having been called upon by President Edgar for some remarks, spoke of the enormous growth of the electrical industries, which within the compass of one generation has arrived at the point where the investment runs into billions. He referred to the fact that the great pioneers like Edison, Thomson, Weston, Brush and Sprague, who, with their contemporaries and followers, laid the foundations of electrical industry of to-day, are still actively engaged in enterprises of great moment. The Association is unique in that under it the scientific or technical and the commercial elements have worked together. Contributing to its proceedings have been men like the late Prof. Rowland, men who with little attention to commercial considerations, devoted their lives to study and experimental research; and men of affairs like Mr. Marsden Perry, of Providence, who put hundreds of millions into applied electricity.

PROGRESS.

The report of the Committee on Progress, Mr. T. C. Martin, was a pamphlet of some 36 pages, dealing with a variety of topics of interest to central station managers. The figures and growth of the industry were shown, and the power plants of the lighting and railway systems of the country were contrasted. It was shown that in 1902 the dynamo capacity of the street railways was 1,204,238 hp, and that of the lighting plants was 1,615,480 hp. The output as reported by the companies showed the capacity of the railways to be in use about 8 hours daily and that of the lighting systems 6 hours. Comparisons were also made between the United States and Great Britain, Germany and Spain. The German and English plants average larger than ours. It was shown that 5 watts of new apparatus was installed per head of population in Spain in 1903, in Germany 7.5 watts in 1902; 12 watts per head in England in 1902-3, and 16 watts in the United States of America in 1902. Madrid has 66 watts installed per inhabitant, as compared with 48 watts in Berlin. The profits of the Spanish stations run high, reaching frequently 30 to 35 per cent. Details were then given as to London and Paris, the price per arc in the latter city reaching $240. Figures were cited as to American rates for current.

Mr. Martin then reviewed the progress in the lighting art, and gave a number of details as to the Nernst, Cooper Hewitt, magnetite arc, osmium, Blandel colored arcs, Just incandescent, reflector lamps and other lamps now competing for a foothold. Reference with data was also made to the twenty-fifth anniversary of the Edison incandescent lamp, and some comparisons were then made with gas. A large section of the report was next devoted to electric heating, citing the 20,000 electrically-heated cars in this country; the special plant in the Government Printing Office at Washington, the Berg hat factory in New Jersey and the cooking of waffles in large quantities for the students at Harvard. A final section was devoted to the development of the three-phase central station at Dublin, Ireland, during the present year.

In the discussion of Mr. Martin's paper Mr. E. F. McCabe, of Lewistown, Pa., referred to the fact that the Census statistics showed there is invested in electric lighting companies $504,000,000, giving a gross income of $85,000,000 and a net income of only $17,000,000. Mr. Martin said he had no reason whatever to question the accuracy of these figures, as they were based upon statements of central station men made to the Census Office at Washington. Mr. Samuel Scovill, of Cleveland, Ohio, said that part of the large capitalization should be considered to represent experience—the foresight, courage, ingenuity and inventiveness which have gone to create a great industry. Mr. Arthur Williams, in referring to the Nernst lamp, said he considered its great field to lie just between the largest size of incandescent lamp that can be used conveniently and the smallest size of arc lamp that will give satisfactory results. Here is a gap which the Nernst lamp of three and six glowers fills very satisfactorily and in which at the present time seems to have no entirely satisfactory competitor. The Nernst lamp in combination with the ordinary incandescent lamp, which latter is of a more yellow color, gives very satisfactory lighting results, and he referred to the satisfactory illumination in a club largely used in exhibiting pictures where the lighting was obtained from Nernst lamps at the ceiling and incandescent lamps at the cornices. A year ago it was reported that more than 400,000 Nernst lamps of various sizes were in use in England for interior and outdoor lighting, and very successfully for municipal lighting. He thinks the English experience is that the larger lamp has a greater field.

A THREE-WIRE, 250-500-VOLT LIGHTING SYSTEM.

Mr. Walter I. Barnes, in a paper of the above title, gave an account of the three-wire, 250-500-volt lighting system of the Narragansett Electric Lighting Company, Providence, R. I. The adoption of this system was decided upon in May, 1899, at which time the company had a connected load of about 4,900 kw in alternating current, 2,700 kw in direct-current, 500-volt motors, and 1,400 kw in arc lamps. The previous year an underground conduit system had been commenced and in December, 1901, 40 miles of streets had been opened and 1,700,000 ft. of ducts laid, in which were drawn about 2,000,000 ft. of cable, 1,100,000 ft. of which belonged to the new direct-current system. A storage battery was also installed consisting of 296 cells of 43 plates, the eight-hour discharge rate being 840 amp.

While the conduit system and storage battery were being installed, active preparations were being made whereby existing installations on the alternating-current, two-wire system might be readily transferred to the direct-current, three-wire system. The several sections of the city that were included in the change were served with about 50,000 incandescent lamps, 1,000 arc lamps and 2,000 hp of stationary motors, which installations were reconstructed to comply with the requirements of the new system. The commercial series arc lamps were replaced by multiple enclosed arc lamps, and the series generators thus released from service at the central station. All motors of the direct-current type were connected to the outside of 500-volt wires. When the changes have been finally accomplished the entire incandescent lamp business of the company, amounting to about 185,000 lamps on a 16-cp basis, will be operated at 250 volts and all motors, both direct-current and alternating-current, will be 500-volt machines. The 250-volt incandescent lamps average 3.3 watts per candle-power and have a useful candle-power area of not less than 4,000 hours, assuming the smashing point to be 80 per cent. of the initial candle-power. In 1899 the average watts for this type of lamp varied from 3.8 to 4. The arc lamps at present used are the twin-carbon enclosed type and operated multiple on 250-volt circuits, the current averaging 2.3 amp. and the energy of the lamp about 575 watts.

The discussion of the paper by Mr. Barnes was quite extensive, covering principally the subjects of grounded distribution and the twin arc lamp used on the Providence circuits. Mr. Junkersfeld expressed doubt if a 250-500-volt system has any advantage over the 125-250-volt system. In the incandescent lamp system there is a considerable difference in the energy loss, owing to the use of low-efficiency lamps, and the arc lamp situation is even more serious. The meter losses are double and the meter slip in the course of a year should amount to a very considerable item. While the difference in the investment required may offset these disadvantages, the adoption elsewhere of the system should be a matter to be very carefully considered. Even under circumstances where it might appear particularly adapted the straight alternating-current system would be a serious competitor. Mr. Alex. Dow thought that with the neutral earthed at different points there would, in towns where there is an electric railway system, be a considerable flow of railway current through the neutral circuit of the lighting system. In a case which came under his observation where two earths were on the neutral three-wire system about 8,000 ft. apart, there was a maintained difference of potential of 10 volts during the evening peak of the electric railway load, this resulting in serious disturbances of regulation and necessitating a special provision for balancing the three-wire system at different points. At times in such cases the current may be so large as to seriously heat the conductors.

Mr. Woodward said that in Providence the lead sheaths of all cables are bonded together in every manhole and there is in every manhole a ground plate bonded to the sheaths and to the copper neutral. In several years' operation no trouble was met with from railway current except in one section of the city very near to a point where the railway cables cross the river. Replying to Mr. Junkersfeld criticisms, he said he understood that by "slip" was meant unaccounted-for meter current, and he failed to see how there would be any more slip with 500-volt meters than with 250-volt meters. When it is considered that a single sub-station with a 250-500-volt, three-wire system would cover 16 times the area that could be supplied from a sub-station operating at 125-250 volts, it would seem a system using the higher voltage would be the better. As to alternating-current competition, he did not see how all classes of motors and all classes of lighting could be supplied with alternating currents at all times, he did not know of a single central station supplying a large area where variable-speed motors are used which has confined itself to alternating-current supply alone. Mr. H. L. Doherty, referring to the matter of meter slip, said that since the torque on the meter is proportional to the amperage and as current is supplied at a higher voltage, the slip would be doubled. As an example of what meter shunt losses may mean, he cited a neutral alternating-current circuit at Madison, Wis., where the shunt meter losses amount to more than the core losses of the transformers. Mr. P. G. Gossler, referring to an account in the paper of the wiring of the Union Trust Building in Providence, the frame of which is used as a neutral conductor, asked what the practice was in buildings not having metallic frames. In reply Mr. Woodward said that in these cases a copper neutral would be run.

In reply to a question from Mr. William Brophy, Mr. Woodward said that the ground of the system consists of a copper conductor neutral; the lead sheathing of the entire cable system and the grounded points at every manhole. In buildings not having iron frames there is a copper neutral, but in such cases the company advocates grounding at all possible points to the water piping of the system in the building. In any event, the copper in the neutral is always sufficient for carrying the current. The grounding of the manholes was an extra precaution which probably was not necessary. Mr. E. V. Matlack, of St. Louis, said that there was a similar system in St. Louis, the voltage, however, being 240-480. The only neutral is the lead sheath of the two-wire cable, while in houses a three-wire circuit is carried as usual. The system has been operated successfully for the last three years without any trouble.

In the discussion of the twin arc lamp it was brought out that the two sets of carbons are in series, the current being 2.5 amp. It was acknowledged that the type of lamp could be improved, but in its present form it gives satisfactory service. The reason for adopting the lamp was that if a customer needed only one arc lamp and the ordinary type were installed, he would have to pay for the current consumed in a rheostat of some similar device. The energy in the lamp is 575 watts, which is the same as would be used in one arc; in one case there is lesser current with two arcs in series, whereas in the other case there would be greater current and lesser voltage.

THE LUMINOUS OR FLAMING ARC.

Mr. Welles A. Holmes read a paper describing the magnetite arc lamp, concerning which an article appeared in these columns last week from the pen of Dr. C. P. Steinmetz. From the paper it would appear that the 320-watt magnetite arc lamp gives slightly more light than a 340-watt open arc or a 460-watt, series direct enclosed or alternating enclosed arc. It is claimed that the main advantage of the lamp is the uniformity of light distribution from it. In the case of the 460-watt lamps the average readable distance from the lamp is 267 ft., while with the 320-watt magnetite lamp this distance becomes 325 ft. The magnetite sticks cost about five cents apiece, and there is no expense for inner globes or washing the same, while the outer globe is of the standard type. It is stated to be necessary to have a perforated globe pan as the lamp is dependent on some slight draft to carry the products of combustion up the chimney; stopping this draft would result in coating the globe with the red oxide given off by the magnetite stick. The life of ½-in. sticks in the lamps used by Mr. Barnes in his station at Watertown, Mass., varies from 63 to 95 hours, and the ⅝-in. sticks have an average life of 182 hours with a maximum of 211 hours. With ½-in. sticks an average life of 100 hours has been obtained.

In reply to an inquiry concerning the coating of globes with red oxide, Mr. Holmes said that at first the holes of the globe were on the side and when the wind blew the oxide was caused to collect on the globe. Experience has shown that the lamp needs a direct upward draft; with the lamp now used the globe opening is indented and has holes drilled in the indented portion so that a side wind cannot get into the globe pan, but must come up from the bottom; this has remedied the difficulty and there is no further coating of the globe with red oxide. The quality of the light depends upon the composition of the magnetite stick and may be varied over a considerable range. In reply to a question he said that the burning of the lamps is in no way affected on windy nights. There is no consumption of the upper electrode, the magnetite stick alone being consumed. The public is very well pleased with the character of the light, and recently after a visit to a town by the mayor and council of another city, the lamp was specified for use in that city. Mr. John F. Hillman referred to the superior street illumination given by the magnetite lamp. With the best 6.6-amp. series direct-current enclosed arcs or the best 7.5-amp. series enclosed arcs, the distance at which a certain line on a luminometer card could be read was 257 ft., while with the magnetite lamp the distance becomes 300 ft. Referring to the amperage of the lamp, it was said that the determination of this was quite a problem. If 6.6 amp. had been used at 80 volts, the same as in the enclosed arc system now operated, there would have been a tremendous amount of illumination, almost like that from a miniature searchlight, except that the light would have been radiated from all four sides. It was finally concluded to adopt an amperage giving the standard illumination as it is to-day; and after getting a little bit better illumination at a distance due to the high efficiency of the lamp and its ability to throw the light horizontally, it was determined to use 300 watts and give the central station the benefit of the difference.

STANDARD RATING OF INCANDESCENT LAMPS.

Dr. Bell, in reporting for the Committee on the Standard Rating of Incandescent Lamps, said that at present primary standard lamps can be procured from more than one concern and in general the conditions relating to standardization of lamps have become such that it is hardly necessary to make an extended report. He feels that the work of the committee was pretty much accomplished when the time came when standard lamps could be easily obtained and a general understanding was arrived at as to what would be desirable in the rating and measuring of lamps, and consequently asked that the committee be discharged. He recommended that in the case of reports of technical character there should be closer co-operation between members of the Association. A proper method of doing work of this kind would be to send to all members of the Association a circular asking for detailed statements of conditions as they find them, and the answers should then be digested and printed as a confidential document, so that every member of the Association would know what the other members were doing. At a following convention a special or general committee could report on the data thus obtained and every one who had participated in gathering material for it could then discuss the situation to the best advantage.

A ONE-HUNDRED-MILE TRANSMISSION LINE.

Mr. Robert Howes described the transmission plant of the Washington Power Company, of Spokane, Wash. The transmission line is 98 miles long to the farthest sub-station, and has three short branches at present. It is supplied with power from two Y-connected, 2,500-kw, 4,000-volt, 60-cycle generators driven by water turbines, the current being stepped up by transformers with taps giving a choice of 60,000 or 45,000 volts line pressure. In crossing a swamp the poles were set on a cluster of five poles, the center one being driven 6 ft. lower than the other and thus furnishing a socket, in which the line pole was firmly clamped with heavy iron bands. No. 2 B. & S. medium hard-drawn copper wire is used. At present unity power factor is usually reached with a load of 1,500 kw, the current in the line being then about 18.5 amp. The line has been in operation for over seven months, during which time the circuit-breaker has been tripped eight times. In two cases this was caused by accidental short-circuits on the line made by the company's workmen; in four cases the cause was short-circuits on the secondaries of customers, and the other two cases were from unknown causes. The total time power was cut off by these troubles 32 minutes.

After reading his paper, Mr. Howes stated that since it was written they have succeeded in holding the voltage at Spokane practically steady, there being a variation not to exceed ¾ volt above or below normal on a 116-volt basis, and at the far end of the line the variation was cut down to a trifle over one-half. This was accomplished by means of the installation of a voltage regulator. A controller was then installed on the induction motor at the far end of the line, which cut down the variation another half. In reply to an inquiry he said that power had never been cut off except to cut in substations, at which times advantage was taken of the opportunity to renew insulators which had been broken by boys throwing stones and shooting rifles at them, making targets of them at rifle practice. In reply to another inquiry he said that they have had a number of severe lightning storms, which are much more frequent in that locality than in the Eastern and Middle States, but they had never experienced any trouble from lightning. During one storm, however, the insulation of a transformer for operating high-tension circuit-breakers in the sub-stations was punctured, which caused a shut-down of ten minutes. This was just before another shut-down of nearly an hour caused by a road supervisor putting several pounds of dynamite under a stump of a tree and projecting it through the wires. Dr. Bell called attention to the fact that people apparently expect of induction motors a greater degree of immunity from troubles produced on the line, and with others that motors are heir to than in the case of direct-current motors. Large induction motors should have the starting rheostats very carefully designed and this is usually not done, the lower steps of the starting rheostats in three cases out of four not being made for the fine gradations that are necessary. With proper attention to the starter relatively little trouble will be encountered with large induction motors. He believes it advisable to run a little under unity power factor all the time, never giving the current a chance to become leading and thereby introducing oscillatory factors, with magnetizing and demagnetizing action on the generator acting in quicker succession in response to changes in load. Mr. W. L. Abbott related some experiences with a 9,000-volt line in Chicago nine miles long with which they frequently have trouble. It was put out of operation once by lightning, twice by boys with hay bailing wire, in one case by a trace chain thrown over the line and again by some one who needed the copper.

GROUNDING THE NEUTRAL OF HIGH-TENSION, HIGH-POTENTIAL ALTERNATORS.

A paper by Mr. George N. Eastman on the above subject (to which we refer editorially in this issue) has for its object to show that any advantage which may be obtained by operating an alternating current insulated from earth, will be more than offset by the liability of obtaining high potentials relative to the earth. The study of the conditions was made on the plant of the Commonwealth Electric Company, of Chicago, and the paper is illustrated with diagrams showing the relations of the several voltages existing in connection with grounded and ungrounded circuits. Mr. Eastman considers that a proper method of grounding the neutral of generators is through as low a ground resistance as can possibly be obtained, in this manner fixing the maximum potential which can be obtained between a system and ground at the normal potential which will exist between the neutral of the generator and its phase terminals. The systems of the Chicago Edison Company and the Commonwealth Electric Company of the same city have been operated with a ground for a period of four years, during which they have apparently been entirely free from the high-potential breakdowns that have occurred on other systems of a similar character operated free from ground.

Mr. Hallberg said that the Cincinnati Gas & Electric Company had operated a system during the past four years similar to that referred to in the paper and with unquestioned success from the practical point of view. He considers it to be by far the most simple and reliable system, and the regulation seems to be everything that could be hoped for. In Cincinnati there has been practically no trouble from lightning, the neutral, if anything, protecting the system from lightning discharges. He recommended, however, that since the neutral is grounded all secondaries should also be grounded.

REMOTE CONTROL OF ELECTRIC APPARATUS.

With the above title Mr. William H. Cole presented a paper describing a system of controlling constant-current transformers connected to circuits of arc and incandescent lamps arranged in single or multiple circuits. As illustrated, the apparatus is shown applied to a constant-current or "tub" transformer. The principle of the device lays in the use of a float connected with the apparatus to be controlled, the float being enclosed in a cylinder to which oil may at will be admitted or withdrawn. The amount of oil, and consequently the position of the float in the tank, is automatically varied in such a manner as to maintain the current constant; the variation in level being produced either by running more oil into the tank or pumping some out of it. In the first case the valve of a supply tank is operated by an electromagnet, and in the second place a small electric motor is started up by means of an electromagnet.

THE ORGANIZATION AND EQUIPMENT OF AN ARC LAMP DEPARTMENT.

Mr. Samuel G. Rhodes described in detail the organization and equipment of a separate department exclusively for the care and maintenance of arc lighting service, in this connection drawing upon experience with the arc lamp department of the New York Edison Company. The paper contains reproductions of seven printed cards and slips used in the system, and gives illustrations of a carbon cutter and punch for cutting washers, an inner globe washing machine, a "Bishop's crook" lamp post and a supply wagon. The method of keeping track of every detail connected with an arc lamp system is described, and the duties of the various classes of employees are detailed. In turning on and off direct-current multiple lamps boys, preferably over 14 years of age and almost exclusively school boys, are employed, receiving $2.50 weekly for 45 minutes actual switching work both night and morning. Three men in charge of the boys cover the entire city of New York.

In the discussion of the paper by Mr. Rhodes it was brought out that during the past several years the arc lighting business appears to have come to a halt. Mr. Gilchrist, of Chicago, said that recently he had noticed a tendency on the part of the general public to use arc lights again, but he thinks this is due to a more strenuous effort on the part of central station people on account of sharp competition from various types of multiple gas burners on the market, and which are a strong competitor to the arc light. Mr. Rhodes said that the advance made in New York has really been the work of the contract department. The lighting engineer is a new departure; when trimmers report that any customer's lamps are acting badly the lighting engineer or one of his assistants is around the next day to remedy any defect. Many people have changed over from the Kitson and Humphrey gas burners, the operation of both of which, especially in the winter time, is very bad. He considers the 3.25-amp. lamp very useful, for if the customer does not want to pay for a 5-amp. lamp he will probably be willing to take a lamp of the lower consumption. Mr. Douglass Burnett, of Baltimore, said that there is little difficulty in getting arc light business now when the solicitation is properly done. The customer should be assisted in locating lamps and sometimes given sketches with a general outline of a scheme for his lighting. For example, he may be advised that for the interior of his store he requires a 5-amp. lamp for every 300 sq. ft. of floor space, the lamp to be located with the arc about 12 ft. above the floor level. For the windows incandescents should be recommended. Arc lamps in the interior of a store will show goods better than anything else to customers, and he cannot produce a brilliant effect in front of the store with interior incandescent lights. In fact, the prospective customer should be advised on every point calculated to make his lighting most effective. He considers that the problem still remains as to how to develop the series arc lamp service.

Mr. Rhodes said that while in the case of large contracts the New York Edison Company does not care for the lamps, yet they keep their eye on the installation and freely offer their service whenever it appears to be called upon. As to maintenance of arc lamps, one trimmer at $14 a week, seven days, will take care of 650 lamps; in the repair shop one man will take care of 2,000 enclosed lamps. In this shop one man at $3.50 a day and the rest at $2 will do the work. Mr. Burnett said that in Baltimore he also used night linemen in the various districts, who were available in case of either an open or grounded circuit and for switching on electric signs and for switching them off again. In reply to a question it was stated that the New York Edison Company and the Omaha Electric Light Company furnish diffusers free to their customers, and Mr. Fleming stated that the General Electric Company will adapt its diffusers to any type of lamp.

LOST AND UNACCOUNTED-FOR CURRENT.

Mr. C. W. Humphrey gave an account of the method used by the Denver Gas & Electric Light Company for determining the losses, known and unknown, from alternating and direct-current circuits. The losses are classified as transformer iron losses, primary resistance losses, secondary resistance losses and meter shunt losses. The methods employed by the Denver Company for determining these losses are given in detail, the paper containing reproductions of forms and curves employed in this work. It was found that the greater part of lost and unaccounted-for current was due to thefts. The paper cites an instance where, through proper attention to reducing losses, the ratio of sales to output increased from 59.3 per cent. to 80.5 per cent. In another case, where a feeder was changed from a 1,000-volt individual transformer to a 2,000-volt, three-wire secondary network, there was a reduction in transformer iron losses of over 60 per cent. In this instance the sales were increased to nearly the original amount and the transformer iron loss reduced to about one-half the original amount, though the primary and secondary resistance losses were increased considerably through the increase of the output of the feeder. In the case of a principal business feeder the watts per lamp of output remained about the same for the entire year, while the watts per lamp of sales increased during the same period to nearly double. The sales increased from 41.6 per cent. to 83.5 per cent., the known losses remained about the same, while the unknown losses decreased from 48.4 per cent. of output to only 5.22 per cent. A check meter placed in a district having nine ampere-hour meters and eleven integrating wattmeters showed a loss in the district of 8.1 per cent., not including about 2 per cent. wattmeter shunt losses. The larger loss was principally due to the ampere-hour meters, which do not start on less than two to four 16 cp lamps.

In reply to a question, Mr. Humphrey said that the total accounted for losses of the Denver station were 10.8 per cent. of the output. In the month of December the sales of output were 85.3 per cent.; the current loss and unaccounted for was 5.2 per cent. and the loss accounted for, 10.5 per cent.

ECONOMY IN MINOR STATION SUPPLIES.

In his paper with this title, Mr. Edgar B. Greene confined himself to a consideration of stations of minor size. In his station there is a course of training which starts a young man as an apprentice either in the steam or electrical side of the plant, and gives him a thorough training in all branches of the work. There is no definite period for this course, the apprentice being promoted as fast as his ability will warrant, there being a distinct understanding that each person must earn his promotion or stand aside for the next man. A number of the apprentices take a course in correspondence schools and this method of education is strongly endorsed. The paper refers to a number of minor economies such as standardizing pipe nipples and valves, using tubing in steam hose for use in cleaning boiler tubes, and a home-made arrangement for bending tubes is described. A lathe has been installed for making simple repairs. The ashes and cinders are carted away free by a railroad company and others having use for them. Arc machine brushes are made from strips of hard-rolled copper .01 in. in thickness; four of these are soldered and a phosphor-bronze strip .02 in. thick is used as a stiffener. All oil from the engines is drained by gravity direct to the oil house, where it is filtered by a home-made apparatus. Defective coils of arc lamps and Thomson recording wattmeters are rewound in the station, as well as all transformers. In reading the meters the routes of the men are changed monthly, and different men instead of the same man are used for this service. After the inner globes of enclosed arc lamps are washed they are tested on a ground steel plate for the closeness of joint and then fitted to the holders, the lower holder being trimmed in the station. At least three days' supply of inner globes are always in course of cleaning or washing, which keeps two days' supply ready for use. With a new man the average life of the inner globe is about 800 lamp-hours for the first month and afterwards from 1,400 to 1,500 hours; the number of lamp-hours per carbon is found about 10 per cent. shorter with a new man on the first month.

In the discussion of Mr. Greene's paper, Mr. N. L. Abbott, of Chicago, said that he knows of nothing which will introduce discord in the operating force so promptly and so continuously as placing an outsider in one of the higher positions over the heads of men who have worked faithfully for years. He has known of cases where discord thus produced has been so great that it was necessary to discharge the entire original force. Concerning oil filtering, he considered there were two functions to be performed, one to remove the grit and the other to remove grease and water from the oil. By removing the water and grease in the settling chamber, he has found there is no need of a filtering material in the oil filter. In reply to a question Mr. Greene said the tubing referred to as prolonging the life of steam hose is the Greenfield flexible tubing made by the Sprague Company, a size being used which will fit neatly in the hose. Mr. M. A. Maxwell, of Easton, Pa., said that he found the life of inner globes to be from 5,000 to 6,000 lamp-hours, and 50 per cent. of the globes replaced are broken by boys. Mr. Greene said that standard Edison fuses are carried by his company in stock for free renewals.

THE GAS ENGINE FOR CENTRAL STATION SERVICE.

Mr. E. E. Arnold contributed a lengthy paper entitled "Notes on the Internal Combustion Engine as Applied to Central Station Service," in which, after briefly outlining the theory of the gas engine, he gives data as to test performances and describes and illustrates a number of central stations equipped with the Westinghouse gas engine. A table gives the results of tests for a large number of gas engines of this type. The best result was on a machine in a Madison (Wis.) central station, which showed a consumption of 9.6 cu. ft. of gas per hp-hour, the gas having a calorific value of 1,050 B.T.U. It is stated that the average efficiency of a producer gas plant may be taken at 80 as a conservative figure. A test is cited of a 75-kw gas engine operating from a Mond producer plant, which during two years' continuous operation showed a consumption equivalent to 1.05 pounds of cheap slack coal per indicated hp-hour. A table is given showing that a 2,000-kw gas engine plant can be run for $3,724 a year less than a steam plant, the higher cost of the gas engine equipment being taken into consideration. In the Bradford (Pa.) central station a gas engine reduced the fuel cost from $9,000 to $3,000 per year. At Madison, Wis., a gas engine plant delivered a kilowatt-hour at the switchboard at a cost of fuel more than ⅓ less than that required for running a steam plant.

TEST OF A 5,500-HP COMPOUND ENGINE AND GENERATOR.

Messrs. J. B. Andrew and W. F. Wells gave the data of a test of one of eleven three-cylinder, 5,500-hp vertical compound engine units installed in the Waterside station of the New York Edison Company. The method of test is described in detail and much of the data are plotted in the form of curves. The test showed that for outputs of from 2,500 to 4,500 kw the steam consumption varied between 17.12 and 18 pounds per kw-hour of net output at the generator terminals. The ratio of the net electrical horse-power to the indicated horse-power varied from 94.5 to 95.2. The best test showed an economy of 11.93 pounds of water per indicated hp-hour or 16.78 pounds per kw-hour. The tests indicated a decided disadvantage in the use of a receiver reheater and steam jacket in this type of engine. The curves show an almost absolute uniformity of economy for a considerable range on either side of the normal rating. Increasing the vacuum from 25.3 to 27.3 in. decreased the water consumption only .06 pound, whereas increasing the receiving pressure from 21 pounds to 36.8 pounds, or changing the distribution of load from about ⅖ on the high-pressure cylinder and ⅗ on the low-pressure cylinder, to about equal load on all three cylinders, decreased the water consumption .25 pound.

THE STEAM TURBINE.

Mr. Francis Hodgkinson contributed a paper entitled "Practical Notes on Steam Turbines," in which, after discussing the principles of this type of prime-mover, brief descriptions are given of the De Laval, Stumpf, Curtis, Zoelly and Rateau turbines, the remainder of the paper being devoted to the Westinghouse-Parsons type. This type is described in detail and a number of curves are given of economy tests. A considerable portion of the paper is devoted to foundations and power plant designs for Westinghouse-Parsons turbine electrical equipments. It is stated that at present 43 turbines of the Westinghouse-Parsons type are in operation or under erection in this country, ranging in size from 400 to 2,000 kw, and aggregating 27,000-kw capacity. There are also 69,400 kw in turbines under construction at East Pittsburg in all sizes up to 500 kw. Including machines in the course of construction, the total is 111 machines, aggregating 96,400 kw, or an average of 868 kw per unit.

The papers by Messrs. Andrew, Arnold and Hodgkinson, and the report of the Committee of Investigation of Steam Turbines by Mr. Eglin, were discussed together. In opening the discussion, Mr. Ralph D. Mershon said he noted that in the plant on which Mr. Arnold gave figures, nothing was allowed for relay capacity, and if this were done it would mean a greater investment to the disadvantage of the gas engine. He has found that most gas engine builders rate their engines at or near the maximum load they will carry, whereas the steam engine is rated so as to have a considerable overload capacity. He considers that the gas engine should be figured as having a less efficiency at lighter loads, as compared with the steam engine. Referring to the figures given by Mr. Arnold as to cost per kilowatt of steam and gas installations, namely, $100 and $125, respectively, he thought that the figure for the gas engine should not be under $150 and nearer $175. Mr. Doherty said that the serious drawback in gas engine development is in securing economical and satisfactory transformation of the heat energy of coal into gaseous energy. Mr. H. G. H. Tarr spoke of the reduction of cost to be obtained in the generation of gas through utilizing the by-products. In one process, if the coal is worth $2.50 per ton, the by-products reduce the cost to the equivalent of $1.50 per ton, these figures being applicable to larger plants of, say, 50-tons capacity in 24 hours and above. A producer using bituminous coal will cost from $17 to $20 per hp. Mr. W. R. Gardner suggested that peat might possibly be used to make a producer gas at low cost. Mr. R. H. Rice, of Lynn, Mass., in answer to a request, gave a description in detail of the Curtis turbine. Up to and including 300 kw this turbine is constructed on the horizontal type and on the vertical type for capacities above. He stated that tests under actual working conditions have shown that the turbine maintains its efficiency with variable loads. Moreover, the turbine retains its original economy as long as it is operated, while the steam engine is stated to rapidly lose in efficiency due to the wear of its reciprocating parts. All large Curtis turbines are made now with four stages. He cited a case where only two reciprocating engines of 500-kw capacity could have been installed in a certain power house, where five turbines of the same size were readily located. Mr. H. L. Doherty spoke highly of the prospects of the gas engine, and said that to-day practically every authority on thermodynamics believes the ultimate prime-mover will be the internal combustion engine. In his opinion the steam turbine will be left behind by the internal combustion engine, which will unquestionably be the eventual prime-mover. To get the best efficiency in the gas engine it should be operated at its maximum capacity, since the losses are 25 per cent. of the capacity, no matter what the load. Gas engines cost more per horse-power at the start and the fixed charges are consequently heavier. It is, therefore, desirable to operate the gas engine the longest possible number of hours, and an ideal arrangement would be to use a gas engine to take care of that portion of the load which is on 24 hours a day, the variable load being taken up by steam engines. He endorsed a statement by Mr. Arthur Williams that the present gas engine is relatively no better developed now than the steam engine was during the life of Watt, and he believed the gas engine has wonderful possibilities ahead. He thought that the question of the gas producer is not receiving in this country the attention which it deserves and which is being given to it in Europe. As to the smaller space occupied by the steam engine, in his work he had found that he could not always avail himself of the lesser space indicated by the turbine without the use of a system of steam piping that would not be good engineering practice. Several methods have been proposed to reduce the space occupied by boilers. One is to have the boilers installed back to back, giving a double boiler room with the firing door on the side, the steam piping being led from one firing alley to the engine room. Another plan is to build the boilers with the firing doors at right angles to the turbine and have short alleys running up to the groups of boilers. Another way is to design a special boiler having little width and considerable depth, this probably involving a vertical boiler. Another method suggested but not looked upon with favor was to put the boiler room on each side of the turbines. As to condensers, Mr. Doherty says he has never been able to satisfy himself that he cannot get a higher vacuum from a jet condenser than a surface condenser, and he hopes next year to have some definite figures on this subject. The question of superheaters is a rather serious one for it is difficult to control the degree of superheat and the tubes burn out.

Mr. Arnold, in referring to Mr. Mershon's remarks concerning the rating of gas engines, said that these are ordinarily rated at a brake horse-power of 15 to 20 per cent. under maximum capacity. Steam engines are rated on their indicated horse-power with, say, 50 per cent. overload, but the difference between indicated and brake horse-power amounts to considerable, and the actual capacities of the two types of engines approach more closely than would ordinarily be supposed. As a lighting station has ordinarily a 20 per cent. load factor, the relay capacity is well taken care of in the way the units are laid out in the case Mr. Mershon criticises. Smaller gas engine units of approximately the same efficiency as large gas engine units, and the smaller gas engines, are notably more efficient throughout their range of load than the steam engine. As to the relative efficiency of the gas engine at light loads, he referred to a curve in his paper showing that at half load the brake thermal efficiency of the engine was 21 per cent., while that of a steam engine of the same capacity would only have a corresponding efficiency of 10 per cent. As to the depreciation and life of a gas engine in comparison to the steam engine, experience points out that the former quite holds its own with respect to depreciation, though it will perhaps be found that it costs slightly more for horse-power repairs than the steam engine equipment, excluding the more intricate designs of multiple-cylinder, releasing-gear steam engines using superheated steam. He cited a lighting station having a 24-hour service equipped with 800 hp rated capacity in gas engines in five units, complete repairs for which in the year 1903, including repairs to igniters, cost only $102, or something less than 13 cents per hp per year. In reply to an inquiry he said that all plants referred to in his paper are connected with alternating-current generators operating in parallel, and many of the plants are giving 24-hour service. He referred to a 3,000-hp gas engine cement plant which operates 24 hours a day and has been in service about four years. In reply to a question, Mr. L. R. Alberger said that if hot well water is kept away from the atmosphere it is liable to keep its temperature better, while it has been shown that in this case there is less likelihood of corrosion taking place in boilers.

THE MECHANICAL STOKER.

Mr. Edwin Yawger read a paper entitled "The Mechanical Stoker and the Human Operator," in which he pointed out the various factors which should be considered with respect to the introduction and use of the mechanical stoker. He considered that no builder of stokers should put in his apparatus unless he has submitted to him a complete furnace design to enable him to adapt the stoker to the particular case. The paper is principally devoted to practical considerations relating to the operation of boiler plants.

Mr. C. H. Parker said that the higher the temperature of a furnace fire, the better the furnace efficiency. Flue gases analyzed with low fire temperature show a large excess of oxygen. When the grate combustion is run up to 40 or 50 pounds per sq. ft. rate, the excess air kept is brought down something like 30 to 40 per cent., and the fire is a dead white. Better economy may be obtained by reducing a grate area and using a greater number of pounds per square foot, and also per square foot of heating surface. Mr. R. S. Hale, of Boston, said that after analyzing a great many boiler tests he had reached the conclusion that, other things being equal, the less draft used the higher will be the efficiency. If it is a question of getting a greater capacity, then of course a greater draft must be supplied. or if a grate surface is cut down more draft must again be supplied. He disputed the statement of Mr. Yawger that the same volume of gas at the same temperature will give up more of its heat when passed rapidly over a heating surface than when passed slowly. On the contrary, better efficiency is secured by passing the gases more slowly over the heating surface. One reason why the best efficiencies are gained with a low draft is that this implies more careful firing in order to keep up the capacity, and hence reduces the amount of air used, thereby reducing the loss of heat in the waste gases; and since the gas is passed more slowly over the heating surfaces, they give up more of their heat.

AWARD OF DOHERTY MEDAL.

Dr. Schuyler S. Wheeler, chairman of the committee on the award of the Doherty Gold Medal, said that of the various papers submitted on the subject of underground construction, there were two excellent ones, one by Mr. W. P. Hancock, of Boston, and another by Mr. Blood, of the same city. While the paper by Mr. Blood was very good and exceedingly well composed, it was unanimously decided to recommend the award of the prize to Mr. Hancock. The president, in awarding the medal to Mr. Hancock, said that his career had been passed with the Boston Edison Company, of which he is now general operating superintendent, and the designer of the two stations to be visited in the afternoon by the members. In accepting the award Mr. Hancock said he wished there was a greater engineering interest in underground construction. The subject is an extremely important one and should be given close attention. The distribution system should be entirely reliable or the reputation of the company will suffer, and the construction should be such as to keep the operating and repair charges as low as possible in the future.

CENTRAL STATION AUXILIARY ICE PLANTS.

Mr. C. L. Wakefield presented a short paper entitled "Electric Light and Power Plants in Connection with Ice Plants," in which he gave the result of correspondence with about 50 plants supposed to have an ice plant auxiliary. The results showed that very few of the plants were actually so equipped, and with three exceptions, where there are equipments they have been installed without any particular purpose. In his station a 300-kw alternating-current plant operates a 100-ton ice-making plant with the addition of one oiler and one fireman to the regular force. The fuel cost per ton of ice varies from 350 to 700 pounds of coal, depending upon the calorific value of the fuel and the manner of its use.

Mr. Scheuck thought that it was a bad plan for electric light companies to operate ice plants or enter into other classes of industry, excepting steam heating, for the reason that it was likely to antagonize municipally influential persons who might be interested in competitive ventures.

DECORATIVE AND SIGN LIGHTING.

The report of Mr. Arthur Williams on this subject is presented in sumptuous printed form and consists principally of views of New York City buildings and interiors, and reproductions of letters printed on toned backgrounds. The illustrations are mostly views of facade lighting of theatres and other buildings, with some views of interior lighting, the most striking being a representation of the Waldorf ballroom on the occasion of the Edison A. I. E. E. dinner. The letters are principally reports from electrical companies on the subject of decorative and sign lighting. The mechanical execution of the brochure does much credit to the press of the New York Edison Company.

ADVERTISING METHODS.

The report of Mr. La Rue Vredenburgh on this subject is bound in an illuminated cover and relates principally to the methods of advertising that have been employed by the Boston Edison Company. Reproductions are given of a large number of newspaper advertisements and of electrical signs soliciting central station business, and the text points out methods pursued by several of the larger companies in soliciting business.

The reports of Messrs. Williams and Vredenburgh papers were discussed jointly. Mr. Scheuck said that methods which might pay in large plants could not be afforded by companies in smaller cities. Mr. Williams and Mr. Vredenburgh's methods were undoubtedly of great efficacy for the large companies, but there were only a few companies in the United States which could afford them. He was connected with several plants in smaller cities, these plants doing both railway and lighting business. He had found one of the best methods of getting new business was to print small booklets and to supply them to metal holders in the street cars each day. In a town of 50,000 inhabitants he had begun with an issue of 4,000 booklets a week and had had to increase the number. The booklets contain humorous items interspersed with advertising arguments; he found that people would take these booklets home and that they had been the means of increasing his lighting and power business. Another method of extending power business is to go to small factories and shops already equipped with motors, but not intelligently so; to re-equip them so as to secure higher operating economy and take photographs of the meter bills before and after the change, using these photographs as advertising material. He advocated making very low rates to stores for electric signs, show window lights, etc., and taking special care to see that the stores maintained their signs and show window lights in good condition. Mr. Scheuck also pointed out that the lighting company's office should be in a good location and well illuminated at night in order to make a good impression on the citizens. Mr. Converse D. Marsh disagreed with Mr. Scheuck as to methods of getting new business. He thought that methods of getting new business should be the same in character in smaller plants as in large ones, differing only in degree. Promiscuous distribution of booklets he did not consider efficacious. Solicitors could not know who had been reached by the booklets, so that a follow-up system could not be applied; the booklets alone certainly would not bring a man up to the point of signing a contract. Mr. Burnett also disagreed with Mr. Scheuck. He was connected with a company in a city of moderate size and had obtained good results by furnishing free electric signs in order to obtain the resulting business. President Edgar, in response to an inquiry by a member, said that the Boston Edison Company spent 5 per cent. of its gross income in advertising and soliciting new business, this amount being about equally divided between the two branches.

FACTORY ELECTRIC POWER.

The report of the Committee on Purchased Electric Power in Factories, consisting of Messrs. W. H. Atkin, chairman; S. Morgan Bushnell and G. W. Brine, gives the result of inquiries made by circular letter concerning the use of electric power in factories. The letters were sent to all of the members of the Association and asked for answers to 13 questions relating to the charge for power, kind of factories supplied, increase of power business, decrease of production cost from use of electric power, kind of electric drive, amount of power sold, etc. To 462 circular letters sent out 61 replies were received. Of these 19 reported no sales of factory power, 11 either gave no information or answered but one or two questions, and 31 replied more or less fully. The average increase of power business of 24 companies reporting was 37 per cent., a larger amount of increase than the lighting load. The rates reported range from 2 to 15 cents per kw-hour, the usual range being from 4 to 10 cents. Among the conclusions of the report are the following:

The sale of electric power by central stations to factories has been limited largely to such industries as have to carry on their business in the centers of cities or towns where space is costly and where the trouble and danger of steam engines become large factors. The great industries of boots and shoes, cottons and woolens, usually produce their own power.

Among printers there is a large patronage from "job shops" and a good proportion of the newspaper offices, but practically none of the book printers, whose "runs" are long and whose "make-readys" are comparatively short.

The committee considers that the best method to increase business is to educate the prospective customer. Although electric power has been in use for 15 years, it is not yet the first power of which a man thinks when he is about to start a new factory. If the central station could have its solicitor on hand to explain the advantages of electric drive over mechanical drive before the prospective customer has purchased his gas engine or steam engine, or made his contract for power from a belt, a great amount of business might be obtained which is lost simply through unfamiliarity with electric power on the part of the power-using public. In this connection it is of the highest importance that the solicitor be thoroughly conversant with different manufacturing processes, and be a man of great power of observation, so that he can take in the situation quickly and give the customer the needed points which will "tell" and turn the scale to electric drive supplied from central station.

After a customer has been secured he should not be left to his own resources, but should be advised as to the number of motors to purchase and their arrangement. Careful attention to the details of installations at the time the motors are purchased will effect economies, and these will go to the credit of the central station service. The customer is naturally quite reluctant to buy several motors, when, so far as he can see, one will do the work just as well; but the solicitor should have at hand facts and figures that will prove conclusively that the extra motors will return a good dividend upon the investment, and that with the individual motor equipment or the group drive, the central station can supply power more cheaply than the customer can produce it himself.

One great point of economy which should be looked after is the use of the electric elevator in place of that operated by steam or hydraulic power. In many factories may be found a slow-speed freight elevator driven by belts from the main shaft. This can always be changed over and connected to an electric motor without calling on the elevator makers and at comparatively small expense. Another important feature in central station service is the facility with which any single department can be run overtime. This often avoids the employment of inexperienced help, and enables the manufacturer to respond more promptly to any unusual demand. Another exceedingly important factor in the advantages of electric power is the ease with which a plant can be enlarged by merely buying additional motors from time to time, instead of taking out and discarding an overloaded steam plant and putting in a new one at enormous expense, or at least adding long lines of shafting and belting.

The ability to move machines about, taking the tool to the work, instead of the work to the tool, is often a great advantage in large establishments, and this may be done with the greatest facility when tools are directly connected to electric motors. The time saved by this arrangement in shops handling large masses of metal would pay a very large dividend on the investment in motors. The cleanliness of a shop supplied with motors instead of with shafting would be a revelation to one who was not familiar with the results which such a change in power produces.

HEATING FROM CENTRAL STATIONS.

The report of the Committee on District Heating, consisting of Messrs. E. F. McSherman, D. F. Magee and C. M. Maunsell, gives the result of an inquiry made among central stations operating steam and hot water systems. Of 100 companies addressed, 52 replied, including 36 operating steam and 16 operating hot water systems. The report gives in tabular form the replies to the 24 questions propounded. The conclusions of the committee are that as a whole it seems clear that the companies now in the heating business are in general making money. Out of the 35 steam systems 31 state and show, by the figures returned, that they are well pleased with the investment. Out of 15 operating hot water systems, 11 are satisfied and 4 are not. The best financial showing is made by those companies basing their charge on readings by meter and cubic feet of air space, which insist on the use of economizing coils, inspect and supervise the installation of buildings and refuse to connect or give service to poorly-designed heating systems; and which keep separate accounts of heating and electrical revenues and expenses, and recognize the value a heating system has as an auxiliary to electric light and power supply. It is at least a coincidence that the companies making the poorest financial showing are those that, from a lack of knowledge of what they are actually doing, are unable to make definite or explicit replies to some of the questions asked.

Replies to one of the questions indicate that there is no difficulty in securing or retaining heating patrons, which would seem to indicate that in most cases companies are not receiving as much for heating service as it would cost the customer to supply himself, and consequently it would seem that prices might properly be advanced. The comparative cost of steam heating and coal heating in buildings does not seem to enter into consideration when central station heating service has once been used. The important matter of depreciation has not had the consideration that should be given to it; only 21 of the 52 companies reporting have seen fit to provide for this. Most companies report low cost of repairs, one that has been in business for six years reporting only 2½ per cent. on mains and services. The question of returning condensation to the power house seems to be one related to local conditions. Very few express themselves favorably on constructing a plant for this purpose, though a few are much in favor of it, probably owing to the local situation. The replies seem to indicate that district heating is now a success and could be made more so if central station managers were to co-operate with the committee for the general good. The paper gives the full text of the replies received from all of the central stations which reported.

In the discussion, Mr. McCabe, in answer to an inquiry, said that of the fifty-two companies that had replied to his inquiries only five or six had made any charge to cover depreciation on mains, etc. One company which had been in the heating business fifteen years charged 2½ per cent. for depreciation. Another company which had been supplying heating service for eight years made no charge. Mr. McCabe thought that the depreciation should be taken into consideration, but that it would be very small. He also pointed out that the supplying of heating service enabled an electric light plant to get lighting business in office buildings and other large establishments, which, if they had to maintain heating plants, would also operate their own lighting plants. Mr. Williams, of the New York Edison Company, said that his company had met this argument usually by offering to furnish labor, fuel and supplies for operating the heating plant and to operate the plant at a lower rate than the records of the office building or other establishment had shown the heating service to cost. He said that his offer had never been taken up, but that it had always proved efficacious in combating the argument advanced by the building owners.

OFFICE METHODS AND ACCOUNTING.

Mr. Frank W. Frueauff, in his report on office methods and accounting, confines himself to an account of the methods used in the offices of the Denver (Col.) Gas & Electric Company. The subject is considered under the following heads: Complaints, bureau of information, meter reading, office mistakes, card records, accumulative reports, receipting machine, adding machine, self-adding sheets, slide rule, Thatcher calculator, tube system, tabulating machine and analysis of steam generation. Reproductions of several forms are included in the report. Mr. Frueauff favors the plan of apportioning the cost of operation to the class of current made and of separating fixed and variable costs. The expenses occasioned in manufacturing and distribution for any one class of current should be kept distinct from those incurred in another, so that the actual cost of manufacture and delivering arc power and alternating current may be known separately. The cost for any one class should also be separated to show the costs that are fixed as distinct from those that are variable. For example, station foremen, meter department, shop expenses, etc., are practically a fixed expense, not varying notably as the business increase or decreases. Boiler fuel, firemen, lamp renewals, carbons, etc., vary with output, and under a third head may be included meter, arc lamp and service repairs, meter reading expense, collection and office salaries. With the cost for any class of current separated into these three divisions, it is possible to know just what results are being obtained, and this method is particularly valuable in figuring rates to be made to secure new business. For example, in figuring to take on a long-hour burning customer, it is known from the figures of cost that the fixed cost will not be materially increased nor the consumer's expenses, and that only the output cost will be increased.

At the close of this discussion, the president appointed the Committee on Nominations, consisting of Messrs. P. G. Gossler, New York; D. P. Robinson, Boston; Irvin Butterworth, Denver; W. C. L. Eglin, Philadelphia, and F. E. Smith, Somerville, Mass.

Mr. H. L. Doherty, chairman of Committee on President's Address, then submitted his committee's report. The committee warmly commended the suggestions in the president's address relating to methods for advancing the interests of the Association. It recommended taking quarters in the Union Engineering Building, and suggested the appointment of a reporter to collect data on the thawing of water pipes by electricity in order to deduce something like standard methods for the work and to arrive at a satisfactory basis of charge for such service.

CENTRAL STATION STANDARD INSTRUMENTS.

In a paper entitled "A Proposed System of Standard Instruments for Operating Companies," Mr. H. P. Davis, after sketching the extreme desirability of accuracy of central station measuring instruments, and consequently the necessity of reliable standards for calibration purposes, suggests that a remedy for the present unsatisfactory condition in these respects may be offered by the manufacturers of high-grade electrical instruments. Such manufacturers, it is stated, have the equipment and facilities necessary for the manufacture of portable or semi-portable instruments possessing the desired requisites, and for their certification and periodical checking while in use, with trained and experienced engineers familiar with the problems involved and the means for solving them. Would it not, it is asked, be most natural and advisable for such a concern to design instruments of this nature; to offer them upon a fair commercial basis for the use of operating companies; and thus to give the purchasers the benefit of their exceptional facilities for designing, manufacturing and maintaining their accuracy in use?

The service as rendered by manufacturers of such standard instruments could be advantageously used to cover their care and recalibration after they were put in the hands of purchasers. All the conditions of manufacture combine to make the manufacturers of such instruments the best able to care for them thereafter.

To render the best service under the plan suggested, the manufacturers of the instruments should make no charge for recalibration and should see to it that prompt return is made to the owners. It might even be found advisable to ask owners to send in instruments to be checked when a considerable period has elapsed without such attention. The owner would be at no expense, except for carriage, and should have no hesitancy in sending his instruments to the maker for attention when desired. The testing departments of operating companies would thus be kept in contact with a standardizing bureau or department, whose certificates should rank in excellence with those of the best and most favorably known government bureau or the most famous standardizing laboratories. It is stated that to render such a system successful requires an instrument far superior to all present types, and to cover the field properly the assortment should be made up of voltmeters, ammeters and wattmeters. Specifications are then given as to the design of the instruments answering the necessary requirements.

SINGLE-PHASE ALTERNATING-CURRENT MOTORS.

Mr. W. A. Layman read a paper on "Single-Phase Power Motors for Electric Lighting Stations," which treated the subject under the following heads: Reliability of single-phase motors; comparative cost of insulation of single and polyphase motors; single-phase motors on polyphase generators; single-phase motors for lighting circuits; single-phase motors for high frequencies; the desirability of motor load for central stations; the special value of motor load to small stations; the day circuit as a factor in the building up of small towns, and power rates for single-phase motor service. The discussion of the subject was based upon the assumptions that the single-phase motor, except for variable-speed work, is to-day the substantial equivalent of the direct-current motor; that polyphase and single-phase types of motors are not competitive, and third, that simplicity of generating equipment and system of distribution are of paramount importance in the profitable development of central station service.

For large plants having polyphase generators, Mr. Layman suggests that the switchboard be arranged for operating first polyphase feeders for all large power and rotary converter service. Second, single-phase feeders for all general lighting service and for all small power work, the switchboard being such that any single-phase feeder may be switched to either phase of the generator buses; where substations are employed similar switchboard arrangements should be made for polyphase distribution in large units and single-phase distribution for all other kinds of service. Third, independent feeder regulations for all polyphase as well as all single-phase feeders. It is stated that the cost of installation of the single-phase motor is actually much less than that of the polyphase; that satisfactory single-phase motor service can be gotten from polyphase generators, and that single-phase motors can be satisfactorily operated from lighting circuits. The New Jersey Public Service Corporation and the United Gas Improvement Companies are installing single-phase motors up to and including 35 hp and the Cincinnati Gas & Electric Company is adding single-phase motors of 15 or less horse-power capacity and considering larger installations individually on their merits. In Chicago motors of 5 hp or less are required to be single-phase and larger installations are considered individually on their merits. Satisfactory single-phase motors can be made for 125 and 133-cycle circuits. There are a number of instances of central stations giving 133-cycle motor service almost up to the maximum capacity of the plant. The paper includes power rates for single-phase motor service as established in Peoria, Ill., and in Cincinnati, Ohio. In the former place the charge varies from 10 cents per kw-hour up to 100 kw-hours per month to 2.8 cents per kw-hour for over 2,000 kw-hours per month and over; 10 per cent. discount being given on all bills paid within ten days. In Cincinnati the basic rate is 10 cents per kw-hour, with discounts varying from 10 per cent. for 100 kw-hours per month to 60 per cent. for over 800 kw-hours per month, there being an additional discount of 5 per cent. on all bills paid within five days.

Mr. J. H. Hallberg stated that the Cincinnati Gas and Electric Company had had to adopt the policy of declining to connect up three-phase motors smaller than 15 horse-power in order to keep down the fixed charges due to the investment for transformers, meters and accessories. They had found that the use of single-phase instead of three-phase motors within the limits mentioned had effected a very considerable economy in fixed charges and had also enabled the company to supply customers whose service would not have been worth obtaining if it had been necessary to run three-phase lines to them and install three-phase transformers, meters, etc. In the case of elevators and other special machinery requiring heavy starting torque, three-phase motors were still used in all sizes.

WRINKLES.

Vying with the "Question Box" in value to all members of the Association, a new department of the Association's work has been initiated in the form of a collection of notes entitled "Wrinkles," giving an account of practical expedients, home-made apparatus, etc., devised by central station men. The editor, Mr. Charles H. Williams, has been able to collect through correspondence no less than 103 items of this character, occupying 107 pages of the *Transactions*. The character of the matter may be judged from the following titles of some of the notes: Truing engine pins; feed water heater on a gas engine exhaust; a home-made traveling crane; repairing a defective boiler crown sheet; keeping a commutator in good shape without turning or sand-papering; a coil-winding machine; running 9.6-amp. lamps and 6.6-amp. lamps from the same machine; reducing standby losses during light load; transformer testing set for line use; locating breaks in series arc circuits; water rheostat used as a starting box; a special transformer for thawing frozen water pipes—there being several notes on this subject; a novel electric sign.

LARGE WATER POWER INSTALLATIONS.

Dr. F. A. C. Perrine presented a paper on Thursday evening which he illustrated by means of lantern slides, giving an account of the genesis of water power electrical generation and describing briefly some plants of this character installed in this country.

ELECTRIC HEATING.

Mr. James I. Ayer presented a very interesting paper on the subject of electric heating, cooking, etc., which will be again noted in later issues.

Mr. Ayer recommended that the plan adopted with respect to arc lamps should also apply to electric heating, and that kitchens and heating outfits of all kinds should be installed free. This system is carried out by the gas companies with great success. The average kitchen for a family of from four to eight persons involves a transformer capacity of about 30 amp. and 3 kw. The average demand of a family of this kind is about 20 amp. and 2 kw at the cooking hour, or about two-thirds the house service. Most of the load for cooking is over by 6 o'clock, so that at most seasons of the year it would not coincide with the peak load. Mr. Alex Dow, of Detroit, said that in Detroit the peak load is in advance of the general maximum lighting in the residence districts, coinciding with the downtown peak. Electrical cooking would add to the main station peak load, but for winter service only. The cooking load is about two hours per day throughout the year. It does not do to sell cooking apparatus unless they are looked out for. An absolutely clean, smooth vessel is better than the ordinary cooking utensil, and the best one is a type of vessel which clamps solidly to the disk. The conducting cords are a nuisance, and he suggested that they should be passed through a hole in the table as in the case of telephone switchboard cord. The devices furnished by various makers for varying the heats are about useless in the hands of the ordinary kitchen servant. He considers that two heats are practically sufficient—one quick and one simmering heat—and that these can be obtained by a double-throw switch, which when open cuts the heat off altogether. The worst fault to be found with electrical cooking to-day is in the repair bill, which is a very serious matter. Mr. Arthur Williams spoke of the desirability of circulating among electric light users information relating to electric cooking, and said that the New York Edison Company has recently been doing this extensively. He thinks electric cooking apparatus will never give to the companies a large revenue, since its use is confined to short periods of the day, but aside from cooking the late afternoon dinner in the winter months, whatever revenue comes from this apparatus is additional per kilowatt of installation. This in itself should encourage effort toward installing electric heating and cooking apparatus. In the months of June, July, August and September the load will not come on at the peak, and in view of this it might be well to adopt the English method of making a lower charge for the current used during these months. He considers that every large device connected with electric cooking should have an indicator which cannot be removed and which will show when current is on and off; he has known of cases where the colored lamps supplied with cooking apparatus have been turned out and the current left on. In one case the current was left on an electric heater during the entire summer season in the absence of the owner. He cited a case of a large factory where electric irons are used for making hats; the price paid for current is 8 or 9 cents per kw-hour and the cost of this service is almost identically the same as that of the former service rendered by gas. The advantages in the use of the electric heating iron are that the men work faster, thus increasing the output; the factory and the men working there are kept cleaner; the atmosphere is cooler and working with the electric iron is much less fatiguing to the employees.

THE NEW TICKET.

Some little difficulty was experienced in selecting the new ticket. Mr. J. W. Lieb, Jr., was in direct line, but it was realized that as incoming president of the Institute he had already more than he could well attend to. Among those favorably discussed were Messrs. Arthur Williams, of New York; J. B. McCall, of Philadelphia, and Alex. Dow, of Detroit. A fortunate solution of the situation was found in the final willingness of Mr. E. H. Davis, of Williamsport, Pa., to serve. The efficiency and popularity of this admirable central station manager as secretary have made the powers of the Association reluctant to lift him out of that onerous position, but the choice has met with universal approval. The officers elected on Thursday night were as follows: President, E. H. Davis, Williamsport, Pa.; first vice-president, W. H. Blood, Seattle, Wash.; second vice-president, Arthur Williams; executive committee, S. Scovil, Cleveland; A. J. De Camp, Philadelphia; W. F. White, St. Louis.

CONVENTION NOTES.

On Tuesday afternoon a tally-ho ride was given to the ladies through the beautiful suburbs of Boston out to the Country Club as far as the Chestnut Hill Club, where tea was served. The return route lay through Brookline. Several vehicles were needed for the party, and the trip was greatly enjoyed. It was in the hands of Messrs. C. J. Hatch, W. E. Holmes and D. P. Robinson. In the evening a lecture was given in the main dining-room of the Hotel Vendome, on "Historic and Technical Boston," accompanied by lantern slides. The lecturer was Mr. Samuel C. Clough, who did his subject justice in an admirable manner. The technical part of the lecture was prepared by Messrs. L. L. Elden and I. E. Moultrop, the former giving his attention to the electrical development of Boston in general, and the latter taking up more particularly the new Boston Edison turbine station. It was a happy idea thus to fill in an evening in an informational way, and add to the stock of knowledge so agreeably. Everyone was greatly pleased and many compliments were paid to Mr. Larue Vredenburgh on his skill and success as an impresario and lecture bureau manager.

On Wednesday afternoon the whole convention, then about 1,000 strong, was given a steamboat excursion around the harbor, special cars taking the party from the Public Library to the wharf. Lunch was provided on board, and the excellent Salem Cadet Band furnished music. After the circuit of the harbor and out to the seashore line, landing was made at the L Street station of the Edison Company, where all the fine plant was shown in operation. In the new turbine room a dummy turbine of lath and paper was set up to scale on one of the bed plates to show exact size and appearance. On the return voyage landing was next made at the Atlantic Avenue station wharf, where special cars again awaited the party for home. The trip was most delightful and a brilliant sucess, reflecting much credit on the committee, Messrs. Sidney Hosmer, P. Hodges, W. C. Woodward and Prof. H. E. Clifford. Wednesday evening was spent by invitation at a popular concert in Symphony Hall, under the conductorship of Adamowski. The entire lower floor within the rail was reserved for delegates and their friends, and refreshments were also served. The committee in charge were Messrs. P. L. Warner, T. C. Wales, R. N. C. Barnes, George C. Ewing and F. W. Lord.

On Friday, when the practical work of the convention had closed, a number of trips were planned, being scheduled to start at different hours of the day. These included the General Electric works at Lynn, Mr. W. C. Fish; the water power plants at Lawrence, Mass., Mr. R. A. Hale; Salem, Mass., Mr. H. M. Batchelder; Bunker Hill Monument and the Navy Yard, Mr. P. J. Kennedy; Fore River Ship Yards at Quincy, Messrs. C. H. Parker and G. H. Berg; trolley trip, Mr. Paul Winsor; New England Gas & Coke Works, Mr. G. H. Finn; Boston Edison plants, Mr. W. P. Hancock; Boston Elevated system, Mr. Paul Winsor; East Boston tunnel, Mr. R. N. C. Barnes; Harvard College, Prof. C. A. Adams; Massachusetts Institute of Technology, Prof. H. E. Clifford; Simplex Electric Company's works, Mr. E. Morss; Holtzer-Cabot Electric Company's works, Mr. C. W. Holtzer; New England Telephone & Telegraph exchange, Mr. T. C. Wales. In connection with the last-named it must be noted that at certain hours free telephone service to New York was courteously accorded during the convention.

The ladies were by no means forgotten during the meeting. In addition to the entertainments elsewhere noted, and in which they were included, they were given a special tally-ho ride and a splendid run around the suburbs in automobiles on Thursday.

President Edgar is not only to be warmly congratulated on the success and smoothness that attended all his thoughtful and generous provision for the convention—in which an excellent committee co-operated with him—but on the success of the convention *per se*. Note has already been made of the work of the convention, but it remains to be added that no fewer than 1,150 people actually registered, and that of these a record proportion represented the strictly central station element. In fact, nearly 40 States and Territories sent some 400 central station men, from about 200 towns and cities. In connection also with the work of the convention one must commend specially the skillful plans and efforts of Mr. Charles H. Hodskinson, of the Boston Edison Company. One of his wrinkles was an envelope plan, by means of which each delegate could leave his papers, etc., in a numbered pouch just outside the meeting hall as he left and get it again when he entered for the next session. The scheme was a great convenience and worked admirably.

Secretary E. H. Davis and his efficient assistant, Miss H. Billings, had their hands more than full of work, but were greatly gratified at the satisfaction evinced by members at the arrangements and the complete state of the plans, papers, etc. But they were so glad when Saturday came!

Electrical Engineers were present at the convention in goodly numbers, and representative of all ranks and varieties of the profession. Among them may be mentioned Prof. Elihu Thomson, Dr. A. E. Kennelly, R. D. Mershon, J. H. Hallberg, Capt. W. Brophy, P. G. Gossler, Dr. Louis Bell, F. E. Cabot, A. E. Childs, C. J. Field, Dr. S. S. Wheeler, E. R. Weeks, T. D. Lockwood, Dr. P. Pivili, of Milan; Dr. Wm. Habirshaw, R. A. Hale. Educators were also conspicuous, including Prof. C. A. Adams, Prof. H. E. Clifford, Prof. H. B. Smith, Prof. Clarence Feldman, Prof. C. H. Porter, Dr. Louis Duncan.

Large Advertising.—One of the object lessons of the convention week was the appearance of a two-page "ad" in the *Boston Herald* giving a large engraving of the new Boston Edison plant and announcing that after a thorough test of the efficiency of a private plant, that well-known newspaper had reached the conclusion that central station service was better, and that its power and light would be bought hereafter from the Edison system. The capacity of the system was given as 1,380,000 lamps, and it was said that 3,000,000 newspaper readers in and around Boston depended for their daily journals on the ever ready and unfailing service of the Edison Company.

Electrical World and Engineer was represented at the convention by Messrs. J. M. Wakeman, G. W. Elliott, C. T. Walker, W. S. Key, A. D. Adams and T. C. Martin. The current issue of the journal was in demand, not only on account of its articles on the situation in Boston and New England, but because of the interesting historical sketch of what was done at the Boston convention of 1887.

The Technical Press was out in force and in addition to the staff of this journal there were present Messrs. C. P. Poole, C. W. Price, L. Cassier, W. F. Collins, W. E. Keily, F. L. Perry, H. C. Cushing, E. E. Wood, A. E. Clifford, A. L. Rice, J. S. Browning, W. K. Beard, I. A. Bennett, S. C. Cole, C. E. Cornell, Jr., F. C. McDonald, W. T. Hunt, S. A. Goddard, P. S. Dodd, H. S. Tuthill, M. L. Godkin, F. R. White, A. D. Stevens, J. H. Smith, W. F. Hanks.

Mr. E. R. Weeks, of Kansas City, one of the early presidents of the Association, gratified a great many old friends by putting in an appearance. It was the first in some years, and Mr. Weeks was very much impressed, not only with the growth of the body, but with the enthusiasm displayed, equalling, if not excelling, anything he had seen in the past. At the opening session he made a few happy remarks, upon the call of President Edgar.

Mr. F. E. Barker attended the meetings on behalf of the Massachusetts Gas & Electric Light Commission, whose work has been so useful and performed so conservatively.

EXHIBIT NOTES.

Mr. Joseph Sachs, who was attending from Hartford, Conn., has just been awarded the award of the John Scott medal of the Franklin Institute for his enclosed fuse protector, and with blushing diffidence received the congratulations of a host of friends.

Mr. Alex Henderson, who has just returned from South America, appeared on behalf of the conduit interests of the Interior Conduit Company. He was elaborately disguised in a Mexican sombrero and tanned cheekbones.

John A. Roebling's Sons Co. had no exhibit, but were represented by Messrs. F. W. Harrington and G. W. Swan, M. R. Cockey, C. B. Cushing, as well as A. Mann, of Boston. They are said to have distributed souvenirs.

The Westinghouse Exhibit displayed in the parlors on the ground floor of the Hotel Vendome was of especial interest because of the number of new appliances shown for use in electric lighting and central station practice. Much attention was given by the visitors to the Westinghouse type A integrating wattmeter, which presents several essential improvements over the well-known integrating wattmeters of that company. Single and polyphase instruments in metal cases, single-phase with glass case, and master wattmeters of this type in glass cases for central station use in checking service meters, were shown. Models of the mechanism on a magnified scale were used to show the construction of those portions of the instrument which form its distinguishing characteristics. This type of instrument has been adapted for prepayment service, and the prepayment type A wattmeter attracted much attention. A new type of high-grade portable testing instrument excited very favorable comments on account of its superior finish and attractive appearance. Of this type were shown a voltmeter, an ammeter, a single-phase and a polyphase wattmeter and a power factor meter. They are particularly adapted to central station use on account of the unusual range of scale and the long open divisions of equal length. These scale characteristics make the voltmeter, ammeter and wattmeter more readable at all portions of the scale than any other instrument of this kind. The polyphase wattmeter is the only portable instrument of this kind on the market. The power factor meter is also a new instrument. Portable transformers, mounted in finely finished mahogany cases, were also shown with the measuring instruments. Arc lamps included five different types of styles: Series alternating, multiple alternating, series multiple-alternating and direct-current series and multiple lamps, all of the enclosed type and new designs of high efficiency. The fan motors were represented in the exhibit by several groups of these devices, some of which were effectively utilized to keep the room cool. A type B oil circuit-breaker for switchboard use received considerable attention because of its compact form, simplicity and high degree of insulation. A new departure in standardizing methods was foreshadowed by the display of a new series of precision instruments, having the advantages of the ordinary instrument—portability and convenience—combined with the extreme accuracy and permanency of the Kelvin balance. The Westinghouse exhibit was in charge of Mr. R. L. Warner, New England manager of the Westinghouse Electric & Manufacturing Company, who was ably assisted by the Boston men. A number of the officials of the company were in attendance, the complete list of attendants being as follows: Mr. F. H. Taylor, vice-president, Pittsburg; Mr. Arthur Hartwell, sales manager, Pittsburg; Mr. W. H. Whiteside, manager Detail and Supply Department, Pittsburg; Mr. R. L. Warner, New England manager, Boston; Mr. C. B. Humphrey, manager, Cincinnati, Ohio; Mr. W. F. Fowler, manager, Baltimore, Md.; Mr. H. D. Bayne, manager, Montreal office, Canadian Westinghouse Company, Montreal, Canada; Mr. C. W. Underwood, manager, Buffalo, N. Y.; Mr. G. B. Dusinberre, manager, Cleveland, Ohio; Mr. D. E. Manson, manager, Boston; Mr. Andrew Raeburn, manager, Westinghouse Machine Company, Boston; Mr. C. C. Chappelle, manager, Westinghouse Machine Company, Chicago, Ill.; Mr. Y. L. Brinsmade, manager, Westinghouse Machine Company, New York; Mr. H. P. Davis, assistant chief engineer, Detail Department, Pittsburg; Mr. F. F. Rohrer, manager Direct-Current Department, Pittsburg; Mr. C. W. Register, Chicago, Ill.; Mr. J. B. Comstock, Pittsburg; Mr. Henry Watts, Buffalo, N. Y.; Mr. A. Goodby, Pittsburg; Mr. George W. Pulver, Syracuse, N. Y.; Mr. Frank B. Erwin, Syracuse; Mr. O. T. Smith, New York; Mr. C. E. Skinner, Pittsburg; Mr. E. E. Arnold, Westinghouse Machine Company, Pittsburg; Mr. F. E. Conrad, Pittsburg; Mr. Francis Hodgkinson, Westinghouse Machine Company, Pittsburg; Mr. J. H. Smith, Pittsburg; Mr. Edwin Yawger, Westinghouse Machine Company, Pittsburg; Mr. H. R. Stuart, Pittsburg; Mr. R. L. Rathbone, Detroit; Mr. C. S. Jennings, Sawyer-Man Electric Company, New York; Mr. C. G. Wilson, Westinghouse, Church, Kerr Company, Boston; Mr. S. M. Bramman, Westinghouse Machine Company, Boston; Mr. F. F. Breed, Westinghouse Machine Company, Boston; Mr. J. W. Lucas, Philadelphia; Mr. C. L. Abbott, Boston; Mr. E. D. Mills, Mr. M. H. Merrill, Mr. G. M. Bates, Mr. R. S. Brown, Mr. F. S. Perry, Mr. G. L. Osborne, Mr. G. S. Gibbs.

The Sawyer-Man Electric Company, of New York, made its first public display of the "Lumino" lamp. The lamps were used to light a large candelabra in the main Westinghouse exhibit room and attracted very favorable attention because of their brilliancy. The lamp is of 54 cp and shows a remarkably low wattage. A handsomely engraved card, showing the "Lumino" lamp, full size, was distributed to all visitors. A full line of standard incandescent lamps was likewise shown by this company.

Pass & Seymour, Solway, N. Y., the well-known manufacturers of tubes in porcelain and other insulating specialties, were much in evidence in the personages of Mr. B. E. Salisbury, the treasurer, and Mr. John W. Brooks, the sales manager of the company, and Messrs. A. M. Little and Hall, the Boston and New York representatives.

The Electric Storage Battery Company was represented by Messrs. Charles Blizard, sales manager, and J. W. Cook, Boston.

The Standard Underground Cable Company were represented by Messrs. F. C. Crosby, T. E. Hughes, C. J. Marsh, W. C. Waldron.

The Duncan Electric Manufacturing Company, Lafayette, Ind., had an attractive exhibit showing the latest types of their well-known D. C. indicating wattmeters. One of the latest improvements to which special attention was called is the new visual bearing, with threadless jewel post. As the name indicates, this bearing may be readily inspected at any time, and may be quickly removed without unscrewing. Among the other apparatus exhibited were switchboard meters in various designs and finishes up to 5,000 amperes. The exhibit was in charge of Messrs. Thomas Duncan and William H. Sinks.

The Phelps Co., Detroit, Mich., were on hand with an exhibit of "Hylos" in charge of President W. E. Phelps and sales manager, Mr. F. L. Du Broy. "Winking" lamps for sign work were a feature of the display. The new "Lazy Man's" lamp also attracted a great deal of attention. This lamp is operated by a modified knife switch enclosed in a small, compact porcelain case which is attached to covered wires of various lengths. The well-known "pull string" and "turn bulb" types were, of course, shown in great variety.

The Bossert Electric Construction Company, Utica, N. Y., were represented by Mr. F. G. Scofield.

Speer Carbon Company.—J. S. Speer, generaal manager of The Speer Carbon Company, St. Mary's, Pa., spent a day at the convention on his way to Maine for a two weeks' outing.

Mr. John Mustard, who has recently accepted the Philadelphia agency for The Wagner Electric Manufacturing Company, was on hand from the opening session and took full advantage of this opportunity of meeting his many electrical friends.

The Sterling Electrtic Manufacturing Company, Warren, Ohio, distributed an attractive souvenir through Stuart, Howland Co., their New England agents. The souvenir took the form of a tape measure enclosed in a celluloid case on which was data to prove that "Sterling Special" lamps are "sixteen all ways."

Mr. J. P. Gilbert, of The Standard Electrical Manufacturing Company, Niles, Ohio, was on hand, of course, to look after the interests of "Star" lamps.

The American District Steam Company, Lockport, N. Y., was represented by Messrs. Charles R. Bishop and H. C. Eddy.

Doubleday-Hill Electric Company. Mr. Charles Phillips Hill, of the Doubleday-Hill Electric Company, Pittsburg, was much in evidence all through the convention, and justly proud of the enormous catalogue which they have just issued, which marks an epoch in electric catalogue making.

The H. T. Paiste Co., Philadelphia, was represented by the genial secretary, Mr. E. A. Jenkins.

Locke High Voltage Insulators as well as other types of insulation made by the Locke Insulator Manufacturing Company, Victor, N. Y., were a prominent part of The Pettingill-Andrews exhibit.

Packard.—It goes without saying that the New York and Ohio Company and Packard lamps were ably represented all through the convention by Mr. W. D. Packard, who has missed only two conventions, and on one of these occasions he was abroad.

Mr. James G. Biddle, of Philadelphia, the well-known dealer in electrical and scientific instruments, took advantage of the convention to meet his many friends in the electrical fraternity.

Mr. Arthur L. Bosley, of The Electrical Material Company, Baltimore, was much in evidence.

The Crouse-Hinds Company, of Syracuse, was ably represented by Messrs. A. F. Hiller and C. Blanding as well as by Frank M. Hawkins, of New York, and S. S. Grady, of Boston. While no formal exhibit has been arranged for, a great deal of favorable comment was aroused by the models of the new Crouse-Hinds "Harpoon" guy anchors, which were shown in miniature, and by the literature which these gentlemen diligently distributed.

General Electric Company did not make an exhibit, although it occupied a large parlor and dispensed hospitality. On Friday a party of the delegates visited the General Electric shops at Lynn, Mass., where a great many interesting departments of the work are carried on. During the convention a paper was read on the new "magnetic" arc lamp, which was exhibited in the meeting room. Among the General Electric representatives present were Messrs. J. R. Lovejoy, E. E. Gilbert, W. C. Fish, C. D. Haskins, E. H. Mullin, C. B. Davis, H. W. Hillman, C. T. Moseman, G. T. Bridgman, J. R. Prentice, A. F. Giles, J. B. Pevear, E. D. Mullen, A. D. Babson, E. E. Peaseley, A. W. Ives, J. S. Butler, P. D. Wagoner, D. R. Bullen, H. L. Monroe, F. G. Vaughan, R. Fleming, F. M. Laxton, J. C. Kalisch, W. J. Hanley, J. Scribner, W. T. Wooley, H. L. Monroe, A. D. Page, G. F. Morrison, W. F. Willcox, T. E. Bibbins, H. H. Crowell, J. P. Felton, F. M. Kimball, S. B. Paine, R. B. Hampson, C. B. Burleigh, J. A. Wilson, H. W. Brown, O. F. Brastow, C. W. Fletcher, A. H. Coffin, M. J. Fitch.

J. G. White & Co. were represented by Mr. P. G. Gossler, lately general manager of the Montreal Light, Heat and Power Company, and Mr. H. J. Dowds, both of New York.

The Allis-Chalmers-Bullock interests were represented by Mr. Arthur Warren, manager of the Department of Publicity; Mr. G. H. Berg, manager of the Boston office of the Bullock Company; Mr. H. E. Rundlett, manager of the Boston office of the Allis-Chalmers Company; Mr. J. R. Jeffrey, assistant secretary of the Bullock Electric Manufacturing Co.; Mr. E. W. Goldsmith, manager of the Bullock offices in New York; Mr. E. T. Pardee and Mr. W. N. Ober, both of the Bullock Boston office. Handsome quarters were occupied on the parlor floor, and were filled with large photographs of notable plants and of machines built by the various interests. The rooms were filled at all times with delegates.

Stuart-Howland Company.—Among the most energetic and up-to-date firms in New England is the supply house of Stuart-Howland Company, Boston. They occupied handsome parlors at the Vendome and the neatness and care shown in their display was much commented upon. The staff were most assiduous in their attentions to all visitors, and were headed by Mr. G. M. Stuart. There were also in attendance A. H. Howland, A. E. Payne, C. R. Fish, Huntington Lee, C. B. Wetmore, James Wilson and W. Merrett. H. De Steese, of the railroad department, was also in attendance. The principal displays were Dale's wireless clusters, Helios arc lamps and Sterling incandescent lamps. Neat little souvenir whist counters were given away by this company.

Stanley Electric Manufacturing Company, Pittsfield, had their usual large corps to look after their interests. They occupied large quarters. The staff included Dr. F. A. C. Perrine and R. D. Lillibridge.

The Stanley Instrument Company, Great Barrington, Mass., had on exhibition a full line of their meters which had as exponents W. C. Andrews, S. O. Ochs, E. W. Gough, F. J. Alderson and F. W. Sanford.

McKenney & Waterbury, of Boston, showed a large line of fixtures and specialties through the attentions of W. A. McKenney, R. J. Green and N. I. Allen, Jr.

The Standard Vitrified Conduit Company, New York, had a fine exhibit and was looked after by the famous warrior, Capt. B. S. Barnard.

H. W. Johns-Manville Company showed a "raft" of their goods through the energetic efforts of Messrs. Joseph Sachs and J. Humphreys.

American Circular Loom Company had handsome parlors and gave out neat little souvenirs. Their representatives were everywhere and included Mr. A. T. Clark, R. B. Corey and Thomas H. Bibber. A face and figure much missed at this convention from this company were those of Mr. H. B. Kirkland, who was unavoidably absent.

The Pettingell-Andrews Company, Boston, exhibited in large and commodious parlors a large line of their various specialties. Their big force of representatives headed by Mr. C. B. Price included Messrs. F. S. Price, Keenan Palmer, Peterson, Johnson, Brokaw, White and Vanstagan.

Mr. George C. Ewing, of Boston, looked after the interests of the Cooper Hewitt lamp. He was also a very efficient member of the general entertainment committee.

The W. S. Hill Electric Company, of New Bedford, showed a complete line of their switches, switchboards and panelboards. Mr. C. S. Mendell was ever attentive to visitors and was ably assisted by Thomas N. White.

Mr. Harvey Hubbell, Bridgeport, exhibited some of his admirable specialties in charge of Mr. T. S. McLean.

Dale's Wireless Cluster was the subject of conversation wherever Mr. John H. Dale was and that was everywhere about the convention. His friends are legion, and he was in receipt of hearty congratulations on all sides on the immense success this new cluster is meeting with. Such specialties are a great boon to the art, and an incentive to the use of current by the consumer.

Simplex Electric Heating Company had a splendid exhibit of the various devices in this new art and was in charge of the veteran J. I. Ayer, who also read an excellent paper on the subject. It also had in attendance Messrs. A. W. Doe, C. W. Richards.

Mr. J. H. Mason had much to say for the merits of Simplex Electrical Company's wires and cables.

The Massachusetts Chemical Company occupied parlors in the Vendome and their interests carefully looked after by C. E. Farrington and L. O. Duclos. Mr. E. C. Green, president, also took a hand in.

The Holophane Glass Company, as usual made an excellent showing. They were represented by Mr. J. S. Codman, of Hale & Codman, Boston agents.

The Lundin Electric & Machine Company was represented by Emil C. Lundin, who is a veteran in the lighting field. The good points of his various specialties were carefully listened to and appreciated.

Chase-Shawmut Company were represented by H. P. Moore, sales manager, and F. D. Masterson.

The Condit Electrical Manufacturing Company, Boston, had Mr. S. B. Condit, Jr., and Fred W. Nason to talk the good features of the Elden circuit-breaker, and distribute quick-acting cutlery.

"Flexduct" was spoken for by Messrs. C. E. Corrigan and C. B. Roulet, of the Osburn Flexible Conduit Company.

C. F. Splitdorf found many interested listeners as to the merits of his new arc lamp cut-out.

Atlantic Insulated Wire & Cable Company were represented by Mr. G. F. Porter, now master of transportation, and invaluable from his long service and acquaintance as secretary of the Association.

Stone & Webster, Boston, were represented by D. P. Robinson, G. L. Tripp.

Albert & J. M. Anderson Co., of Boston, were represented by their president, Mr. Albert Anderson.

Holtzer-Cabot Company, of Brookline, Mass., were represented by President C. W. Holtzer, who took an active part in the proceedings.

National Electric Company, of Milwaukee, sent Mr. M. E. Baird to speak for its dynamos and motors, now becoming so widely known.

Electric Carriage Call Company made signals through Mortimer Norden and T. G. Bloomberg. It had an exhibit of much interest in its electric signs and calls.

Standard Chemical Company sent on G. B. Davis, president and manager.

Elliott Addressing Machine Company gave an admirable actual demonstration of what their machine could do. Mr. W. C. Mills, Boston manager, handled the exhibit with Mr. E. E. Mills, manager.

Phoenix Glass Company were fortunate to have present their veteran and popular manager, Mr. A. H. Patterson, with Mr. E. H. Peck as an affable "understudy." Mr. E. P. Elberts also helped them.

C. S. Knowles was represented by Messrs. C. H. Clark, Duncan Kennedy, G. Ober, G. S. Hutchins, J. Keefe, H. M. Saben.

Weston Electric Instrument Company had on hand their Boston manager, Mr. G. H. Moseman.

Mr. George Cutter, of Chicago, was a worthy and typical exponent of Western sentiment and progressiveness.

Buckeye Electric Company were represented by Mr. Le Roy P. Sawyer from the Cleveland office.

Bryan-Marsh Company had a good delegation in Guy V. Williams, J. P. Williams, D. W. Eyman, E. H. Houghton, G. C. Keech, S. E. Doane, F. W. Godfrey, W. C. Ballda. Converse D. Marsh was off somewhere regaling his cronies with Rabelaisian reminiscences; and draughting ads and other things.

"Okonite" delegation, like its trade mark, was twain. Its two halves, of course, were Willard L. Candee and G. T. Manson. These veterans have sometimes been seen apart, but not at a convention.

When the next Association amateur theatricals are given they are to play Damon and Pythias. They may be tempted to play the two Dromios.

NATIONAL CONDUIT & CABLE COMPANY had an excellent delegation in President George J. Jackson—"white"—and Messrs. W. S. Eckert, F. S. V. Sias, J. B. Honan, J. A. McQuale, Jr.

MR. F. W. LORD referred occasionally to the Lord Electric Company.

MR. C. O. BAKER was most unfortunately unable to attend, but the interests of Baker & Co., Inc., platinum, were well cared for by Mr. J. J. Lowthian.

ELECTRIC GAS LIGHTING COMPANY, of Boston, had an apparently ceaseless flow of representatives on tap. They "kept coming." Some of them answered to the names of W. F. Abely, K. L. Norris, F. H. Sherman, A. H. Boardman, C. H. Howes, C. E. Lee, S. A. Koltonsai,

AMERICAN DIESEL ENGINE COMPANY has no big American station yet like the Boston Edison, but Mr. Norman McCarty wept salt tears when he saw so much good money being wasted there on steam turbines. Sobs broke his utterance every time he spoke of it. And he had figures to prove it, too. With him was their assistant engineer, Mr. J. D. McPherson.

LOMBARD GOVERNOR COMPANY had a strong engineering delegation in Dr. Allan V. Garratt and Mr. R. B. Smith. With them was R. B. Stafford.

McINTOSH, SEYMOUR COMPANY were influentially represented by Messrs. J. A. Seymour from Auburn, N. Y., and by Mr. E. A. Merrill, of the New York office.

AMERICAN ELECTRICAL WORKS, of Providence, R. I., sent Mr. T. B. Baker from the Phillipsdale works and Mr. W. J. Watson from Gotham.

AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., placed their interest in the hands of Messrs. C. R. Bishop and H. C. Eddy.

NATIONAL CARBON COMPANY were represented by Manager N. C. Cotabish from the Cleveland home circle and by Messrs. F. H. Murray, J. C. Irvine, J. F. Kerlin, F. C. Park, A. D. Spear.

MR. B. S. Barnard, the energetic president of the Standard Vitrified Conduit Company, got many a friendly handshake.

WAGNER ELECTRIC MANUFACTURING COMPANY were well represented by Messrs. Layman and Godfrey from out the West, as well as by Mr. B. Faxon, of their Boston office. They had a nice parlor on the first floor. Mr. John Mustard also greeted many old friends in his capacity as a Wagner man from Philadelphia.

ALBERGER CONDENSER COMPANY found their topic quite interesting to many central station men, and President L. R. Alberger and H. M. Montgomery were busy all the week getting in touch.

CROCKER-WHEELER ELECTRIC COMPANY, of Ampere, N. J., was represented by its president, Dr. S. S. Wheeler, and Secretary A. L. Doremus, and by R. N. C. Barnes, C. R. Metchear, A. J. Newell.

SHELBY ELECTRIC COMPANY, of Shelby, Ohio, was represented by Mr. C. W. Cartwright.

NERNST LAMP COMPANY found an efficient agent in Mr. George C. Ewing, who also proved a very competent and indefatigable local committeeman. He was aided by Mr. R. T. Vredenburgh, Mr. M. W. Hanks, Mr. E. R. Roberts, Mr. F. Gibbs.

SPRAGUE ELECTRIC COMPANY had present Messrs. H. G. Issertel, of its engineering staff, and Messrs. H. C. Farnsworth, A. Henderson.

GENERAL INCANDESCENT ARC LIGHT COMPANY sent Messrs. P. H. Klein, A. Foster, its Boston manager; F. Raymond, R. S. Hale, S. H. Blake.

MARSHALL SANDERS COMPANY was represented by Mr. Norman Marshall and C. A. Sanders.

H. S. POTTER ELECTRIC COMPANY were spoken for by the principal of that name.

MR. FRANK RIDLON needed no introductions to any central station man or supply man either. He was the Nestor of the convention, and fell easily into narrrtive, beginning "In the year one—." With him were E. W. Kellogg and N. L. Wood.

TRENTON PORCELAIN WORKS, with Messrs. George E. Maguire and Russell Howland, had the right blend of oratory and convincing "selling points."

WESTERN ELECTRIC COMPANY was one of the few Western houses making anything of an effort to be on hand. Mr. E. W. Rockafellow came up from New York to show that Chicago still remembers where the telephone started. With him was Mr. A. C. Morse.

DEARBORN DRUG & CHEMICAL COMPANY, of Chicago, were very adequately represented by Messrs. W. H. Edgar and W. B. McVicker.

FORT WAYNE ELECTRIC WORKS had a very handsome exhibit in one of the main ground floor parlors of all their well-known specialties in meters and other lines, while their famous little breeze circulators infused a grateful coolness into many a nook and corner of the room, the meeting hall, the committee rooms, and the hotel generally. The company was largely represented, its staff including Messrs. J. A. Smith, T. L. Sturgeon, J. C. Lott, F. S. Hunting, J. W. Hilgeman, J. Kent, A. A. Serva, J. O. Spear, Jr.

DOSSERT & Co., of New York, sent President J. J. Dossert and Secretary A. H. Willmont to safeguard their interests.

PRESIDENT B. C. KENYON, of the Diehl Manufacturing Company, was not able to arrive until the convention was in full swing, but he was not slow in "getting into the game" and helping to keep the ball in play. The company is extremely busy in all branches of its dynamo electric machinery.

CANADIAN GENERAL ELECTRIC COMPANY were represented by Mr. E. D. McCormack and Mr. A. B. Lambe. Young Mr. Nicholls was also present for himself and his father, Past President Frederic Nicholls, one of the best executives the Association ever had.

MR. RAY D. LILLIBRIDGE came during the week in behalf of the interests of his technical publication and advertising bureau, which has so large a patronage in the electrical and mechanical fields.

SUPPLY MEN were legion, as will be gathered from the items herewith as to exhibits and companies represented. The light and power art is throwing out its fibres and roots in various directions and bringing many industries within its scope. In addition to the concerns already noted, with the names of their sponsors, may be given the following, somewhat in order of registration: Federal Electric Company, W. H. McLain; Chicago Fuse & Wire Company, W. E. Weinsheimer, R. W. Smith; Manhattan Electrical Supply Company, J. W. McDonald; Bryant Electrical Company, F. V. Burton; Peerless Electric Company, A. Dunlop; De Laval Steam Turbine Company, C. Garrison; Benjamin Electric Manufacturing Company, B. G. Kodjbanoff; Safety Insulated Wire & Cable Company, F. B. Parsons; C. H. Whall & Co., F. R. Whall; Wheeler Reflector Company, H. C. Hawks; Munder Electric Company, C. F. Munder; Crescent Gas & Fixture Company, H. S. Beaman; Triumph Electric Company, C. A. Cotton; Kimmey Electric Company, C. A. Brown; Jandus Electric Company, E. L. Nash; Kinsman Electric Railway Supply Company, F. E. Kinsman; Ballou-Hutchins Electric Company, C. A. Ballou; Washington Carbon Company, J. S. Crider; Phillips Insulating Wire Company, A. N. Palmer; D. & W. Fuse Fuse Company, W. S. Sisson; R. D. Wood & Co., C. W. Lummis, H. G. H. Tarr; Re-New Lamp Company, G. H. Smith, H. Hastings; Tipless Lamp Company, R. S. Carrick; Crescent Insulating Company, L. F. Jackson; Magnet Wire Company, H. Hill; The Wire & Cable Company, E. F. Sise; Marion Insulated Wire & Rubber Company, J. L. Lucas; Fostoria Incandescent Lamp Company, H. S. Potter; Novelty Electric Company, C. E. Trump; Emerson Electric Manufacturing Company, E. L. Barkhouse; Electric Material Company, A. L. Bosley; Power & Mining Machinery Company, F. P. Thorp; Warren Arc Light Company, J. A. Stewart, I. P. Frink, Frank Stout; Sibley & Pitman, F. S. Gardner; Adams-Bagnall Electric Company, G. A. Thomson; Standard Varnish Works, J. C. Dolph; Lawrence Gas Fixture Company, C. V. Daiger; Buckeye Engine Company, A. K. Ashworth; E. B. Latham Company, E. B. Latham; National Wire Corporation, F. B. Parsons; Page Electric Company, J. P. Coghlin, F. S. Miller; New Britain Machine Company, R. S. Brown; Standard Electrical Manufacturing Company, J. P. Gilbert; Independent Incandescent Lamp Company, W. M. Rothschild; H. B. Camp Company, C. C. Baird; American Vitrified Conduit Company, S. A. Douglas; Wirt Electric Company, W. J. Thompson; Fred J. Lucey, of F. J. Lucey Co.; Sampson & Allen, A. T. Sampson; T. F. Carey Co., Thomas F. Carey, C. H. Currier; Hewes & Phillips Iron Works, Franklin Phillips; McMichal & Wildman Company, F. B. Wildman; Ansonia Brass & Copper Company, R. A. Cowles, F. H. Sherwood; Nightingale & Childs Co., E. G. Crosley; Charles A. Schieren & Co., G. H. Hamblett, E. A. Usina; National Biscuit Company, E. F. Cullen; American Steel & Wire Company, R. K. Sheppard, V. Goldthwaite, F. A. Keyes, A. F. Walker; Gillender & Son, Inc., W. Croft, Jr.; India Alkali Works, C. P. Powers; M. K. Kendall & Co., M. K. Kendall;

Packard Electric Company, Canada, G. C. Rough; White Automobile Company, T. H. Tucker; J. Wilkinson & Co., L. C. Billings; H. L. Slade; Bates & Neilson, J. Neilson; National Pipe Bending Company, W. G. Ruggles; M. W. Dunton Co., F. Chapman; Dwyer Machine Company, E. F. Dwyer; Potter & Earle, J. L. Potter; Heine Safety Boiler Company, E. L. McGregory; New England Machine Company, F. W. Smith; Macbeth-Evans Glass Company, E. S. Briggs, M. B. May; Gamewell Fire Alarm Telegraph Company, H. E. Stover; Falls River & Machine Company, G. A. Irving, E. J. Electric Insulating Company, M. H. Stearns; Colonial Electric Company, W. F. Curtis; W. Frederick Swift & Co.; J. H. Hallberg; Fields-Foulk Company, C. J. Fields; Standard Paint Company, L. G. Goodrich; Bryant Electrical Company, W. C. Bryant, F. V. Burton; American Brass & Copper Company, Randolph Osborn; Standard Optical Company, J. E. Bowker; Alphaduct Manufacturing Company, Russel Dart.

Habirshaw."—It was a great pleasure to see the interests of the India Rubber and Gutta Percha Insulating Company represented by the "good gray" Doctor himself. Besides Dr. W. M. Habirshaw, it sent Mr. J. B. Olson, the suave sales manager from New York.

Richmond Electric Company sent Mr. W. H. A. Davidson, who met many old electrical friends.

Mr. F. S. Terry, of the Sunbeam Incandescent Lamp Company, and the animating genius of the incandescent lamp pool was a late arrival, but none the less conspicuous. He was not allowed to lack opportunities for conversation. With him was Mr. B. G. Tremaine, the well-known manager, etc., of the Fostoria Incandescent Lamp Company.

Gould Storage Battery Company did not make an exhibit, but were energetically represented on the firing line by Dr. W. E. Winship and E. L. Draffen.

De La Vergne Machine Company were welcome strangers, and were able to send very acceptable representatives in George Richmond, Seward Babbitt and H. Borgstedt.

New York Insulated Wire Coompany referred to several big buildings in Boston as exhibits, and for other cities left its testimonials in the hands chiefly of Mr. James Wolff, of Chicago, and W. B. Fearing.

Swazey & Smith Co. were represented by H. W. Smith, T. Dun, G. H. Swazey.

CENTRAL STATION MEN.

The central stations of the country were more largely and widely represented than at any previous convention. Those registering were as follows:

Allegheny, Pa.—C. S. Mitchell, C. E. Warner.
Alliance, Ohio.—D. W. Law.
Altoona, Pa.—E. B. Greene.
Amesbury, Mass.—H. A. Sawyer..
Amherst, Mass.—D. Barry.
Asheville, N. C.—H. W. Plummer.
Atlanta, Ga.—T. J. Harper, A. L. Balsley.
Attleboro, Mass.—E. Fregoning, H. Daggett.
Auburn, Me.—H. T. Sands.
Auburn, N. Y.—J. S. Wise, Jr.
Augusta, Ga.—H. V. Schreiber.
Baltimore, Md.—J. F. Dusman, Douglass Burnett.
Bangor, Me.—J. W. Cartwright.
Bennington, Vt.—E. E. Larrabee.
Birmingham, Ala.—J. M. Bradley, R. Jemison.
Boise, Idaho.—D. Blanchard.
Boston, Mass.—C. L. Edgar, E. S. Mansfield, L. L. Elden, L. Vredenburgh, W. H. Atkins, L. M. Wallace, C. J. Hatch, G. V. Rowe, S. Hosmer, C. H. Parker, J. E. Larrett, F. S. Wilson, P. Winsor, C. D. Walker, A. S. Knight, C. H. Hodgkinson, A. H. W. Jaynes, I. E. Moultrop, S. J. Lent, E. H. Belden, W. D. Dyer, C. H. Ingalls, J. C. Redmond, W. P. Hancock, J. S. Vogler, D. Goss, A. C. Gray, G. P. Wisdom, H. P. Driver, C. R. Brown, W. Carrasco, A. G. Pierce, L. L. Edgar, J. W. Cowles, W. P. Fiske, W. H. Francis, G. Goettling, S. C. Clough, C. H. Herrick, W. W. Cummings, E. L. Caldwell, J. T. Boyd, W. T. Willey, W. C. Ross, G. B. Adams, W. E. Cook, H. F. Leavitt, F. Marshall, J. S. Cartwright, J. L. Bayle, E. B. Spike, T. F. Malone, G. W. Moses, F. B. Pitcher, F. V. Edgell, J. E. Elliott, W. H. Gardiner, Jr., W. J. Kennedy, P. Kent, R. E. Curtis, F. Brophy, F. D. Stiles, E. E. Phipps, W. H. Spaulding, F. Willis, C. F. Baker, G. S. Lawler, T. I. Donahue, H. E. Cutler, J. Y. Bradbury, B. Houghton, G. Attwood, E. J. Beugler, A. W. Friend, E. Mahler, A. E. Griffin, S. F. Lunt, W. C. Swan, H. F. Elden, F. G. Havlin, C. W. White, C. W. Enright, W. Minkler, W. E. Pierce.
Braintree, Mass.—W. P. Mercer.
Brattleboro, Vt.—L. C. White.
Brandon, Vt.—E. D. Blackwell.
Bridgeport, Conn.—W. T. Oviatt.
Bridgeton, Me.—C. A. Badwell.
Brockton, Mass.—P. Player, F. S. Pratt.
Brookline, Mass.—G. E. Crosby, J. A. Gould, J. W. Dodd.
Brunswick, Me.—A. C. Hopkins.
Buffalo, N. Y.—W. R. Huntley.
Burlington, Vt.—F. H. Parker.
Cambridge, Mass.—F. H. Raymond, R. A. Faye, W. R. Eaton.
Chicago, Ill.—L. A. Ferguson, W. M. Anthony, J. H. Gilchrist, R. L. Elliott, G. N. Eastman, W. L. Abbott, P. Junkersfeld.
Chelsea, Mass.—H. W. Moses.
Cincinnati, Ohio.—W. Von Phul.
Cleveland, Ohio.—S. Scovil, S. C. D. Johns, M. E. Turner.
Clinton, Mass.—R. R. Mackenzie.
Cohasset, Mass.—E. W. Bates.
Concord, Mass.—A. W. Lee, G. B. Lauder.
Connellsville, Pa.—L. Hill.
Denver, Colo.—I. Butterworth, H. L. Doherty, C. W. Humphrey, W. J. Barker.
Des Moines, Iowa.—F. L. Dame, R. H. MacMillan.
Detroit, Mich.—A. Dow, E. F. Phillips.
Dover, N. H.—T. Hawken.
Easton, Pa.—M. A. Maxwell.
Elmira, N. Y.—H. M. Beugler.
El Paso, Tex.—H. T. Edgar.
Evansville, Ind.—W. B. McDonald.
Fair Haven, Vt.—M. Patterson.
Fall River, Mass.—H. Bottomley.
Fitchburg, Mass.—W. F. Coggshall, A. H. Kimball.
Fort Collins, Colo.—G. B. Tripp.
Fulton County, Pa.—J. B. Klumpp.
Gardner, Mass.—H. H. Taylor, E. W. Furbush.
Glens Falls, N. Y.—B. E. Morrow.
Gloucester, Mass.—E. L. Munger.
Gloversville, N. Y.—J. C. De Long.
Greenville, Pa.—S. A. Gillespie.
Greenwich, Conn.—T. E. Fox.
Hartford, Conn.—A. C. Dunham, R. W. Rollins.
Holyoke, Mass.—A. W. Darby.
Hoosic Falls, N. Y.—R. D. Smith.
Hot Springs, Ark.—J. E. Cowles.
Houghton, Mich.—A. W. Leonard.
Hudson, Mass.—W. G. Lawrence.
Jackson, Mich.—W. P. Stephens.
Jamestown, N. Y.—F. W. Bullock, A. Weis.
Jersey City, N. J.—W. W. Titzell.
Joliet, Ill.—J. R. H. Staley.
Kenosha, Wis.—R. N. Kimball.
Kingston, N. Y.—F. Tobey, Jr.
Knoxville, Tenn.—L. H. Scherck.
Lockport, N. Y.—O. M. Diall.
Long Island City, N. Y.—J. N. Bissell.
Louisville, Ky.—A. M. Worthington.
Lowell, Mass.—N. T. Wilcox, D. Moore, J. J. Markham.
Lake Charles, La.—T. J. Bird.
Leavenworth, Kan.—A. S. Cook.
Lebanon, Pa.—F. C. Wright.
Leicester, Mass.—E. L. Watson.
Lewiston, Idaho.—E. H. Libby.
Lewiston, Pa.—E. F. McCabe.
Lexington, Ky.—T. Fitzgerald, Jr.
Lexington, Mass.—C. H. Miles.
Lima, Ohio.—J. A. Bendure, B. A. Conolly.
Lexington, Mass.—J. A. Sweetser.
Lynn, Mass.—C. F. Pritchard, W. P. Hazletine.
Madison, Wis.—R. D. Mershon.
Malden, Mass.—F. P. Royce, F. C. Sargent, A. E. Bliss.
Manchester, N. H.—J. B. Smith, S. P. Hunt.
Marion, Ind.—G. N. Tidd.

Marlboro, Mass.—C. B. Russell. H. E. Ryder, B. G. Scribner, A. A. Irish.
Marquette, Mich.—C. Retallic.
Mechanic Falls, Me.—H. A. Edgecomb.
Memphis, Tenn.—F. G. Proutt.
Meriden, Conn.—H. Minkwitz, C. A. Learned.
Middlebury, Vt.—C. C. Welles.
Milwaukee, Wis.—T. R. Mercein.
Minneapolis, Minn.—L. E. Eustis.
Montgomery, Ala.—H. C. Abell.
Montreal, Que.—R. M. Wilson, J. A. Burnett, W. McL. Walbank, R. S. Kelsch.
Morristown, N. J.—P. H. Lynch.
Mt. Vernon, N. Y.—J. T. Cowling.
Mystic, Conn.—T. C. Perkins, J. B. Smith.
Nantucket, Mass.—E. A. Chapel.
Nashville, Tenn.—J. P. W. Brown.
Nashua, N. H.—G. L. Sadler, P. T. Norton.
Newark, N. J.—J. J. Gaffney, H. D. King, D. Farrand, A. B. Carlton
New Britain, Conn.—L. S. Risley.
New Bedford, Mass.—G. R. Stetson, C. R. Price, F. H. Tabor.
Newburgh, N. Y.—E. J. Richards.
New London, Conn.—F. M. Tait.
Newton, Mass.—W. E. Holmes, W. H. Cole, W. A. Learned, C. K. Pierce.
New York City.—N. F. Brady, A. Williams, F. W. Smith, W. E. McCoy, J. D. Andrew, S. G. Rhodes.
New Haven, Conn.—A. F. Hunie.
Newport, R. I.—W. B. Gosling, M. W. Tenney.
Niagara Falls, N. Y.—J. E. Montague, G. W. Davenport.
Norristown, Pa.—D. A. Bertalette.
North Adams, Mass.—F. S. Richardson.
North Tonawanda, N. Y.—A. S. Allen.
North Abington, Mass.—F. N. Sanderson.
Nyack, N. Y.—S. R. Bradley, Jr.
Omaha, Neb.—H. A. Haldrege.
Oneida, N. Y.—C. W. Koiner.
Orange, N. J.—W. Partridge.
Ottawa, Ont.—J. Murphy.
Pawtucket, R. I.—J. A. Welch, A. Smith.
Peabody, Mass.—W. D. King.
Peoria, Ill.—R. S. Wallace.
Phoenixville, Pa.—J. W. Gillette.
Philadelphia, Pa.—J. B. McCall, W. C. L. Eglin, A. J. DeCamp, A. H. Manwaring, W. H. Johnson.
Pittsburg, Pa.—N. C. McPherson.
Pittsfield, Mass.—W. R. Gardener.
Plymouth, Mass.—E. P. Rowell.
Port Huron, Mich.—J. E. Davidson.
Portland, Me.—E. H. Mather, H. B. Chandler, C. A. Raymond.
Portsmouth, N. H.—J. S. Whitaver.
Poughkeepsie, N. Y.—T. R. Beal.
Providence, R. I.—W. I. Barnes, W. C. Woodward, A. B. Lisle, E. A. Barrows, W. S. Kelley, C. L. Smith.
Quebec, Can.—G. Hartmann.
Quincy, Mass.—F. W. Austin.
Reading, Mass.—S. S. Bell.
Renovo, Pa.—W. J. Murphy.
Revere, Mass.—A. B. Tenney.
Richmond, Va.—G. H. Whitfield.
Rockford, Ill.—M. A. Beal.
Rumford Falls, Me.—C. A. Mixer.
Rutland, Vt.—G. H. Haley.
Salem, Mass.—G. E. Teel, H. Kingsley, S. F. Smith, A. Morrill.
Sanford, Me.—W. E. Davis, W. J. Bodwell.
San Antonio, Tex.—H. H. Scott.
Sandy Hill, N. Y.—J. W. Wright.
Schenectady, N. Y.—E. F. Peck.
Silver City, N. M.—Wm. Merrill.
Sioux City, Iowa.—C. T. Gartland.
Skowhegan, Me.—C. J. Abbey.
Somerville, Mass.—F. E. Smith.
Southbridge, Mass.—A. F. Hall.
Suffield, Conn.—E. S. Goldthwaite.
Spokane, Wash.—R. Howes.
Springfield, Mass.—W. L. Mulligan, F. M. Fowler.
Steubenville, Pa.—S. P. Curtis.
St. Louis, Mo.—W. Gallagher, T. B. Carter, E. V. Matlack, O. M. Rau, W. F. White, Foster White.
St. Paul, Minn.—H. J. Gille, P. Doty.
St. Johnsbury, Vt.—E. E. Gage.
Syracuse, N. Y.—W. B. Ross, E. B. Doen.
Tampa, Fla.—B. R. T. Collins.
Terre Haute, Ind.—C. T. Mordock.
Thompsonville, Conn.—E. H. Farr.
Topeka, Kan.—C. R. Maunsell.
Toronto, Can.—H. G. Nicholls.
Trenton, N. J.—F. P. Lupke.
Utica, N. Y.—W. J. Brayton.
Washington, D. C.—L. E. Sinclair, E. S. Marlow.
Wallingford, Conn.—A. L. Pierce.
Waltham, Mass.—H. H. Kelly.
Waterbury, Conn.—D. B. Nish.
Waterville, Me.,—E. W. Crawford, R. J. Patterson.
Watertown, Mass.—O. W. Halladay.
Westboro, Mass.—G. L. Smith.
West Chester, Pa.—J. E. Pyle, Paul Spencer.
Williamsport, Pa.—E. H. Davis.
Winchendon, Mass.—F. W. Nourse.
Woodsville, N. H.—G. E. Mann.
Woonsocket, R. I.—F. S. Pond.
Worcester, Mass.—H. H. Fairbanks, W. H. Coughlin, F. H. Smith.

Death of William Wallace.—Every electric lighting man was grieved to learn during the convention of the death on Sunday last, in Washington, of Mr. William Wallace, who did so much pioneer work, for himself and with such men as Prof. Farmer to develop arc lamps, dynamos, carbons and other features of the industry. Many of the convention knew him and admired his fine personality.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JUNE 4, 1904. No. 23.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, JUNE 4, 1904.

CONTENTS.

THE TELEPHONE INDUSTRY.

We present on another page some very interesting statistics, the first compiled in this country, with regard to the telephone industry, as regarded from the public service standpoint, and not including statistics of manufactures, given already in the Census of 1900. The work thus done now by the United States Bureau of the Census is of an extremely interesting and useful character, and these figures supplement admirably those which have already been presented with regard to street railways and central electric lighting plants. It will be seen that the telephone industry represents a capital of just over $450,000,000, covering slightly over 4,000 systems, with 2,315,297 telephones of all kinds, over which were exchanged during the year 1902 the extraordinary number of more than 5,000,000,000 telephone conversations. This industry employed 64,628 wage earners, to whom was paid $26,369,735, and 14,124 salaried officials and clerks, to whom was paid $9,885,886. The revenue derived from the industry reached the splendid total of $86,825,536, which is almost exactly the same as the sum returned for electric lighting central stations for 1902—certainly a striking coincidence—while it is also to be borne in mind that the capitalization of the electric lighting industry is very nearly the same as that of the telephone, being reported at the time mentioned as $504,000,000. The expenses for the year were $61,152,823. The interest on bonds was $3,411,948, and the dividends paid were $14,982,719. It would appear that, exclusive of the interest on bonds, the expenses were just about 70 per cent. of the income.

A very interesting feature of the report is that which shows up the extent to which rural telephony has grown and extended. The report includes 994 mutual systems, which are all of rural character, with 89,316 instruments, and 70,915 miles of single wire. In addition to these the commercial companies operate 15,598 rural lines with 138,426 miles of single wire and 121,905 telephones. Nor was this all, for the report included in addition 4,985 independent farmers' lines, with 49,965 miles of single wire and 55,747 instruments. These figures added to the others quoted above give a grand total for continental United States of 9,136 systems and lines; 4,900,451 miles of single wire, and 2,371,044 telephones.

One of the most interesting features also in connection with these statistics is the power which it gives us to make some kind of comparison between the Bell system as a whole, and that of the "independents" as a whole. Within the last year or two it has become the fashion in some circles to assert that the independent movement by its rapid growth had carried the statistics of independent exchanges so far as to leave those of the Bell exchanges utterly in the shade. The marked development of the independent system is beyond all controversy, but we have pointed out from time to time that the figures available did not altogether justify the claims put forward by some of the more enthusiastic independents as to the minority status into which the Bell system had been thrown. It would appear from the figures before us that the capitalization per telephone installation is about $195. It is generally conceded from the fact that the Bell system is largely centered in the cities, that the capitalization for the Bell installations would necessarily be heavier than for those in the independent networks. Yet even on the basis of $195 over the entire industry, and accepting the Bell stations at the end of 1902 as being only 1,277,983, it would appear that the Bell investment was the larger half. We should not be surprised if out of $452,000,000 aggregate it represented $300,000,000. The total revenue is placed at nearly [illegible] per [illegible] the Bell figures would represent at the [illegible] 1902 $64,000,000, [illegible] nearly 75 per cent.

The total of single wire for the whole industry is placed at 4,850,486 miles. The Bell system at the end of 1902 had slightly more than half this. The total number of telephone talks is given as slightly over 5,000,000,000 for the whole industry, while the figures for the Bell system for 1902 were given in the annual report of that year as 3,000,000,000. In fact, from whatever point of view the comparison may be made, the Bell system shows up in a favorable light, and must be regarded as holding its own. The increase in the investment in telephony is supposed to reach from fifty to seventy-five millions a year at the present time, but even on this basis the Bell system compares excellently, for the total amount added to construction and real estate by the companies in the system during 1903 was put down at $35,000,000, while in 1902, the year of the Census report, it is even said to have reached $37,000,000. One of the facts, however, that no census can bring out, but which we would all like to know, is, how much of the growth of the Bell system of late years is really attributable to the spur and stimulus of the competition engendered by the independent movement, which has undeniably been one of the most wonderful industrial "booms" of recent years, and one which has brought a maximum of benefit to the public with a minimum of drawbacks.

The Government and Wireless.

A newspaper dispatch announced some days ago that the President's Cabinet had directed the Navy Department to assume control of all wireless telegraph stations on the coast line of the United States and to operate them in the public service in connection with existing land wire systems. While the report has in rather vague terms been contradicted by Secretary Moody, the Chief of the Navy Bureau of Equipment appears to confirm it, and while disclaiming any intention to interfere with the present Marconi station on Cape Cod, gives as a reason for this exception that "The stations * * are for the general convenience and safety of the public, in a broad way supplementing the work of the Hydrographic office." If this means anything it would appear to indicate an intention to develop a coast line wireless service under naval control, which would involve, owing to the matter of interference, the prohibition of further stations operated by private enterprise. Such a policy cannot be too strongly condemned, not only because it involves an extension of military authority over what in times of peace is a purely commercial function, but because of the deadening effect on development of the art that would inevitably result from bureaucratic control.

That some government control over the location and operation of wireless stations is desirable cannot be denied, in view of the experiences with interference at yacht races between rival systems endeavoring to operate simultaneously in the same locality. Such control, however, would appear to come properly under the cognizance of one of the civilian departments of the government—the Department of Commerce, for example—and its details fixed after consultation with the various interests affected, rather than be assumed by a military department and exercised in the arbitrary manner inseparable from military control. Assuming the absence of present plans placing the coast line in a state to meet immediate war, under the suggested plan the wireless organization could very simply be transferred when actual war threatened, from the civilian to the military department. The Navy Department is particularly disqualified at the present time from becoming the custodian of wireless for the reason that in the past it has consistently turned a cold shoulder to American workers in the field. In the announcement of the Bureau Chief above referred to, the partisanship for the German system adopted by the navy—a system which owes its vogue in Germany not to merit but to the personal favor in which the inventor is held by the German Emperor—is displayed, and an entirely uncalled-for fling at the Marconi system indulged in. It would be gratifying if Secretary Moody's disclaimer could also be interpreted to cover the newspaper statements attributed to his subordinate.

Wave-Length Measurers.

The article by Dr. J. E. Ives appearing on page 1074 of this issue contains a number of interesting details and several novel features. Two oscillating circuits are commonly compared in periodic time by establishing an inductive relation between them (transformer fashion), whereby the oscillations produced in one might be aided to set up resonant sympathetic oscillation in the other. Under resonant conditions, the periodic times, or natural periods of the two circuits become equal, and, therefore, the wave lengths of the disturbances emitted by the two circuits become equal. In the ingenious apparatus described by Dr. Ives, the circuit to be tested is connected *conductively* to a small part of the excited circuit, so that a small voltage drop in the latter may be enabled to excite sympathetic resonance in the tested circuit. The connection between the two circuits is made at or near the neutral axis of the exciting circuit, or at the shank of the electric tuning fork, where the oscillation currents find a maximum or ventral segment, but where the oscillating voltage is zero, or finds a node. In this way the voltage brought to bear upon the tested circuit in resonance is only drop voltage due to current traversing reactance, or ix drop; and not the free voltage of the oscillating circuit.

As described in the article, the apparatus is a simple form of Hertzian oscillator, with symmetrical wings, or tuning fork limbs. Each limb has an adjustable Franklin pane capacity and an adjustable inductance. The two capacities are arranged to be matched or balanced. The two inductances are arranged to be symmetrical and to work together, so as to match. The resultant capacity may be varied in twelve steps from 200 abstatfarads up to about 22,500 abstatfarads. The inductance may be varied, by fine gradations, between about 3,600 abhenries and 5,800 abhenries. The wave length is always the circumference corresponding to the geometric mean of the abstatfarads and abhenries as radius; so that the apparatus can measure any wave length from $2\pi\sqrt{200 \times 3{,}600}$, or 5,340 cm. up to $2\pi\sqrt{22{,}500 \times 5{,}800}$, or 71,800 cm. Or, expressing the results in quarter wave lengths, and in feet, instead of in wave lengths and centimeters, the apparatus has a range of quarter wave measurement comprised between about 44 ft. and 590 ft. The quarter wave expression is convenient because it represents the mast height of unloaded wireless telegraph antenna having the wave length and frequency considered. It is a curious coincidence, by no means devoid of physical interpretation, that an abstatfarad is a centimeter in text-book lore, and an abhenry is also a centimeter in text-book phraseology. Consequently, the wave length of any oscillation circuit is the circumference of that circle whose radius is the geometrical mean of the electrostatic centimeters and magnetic centimeters. This is also an easily remembered rule.

The junction of the two wings of the Ives electric tuning fork is made through what appears to be a fairly massive brass rod of 20 mm^2 in cross-section. The resistance per centimeter of this rod may be one or two microhms, a quantity quite insignificant to produce an appreciable drop of pressure with any ordinary strength of current; but the inductance per centimeter may be, say, 3 abhenries, and at 3 million cycles per second, the mean frequency of oscillation of the apparatus (midway between the extremes produced of 417,500 and 5,620,000), the reactance per centimeter will be 56.5 millions of absohms, or over 1/20 of an ohm. A couple of feet of this brass rod would thus offer a reactance, or impedance, of about 3 ohms to such a frequency. With an oscillating current of even so feeble a strength as 100 virtual amperes, the voltage drop across two feet of the rod would be about 300 volts. This is quite a respectable voltage with which to attempt exciting an adjacent circuit into resonance, since, at resonance, such a circuit has no appreciable impedance beyond the omic resistance of its conducting parts.

The apparatus can, therefore, be brought into the neighborhood of a wireless telegraph antenna without sensibly disturbing the electromagnetic condition of the latter. The wireless antenna is then cut at the apparatus, and a few inches or feet of the brass rod are inserted in the gap. The capacity and inductance of the oscillator are then varied until the sympathetic frequency of the antenna is struck. The power of oscillating circuits in general, and of wireless telegraph antennæ in particular, as illustrated by the preceding numerical data, is very striking. We look at a 5,000-kw generator as a tremendously powerful machine. We then look up at the slender antenna running to the masthead of an ocean steamer, and are apt to consider the power of the apparatus as trivial because, forsooth, a few storage cells will operate it. The fact is, however, that the power of a wireless antenna is often of the same order as that of the 5-megawatt generator; only the generator keeps down to business and sustains the power steadily, while the antenna oscillates very powerfully for a microsecond or so, and then relapses into quiescence for a relative age.

HIGH VOLTAGE THREE-WIRE SYSTEMS.

Mr. Barnes' Convention paper, describing the 500-volt, three-wire lighting system at Providence, R. I., was received with much interest and aroused not a little profitable discussion. The use of high-voltage—that is, 200 to 250-volt lamps—has come to be somewhat common, particularly in isolated plants, but the development of the idea into a complete three-wire system is much out of the ordinary, and such a system, carrying as in this case more than 80,000 connected incandescent lamps besides motors and arcs, occupies a unique position among central stations. Obviously, the gain in copper by passing from the ordinary voltage for direct-current lighting distributions to 500 volts between the outside wires is very great indeed, and had it been practicable to secure it in the early days of the art it is safe to say that these high-voltage systems would have become common if, indeed, they had not displaced the low-voltage systems altogether. The alternating system came in, however, and crude though it was in the earlier stages of its development, it made plain the fact that economy of copper and wide radius of distribution could be obtained by it in a very simple and effective manner. The motor difficulty, however, remained for some time and not until the polyphase distributions were worked out was it possible to give good motor service with alternating currents. When, therefore, it became feasible to use a three-wire system with toward 500 volts across the outside wires, the field was already fairly well occupied by the polyphase systems.

The most serious consideration in the case of a high-voltage, three-wire system is the possibility of securing efficient and durable incandescent lamps, in the lack of which service must suffer and economy must fall. Five years ago when high-voltage lamps were relatively new they were very far from being satisfactory. The filament of such a lamp is necessarily very long and slender, and it cannot safely be driven so hard as a shorter and firmer filament. The early high-voltage lamps rarely did better than 4 watts per candle, and even at this figure their life was short. Of course, they could be made to do somewhat better in the larger sizes—24 to 32 cp—but these larger lamps have never been favorites in central station practice. At the present time, according to Mr. Barnes, the lamps in use of the Providence system average 3.3 watts per candle when new and have a satisfactory life before falling to 80 per cent. of the initial candle-power. We do not know how these lamps are treated in measurement, but if rated in the same way as lamps of half the voltage the performance is certainly very remarkable. Obviously, however, it is less good than can be obtained with lamps of lower voltage, which are also decidedly cheaper than high-voltage lamps, so that as against saving in copper must be charged up a steady loss of energy, or its equivalent in something else. In the case of alternating distribution, lamps of the highest class can be used and a still very much larger saving in copper can be secured, but at the cost of investment in transformers.

The arc lamp situation is far more serious than the incandescent problem. It is true that by adopting twin lamps the Providence company has been able to maintain an arc service, but of what quality? In the discussion which followed Mr. Barnes' paper, Mr. Woodward characterized the arc lamps as quite satisfactory, but it needs no argument to prove to any of our readers who have ever dealt with enclosed arcs that such an arc operated at 2.3 amp., whether singly or in pairs or groups, gives a light of singularly poor quality. The thin blue arc produced under such conditions is bad as light and most inefficient in production. We have grave doubts whether its efficiency in watts per candle-power is as high as that given by incandescents, and the color is nearly as objectionable as that from a mercury arc. So long as arc lights are a considerable item in central station practice, any distribution with a minimum voltage of about 250 at the customers' terminals is likely to be disadvantageous in this particular. In some cases arcs of large amperage grouped in series may help one over the difficulty, but broadly a high-voltage, three-wire system is at a very grave disadvantage in the arc lighting feature of the programme. On an alternating system at similar voltage one could fall back on Nernst lamps, but even this refuge seems to be denied at present to the direct-current distribution.

The motor service is easily handled on a high-voltage system, and we are disposed to think that fear of alternating motors has been the motive in installing the plant under consideration. It is well nigh impossible to persuade well-seasoned direct-current men—who even yet form an influential coterie—that first-class motor service can be given except by direct-current motors. Yet such is the case, as those familiar with polyphase motors well know. Even the variable speed problems, which are none too easy, can be solved by tact and skill. If the commutating alternating motor, such as is now being exploited for railway service, comes anywhere near meeting the hopes of its inventors, it will be at once available for stationary work. However this may be, the real or imaginary difficulties of alternating motor service are to-day no adequate reason for abandoning alternating distribution in favor of high-voltage three-wire working. Within a somewhat limited range of conditions the latter is unquestionably useful, but save in cases when the supply of energy is extraordinarily cheap, we do not see how it can equal a well-organized alternating system in economy. The mere fact that so high a voltage as 500 has to be used in interior work is serious from the standpoint of safety. Fixtures and accessories adequately safe can doubtless be secured, but either at higher cost than usual or with reduced factor of safety; and a voltage of 500, while not necessarily dangerous to life, cannot be trifled with. It would seem wise, therefore, to go slowly in adopting high voltage for the general work of interior wiring. It is perfectly true that high voltage sometimes gets upon the secondary wiring of an alternating system with disastrous results, but a well-grounded neutral desirable in every class of multiple-wire distribution is an effective safeguard in this particular. The future of electrical distribution depends on the development of new methods of lighting. With our present methods and apparatus, a 500-volt, three-wire system seems a questionable compromise.

Telephone Statistics of the United States.

Mr. W. M. Steuart, chief statistician of the Department of Manufactures in the Bureau of the Census, now part of the Department of Commerce and Labor, has just issued the following preliminary report on the telephone systems of the United States for the year ending December 31, 1902. This report, which is in line with those already issued in regard to street railways and the electric lighting industry, includes all commercial telephone plants, all mutual systems, and all separate "farmer" or rural lines in operation during any portion of the year. It does not include, however, any single lines of an exclusively private character. The inquiry is the first of the kind as to the telephone ever undertaken in this country, and has been extremely difficult on account of the rapidity of recent growth and the heterogeneous nature of the systems.

CONDENSED BALANCE SHEET.

	Total.	Commercial.	Mutual.
Total assets	$452,172,546	$449,485,693	$2,686,853
Construction and equipment (including real estate and telephones)	389,278,232	386,662,619	2,615,613
Stocks and bonds of other companies	9,938,342	9,938,342	....
Machinery, tools and supplies	9,689,691	9,657,956	31,735
Bills and accounts receivable	30,629,677	30,619,294	19,383
Cash and deposits	12,291,840	12,271,718	20,122
Sundries	344,764	344,764	....
Total liabilities	452,172,546	449,485,693	2,686,853
Capital stock	274,049,697	273,388,432	661,265
Bonds	73,981,361	73,978,361	3,000
Cash invested (unincor. systems)	6,161,299	4,571,318	1,589,981
Bills and accounts payable	44,491,066	44,411,639	79,427
Sundries	1,124,265	834,561	289,704
Net surplus and reserves	52,364,858	52,301,382	63,476
CONSTRUCTION, EQUIPMENT, ETC.			
Number of systems	4,151	3,157	994
Miles of single wire	4,350,486	4,779,571	70,915
Telephones of all kinds	2,315,297	2,225,981	89,316
Number of subscribers	2,137,256	2,048,736	88,520
Number of automatic pay stations	73,887	73,869	18
Number of all other pay stations	48,393	48,009	384
Farmer or rural lines owned by com. systems:			
Number of lines	15,598	15,598	....
Miles of single wire	138,426	138,426	....
Number of telephones	121,905	121,905	....
Number of party lines	258,166	(1)248,908	(2)9,258
Number of telephones on party lines	886,152	308,571	77,581
Number of public exchanges	10,361	9,419	942
Number of private branch exchanges	7,883	7,883	....
Manual switchboards, total number	10,842	9,901	941
Common battery system	837	830	7
Magneto system	10,005	9,071	934
Automatic switchboards	54	53	1
Mes. or talks during year, total No.	5,070,555,345	4,971,413,070	99,142,275
Local exchange	4,949,850,491	4,851,416,539	98,433,952
Long distance and toll	120,704,854	119,996,531	708,323
Employees and Wages:			
Salaried officials and clerks:			
Total number	14,124	13,958	166
Total salaries	$9,885,886	$9,871,596	$14,290
Wage-earners:			
Total average number	64,628	63,630	998
Total wages	$26,369,735	$26,206,065	$163,670
Revenue and Expenses:			
Total revenue	$86,825,536	$86,522,211	(3)$303,325
Total expenses (including taxes & fixed charges except int. on bonds)	61,152,823	60,871,002	281,821
Dividends paid	14,982,719	14,981,649	1,070
Interest on bonds	3,511,948	3,511,768	180
Net surplus	7,178,046	7,157,792	20,254

(1) Urban party lines.
(2) Rural party lines.
(3) Includes assessments.

In addition to the reports obtained from commercial and mutual telephone systems, shown in the above table, the bureau secured reports of 4,985 independent farmer or rural lines having 49,965 miles of single wire and 55,747 telephones. These figures added to the totals for the commercial and mutual systems give a grand total for the continental United States of 9,136 systems and lines, 4,900,451 miles of single wire and 2,371,044 telephones.

A number of commercial systems operate in rural districts, but combining the totals for farmer or rural lines owned by commercial systems, mutual systems and independent farmer or rural lines gives a total of 21,577 systems and lines, 259,306 miles of single wire and 266,968 telephones, operated exclusively in rural districts.

In addition to the statistics presented above for the continental United States, reports were received for one commercial system in Alaska and seven in Hawaii, having a total of 4,732 miles of single wire, 2,493 telephones of all kinds, 3,461,000 messages or talks during the year, $112,068 total revenue, $76,307 total expenses (including taxes and fixed charges), and $25,858 paid in dividends, leaving a net surplus of $9,903.

The final report will contain an analysis of the above totals and present detailed statistics by States and for other phases of the industry. This report will be in the nature of a full discussion of the subject, in the manner of the reports that have been prepared nad are also to be published in regard to electric lighting, street railways and electric manufacturing hen these are all finished the electrical industries of the United States will have received a thorough treatment of the kind, and will have been reviewed so as to present a permanent record of the state of the art and its industries at the beginning of the century. This information, therefore, in addition to its present value, will constitute a basis of comparison for all time.

Programme of International Electrical Congress.

Below is the preliminary programme for Sections B and C of the International Electrical Congress. The programme of Section A has already been published and that of the other five sections will shortly be given out:

SECTION B—GENERAL APPLICATIONS.

Chairman, Prof. C. P. Steinmetz; secretary, Prof. Samuel Sheldon.

Name of Author.	*Title of Paper.*
Prof. E. Arnold,	Direct-Current Commutation.
Dr. O. S. Bragstad,	Compensated Alternators.
Col. R. E. Crompton,	Standardization of Dynamo-Electric Machinery and Apparatus.
M. Andre Blondel,	Calcul des Alternateurs.
Profs. Drs. Elster and Geitel,	Uber die Naturliche Radioactivität der Atmosphare und des Erdbodens.
Prof. Dr. Clarence P. Feldmann,	The Distribution of Voltage and Current in Closed Conducting Networks.
M. A. Heyland,	Self-Regulating and Compounded Synchronous Machines.
W. M. Mordey,	To be announced.
A. Nodon,	Rectifiers.
Sir W. H. Preece,	Electricity in Ancient Egypt.
Prof. C. A. Adams,	Magnetic Leakage in Alternating-Current Machinery.
Mr. C. Day,	Electric Motors in Shop Service.
Mr. J. W. Esterline,	Carrying Capacity of Cables and Conductors.
Mr. H. W. Fisher,	Sparking Distances Corresponding to Different Voltages.
Prof. H. J. Ryan,	The Design of Insulators.
Mr. D. B. Rushmore,	The Regulation of Alternators.
Prof. E. B. Rosa,	The Influence of Wave Shape upon Alternating-Current Meter Indications.
Dr. Clayton H. Sharp,	The Equipment of a Commercial Testing Laboratory.
Prof. H. B. Smith,	Very High Voltage Transformers.

SECTION C—ELECTROCHEMISTRY.

Chairman, Prof. H. S. Carhart; secretary, Mr. Carl Hering.

Prof. Dr. S. Arrhenius,	Methods of Determining the Degree of Dissociation.
Geh. Reg. Prof. Dr. W. Borchers,	Electrometallurgy of Nickel.
Sherard O. Cowper-Coles,	Electrolytic Methods for the Rapid Production of Copper Sheets and Tubes.
Dr. F. Dolezalek,	Subject to be announced.
J. Sigfried Edstron,	Electrical Extraction of Nitrogen from the Air.
Dr. H. Goldschmidt.	Alumino-Thermics.
Prof. Dr. F. Haber,	Electrolytische Zerstörungen in der Erde.
Dr. P. C. L. Heroult,	Electrometallurgy of Iron and Steel.
Mr. J. Swinburne,	Chlorine Smelting.
Prof. W. D. Bancroft,	The Chemistry of Electroplating.
Mr. A. G. Betts and Dr. Edward Kern,	The Lead Voltameter.
Prof. H. S. Carhart and Dr. C. A. Hulett,	The Preparation of Materials for Standard Cells.
Thos. A. Edison,	Alkaline Batteries.
Dr. K. E. Guthe,	The Silver Voltameter.
Mr. Carl Hering,	The Units Employed in Electrochemistry.
Mr. J. T. Morrow,	Notes on Electrolytic Copper Refining.
Prof. J. W. Richards,	The Energy Absorbed in Electrolysis.
Prof. T. W. Richards,	The Relation of the Theory of Compressible Atoms to Electrochemistry.

The Largest Electric Water Power Plant in New Hampshire.—II.

Hydraulic power can seldom be developed while the dam intended to maintain the head of water is in detached sections, the canal that conveys the water is incomplete, and the greater part of the electric station to be operated by the water remains unbuilt; but this is being done at Garvin's Falls, N. H. These conditions were made possible by the old dam 700 ft. up stream from the site of the new, by the upper section of the old canal that brings water from one end of the old dam to the head gates of the new canal, and by the fact that one-third of the electric station was completed some months before the other two-thirds were begun.

FIG. 1.—TAIL RACE, GARVIN'S FALLS.

After it was decided to replace the old dam 1,240 ft. up stream from the incomplete electric station, by a new dam some 700 ft. down stream, to replace the lower section of the old canal by a new one of much greater section 500 ft. long, and to extend the electric station, the problem was to discontinue the use of the electrical equipments already installed during the shortest time possible.

This problem was solved by deepening the tail race below the electric station, building the 500 ft. of new canal and extending the forebay wall and station foundations between June 5, 1903, when the contract for the work was signed and November of the same year, when water from the upper section of the old canal was let into the new.

The old canal is unable to bring down the entire flow of the Merrimac River from the old dam even in the summer season, and a coffer dam was, therefore, built a little above the site of the new masonry dam to lay bare a part of the river bed. This coffer dam for the greater part of its length, including that next to the right bank of the river, is built with bags of sand that were transported to their positions by wheelbarrows. Heavy rocks and earth make up the coffer dam in that part nearest the left bank of the river, and a break spanned by a wooden bridge remains open between the end of the coffer dam and this bank for the water that cannot pass down the canal. In this way the water flowing over the old dam was forced to the lowest part of the old channel, while sections of the new dam were built in other parts. The site selected for the new dam was particularly favorable because it afforded a foundation of bed rock all the way across the river with comparatively little excavation. Surface seams in the bed rock on the dam site were filled with mortar, and all loose parts were removed by barring so as to leave a clean surface for the mortar in which the masonry was laid, thereby making a water-tight joint. Any springs flowing up through seams in the ledge were grouted and piped.

Along the entire length of both the high and low-crest sections, the dam, it is set into a trench cut for its entire width in the river ledge. The bottom of this trench is divided into two parts by a projection of the ledge parallel to the length of the dam, and the lower part is that beneath the heel. For the low-crest section of the dam the approximate width of the trench in the bed rock is 31 ft., and the width of the deeper part of the trench, that beneath the heel of the dam, is about 8 ft. In depth the trench varies somewhat with the solidity of the ledge, but the approximate figures are 6.5 ft. at the heel and 4 ft. at the toe of the dam in its low-crest section. The projection of the bed rock in front of the heel of this part of the dam is about 4 ft.

In height the low-crest part of the dam is about 25 ft. above the bottom of the trench at the heel, and 18.5 ft. above the surface of the bed rock outside of the trench. The top of this low-crest section of the dam is at the same elevation as the top of the old dam that is 700 ft. up stream. This equality of elevations will prevent the loss of any flowage rights on the one hand, or any land damages on the other, after the old dam is removed. The great width compared with height in this dam is designed to provide stability against the high freshets to which the Merrimac River is subject. During the highest freshet on record the river at Garvin's Falls reached an elevation of 9.7 ft. above that of the low-crest section of the new dam, on March 2, 1896. The low-crest section of this dam as now constructed has a pressure line that just coincides with the down stream side of its middle third at an elevation 20 ft. below the crest, when the water over this crest is 20 ft. deep. Toe stones in this section of the dam have an elevation 16 ft. below the crest at their upper outside corners, and each of these stones stands about 2 ft. above and extends about 1.5 ft. below the natural ledge beyond the toe. On the up stream side of the dam the batter is 5 to 1, and the space between this batter surface and the side of the trench is filled with concrete. Between the top corner of the toe stones and the natural ledge to a distance of some feet down stream there is a sloping layer of concrete.

At the top corner on the up stream side of the dam the surface to the crest line is curved with a 10-ft. radius. Then comes a horizontal surface 1 ft. wide and tangent to this another surface with a 10-ft. radius turns the down stream corner of the crest. Next is a slope of 5 to 3 for a distance of 7.34 ft., and then comes a concave surface of 10-ft. radius that extends to within 1 ft. of the toe line. This last foot of surface on the down stream side of the dam is horizontal.

Of the total dam length of about 550 ft. between abutments, 75 ft. is taken up by the high-crest section, which juts out into the river from the left bank. The crest elevation of this section is 2 ft. above that of the low crest, and the height of this section above the bed rock is as little as 10 ft. in some parts. This high section of the dam, like the lower one, sets in a trench cut through the bed rock of the river. In width the trench is 8 ft. under the heel, and 22 ft. from heel to toe of the dam. On the up stream side the depth of the trench is 6 ft., on the down stream side 4 ft., and the ledge projection against the down stream side of the heel is approximately 3.5 ft. high. From heel to crest this section of the dam measures as much as 18.5 ft. On the up stream face of the dam the batter is 5 to 1, and on the down stream face it is 5 to 3. In this

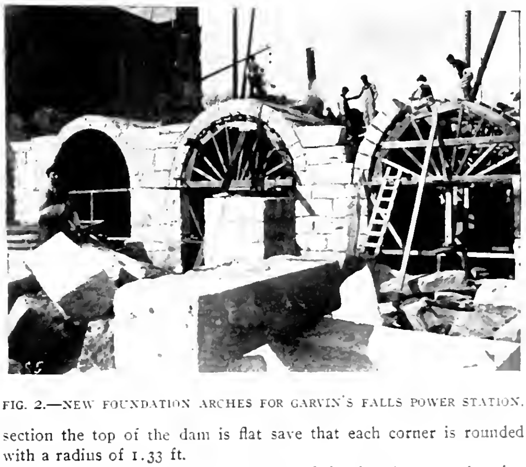


FIG. 2.—NEW FOUNDATION ARCHES FOR GARVIN'S FALLS POWER STATION.

section the top of the dam is flat save that each corner is rounded with a radius of 1.33 ft.

At the toe of this section the stones of the dam have an elevation about 1 ft. above that of the bed rock just beyond, and a layer of concrete with a sloping surface is used next to the toe.

Each capstone on the crest of the dam along the up stream side, which is cut to shape on its two exposed sides, is not less than 4 ft. square and 2.5 ft. thick, and is secured to the two courses next underneath by 4-ft. long dowels. All the other capstones are also cut to dimensions and are not less than 4 ft. long lengthwise of the crest, and 2.5 ft. deep. The down stream face of the dam as well as the crest is composed of ashlar masonry in both sections, but the up-stream face of the dam below [illegible] and also its core is of rubble masonry. The two faces of the dam and also its crest are laid with mortar composed of one part of Portland cement to two parts of sand, and the hearting of the dam is laid with mortar of one part Portland cement to 2.5 parts of sand. Every stone in the dam was required to be laid in a bed of mortar, and no grouting was permitted. In the heart of the dam various sizes of stone were used and regular coursing was avoided so as to obtain good vertical as well as horizontal bonding. For the rubble on the up stream face of the dam every third stone in each course was required to be of headers, and this is also true for the ashlar masonry on the down stream face.

The length of headers in the down stream face is not less than 4 ft., and the length of stretches not less than 2 ft., in a direction normal to the face. The rise of courses is between 18 and 24 in., the minimum face length of stretchers is not less than 3 ft. and that of headers 2 ft. On the down stream face of the dam the width of joints to a depth of 3 in. is ½ in., and in the entire depth of joints the width is not more than 1½ in. Along the entire crest of the dam and for several courses above the toe of the overflow section, the adjoining stones of different courses are secured to each other by dogs. Toe stones in this section are very heavy and have cross-sections about 4 ft. square in plains normal to the face of the dam. All dowels, dogs, clamps and flashboard pins were made of 1¼-in. round wrought iron galvanized, and the dogs were galvanized after bending.

No masonry or concrete in any part of the work was allowed to come in contact with water until it had been in position at least 24 hours. Work in laying masonry in the dam was permitted when the temperature was as low as 22° F., on condition that the materials for the mortar were heated and that salt was mixed with them. All cement used in the dam, canal and power house was of the Portland variety and equal to the best American manufacture. Granite was the only stone used in the dam and other masonry.

The left bank abutment consists of a concrete core wall that extends several rods up into the bank, a cross wall at its river end, and two wing walls for this cross wall. Like all other parts of the dam this core wall is based on bed rock, and its cross-section is tapering, being about 8 ft. wide at the bottom and 3 ft. at the top, with a height not far from 20 ft. Concrete for the core wall was mixed with one part Portland cement, 2½ parts sand and 4½ parts broken stone. Cross and wing walls at the river end of the core wall were built of rubble masonry and ashlar facing. Between the core walls and the wing walls the spaces were filled with layers of earth and small stones thoroughly rolled or rammed.

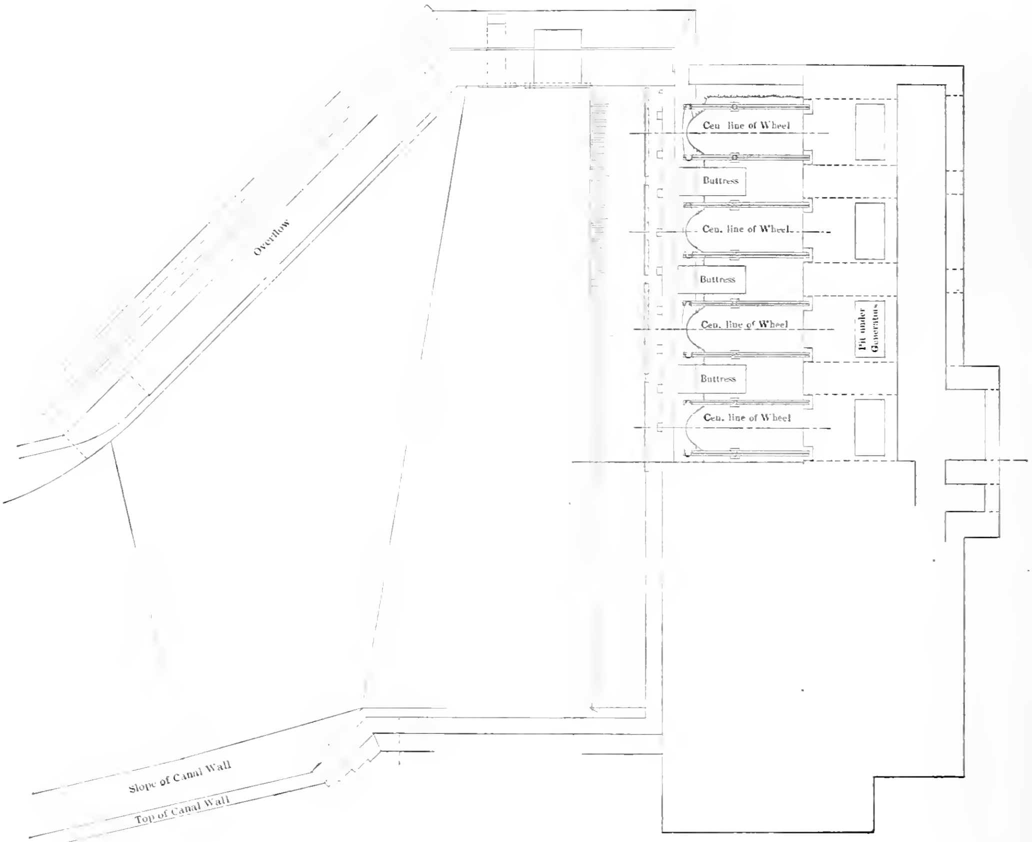


FIG. 3.—PLAN OF FOUNDATION AND FOREBAY WALLS, GARVIN'S FALLS, N. H.

The right bank abutment consists of a cross wall, a wing wall about 60 ft. long on the down stream side, and a wing wall about 139 ft. long on the up stream side. In the length of the down stream wing wall 47.5 ft. forms an overflow section on the river side of the new canal. This overflow section has an elevation 3 ft. greater than that of the low-crest portion of the dam, and 1 ft. greater than that of the high-crest section. At the ends of this overflow section on the wing wall the elevation is that of the main portions of the canal walls or 5 ft. tbove the low crest of the dam. On its river side this overflow section has a batter of 4 in. per foot. In its central portion the cross wall of this abutment has its top 5 ft. above the low crest of the dam. The site of both wing walls at the right bank abutment was a natural ledge that formed the river bank, and this ledge was higher than the present top of the down stream wing wall so that a large amount of rock excavation was necessary both in the bed of the canal and at the site of the wing. Where the cross wall joins the down stream wing a large section of the natural ledge was left to bind the corners together. Rubble stone masonry faced with ashlar on the river side of the overflow section was used in the down stream wing wall.

The cross wall was built of rubble concrete masonry, and this type of masonry was also used in the up stream wing wall, which is also the head gate wall; above an elevation 5 ft. higher than the low crest of the dam. Rubble concrete for this purpose was mixed with one part Portland cement, 2.5 parts sand and 4.5 parts stone or gravel. No stone of large area in this concrete was allowed within 10 in. of the outside surfaces of the work. Below an elevation 5 ft. above the low crest of the dam the head gate wall is formed of concrete mixed with one part Portland cement, 2.5 parts sand and 4.5 parts stone or gravel graded up to not more than 2 in. in its greatest dimension.

FIG. 4.—UPPER END OF CANAL, GARVIN'S FALLS.

Entrance to the new canal is closed by 95 ft. in the length of the head gate wall, and the remaining 44 ft. of its length forms a wing that runs up into the bank. From the end of this wing a concrete core wall crosses the right of way occupied by the express tracks of the Boston & Maine Railroad which borders the canal. Along its top the elevation of the head gate wall is 15 ft. above that of the low-crest dam, and the width at the base is 30 ft. in that part of the wall that contains the head gates. At its top the width of this wall is 8 ft., its up stream face is vertical and on its down stream face the batter is 4 in. per foot down to a level 12 ft. below the top, where the abutments begin. The base of the wall is pierced by six archways leading from the river into the canal, each of these archways being 10 ft. wide and 15 ft. high. The floor level of these archways corresponds with that of the canal adjoining them, and is 12 ft. below the low-crest portion of the dam. From the floor of the archways to the top of the head gate wall above them the distance is 27 ft. The sill outside of the arches on the river side of the forebay wall is 3 ft. below the arch floors. On its canal side the length of the head gate wall is 90 ft., and the center line of the wall makes an angle of approximately 56° with the center line of the canal. It is consequently necessary for water entering the canal through the head gate arches to change its direction of flow by 34° before passing down the canal.

This change in the direction of water entering the canal begins just inside of the head gate wall, and is effected by a section of the canal wall toward which the flow through the head gate wall is directed. In this section the canal wall is formed of concrete 4 ft. wide at its top and 5 ft. at the thickest part of its base. Natural ledge in which this part of the canal is excavated forms both the foundation and the backing for this concrete section of the canal wall. The entire canal wall between the head gates and the forebay has a top elevation 5 ft. greater than that of the low-crest dam, save in the overflow section already mentioned. Just inside of the head gate wall the elevation of the canal bottom is 12 ft. less than that on the low crest of the dam, and there is a gradual fall in the bottom of the canal so that at the line where it widens into the forebay the elevation is 13 ft. below the overflow portion of the dam. From this it may be seen that the general height of the canal wall is 17 to 18 ft. above the canal bottom. Along almost its entire length of 500 ft. the canal was excavated either wholly or partly in rock, and much of the sides consists of the natural rock surface. At some points such surfaces had large seams and these were dug out and filled with concrete. Along the greater part of the canal the walls were laid with dry rubble masonry, either from the bottom up, where the cut was in earth, or above the top of the natural ledge, where the cut was in rock. These rubble side walls are laid with a slope of 6 in. per foot of height, and is 3 ft. thick. At a distance of about 113 ft. from the down stream face of the head gate wall along the center line of the canal the bottom width shrinks to 62 ft., the width at the elevation of the low crest of the dam to 74 ft., and the width on a level with the tops of its side walls to 79 ft.

The canal holds these widths to a point on its center line that is distant about 144 ft. from the canal side of the end wall of the forebay, and then begins to widen. At the face of this end wall the top width of the forebay is 134.5 ft. Near that cross-section where the canal begins to widen into the forebay the bottom takes on a slope that carries it from an elevation that is 13 ft. below the crest on the river section of the dam down to 17 ft. below that crest, along a line that is 60 ft. at one end and 37 ft. at the other from the inner face of the head forebay wall. Between this line and the head wall the bottom of the canal is level. On the river side of the forebay there is an overflow section 90 ft. long and with its top 2 ft. higher than the low crest of the dam. This overflow section is 8 ft. wide on top, about 19 ft. wide at its base, is 15 ft. high above the natural ledge on which it stands, and is built of rubble stone masonry laid in cement mortar. Between the down stream end of this overflow section and the head wall of the forebay, there is a stretch of wall 40 ft. long on the river side that contains openings for the flush and waste gates. The waste gate opening is 4 ft. wide, of about the same height, and has its bottom approximately on a level with the forebay floor at that point. The opening for the waste gate is 10 ft. wide, has its bottom 10 ft. above the forebay floor and 7 ft. beneath the low-crest level of the dam, and extends to the top of the wall in which it is located, 5 ft. above the low crest of the dam.

Rubble stone masonry laid in cement mortar forms the head wall of the forebay, and this wall serves also as one side of the wheel room in the power station. On top the elevation of this wall is 8.5 ft. greater than that of the low crest of the dam, and its base runs down to a plain 20 ft. below that crest. At its top the thickness of this wall is 3.5 ft., at the low-crest level of the dam, and the flow at line of the canal the thickness is 7 ft., and at the level of the forebay floor the thickness is 10.5 ft. This wall is further strengthened by buttresses that extend into the wheel room between the wheel cases.

FIG. 5.—HEAD GATES, GARVIN'S FALLS.

On its forebay side the head wall of the forebay is vertical and in front of this wall is the steel rack 134.5 ft. long and 20 ft. in vertical height, reaching from the bottom of the forebay to a line 3.5 ft. above the low crest of the dam. The face of this rack is 11 ft. 10⅜ in. from the face of the head wall at the bottom, and 6 ft. 10⅞ in. at the top. In structure the rack is built up with 15-in., 42-pound steel I-beams reaching from top to bottom and spaced with centers 10 ft. 6 in. apart. At their lower ends these 15-in. beams are riveted to a 20-in., 60-pound horizontal I-beam, and at their tops to a 15-in., 42-pound I-beam, while three other horizontal beams tie those running up and down the rack together at intermediate points. The horizontal 20-in. I-beam at the bottom of the rack is set in a bed of concrete and bolted to the natural ledge beneath. At the top each I-beam running up and down is secured to the forebay wall by an 8-in., 25-pound beam, and at 8.5 ft. from its lower end an I-beam of 10 in. and 40 pounds weight serves a like purpose.

The face of the rack is made up of wrought-iron bars set edgewise, each bar being 3.5 in. wide and ¼ in. thick. Bars are held together by round rods of ⅜ in. diameter that pass through them, and the spaces 1¼ in. wide between bars are obtained by placing a length of standard ⅜-in. iron pipe 1¼ in. long on each rod between each pair of the ¼ by 3.5-in. bars. The face of the rack is divided horizontally into upper and lower sections. In the upper section each of the ¼ by 3.5-in. iron bars is 12 ft. ⅝ in. long and is held in position by four of the ⅜-in. round rods. In the upper section each of the ¼ by 3.5-in. bars is 8 ft. 5¾ in. long and is held in position by three of the ⅜-in. round rods. Vertically the face of the rack was made up of sections most of which were 3.5 ft. wide each.

Beyond the head wall of the forebay and its buttresses the natural ledge beneath the power station was excavated to an elevation 33 to 35 ft. beneath the low crest of the dam, and 16 to 18 ft. below the floor of the forebay. This depth of excavation provided room for the foundations and the escape of the tail water, and permitted an ordinary depth of tail water of at least 5 ft. On a line about 20 ft. beyond the vertical face of the natural ledge that forms the foundation of the main portion of the head wall of the forebay, and about 10 ft. beyond the ledge projections that support the buttresses, the arches underneath the generator room of the power station begin. These arches, seven in number, form a continuous row from one end of the power station nearly to the other, and the length of each arched opening in this row is 20 ft. Between the up stream face of this row of arches and the foundation of the forebay wall there is no masonry, and the space is spanned by steel I-beams each 27 ft. long that are supported at one end by the head wall of the forebay, and at the other end by the arches just named.

FIG. 5.—BUILDING THE DAM, GARVIN'S FALLS.

These I-beams are placed in pairs close together, and from center to center each pair is distant about 11 ft. from the next. Two pairs of these I-beams serve to support each wheel case and the draft tubes from the wheel cases drop down between the beams to the tail water below. In the line of arches above mentioned each of the six main archways through which the tail water from the large wheels passes is 14 ft. wide and 16 ft. high above the bed rock floor. Between the archways the walls are 7 ft. thick, and the top of the arch masonry is 16 ft. lower than the crest of the dam. Between the down stream side of this row of large arches and another row of arches that makes up the foundation for the down stream wall of the power station there is an open space nearly as long as the station and 10.25 ft. wide for most of its length. This space is spanned by steel beams and above these beams and the row of arches already described comes the floor of the generator room at an elevation 15 ft. beneath the low crest of the dam, and 13 ft. above the ordinary tail water level. The arched wall that supports the down stream wall of the station is 4 ft thick and contains seven archways which are respectively opposite to the seven archways beneath the floor of the generator room.

All of this arch work beneath the station is of rubble stone masonry laid in cement mortar, and rests on the natural bed rock. Just outside of the arches under the down stream wall of the station the bottom of the tail race has an elevation 33 ft. less than that at the low crest of the dam, and there is a little slope from this point to the river a few rods distant. The wall of the tail race is dry rubble masonry. To provide for the increased flow of water, the lower end of the tail race was deepened while the extension of the station foundations was in progress.

The kindness of Hollis French and Allen Hubbard, of Boston, the engineers of all the above work, has made it possible to give these structural details of the largest electric water power plant in the State of New Hampshire.

On a New Standard of Wave-length.

By Dr. James E. Ives.

In a recent number of the Electrical World and Engineer (February 6, 1904), I have given the results of some measurements of the wave-length of free vibrations in antennæ and closed oscillating circuits. I now propose to describe the *standard of wave length* with which these measurements were made.

This instrument was designed for the American De Forest Wireless Telegraph Company, conjointly by Dr. Lee de Forest and the author. Its general appearance is shown in Fig. 1. It stands 22 in. high, is 30 in. wide and 14½ in. deep. It is symmetrical in form, consisting of two variable condensers, and two variable inductances similarly placed on each side of a spark-gap. The condensers are made of sheets of glass covered with tin-foil, and placed in the base of the instrument. Each of the inductances consists of two concentric circles of wire supported by hard-rubber rings, the outer rings being fixed in a common vertical plane, and the inner, rotating together about a horizontal diameter. The circles and all connecting wires are made of No. 10 bare copper wire (.102 in. in diameter).

Starting at the spark-gap and tracing the connections on the right-hand side, we see that a wire leads to the right-hand condenser; from the condenser a wire passes to the outer circle of the right-hand inductance; from the outer circle we pass by means of a sliding contact to the inner circle, and from the inner circle by means of another sliding contact to a wire that goes to the *contact bar* at the top of the instrument. The contact bar is a brass rod of rectangular cross-section, which, as will be seen from Fig. 1, is bent upon itself. The dimensions of its cross-section are ¼ by ⅛ in.

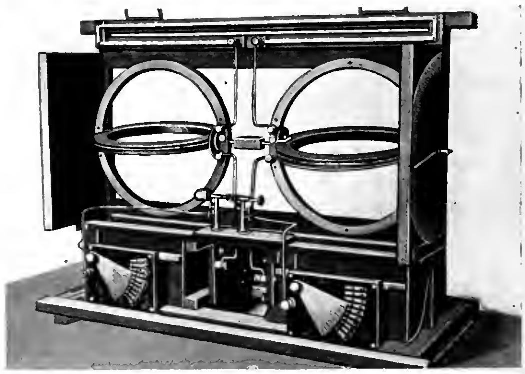


FIG. 1.—VIEW OF INSTRUMENT.

The outer circles of wire are 11¼ in. in diameter, and the inner circles 9⅝ in. The sliding contacts are made by means of two small concentric flat brass rings, which are attached to the inner hard-rubber ring, making contact with two small brushes fastened to the outer ring. The inner hard-rubber rings are rigidly connected so that they must always rotate together. Pointers attached to these rings indicate the angle moved through upon semi-circular dials on the sides of the instrument.

Each of the condensers consists of 43 glass plates, 8 in. square, coated with tin-foil 7 in. square. The plates vary in thickness from 1/32 to ¼ in. The thicker plates are, of course, used for the smaller capacities. The plates are divided into groups of suitable capacity, ten leads being taken off from the front of the condenser and nine leads from its inner side. As will be seen from Fig. 1, the number of sections used can be varied at will by means of a fan-shaped contact. There are similar contacts on the inner sides of the condensers, directly under the spark-gap, which cannot be seen in the photograph.

The electrical circuit of the instrument is shown schematically in Fig. 2. r_1, r_1', r_2 and r_2' are the outer and inner circles of the variable

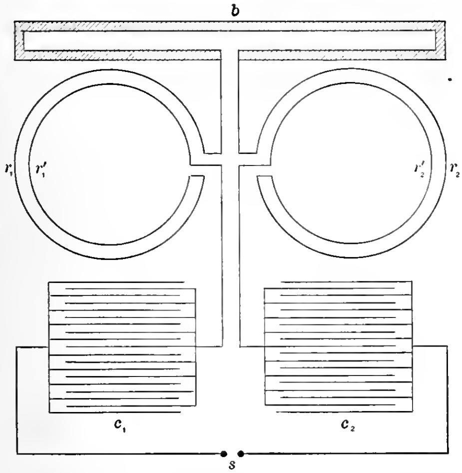


FIG. 2.—SCHEMATIC DRAWING OF THE CIRCUIT OF THE STANDARD.

inductances; c_1 and c_2 are the variable condensers; s is the spark-gap used to excite the system and b the *contact bar*, to which the circuit whose wave length is to be measured, is attached. Both parameters of the circuit, viz.: its inductance and its capacity, are variable. Its resistance can be neglected.

CALIBRATION OF THE STANDARD.

The calibration was made by means of Lecher wires. Two No. 10 bare-copper wires were stretched parallel to each other at a distance of 6 in. apart, and about 4 ft. above the floor, between the end walls of a loft 122 ft. long. The loft was about 50 ft. wide and divided by three rows of wooden pillars into four alleys. The parallel wires were stretched in the middle of each alley, and connected by cross wires at alternate ends, making the total length of parallel wires about 500 ft. (See Fig. 3). They were subdivided into lengths of 12 ft. or less by cutting the wires, making loops at the ends, and tying these ends together with short pieces of heavy cord. When desired, the cuts could be bridged with short pieces of the same wire fitting snugly into the loops. In this manner the parallel wires could be made of any desired length.

To perform the calibration the parallel wires were attached at one

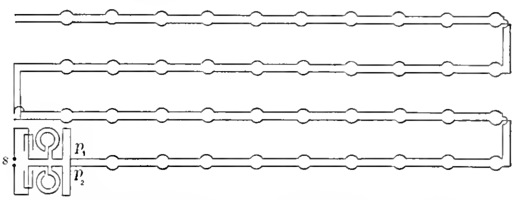


FIG. 3.—DIAGRAM SHOWING THE ARRANGEMENT OF THE LECHER WIRES BY MEANS OF WHICH THE STANDARD WAS CALIBRATED.

end to the points p_1 and p_2 on the "contact bar" of the standard (see Fig. 3). The standard was then excited with a small induction coil, causing a spark to pass between the balls of the spark-gap, s. This sparking produced electrical oscillations in the standard, and also in the Lecher wires, since they were attached to it. A Geissler tube was then placed across the free ends of the parallel wires, and the capacity of the condensers of the standard varied until the tube began to glow. The final adjustment was made by rotating the movable coils until the glow became a maximum. The standard and the Lecher wires were then in resonance; and the *quarter wave length* of the standard was equal to the length of the parallel wires. This process was repeated some fifty times, starting with the wires 40 ft. long, and increasing their length a few feet at a time up to 500 ft. The results are shown in the *calibration curve,* Fig. 4. It will be seen that the curve is made up of twelve sections, each section corresponding to a certain number of condenser leads. For the first section of the curve, we have *one* front lead, and *one* side lead; for the second section *one* front lead and *two* side leads; for the third section *two* front leads and *two* side leads, and so forth. Both condensers must, of course, have the same number of front and side leads. The readings in degrees on the dials are plotted as abscissas,

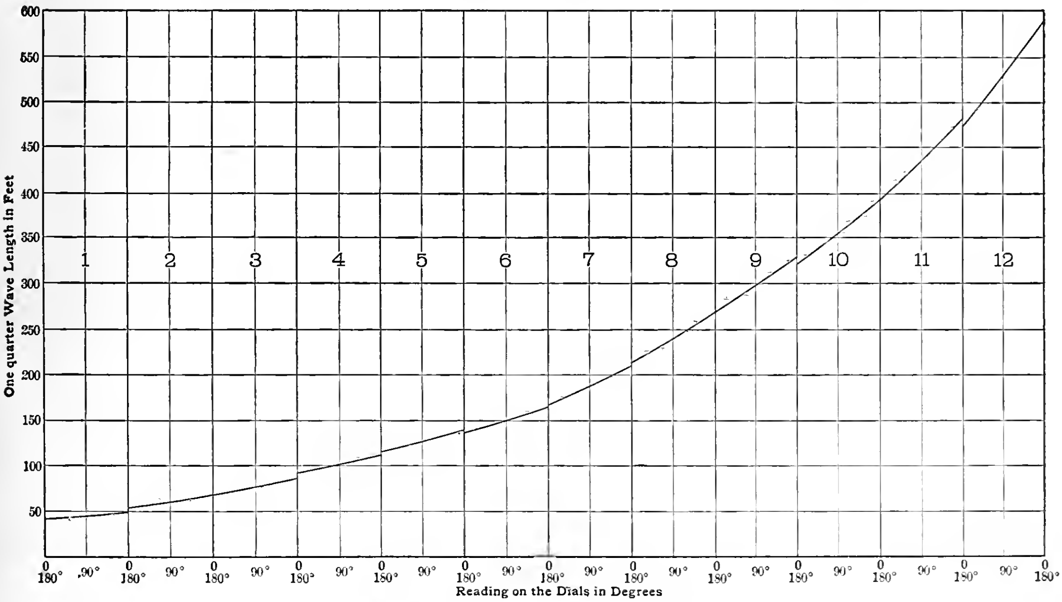


FIG. 4.—CALIBRATION CURVE OF THE STANDARD.

[illegible] quarter wave lengths as ordinates. The curve is broken as it was difficult to adjust the capacities of the successive sections of the condensers, so that the different sections of the curve would fit on to each other.

To test the accuracy of this experimental calibration, the quarter-wave length of the standard was *calculated* for each section, for the movable coils in the position of maximum inductance. This necessitated the measurement of the capacities of the sections of the condensers, and the calculation of the maximum inductance of the concentric circles. The results are given in Table I and show that the observed and calculated values differ from each other only by a few per cent.

TABLE I.

No. of section of curve	Capacity in microfarads of the two condensers in series.	Maximum quarter-wave-length in feet. Calculated.	Observed.
1	.0248	586	587
2	.0174	490	478
3	.0116	409	390
4	.00815	336	328
5	.00525	269	267
6	.00325	212	208
7	.00204	167	163
8	.00149	144	138
9	.00091	112	110
10	.00054	86	85
11	.00037	63	67
12	.00022	54	50

The maximum quarter-wave length was calculated from the formula

$$\lambda = 2\pi v \sqrt{L C}, \tag{1}$$

where

λ is the wave length,

v, the velocity of propagation of electric waves, taken in this case as 3×10^{10} cm. per second,

L, the maximum inductance of the standard,

C, the capacity of the number of sections of condenser used.

The inductance of the standard is, of course, equal to the sum of the two inductances, and its capacity equal to half that of either condenser. The total maximum inductance of the standard was found to be equal to 5,830 absolute units or abhenries. This is made up of two parts, viz.: the inductance of the concentric circles, amounting to 4,910 abhenries; and the inductance of the rest of the circuit amounting to 920 abhenries. The minimum inductance of the concentric circles was found by calculation to be equal to 2,670 abhenries. The total inductance of the standard, therefore, when the circles are in the position of minimum inductance is relatively large and equal to 3,590 abhenries. This accounts for the large initial ordinate of each section of the calibration curve.

The inductance, L, of formula (1) is made up of six parts, as follows:

$$L = L_1 + L_2 + 2 M_{12} + L_3 + L_4 + 2 M_{34} \tag{2}$$

where

L_1 is the inductance of the left-hand outer circle,
L_2, the inductance of the left-hand inner circle,
M_{12}, their mutual inductance,
L_3, the inductance of the right-hand outer circle,
L_4, the inductance of the right-hand inner circle,
M_{34}, their mutual inductance.

But since $L_1 = L_3$,
$L_2 = L_4$,
and $M_{12} = M_{34}$,

formula (2) reduces to

$$L = 2 L_1 + 2 L_2 + 4 M_{12}. \tag{3}$$

It was found by calculation that

L_1 = 1,038 abhenries,
L_2 = 855 abhenries,
and M_{12} = 280 abhenries

To calculate L_1 and L_2, the following formula was used:

$$L = 4\pi R \left(log_e \frac{R}{g} + .08 \right) \tag{4}$$

where R is the radius of the circle and g the radius of the wire, both in centimeters.

To calculate M_{12}, the formula for two concentric circles was used, viz.:

$$M = 4\pi R \left(log_e \frac{R}{d} + .08 \right) \tag{5}$$

where R is the radius of the inner circle, and d the distance between the two circles, both in centimeters.

METHOD OF USE.

The standard may be used to determine the wave length of a closed circuit or of an open circuit, e. f., of a tuning coil, or of an antenna.

To determine the wave length of the closed circuit, $A S C$, shown in Fig. 5, we open it at some convenient point and attach it to the "contact bar" of the standard at the points p_1 and p_2. It is now linked to the circuit of the standard, and when electrical oscillations are set up in the standard by a spark at S, oscillations both of current and potential will be produced in it, if its resistance be not too great. The amount of the current oscillations will be shown by the reading of the hot-wire ammeter, A, placed in the neighborhood of a current loop. When the two circuits have the same period of oscillation, the disturbance in each, by the principle of resonance, will have a maximum value. The inductance and capacity of the standard are, therefore, varied until a *maximum* deflection is obtained on the ammeter. The wave length of the standard is then equal to that of the unknown circuit.

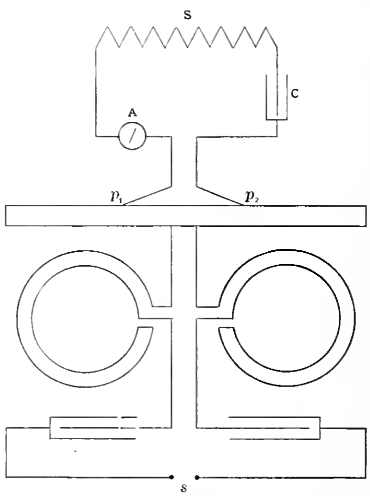


FIG. 5.—DIAGRAM SHOWING MANNER OF ATTACHING A CLOSED OSCILLATING CIRCUIT TO THE STANDARD.

The amount of the electrical disturbance of the unknown circuit can be regulated by varying the distance apart of the points of attachment, p_1 and p_2, on the contact bar. By bringing these points together, the reading on the ammeter may be made as small as desired.

The connecting wires from the unknown circuit to the contact bar should be heavy, and as near to each other as possible, so as to reduce the inductance of this part of the circuit to a minimum. If insulated, they may advantageously be twisted together. The "contact bar" is relatively heavy and the inductance introduced by it into the unknown circuit can usually be neglected.

To measure the wave length of an open circuit, such as an earthed antenna, we cut the wire at some convenient point, near to the earth plate, and link it to the standard, as shown in Fig. 6. In the figure, p_1 and p_2 are the points of attachment to the contact bar; a is the aerial wire; E the earth plate, and A the hot-wire ammeter.

GENERAL REMARKS.

This form of standard is compact and covers a large range of wave lengths. One advantage of the symmetrical form is that it can be calibrated by Lecher wires, these affording a simple and accurate means of calibration.

In its present form the inner circles of wire rotate about a common horizontal axis, and, since they are rigidly connected together, are always in the same plane. Their mutual induction, therefore, remains constant as they rotate. In an earlier form the inner circles were made to rotate about *vertical* axes, and consequently were not always in the same plane. This introduced a variable mutual inductance which disturbed the calibration curve in a peculiar manner, especially for the longer wave lengths. In these sections, the curve became steeper and steeper up to about 120°, and at this point became so indefinite that it was impossible to plot it farther. This trouble disappeared at once when the present arrangement was adopted.

To determine the condition of resonance, both a spark-gap and a Geissler tube were used across the ends of the parallel wires and were found to give the same results. Neither the Geissler tube nor the spark-gap appeared to have any appreciable effect upon the wave length of the wires.

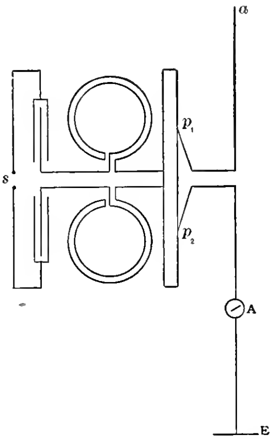


FIG. 6.—SHOWING THE WAY IN WHICH THE STANDARD IS LINKED TO AN ANTENNA IN ORDER TO MEASURE ITS WAVE LENGTH.

Lecher wires are in resonance with any given circuit, if their length is equal to one-quarter of the wave length of the circuit, or to an odd number of quarter-wave lengths. In determining the wave length of a circuit by measuring the length of the parallel wires, most accurate values are obtained by making the wires three or more quarter-wave lengths long, and measuring the distances between the nodes. Some values for the standard obtained in this way, I found to be greater by two or three per cent. than those obtained by using a single quarter-wave length. Since in calibrating the standard I used a single quarter-wave length in each case, the values given in the calibration curve are probably too small by two or three per cent. This supposition is borne out by the difference between the observed and calculated values given in Table I.

In making these measurements, no trouble was experienced from the presence of overtones. In fact, I did not observe any.

I wish to express my thanks to Mr. James B. Gottsberger for his assistance in this work.

Water Power in Germany.

Mr. Langer, U. S. Consul at Solingen, Germany, reports that the German Government is planning water power development in Germany on a large scale, the intention being to find out what there is in the country as to water power and to what extent the same is being utilized. Besides compiling the water level observations since the year 1896, water volumes shall also be ascertained, and furthermore it is intended to obtain information as to the power used by manufacturing plants gaining their energy from water power. It is also suggested to find out how much water power is used for each particular industry, as well as for agricultural purposes. This, in turn, would show which branches of trade should receive the first attention in having water supplied to them for power purposes.

Efficiency Curves of Rotary Converters.

BY A. S. MCALLISTER.

IN connection with the article by Dr. Kennelly on the "Efficiency Curves of Constant-Potential Transformers" and the editorial comment appearing in the ELECTRICAL WORLD AND ENGINEER for April 16, 1904, and the subsequent discussion thereof by Prof. H. S. Carhart, the following facts concerning the curves of rotary converters may be of interest.

Due to the simultaneous operation of a rotary converter, both as a motor and as a generator, the field distortion from the motor action is to some extent counteracted by that from the generator action, so that under proper field excitation, the field strength remains quite approximately constant throughout a great range of load. Hence, the armature iron loss varies but slightly with the load and, with a degree of accuracy fairly equivalent to that obtaining with constant potential-transformers, the iron loss may be considered to be independent of the load current. The variable loss is due almost exclusively to the copper loss in the armature winding.

The rotary converter with constant impressed alternating e.m.f. considered as a direct-current generator, tends always to produce the same direct external e.m.f. The apparent measurable pressure, however, drops off as the load is applied, due to the copper loss of the armature, and such drop is a direct measure of the loss within the armature.

At any chosen value of load current the sum of this loss in watts added to the output watts of the converter gives a value which would be directly determined by the product of the direct e.m.f. at its no-load value and the load current at its chosen value. It thus appears that with load amperes plotted as abscissas and watts as ordinates the curve of armature output plus copper loss due to load current is a right line and may be drawn at once for any value of output current (Fig. 1). The ratio of the watts loss in the armature copper, due to any load current, to the value of the load current gives the effective value of the armature resistance.

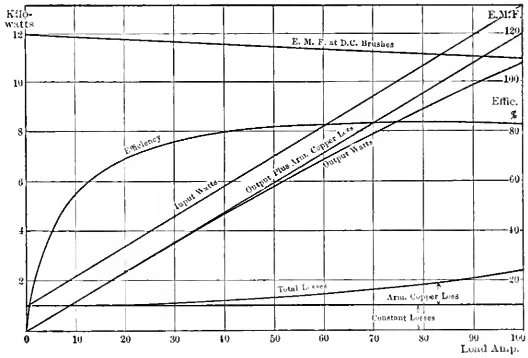


FIG. 1.—CHARACTERISTICS OF ROTARY CONVERTER.

Knowing the no-load losses of the converter and the effective armature resistance the complete performance may be calculated as follows:

Let W = no-load watts input,
R = effective armature resistance,
E = no-load direct e.m.f.,
I = any chosen value of load current;

then I^2R = copper loss of armature due to load,
$E - IR$ = apparent external direct e.m.f.,
$W + EI$ = input,
$EI - I^2R$ = output,

$$\frac{EI - I^2R}{EI + W} = \text{efficiency,}$$

which becomes a maximum when $I^2R = W$, *as a close approximation.*

It should be noted that the losses are $W + I^2R$, and that while the ratio of EI to $W + I^2R$ is a maximum when $I^2R = W$, at any armature load current, I, the input is $IE + W$ and not simply IE, as was given in ELECTRICAL WORLD AND ENGINEER April 30, 1904, page 824.

The above equations are based on the assumption of constant iron, friction and windage loss, which assumption is closely exact as stated above. In addition to these losses, the value, W, includes the armature copper loss for the no-load current, and the field copper loss for exciting current. Since for efficient service the exciting current should have a constant value, it follows that the loss from this source decreases as the machine is loaded due to the fact that the direct voltage decreases, requiring less loss in the regulating rheostat. The no-load armature current is of totally an alternating nature and traverses the whole armature winding, and during a portion of its route through the armature is superposed upon that part of the alternating supply current, which is about to be converted to direct current. While its effect alone upon the armature resistance would give a constant value of loss, when the two currents intermingle their combined loss is greater than the sum of the losses of the two considered separately, since in any case $(x + y)^2$ is greater than $x^2 + y^2$. It is thus seen that, among the losses which have a practically constant value, one increases with the load while another decreases, tending somewhat to keep the total at a constant value.

From the above facts and equations it appears that the curves of *constant losses, variable losses, output, input* and *efficiency* may be constructed from the two value, *no-load input* and *effective armature resistance* (Fig. 1).

Due to the fact that the alternating current of the motor portion of the converter flows in general in a direction opposed to that of the direct-current generator portion, the effective armature resistance for polyphase converters is less than that of the same machine used as a direct-current generator. The ratio of effective armature resistance to its true generator value is as follows:

2	rings converter,	1.39
3	" "	.56
4	" "	.37
6	" "	.26
8	" "	.21

Fig. 1 gives graphically the results of calculations of the characteristics of a certain rotary converter of which the no-load losses are 1,000 watts and effective armature resistance .125 ohm.

The major portion of what has been given above applies in general to shunt-wound generators or motors, but the assumption of constant armature iron loss is less exact with the later machines than with the rotary converter.

Governmental Control of Wireless Telegraphy.

The report from Washington that the Cabinet, co-operating with the Navy Department, had decided to assume control of all wireless telegraph stations on the coast line of the United States and operate them in the public service in connection with existing land wire systems has been contradicted. Secretary Moody, of the Navy, is quoted as saying: "The newspaper article probably has reference to the authority granted by this department to the Bureau of Equipment for the use of the naval wireless telegraph stations as an accommodation to ships of other navies and the merchant service where there are no commercial stations to receive and transmit messages. As a result of negotiations with the various land telegraph companies, the Western Union and Postal Telegraph Companies have agreed to transmit messages of the character above mentioned received at naval wireless telegraph stations from vessels at sea without holding the government responsible for the toll."

Captain Manney, chief of the Bureau of Equipment, says: "The Government will not in any way interfere with the Marconi station on Cape Cod. These stations have a range of not more than 240 miles out to sea and are for the general convenience and safety of the public, in a broad way supplementing the work of the Hydrographic Office. The reason for taking control of the stations and placing them under one system is to prevent interference on short-distance messages. Arrangements have been made by the Govrnment with both the Western Union and Postal Companies under which the Government turns over to these companies all private dispatches received and the same will be forwarded without prepayment. The system employed by the Government is a modification of the Slaby-Arco, known as the Telefunken, and is used by the German navy entirely."

An English Municipal Electric Railway.

On May 18 the municipal tramway line of Leicester, England, was declared open for public use, having been under construction since April of last year. The system will eventually comprise 19½ miles of double and 3½ miles of single track. Of the equivalent of 42 miles of single track, 33 miles are now completed and work on the remainder progressing. The routes are moderately straight and with no excessive grades, the steepest being 1 in 16 for a distance of about 50 yards. It has been found necessary, however, to lower the roadway under seven railway bridges, in one case as much as 2 ft., in order to obtain sufficient head room for double-deck cars.

The sharpest curve on the system is 37 ft. radius to the center of

FIG. 1.—ENGINE ROOM, POWER STATION.

the track. A minimum radius of 40 ft. for all curves was aimed at, and with one or two exceptions this has been attained. The distance from center to center of tracks with side pole construction is 8 ft. 1 in., giving 3 ft. 4½ in. from gauge edge to gauge edge between tracks, and for center pole construction 10 ft. 11½ in., giving 6 ft. 3 in. between tracks. The gauge of the track is 4 ft. 8½ in.

In laying the track the ground was excavated to the required depth, and the rails laid and packed up to the required level on wedge-shaped blocks of concrete, 10 in. square at the base and 8 in. square

FIG. 2.—EXTERIOR OF POWER STATION.

at the top. Where bad ground was met, or the surface worked up owing to inclement weather, these blocks were again supported on circular blocks of concrete, 6 in. thick and 18 in. in diameter, to distribute the weight over a greater area. When the rails were leveled up, a concrete foundation, composed of six parts of granite and Destructor clinker to one part of best Portland cement, was then laid, a space of about 1 in. being left under the rails for packing, great care being taken to make the concrete perfectly solid for a space of 6 in. on each side of the flange of the rails. The space between the concrete and the rails was then very carefully packed by means of beater picks with 6 to 1 fine concrete in a semi-dry condition. The total depth of concrete under the rails is 7 in., and under the paying 6 in.

Two solid copper "Crown" bonds of No. 4/0 B. & S. gauge are inserted at each rail joint. The track is cross-bonded every 40 yards and the two tracks every 80 yards.

The power station has been erected centrally to the system, and it is well situated for the delivery of coal either by barge (the canal basin running alongside the boiler house), or by rail. The buildings are faced externally with red sandstock bricks with stone dressings, copings, etc. The station comprises engine room, boiler room, pump room, condenser room, battery room, test room, engineer's office, general office, inquiry office, mess room, fitting shop, stores, engine house lavatory and office lavatory. Bath rooms have been attached to the two latter.

The engine room is 118 ft. by 60 ft. and 40 ft. high to the eaves. It is lighted mainly from the top by means of patent glazing, which has also been used in the fitting shop and battery room. The only side lights in the engine room are bull's-eye windows above the traveler rail. The room is lined internally up to the height up the traveler rail with glazed tiles having patent keyed backs, moulded tiles being carried up to a height of 6 ft. to form a dado. Moulded tiles are also carried round all the arches, wtih moulded faience blocks under the traveler rail. This tiling gives the room a very fine appearance. The entrance hall and the floor in the engine room, except the space reserved for the extra set, have been laid in mosaic.

The boiler room is 108 ft. by 77 ft., and a stoking floor 18 ft. wide extends its full length with an ash tunnel under. At present the stoking floor is covered with a temporary corrugated iron roof. The boiler room has been so arranged that when the coal is delivered by barge alongside it will be lifted by a crane fixed at the northwestern end of the boiler house into a conveyor, and conveyed into the coal bunkers. The conveyor will be continued round and through the ash tunnel for the removal of the ashes. The boiler

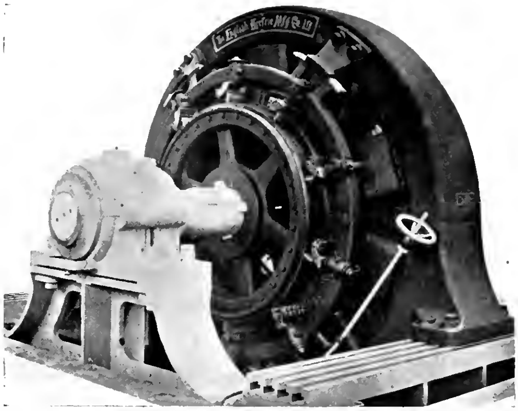


FIG. 4.—ONE OF THE GENERATORS.

house is lighted principally from the roof by means of patent glazing. Windows have also been inserted in the southwestern elevation.

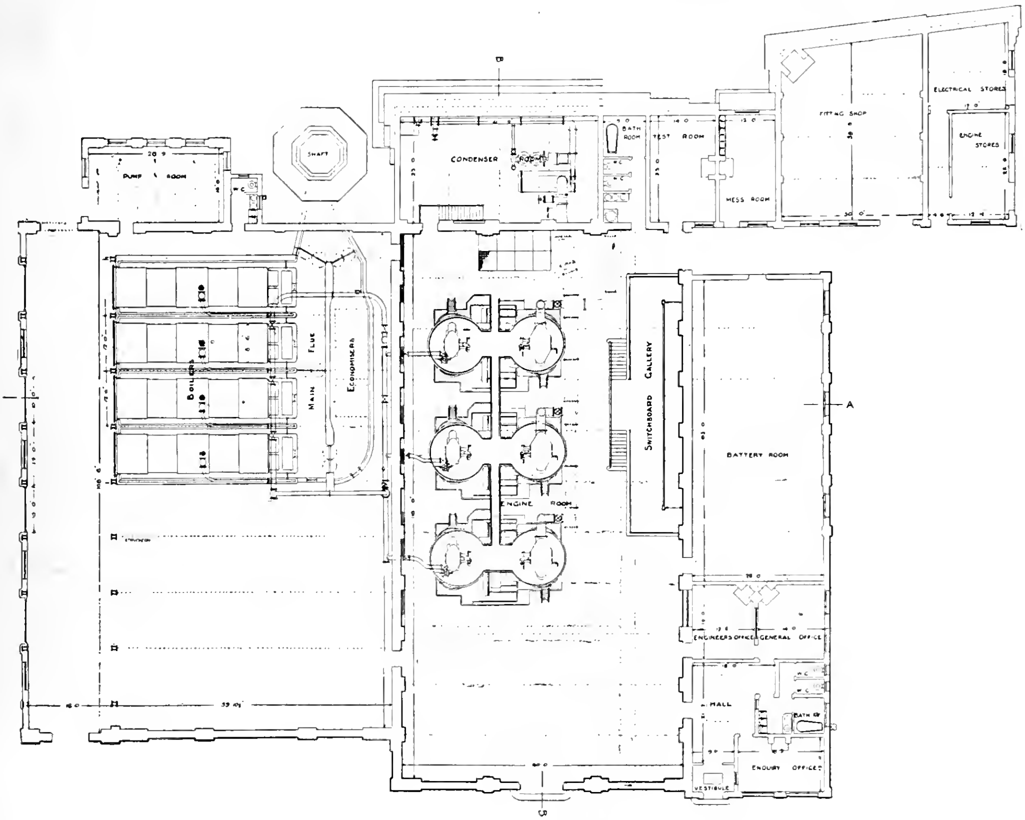


FIG. 3.—PLAN OF POWER STATION, LEICESTER MUNICIPAL TRAMWAY.

Kinnear rolling shutters have been inserted in the doorways opposite the fronts of the boilers.

The generating outfit consists of three 500-hp Gates & Thorn vertical cross-compound Corliss condensing engines, direct-connected to the same number of Dick & Kerr railway generators. In addition with the ordinary governor, which [illegible] very sensitive one, the engine is fitted with a special safety stop which will operate in case the engines reach a speed of 10 per cent. above the ordinary working speed. It will also stop the engine in the event of any failure of the governor gear, although it does not interfere with the engine taking excessive overloads, even beyond the full range of the cut-

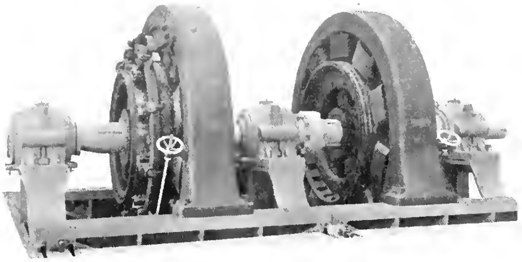


FIG. 5.—BOOSTER.

off gear. The fly-wheel is 16 ft. diameter, and weighs about 25 tons. A very complete system of lubrication has been supplied to these engines, consisting of two ram pumps worked by a drag shaft from the main cranks, and delivering oil under pressure to all the main bearings about the engines.

The switchboard, which was also supplied by Dick, Kerr & Co., consists of twenty-five panels of white marble, controlling, besides the three 500-kw generators, a negative feeder booster set of 20-kw capacity, a positive feeder booster set of 60-kw capacity, an automatic reversible battery booster set of 40-kw capacity, the station lighting and motors and the distribution.

The battery is composed of 240 cells of the Standard Tudor pattern type No. 413 HF 19. It is capable of giving 600 amp. for one hour, or 900 amp. for short periods, and can be charged normally at 270 amp., or at 450 amp. for short periods. The cells are in lead-lined wood boxes, resting on glass oil insulators. The stands are entirely of pitch pine without any metal fastenings, and rest on large porcelain oil insulators. The battery is used in connection with a reversible booster controlled by means of a Thury's patent regulator. This booster has a smooth armature core and tangential

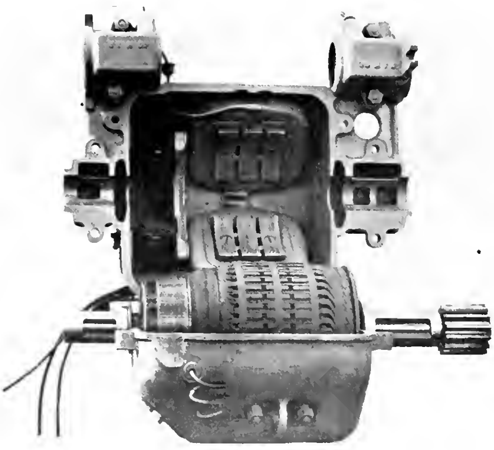


FIG. 6.—VIEW OF INTERIOR OF CAR MOTOR.

field coils. As the armature winding is placed as near as possible to the periphery, and as the field iron is reduced to its possible minimum amount, the machine is most sensitive, and is claimed to act almost as quickly as the load peaks occur.

The overhead equipment has been designed and arranged with a view to obtaining the greatest possible immunity from break-down, also that the fittings should appear as artistic as possible. The design of pole ornamentation was prepared by Mr. Mawbey in conjunction with the Leicester Art School. Span wire construction has been adopted generally, but where streets and roads are wide enough center poles have been introduced, as shown in Fig. —. In the center of the town, where suitable attachments could be obtained, poles have given way to rosettes, except at junctions, these being erected on poles throughout. Each center pole has been fitted with two incandescent gas lamps, and the vase is protected by a neat elliptical guard curb. Side bracket arms have been used on one short length to the number of nine, each 17 ft. 6 in. long, also on the siding to the power station.

The trolley wire is No. 000 B. & S. gauge throughout, except at the car houses, which are wired with No. 0; and the span and guard wire are of galvanized steel, 7-12 and 7-16 respectively. Flexible suspension and double insulation have been adopted throughout. Line fittings of extra strong design have been used throughout, the insulator bolts being of drop-forged mild steel, screwed ¾ in.

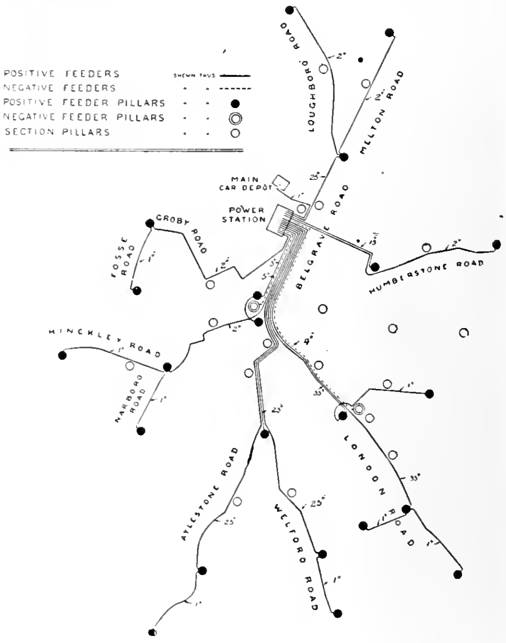


FIG. 7.—PLAN OF FEEDERS.

Four sizes of section and feeder pillars are used. These are fitted with white marble panels, which carry the various quick-break switches, kicking coils and safety fuses for automatically disconnecting the overhead line in case of failure. The feeders are connected up to the main switchboard at the power station through automatic circuit-breakers, which are set to cut out any one of the feeders should a short-circuit occur on any of the sections supplied by that feeder, thus insuring that should a trolley wire break on any portion of the line either the fuses in the nearest section pillars would "blow," or the circuit-breaker at the station would open, rendering that portion of the line dead. Each pillar is also fitted with a Garton lightning arrester, and an ebonite panel carrying the test and telephone terminals. All holes in the panels are fitted with ebonite bushes and washers.

A specially designed telephone shutter, operated by a separate key, has been fitted to each pillar, arranged so that it is unnecessary to open the pillars in order to use the telephone, the jack being inserted from the outside, thus obviating the danger of any one accidentally coming in contact with the "live" fittings in the pillar when using the telephone. The telephone instruments are carried on the cars, one being supplied to each car.

Two negative feeder pillars are erected to meet the present requirements, approximately 1,100 yards and 2,700 yards, respectively, from the power station. They contain the usual instruments to meet the Board of Trade requirements. All section and feeder pillars, and the poles up which the feeder cables have been carried, are bonded direct to the rails by a 4/0 copper bond, to prevent the possibility of their becoming "alive" owing to break-down of the insulation at these points. The whole of the equipment, including poles, wires, section and feeder pillars, etc., have been supplied and erected by R. W. Blackwell & Co.

All of the cables in connection with this work were supplied and drawn in by W. T. Glover & Co., Limited, of Manchester. Stoneware conduits are used, and are of the patent self-centering type with composition joints. The total quantity of conduits supplied was equivalent to about 80,000 yards of single-way. Throughout the entire system the conduits are laid at the side of the track. The cables are single conductors, insulated with diatrine impregnated paper and lead-covered, jointed by means of lead sleeves wiped on to the lead of the cables. At intervals of approximately ¼ mile the lead covering of the cables is earthed to the rails by means of bare copper bonds, as a preventitive against electrolysis.

Three negative feeders have been carried out to different points of the system, and are connected to the rails through special feeder boxes. Each cable bears a brass label in every box, denoting its size, voltage and termination. The sizes of the feeders range from

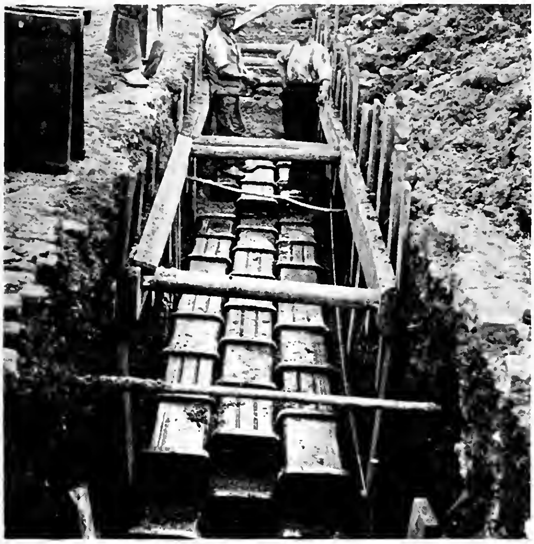


FIG. 8.—CONDUITS AT ENTRANCE TO POWER STATION.

.1 sq. in. to .5 sq. in., the total length being over 20 miles. A complete system of telephone and pilot cables is also drawn into separate ducts along each feeder route, and connected up in every feeder and section box.

All lead-covered cables terminate in the basement of the power station; connection being made to the switchboard with fire-resisting cable of Glover's latest type. In addition to the feeder cables terminating on the switchboard with fire-resisting cable, the whole of the back connections and cable work in the station is also of this description. All of the feeders and pilots were submitted to a pressure of 1,000 volts alternating current for one hour. They were then tested for insulation resistance.

N. E. L. A. Membership.

At the Boston meeting of the National Electric Light Association, which was held last week, an amendment to the constitution was adopted dividing the membership in five classes, as follows: Class A, member companies; entrance fee, $25; annual dues, companies in towns of less than 20,000 population, $10; 20,000 to 300,000, $25; over 300,000 population, $50. Class B, members; entrance fee, $5 and annual dues $5. Class C, associate member companies; entrance fee, $25; annual dues, $20. Class D, associate members; entrance fee, $5 and annual dues, $5. Class E, honorary members; no entrance fee; annual dues, $4.

Electric Transportation Within the World's Fair Grounds.

By CLOYD MARSHALL.

NEW problems of transportation arise as each international exposition grows in extent, and these have been met at St. Louis in several ways. The first and most important means of transportation about the grounds is by the intramural railway, which is a complete electric railway system consisting of seven miles of double track encircling the grounds and running nearby each important building. Its operation is similar to that of an elevated railway with stations at convenient points and a uniform fare of ten cents for all or any part of the trip. Such a means of communication is a real necessity, not simply catering to the pleasure to the visitors. This has recently been demonstrated. The intramural track has formed an important portion of the railroad system within the grounds. Since the Exposition opened, all cars with exhibits and materials have been switched on the sidings or into the buildings at night. To permit this the intramural cars have ceased running at 10.00 o'clock, which is about the time when the visitors are enjoying the amusement features of the Pike. Those who wish to return to the Inside Inn or go to the opposite entrances have to walk about two miles, and, therefore, have made loud objections to the intramural schedule. A complete circuit around the grounds by means of the intramural railway is perhaps the best introduction to the whole Exposition that the visitor can have. He will be im-

FIG. 1.—LAUNCH ON THE LAGOONS.

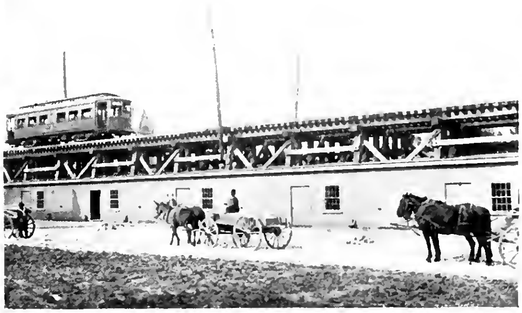


FIG. 2.—ELECTRIC RAILWAY IN GROUNDS.

pressed by the vast extent of territory covered, the beautiful arrangement of the grounds, and the size and number of the Exposition buildings.

A trip which is even more enjoyable and instructive is one on an electric automobile through the heart of the Exposition. This is the first World's Fair at which such a service has been rendered, and the generous patronage received indicates that it meets an actual want. The World's Fair Automobile Transit Company has secured a large number of electric vehicles and will have over one hundred later in the season. This service has been available for over a year. As many as 3,500 persons have patronized the automobiles in one day during the pre-Exposition period. The regular route covers the center of the Exposition and a visit to each of the exhibit palaces. At intervals a stop is made, and the chauffeur explains those things which interest his passengers. A fare of twenty-five cents is charged.

If the visitor wishes the exclusive [illegible] vehicle, he can hire a cab or brougham at a rate of $4 per [illegible] and take his friends to any part of the grounds he may desire. There is but one forbidden roadway, which is between the Louisiana Purchase Monument and the Grand Basin, and over this no vehicles can pass.

The company also has a number of large automobiles running from the principal hotels in the city into the Exposition grounds. The fare for this ride is 50 cents. Arrangements are also made to meet parties or delegations at the trains and convey them to the grounds or to the Inside Inn. A special gate into the grounds is provided for the automobiles. The automobile service begins at 8.00 A.M. and continues until 1 o'clock at night. While the intramural is not running after 10 o'clock, about ten automobiles are used at night carrying the pleasure seekers on the Pike to the Inside Inn or to the distant entrances. In order to reduce the fire hazard, all gasoline automobiles are excluded from the grounds, which leaves the field exclusively to storage battery vehicles. The World's Fair Automobile Transit Company had no precedent by which to gauge the needs of such service, and had no standard of equipment. There are a number of different types of vehicles in use, some of which have been acquired from the Buffalo Transportation Company, the Boston Auto Express Company and others, the vehicles being modified to suit the local conditions. One of the landaus in use was that which conveyed President McKinley to the Music Hall at the Pan-American Exposition before his assassination.

FIG. 3.—STATION ON ELECTRIC RAILWAY.

FIG. 5.—VIEW ALONG THE TRACK.

FIG. 4.—A CAR ON THE ELECTRIC RAILWAY.

FIG. 6.—LARGE AND SMALL AUTOMOBILES ON GROUNDS.

Recently a number of large tally-hos seating forty persons have been put in service between the grounds and the hotels. The Electric Vehicle Equipment Company has furnished a number of buses with a capacity of eighteen passengers. Fifty 20-passenger brakes are now being delivered by the Auto Car Equipment Company, of Buffalo. Not less than thirty cabs, landaus and broughams are to be in commission. The automobile company has made an excellent record, as not one accident of any kind has occurred with their vehicles. This is due largely to a rigid system of inspection to keep the automobiles in good condition, and to the careful instruction of all its operators. There is no prescribed speed regulation, because fast driving would defeat the purpose of the trip, which is to give the passengers a chance to comprehend the beautiful surroundings. The automobiles seldom if ever exceed eight miles an hour. Each driver must be an experienced chauffeur and before taking charge of a vehicle is tutored by an instructor with reference to the care and operation of the automobile and also regarding the fact and figures about the exposition which will be of interest to his future passengers.

The company has built a garage and charging station at the east end of the Model City and near the De Forest tower. Three 50-hp gas engines are belted to Edison 110-volt generators to supply the current. The leads extend to the charging plugs along one side of the building where fifty-five batteries can be charged at a time. Another charging station is down town at the corner of Thirteenth and Locust Streets. There are two batteries or sets for each automobile, so that each vehicle can be kept in continuous service, one battery being charged while the other is in service. The battery is carried beneath the body of the automobile, and when it is to be leased the vehicle is run over a lift which is level with the floor. A wheel truck is pushed over the lift and under the battery. It is then raised to receive the battery, and when lowered is moved to a charging plug. There are four of these lifts operated by Ingersoll-Sargeant oil pumps driven by electric motors. Six batteries can be removed and replaced every ten minutes. The charging generators are kept at 110 volts, and the current charge to each battery is regulated by a rheostat. As there is an attendant at the generators and at the batteries all the time no automatic overcharge or release is employed. The batteries receive charges once a day, which is sufficient for a twenty-five-mile run. Once a week each battery is discharged under the observation of an expert and readings are taken every five minutes. Any necessary repairs or renewals are made at this time. When fully charged the density of the electrolyte is kept at 1,300, which falls to about 1,250 at the end of normal discharge. The plates for these batteries are shipped direct from the Electric Storage Battery Company and assembled and the connections burned together at the station. Wooden separators are employed as they seem to give better results than rubber. All batteries have forty-two "exide" cells, with from nine to nineteen M. V. plates, depending upon the size of the vehicle. The motors are

FIG. 7.—SMALLER PASSENGER AUTOMOBILE.

either General Electric or Westinghouse, of 80 volts and 20 to 35-amp. capacity, with series parallel control.

After a circuit of the grounds in an automobile has been made during the day, the visitor will find great pleasure in a launch trip about the lagoons during the evening. The most beautiful effect imaginable is during the illumination when the myriad lights on the buildings are reflected in the placid waters of the Grand Basin and lagoons. A journey of two and one-half miles can be made through the Grand Basin across the base of the Cascades around

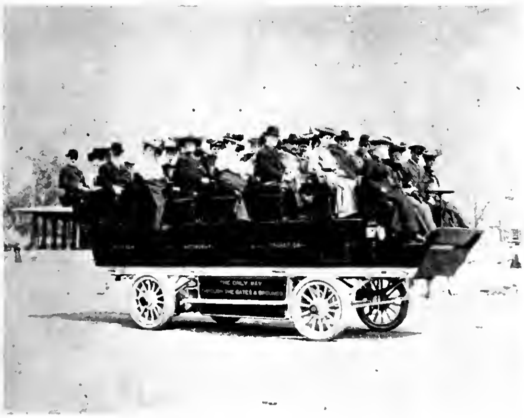


FIG. 8.—LARGE PASSENGER AUTOMOBILE.

the Palaces of Electricity and Education, and past the Machinery, Varied Industries, Manufacturers', Mining and German Buildings. During the daytime the launches are covered with awnings to make it comfortable for passengers in the heat of the day, but in the evenings the sun shades are removed. The Launch & Gondola Concession Company has thirty-one electric, five gasoline launches and fifteen gondolas. The gasoline launches are made in fantastic designs representing swans, peacocks, dragons, etc. The gondolas are imported direct from Venice and the singing Venetian gondoliers who accompany them have been selected both for their voice and for their skill with the oar. The launches are thirty-five feet in length and seven beam, and draw thirty inches of water when loaded. About forty passengers can be carried and the fare for the trip is twenty-five cents. The electric boats travel at the rate of four and one-half miles per hour and make the circuit in about a half hour.

The launches, which were made by the Truscott Boat Manufacturing Company, are equipped with Willard batteries. Each contains forty-four cells of 140-amp.-hour capacity, the positive plates having the new type Willard envelope, which gives excellent results by preventing to a great extent the shedding of active material. Each battery is divided into two parts, which by means of a Hertner

FIG. 9.—LAUNCH ON THE GRAND BASIN.

series parallel controller gives three speeds forward and two on reverse. The motors were supplied by the Hertner Electric Company and are of 2-hp, compound-wound, four-pole, with ball, thrust and axle bearings. On account of the slack water and the lagoons being sheltered from the winds, a boat will run 100 miles on a charge. At present they are in service from five to six hours a day, and the busiest time is from 5 to 10 P.M.

The charging station for the launches is under the bridge just west of the Electricity Building, from whence is received a 250-volt supply of current. Along the bank are leads to thirty-two Anderson automobile charging plugs, two batteries being charged on each circuit. At the switchboard are the wattmeter, volt and ammeters, pilot lamps

FIG. 10.—ANCHORAGE FOR LAUNCHES.

and Wirt rheostats for regulating the supply of current. Mr. H. B. Barnes, who is in charge of the station, has arranged the voltmeter and pilot lamp circuits so that he can tell at a glance the condition of charge of all batteries connected. The normal charge rate is 25 amp., and the charge is continued until the cells average about 2.55 volts. The electrolyte is maintained at a density of 1,250 at full charge and about 1,200 when the cell is discharged.

By a judicious patronage of the intramural, the automobiles, launches and roller chairs the visitors can cover the great area within the World's Fair grounds without undue fatigue or expense.

Performance of Parsons Steam Turbines.

In a paper read before the May meeting of the British Institution of Electrical Engineers, the Hon. Charles A. Parsons presented a paper on the steam turbine as applied in electrical engineering, which includes the data of a number of tests of electric turbine generating plants made by various consulting and central station engineers. Referring to the design of the Parsons turbine, it is stated that some of these were formerly made of the tandem type, in which the expansion of the steam was first carried out in a high-pressure cylinder and then completed in a low-pressure cylinder, but it was soon found that better economy, except possibly in very large sizes, could be obtained by having the whole turbine in one cylinder.

Fig. 1 is a curve from the paper showing the effect of varying vacua in the case of a turbine at Hulton colliery operating a 300-kw.

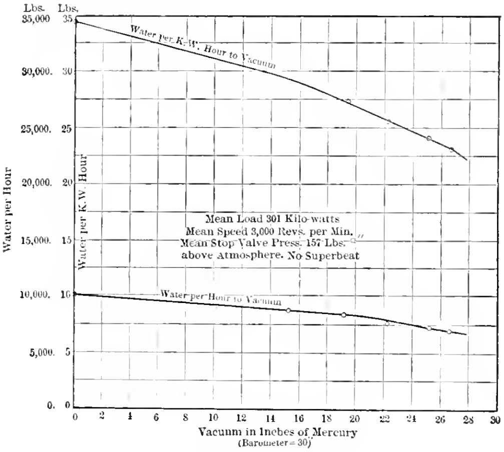


FIG. 1.—CURVES SHOWING EFFECT OF VARYING VACUA.

three-phase alternator. In Fig. 2 are curves from a 1,500-kw turbo-generator in the plant of the Sheffield Corporation, the turbine driving a two-phase alternator supplying current at 2,000 volts.

Mr. Parsons states that tests show that under the conditions of,

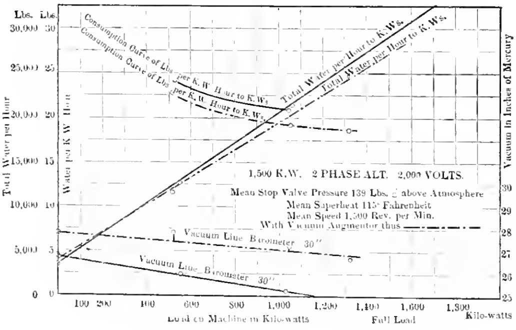


FIG. 2.—PERFORMANCE CURVES OF 1,500-KW TURBO-GENERATOR.

say, 140 pounds steam pressure, 100° F. superheat and a vacuum of 27 in. with the barometer at 30 in., the steam consumption of turbo-generators are, in round numbers, as follows:

A 100-kw plant takes about 25 pounds of steam per kw-hour at full load, which figures become 22 pounds for a 200-kw plant; 20 pounds for one of 500 kw; 19 pounds for one of 1,000 kw; 18 pounds for a 1,500-kw plant, and 16 pounds for a 3,000-kw plant. These figures are stated to be derived from averages of a large number of tests which have been made from time to time. Without superheat the consumptions are about 10 per cent more, and each 10° F. superheat up to about 150° F. affects the consumption by about 1 per cent.

In a turbine the benefit derived from the vacuum is much more than in a reciprocating engine, every inch of vacuum between 23 and 28 in. affecting the consumption on an average of about 3 per cent. in a 100-kw machine, 4 per cent. in a 500-kw machine and 5 per cent. in a 1,500-kw machine, the effect being more at high vacua than at low. The maintenance of a good vacuum necessitates a suitable condenser, which implies sufficient tube area and also ample way for the steam between the tubes; proper velocity of water in the tubes; sufficient supply of cooling water and a sufficient means of cooling the condensed water so as to keep the air pump cool, and full provision for extracting by the air pump and other means the inevitable small quantity of air which must leak in.

It is stated that by attention to these requirements it is unnecessary to increase the size of the condenser beyond that used in ordinary practice. In the case of the most recent condensers for steam turbines, from 10 to 12 pounds of steam are condensed per square foot per hour, at which rate of condensation a vacuum may be obtained at from 27½ to 28 in. at full load. The amount of cooling water generally allowed is about 50 times the full load steam consumption, which will increase the vacuum under normal conditions by about ¾ in. or 1 in. over that obtained by the usual circulating allowance of 30 times the steam used. With a proper arrangement of pipes and condensers in a plant taking 18 pounds of steam per kw-hour and assuming 50 per cent. efficiency in the pump and motor, the power used by the circulating pump is only 1 per cent.; by circulating water 30 times the steam consumption it would be .6 per cent., which small reduction is not to be compared with the gain of 4 or 5 per cent. in the turbine by the use of increased circulating water.

The paper described a vacuum augmenter which has recently been introduced and which is illustrated in Fig. 3. A pipe is led from

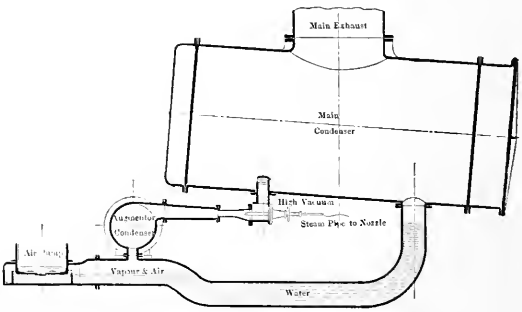


FIG. 3.—ARRANGEMENT OF VACUUM AUGMENTER.

near the bottom of the main condenser to an auxiliary condenser having generally about 1/20 the cooling surface of the main condenser. In a portion of this pipe a small steam jet is placed which acts in the same way as a steam exhauster and sucks nearly all the residual air and vapor from the condenser and delivers it to the air pumps. A water seal is provided, as shown, to prevent the air and vapor from returning to the condenser. With this arrangement, if there is a vacuum of 27½ or 28 in. in the condenser there may be only about 26 in. in the air pump, which, therefore, need only be of small size, the jet compressing the air and vapor from the condenser to about half or less of its original volume. The steam jet used only about 1½ per cent. of the quantity of steam used by the turbine at full load. Condensation takes place in the condenser much more rapidly and effectually if the air is thoroughly extracted.

In Fig. 2, which represents tests of the 1,500-kw plant at Sheffield, one curve was taken with and another without the vacuum augmenter in operation. The difference of vacuum is shown, and when it is remembered the augmenter jet took only about 1½ per cent. of the full load steam consumption, it is easily seen from the gain of vacuum where the total gain by the use of the augmenter comes in. In this case the vacuum was not as good as it should be, since the cooling water was at a temperature of 85° F., and was in volume only about 30 times the steam consumption at full load.

Referring to the design of dynamos and alternators to be coupled to steam turbines, it is stated that special regard is to be paid to the large centrifugal force to be encountered. Diameters have to be kept down, and excessive surface speed must also be avoided. Since then the diameter has to be small, the length must be increased in proportion and a long core is the result, with moderate diameter, the contrary of slow-speed machines. At the same time, on account of the higher surface speed, the pitch of the poles is greater, thus

TESTS OF PARSONS TURBINES.

	Steam pressure at stop valve.	Superheat. F°.	Vacuum inches.	Speed. Revs. per minute.	Load in K.W.	Pounds steam per K.W.-hr.
75-kw Continuous-Current Turbo-Generator—Banbury.	141.2	84.2	27.1	4,140	75.7	26.4
	144	0	27.0	4,140	75.2	29.2
	142	0	27.1	4,140	56.6	31.2
135-kw Turbo-Generator—Findlay, Durham & Brodie.	150.8	99.0	27.15	3,600	138.3	22.8
	151.0	81.0	27.3	3,600	66.9	27.6
200-kw Continuous-Current Turbo-Generator—Shipley.	150	57	27	3,000	204.2	22.23
	151	55	27.9	3,000	101.2	26.67
	156	181	27.3	3,000	202.5	20.39
	151	166	28.0	3,000	100.27	24.41
375-kw Turbo-Generator—Dundee.	152.9	——	27.4	3,000	376.9	21.6
	149.4	148.9	27.5	3,000	374.06	19.25
350-kw Turbo-Generator—Pennsylvania Salt Co.	150	71.3	27.82	3,360	359.5	20.64
	152	65.7	28.27	3,151	185.5	23.44
	140.2	92.3	17.4	3,430	353.5	25.54
	143.4	82.5	17.4	3,255	177.2	32.26
300-kw Turbo-Generator — Hulton Colliery.	161.0	0	0	3,000	296.6	34.2
	158.0	0	15.33	3,000	297.4	29.36
	157.0	0	19.33	3,000	305.1	27.43
	152.0	0	22.33	3,000	303.4	25.59
	154.0	0	25.33	3,000	303.15	24.19
	158.0	0	26.58	3,000	303.2	23.15
300-kw Turbo-Generator—De Beers Explosives Works.	150.0	53.3	27.88	3,000	312.1	20.06
	153.0	50.0	27.78	3,000	231.8	21.45
	150.5	40.2	27.9	3,000	154.5	23.75
1,500-kw Turbo-Alternator—Newcastle-on-Tyne, E. S. Co.	196	76	27.45	1,200	1,442	18.0
	197	84	27.35	1,200	1,015.5	19.8
	196	76	27.95	1,200	714.0	21.4
	199	77	28.35	1,200	360.5	25.2
	200	68	28.45	1,200	——	——
After 16 months' use the following figures were obtained:	203	92	26.11	1,210	1,823	17.7
	207	66	26.46	1,208	1,513	18.23
1,500-kw Turbo-Generator—Sheffield Corporation. With Vacuum Augmentor and including 450 lbs. steam per hr. used by it.	113.6	108.3	26.69	1,455	1,316.5	18.75
	111.6	156.4	27.12	1,500	1,061.6	18.66
	141	113	27.72	1,500	512.7	22.3
	154	47.5	27.72	1,500	0	0
Without Vacuum Augmentor.	115.6	143	25.18	1,500	1,029.3	20.7
	137	119	25.97	1,500	534.25	24.02
	150.3	72.4	26.62	1,500	0	0
Non-Condensing Turbines. 250-kw Continuous Current—Messrs. Guinness, Son & Co.	144	0	0	3,047	251.55	37.80
	142.6	0	6	3,047	255.82	41.38
	138	0	11.1	3,055	253.15	44.15
	143	0	11.0	3,115	125.45	59.58
500-kw Turbo-Generator—Metropolitan E. S. Co.	142	0	0	1,800	506.2	33.39
	147	0	15.67	1,800	509.06	29.07
	144	0	18.57	1,800	514.9	28.33
	145	0	20.67	1,800	512.2	27.22
	146	0	22.57	1,800	509.85	26.89
	154	0	0	1,800	0	——
	151	0	26.1	1,800	0	——

giving more ampere-turns per pair of poles than is usual. In alternators this gives no trouble at all, as all that has to be provided is

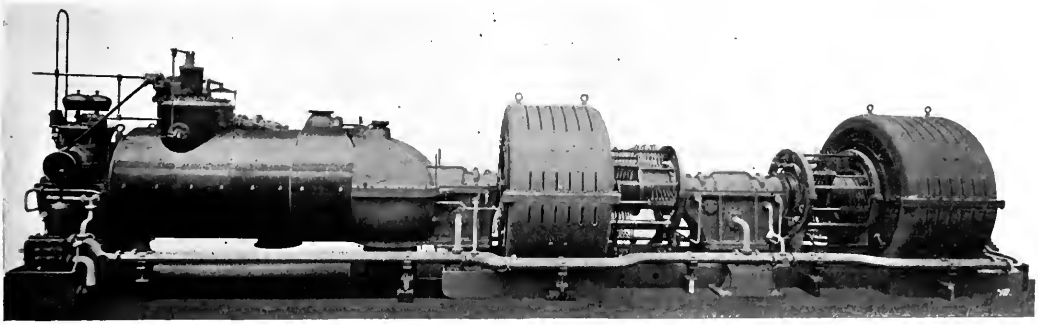


FIG. 4.—1,800-KW PARSONS TURBINE, MANCHESTER.

sufficiently strong field magnets to overcome the reaction of the armature, and sufficient magnetic resistance to allow of strong field magnets. This extra magnetic resistance can be given either in the air-gap or by saturation of the poles, as may be found desirable. These large poles also conduce to diminish magnetic leakage, and as a result very good regulation can be obtained.

In low-voltage alternators rotating armatures are preferable, as the iron and copper losses are much less, especially where there are only two or four poles, but rotating armatures, although satisfactory for 500 to 2,000 volts, have not been found suitable for the higher voltages of 6,000 and 10,000 which are now common, and therefore rotating fields and fixed armatures have been adopted in many of the recent alternators. For continuous-current dynamos the same remarks apply, only here sparkless commutation has to be provided for. Carbon brush blocks cannot be used, as at these speeds the brushes are apt to vibrate, and so diminish the intimacy of contact and cause heating and undue wear. The result is that it has been found best to form the brushes of wire, gauze or foil, preferably of brass, and these must be sufficiently flexible so as to maintain a good contact with the commutator over the whole section of the brush. It follows, therefore, that the properties of the carbon brush

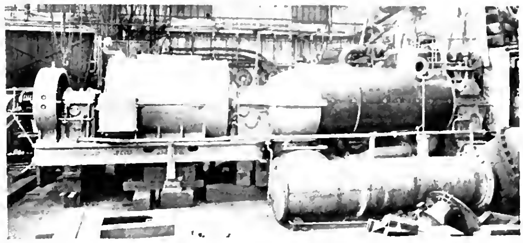


FIG. 5.—2,000-KW PARSONS TURBINE.

blocks in giving sparkless commutation without alteration of the lead of the brushes, cannot in turbine-driven dynamos be utilized, and other means must be adopted to secure sparkless commutation at varying loads. One way is to shift the brushes automatically according to the change of load, and this can be effected by connecting the brush gear to a steam cylinder controlled by a spring and supplied with steam from the point where the steam enters the turbine. At this point the pressure of the steam is proportional to the load of the dynamo, and therefore the piston in the steam cylinder being controlled by a spring takes up a position proportional to the load and thus shifts the brushes to the point of sparkless commutation. Another method is to provide commutating poles as proposed by Prof. Ryan and others, but the best method is to provide compensating winding as proposed by Prof. Forbes, Deri, etc. By these means, with the improvements recently adopted, absolutely sparkless commutation can be secured with fixed brushes, up to, in plants for traction purposes, 100 per cent. overload.

Mr. Parsons points out that the size of turbines is rapidly increasing, many of from 4,000 to 6,000-kw capacity now being in the course of construction, and it is anticipated that still larger plants will be made shortly. Up to the present there are about 600.000 hp of turbines of the Parsons type at work and on order in England and on the continent, in various sizes ranging up to 7,000 kw.

Electrical Interests at Panama.

A cable dispatch from Panama says that the electric light and tramway plants and telephone system in the Panama Canal zone have been bought by a syndicate in which American capital in interested.

Chicago Meeting of American Society of Mechanical Engineers.

The 49th meeting of the American Society of Mechanical Engineers, held at Chicago May 21 to June 3, was a joint meeting with the British Institution of Mechanical Engineers. The professional sessions were held in the evenings in the Music Hall of the Fine Arts Building and in the mornings in the Auditorium Hotel, with the exception of the last meeting, which was held on the morning of June 3 in the auditorium of Lewis Institute. The local committee had prepared for the use of members a pamphlet guide to points of interest in Chicago, and made very complete arrangement for the entertainment, both professional and social, for visiting members.

The meeting was opened on Tuesday evening by an address of welcome by Mayor Harrison, which was responded to by President Ambrose Swasey, of the American Society of Mechanical Engineers, and President J. Hartley Wicksteed, of the British Institution of Mechanical Engineers. The local committee carried out an elaborate programme for the entertainment of the ladies of the party, and half of each day was devoted to a visit to some point of professional interest in Chicago or vicinity. On Friday evening the local members of the American Society of Mechanical Engineers provided a special concert by the Thomas Orchestra in the Auditorium Hotel to visiting members of the American and British Societies.

Three of the papers on the programme were on the steam turbine, covering respectively the De Laval, Westinghouse-Parsons and Curtis types. The paper on the first-mentioned type was contributed by Messrs. E. S. Lee and E. Meden, the first part of which is devoted to a description in detail of the turbine. The applicability of this type of turbine for driving centrifugal pumps and blowers is pointed out. In both cases high velocities are required for good efficiencies, and with the De Laval turbine it is easy to produce the most suitable velocities. For lifts from 15 ft. to 150 ft. smaller turbines having one gear shaft may be employed, and for lifts of 40 to 300 ft. large turbines with gear shafts; for a greater lift the centrifugal pump has been directly connected to a high-speed turbine shaft, the pump wheel in this case revolving with a velocity of from 10,000 to 30,000 r.p.m. As the pump wheel in the latter case will naturally be very small and not produce any suction, it must be fed by another pump connected with the gear shaft running at a considerably reduced velocity. Pumps of this type have been made for lifts up to a normal head of 850 ft. on a single wheel and in some cases this type has been made for feeding boilers.

The Curtis turbine is represented by a paper contributed by Mr. W. L. R. Emmet. The claims for this type of turbine with respect to its rivals are treated at some length, and the paper contains a number of illustrations of the turbine as a whole and of some of its parts. It is stated that practically no troubles or interruptions have been caused by the step bearings, which have developed a ruggedness and stability far beyond the expectations of the designers. In newer designs, however, a powerful brake will be provided, bearing on the lower surface of a chilled iron ring carried by the lower wheel. This brake can be conveniently operated from the outside and can be used to take the whole weight of the revolving part in case the step bearing should fail. In ordinary operation the shoes of the brake will be set about .01 in. below the brake ring to be in position to receive the revolving part in case the step bearing part should fail. Another function of this brake is to stop the machine when it is desired to do so, and it is stated that one of the 5,000-kw vertical machines will run for four or five hours after the steam has been shut off unless load is put upon it or a brake is applied.

The data are given of the test of a 2,000-kw machine operating a 6,600-volt, 25-cycle generator in the General Electric Works at Schenectady at a speed of 750 r.p.m. With a load in kilowatts of 637 and a vacuum of 28.2, the consumption of steam was 20.1 pounds per kw-hour; with a load of 1,000 kw and a vacuum of 28.9 the consumption was 16.3 pounds; with a load of 2,000 kw and a vacuum of 28.3 in., the consumption was 15.3 pounds per kw-hour.

Mr. Francis Hodgkinson contributed a paper entitled "Some Theoretical and Practical Considerations in Steam Turbine Work," which related principally to the Westinghouse-Parsons type of turbine. The paper after a résumé of the fundamental principles of the steam turbine, gives short descriptions of the several types of steam turbines now on the market, and then takes up the description in detail of the Westinghouse-Parsons type. The description, which is the best that has yet appeared of this type of turbine, enters largely into matters of direct practical interest. In explaining why three diameters of a barrel have been generally used in this type of turbine, it is said that this selection has no bearing whatsoever on the theory of the machine, but is merely one of mechanical convenience. The proper expansion can be provided for just as well should there be one or several different diameters. It will be found, however, that if a speed and diameter of a drum were selected that would permit convenient proportions of the blades of the outlet, the blades at the inlet of the turbine would become mechanically small; similarly, if diameters and speeds were selected to suit the inward blades, the areas of the blades in the last stages would become unmanageably large. Referring to the matter of leakage, it is pointed out that in order to avoid overestimating its probable extent, it is necessary to bear in mind a point which is usually lost sight of and which in a considerable measure offsets the loss from this source. This is that since in a machine of given size the radial clearances between the ends of the blades and the walls of the turbine are constant, the greater leakage naturally occurs at the high-pressure ends of the turbine or at the beginning of the expansion; and by the time the lower stages of the turbine have been reached, the total volume of the steam has become so great compared with the clerance area that the latter becomes unimportant. All leakage steam returns energy to the working steam in the form of heat, as its action is similar to wire drawing treating in a restricted opening. Hence, it is superheated in a slight degree and serves to partially dry the working steam, which contains considerable moisture due to adiabatic expansion.

Referring to the early Westinghouse-Parsons turbines of large size which were constructed in tandem, two-cylinder form, it is stated that the two objects of this construction were to reduce the span between bearings and to allow the use of a reheater between the high and low-pressure cylinders. Exhaustive tests have, however, shown that the reheater is of little or no value in increasing the economy of a turbine. Referring to the effect on economy of entrained moisture in the steam, it has been found that the steam consumption is increased to an amount about twice the percentage of moisture in the steam; that is to say, 2 per cent. of moisture will decrease the economy about 4 per cent. While in small sizes of turbines flexible bearings are used consisting of a nest of concentric bronze sleeves with sufficient clearance between them to permit the formation of oil films to act as cushions, such bearings have not been found necessary in the larger sizes of machines, or in fact for any machines running below 1,200 r.p.m. One of the recommendations of the steam turbine is that it makes possible the use of a still further type of electrical generator which, although possessing difficulties in design for adaptation to ordinary engine speed, becomes ideally suited for direct-connection to the turbine. The machine referred to is the induction generator; that is to say, the induction motor run as a generator. While its peculiar electrical characteristics impose limitation upon its general use in power station work, when employed in conjunction with synchronous apparatus such as between alternators, synchronous motors and rotary converters, it becomes peculiarly suitable for the extension of a power system in which the limit of generator capacity has already been reached. When used on a system to which synchronous motors are connected, by overexciting the fields of these latter, the effects can be neutralized of the magnetizing currents required by the induction motor. This is one of the few cases in which the electrical and mechanical conditions concerning generator and prime-mover are almost exactly suited to each other. In general the higher the speed at which the induction generator can be safely operated, the less the material necessary and the smaller the losses, resulting in an extraordinary efficiency and power factor. For example, with a two-pole, 60-cycle induction generator of 500 kw, running at 3,600 r.p.m., the power factor may be brought as high as 98 per cent. or higher at full load, and the total efficiency will be far greater than that of present generating machinery. The paper concludes with an account of tests of Westinghouse-Parsons turbines and information relating to foundations and power plant designs.

Mr. Lionel S. Marshall, of Cambridge, Mass., contributed an interesting paper entitled "The Use of Superheated Steam and Reheaters of Compound Engines of Large Size." This gives the result of a number of tests made during the past five years on several high-speed, two-cylinder compound engines, all built by the same makers and all of the same type. The investigations were made to determine the economy of the engines under different loads both with and without jacketing and reheating. The paper contains reproductions of almost two-score curve sheets and gives the details of the various tests together with their data. The conclusions are that in the case of large size high-speed compound four-valve engines of common proportions, the jacketing of the high-pressure cylinder is of but little avail when moderately superheated steam (100° F. is used). Reheaters are probably a source of loss unless they superheat the receiver steam at least 30° F., and is not fully effective unless it superheats 100° F. Jacketing the low-pressure cylinder is shown to be unnecessary by reference to the steam qualities during expansion in that cylinder, and, therefore, undesirable when the reheating is effective. The effect of admitting moderately superheated steam to both the high-pressure and low-pressure cylinders is to keep the heat consumption per indicated horse-power practically constant throughout a considerable range of loads—from half load to about one-fourth overload.

Mr. William P. Flint, in a paper entitled "Commercial Gas Engine Testing and a Proposed Standard of Comparison," advocates the determination of the available or brake horse-power and not the indicated horse-power, and a basis of comparison depending upon the suction displacement per minute. It is stated that the results of tests of a large number of gas engines using natural gas for fuel have shown that every 345 cu. ft. of suction displacement per minute will give in the neighborhood of 115 maximum brake hp or 100 effective brake hp. Knowing the diameter of cylinder, the stroke, the test speed and the number of charges possible per double revolution, the suction displacement per minute is simply calculated. The result in cubic feet when used as a numerator of a fraction of which 345 is the denominator, gives what is called a reduction factor. Then, having the brake horse-power and the British thermal units of any given test, if these be multiplied by the reduction factor found as above, the result will be the brake horse-power and the British thermal units on a 100-hp basis. By applying in this manner the results of a large number of tests of gas engines, the manufacturer can ascertain the characteristic British thermal units per brake horse-power curve for each size and type, and from these can predict what new sizes should do. Besides enabling an average performance curve to be located with considerable certainty, this 100-hp basis method also lends itself well to the determination of limiting curves between which the performance of any engine may be expected to fall. This is often found very useful in drawing attention to defects in an individual engine and in detecting errors which occasionally may be made in shop tests.

In a paper entitled "The Potential Efficiency of Prime-Movers." Mr. C. V. Kerr designates by this term in the case of water wheels, the ratio between 550 × the brake horse-power developed, and 62.3 × the flow in cubic feet per second × the head in feet; and in the case of steam engines, the ratio of the heat equivalent of a horse-power or 2,545, and the weight of steam per horse-power-hour × the difference between the initial and final total heat in the steam. Tables are included giving the potential efficiency of a large number of types of water wheels and steam engines. In the case of water wheels this efficiency ranges from 68.3 per cent. to 86.8 per cent. in the case of turbine wheels, and from 81 to 91 per cent. in the case of reaction wheels. In the case of reciprocating steam engines, the efficiencies thus calculated from authoritative tests are with few exceptions above 60 per cent., and going as high as 80.5 per cent. in the case of a Schmidt engine tested at Pabienice, Poland, and to 80.2 per cent. in the case of a Snow pumping engine at Indianapolis. For steam turbines the potential efficiency thus determined is considerably lower than for the steam engine, in only two cases going above 70 per cent.; one of these cases being the test of a Westinghouse 1,000-kw unit giving 70.8 per cent., and a Brown-Boveri-Parsons turbo-alternator giving 71.8 per cent. It would appear, however, that in the case of the steam turbine the efficiency is the combined efficiency of the turbine and generator.

Dr. Pupin Before the New York Electrical Society.

The 243d meeting of the Society was held at Havemeyer Hall, Columbia University, May 25. The secretary read the following statement: "On the first of June last year a special meeting was held for the purpose of considering and discussing the revision of the constitution and by-laws of the Society, which had been adopted by the executive committee for report to the 243d meeting of the Society. At that special meeting certain amendments were passed. The legality of the action of this meeting in so passing these amendments was subsequently called into question, and in order to determine its validity the executive committee empowered the president to secure legal advice on the point. I have here the opinion on the same duly rendered by Parker & Aaron. The document, which is somewhat lengthy for present reading, advised the president of the Society that the action of the special meeting in question was not legal, and that he, the president, must not recognize any validity as attached to the attempted amendments. This opinion was submitted to the executive committee at its March 31 meeting, and duly approved and formally adopted by the committee. On the direction of the executive committee, the president subsequently appointed as a committee to revise the constitution and by-laws of the Society three of its past presidents, Francis W. Jones, Gano S. Dunn and Arthur Williams. The report of this committee was duly submitted to the executive committee and approved and adopted by it at its meeting of April 26. The revision, as recommended by the committee and as approved by the executive committee, will now be submitted to the Society. The further action necessary in this case is that this revised edition of the constitution and by-laws shall be further submitted to the Society at its next meeting, at which it shall require a two-thirds vote for its adoption." The revision of the constitution and by-laws, as submitted by the revision committee to the executive committee, and approved by the executive committee, was then read.

The subject of the evening was "Selective Signaling by Electrical Resonance." Dr. M. I. Pupin explained that he had originally intended, according to promise, to lecture to the Society on the "Physics of Wireless Telegraphy," but, owing to absence in Europe and lack of time, he had been unable to prepare an adequate lecture on that subject. The present subject, however, was closely identified with many of the phases of wireless telegraphy, which he had intended to treat in the lecture first proposed. Dr. Pupin proceeded to explain the principles and essential elements of the system of transmission by electrical resonance, classifying these elements as the multi-frequency alternator, the transmitter, the distributors, the resonators and the rectifiers. As described by Dr. Pupin, the alternating-current generator consists of six fields and six armatures, mounted on the same shaft. The various fields and armatures differ from each other in the number of poles. The number of poles is 4, 6, 10, 16, 24 or 34, giving frequencies of from 60 to 512. The various e.m.f's generated by these machines are impressed upon the line by tuned transmitters. At the receiving end there are branch circuits in parallel with each other, each branch consisting of a coiled condenser, so adjusted that the branch will offer a minimum impedance to one of the six frequencies transmitted. In inductive relation with these distributors are local resonators tuned electrically to respond to one of the six frequencies. Each resonator works upon a local relay circuit, this circuit consisting of a relay constructed like a Weston direct-current voltmeter. In series with the relay is a polarization cell, consisting of platinum electrodes in dilute sulphuric acid. In series with the relay is a rectifying polarization cell described by Dr. Pupin in several publications, and patented within the last few years. The polarization cell enables the alternating current to actuate the direct-current relay.

At the special request of the United States Patent Office Commissioner, Dr. Pupin has prepared an exhibit for the United States Patent Office, at the St. Louis Exposition, illustrating the transmission of telegraphic messages by alternating currents of various frequencies, the receiving and transmitting apparatus being electrically tuned to the frequencies, which they are intended to receive and transmit. This exhibit was shown at the lecture, but much to Dr. Pupin's disappointment it was not in working order, owing to an accident which had occurred during the afternoon. The polarization cell anodes had been covered with platinum black and this defect was not discovered until some time after the lecture.

The annual meeting of the Society is to be held in June at the Lamp Testing Bureau, Eightieth Street and East End Avenue, when the regular business of the occasion will be supplemented by some interesting features. A large attendance is expected.

New Telephone Patents.

EXCHANGE SYSTEM.

Just as two-wire common battery switchboards have superseded the three-wire boards in some localities, in the attempt to successfully bring the maximum number of subscribers' lines within the reach of an operator, so is it natural that a one-wire wiring scheme for multiple jacks should be brought forward as a further step in the same direction. At first sight the difficulties to be overcome in designing circuits for such a switchboard seem almost insignificant; but to devise a system to meet the demands of modern operating methods is no mean problem, first because of difficulty in obtaining the desired signals for supervision, and second because of the difficulty of balancing such a system. The first of these difficulties seems to have been rather simply overcome by Mr. C. E. Scribner in a system described in a patent just issued to him and assigned to the Western Electric Company. All relays are associated directly with the various subscriber's lines, the cord circuit containing no signaling apparatus except the ringing keys and supervisory lamps, these latter being included in the talking circuit. Herein would seem to lie a serious disadvantage from the "talking" standpoint, because of the introduction of the lamp terminals into a part of the talking circuit carrying continuous current. This, coupled with cross-talk difficulties, will probably render the system in its present form valueless from a practical standpoint.

LIGHTNING ARRESTER.

In Fig. 1 is shown a very compact and neat arrangement of fuse and open-space cut-out for combined use as a lightning arrester. It

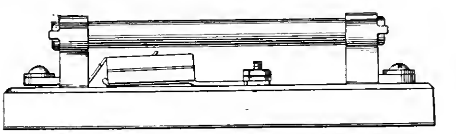


FIG. 1.—BARCLAY LIGHTNING ARRESTER.

is the idea of the inventor, Mr. J. C. Barclay, of New York City, to bring these two devices into as small a space as practicable and yet have either removable for inspection without disturbing the other, and he has certainly succeeded admirably.

SELECTIVE SYSTEM.

Messrs. F. C. Penfield and O. Templin have recently patented a selective system adapted for independently ringing up to ten parties upon a single line. The system depends upon the point use of both sides of the line and the ground in various combinations with relays and selective bells and several sources of current. At two of the stations both relays and bells are responsive to alternating currents, the selection of one of these stations being dependent upon the application of such current to one side of the line only. At these stations the relays are arranged to open the bell circuits when energized, and each is wired through a condenser to ground from the side of the line other than that from which its bell is wired. There-

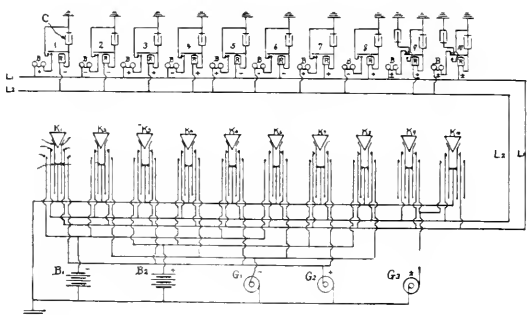


FIG. 2.—PENFIELD AND TEMPLIN SELECTIVE SIGNAL SYSTEM.

fore, when the relay is operated the bell cannot be. For every other station the bells are normally upon open circuit, being grounded only by the actuation of the corresponding relay. Both relays and bells at these stations are polarized and the latter are biased to respond to impulse currents of one sign only. For these stations the relay is normally grounded through a condenser, but it is found that the charging of this latter is sufficient to cause the relay armature to respond sufficiently to automatically short-circuit the condenser as long as the actuating current is maintained. Fig. 2 shows diagrammatically the circuit of this system, the signs indicating clearly the current combinations necessary for the different stations.

AUTOMATIC SYSTEM.

Several years since an automatic exchange system was patented by J. C. Slater, of St. Louis, for which an improvement now appears. The system referred to requires the subscriber calling to insert a pin in a socket corresponding to the desired number, and then to release a rotating arm which, under the influence of a motor, proceeds synchronously with a central office switch arm. Upon the completion of the connection it is necessary to withdraw the above-mentioned plug to restore the apparatus to normal, and it is the subscriber's failure to do this which has led to the present improvement. With the modified apparatus, if the receiver be returned to the hook and the plug not withdrawn, an auxiliary signal bell notifies the subscriber of his error.

CIRCUIT CHANGER.

Under this title a method of bending springs for switchboard keys or hook switch elements has been patented. The peculiarity of these springs is that the flaring of the end is about a line diagonal to the length of the spring, the inclination of this line with the edge of the spring being such as to correspond with the angle from which the actuating plunger approaches. C. C. Cadden, of Cleveland, Ohio, is the inventor, the Williams Abbot Electric Company obtaining the patent by assignment.

Trolley and Steam Developments in New England.

It is stated, from New England sources, that trolley competition, which has seriously affected the profits of steam roads in Central New England, will be met by a reduction of fares by the Boston & Maine Railroad, which is paralleled by trolley roads between Springfield and Greenfield, a distance of 40 miles. The New York, New Haven & Hartford Railroad and the Boston & Albany division of the New York Central Railroad, which are affected by trolley competition, are also considering similar measures.

The schedule of fares which will go into effect on the Connecticut River Division of the Boston & Maine Railroad is in every instance as low as the trolley rates. The railroad has suffered especially heavy loss in local traffic between Springfield and Northampton. Under the new schedule the fare from Springfield to Holyoke, a distance of nine miles, will be reduced from 15 to 10 cents. Between Northampton and Springfield, 18 miles, the fare will be cut from 33 cents to 20. From Springfield to Greenfield the rate will be 50 cents instead of 83. Reductions will be made in about twenty instances. The road provides frequent service, and expects to regain traffic which patronizes the trolleys for economical reasons.

The railroad officials believe that the saving in time and the more comfortable accommodations which steam cars afford in stormy weather will result in a return of the public to the steam cars except for short distances. The action of the railroad comes as an entire surprise. Electric road officials admit that the reduction will hurt their business, as they have no way of checkmating the new schedule except by concessions which would eliminate profits.

The New York, New Haven & Hartford Railroad, which has met trolley competition in parts of Connecticut by obtaining control of the trolley lines, will, it is authoritatively stated, adopt a different method to regain traffic between Hartford and Springfield. The road runs but few trains between the two cities over the Highland and Central New England divisions. These routes, it is said, will be equipped with the third-rail system and cars run at frequent intervals. The fare will be the same as by trolley, with the advantage of greater speed.

The Consolidated Railway Company—the corporate name of the new combination of trolley roads controlled by the New York, New Haven & Hartford Railroad, and including the Fair Haven & Westville, of New Haven; the Worcester & Connecticut Eastern, and the Meriden Electric Railroad—has just been formally organized. Officers were chosen as follows: President, C. S. Mellen; first vice-president, E. H. McHenry; second vice-president, H. M. Kochersperger; secretary, J. G. Parker; treasurer, A. S. May; assistant treasurer, T. F. Paradise.

CURRENT NEWS AND NOTES.

HARD TO GET ELECTRICIANS.—The artillery corps of the Army is, according to the New York *Tribune*, having great difficulty in obtaining master electricians. The place has existed for a year or more, and the War Department has been able to appoint only six who are in all respects qualified. Six others are being trained in the practical discharge of the duties of the place at Fort Totten, N. Y., preliminary to final appointment, but no one has any idea where the remaining thirteen master electricians are to come from. These men receive $75 a month, the highest pay of any of the enlisted force of the military establishment. Their duties are technical, and, as is indicated by the title of the place, relate to electricity in the coast forts. It was expected that civilians would be induced to come into the army, but the restrictions of military life do not seem to attract good electricians from that quarter. So far only two appointments have been made from civil life.

ANOTHER DANGER FROM ELECTRICITY.—The New York *Sun* prints a letter from a Mr. J. S. Daggett, of Saratoga, who brings a new charge against electricity. There are, he says, irrefutable facts at hand proving that the use of electricity has caused during the past fifteen years a greater loss of property by fire, flood, storm and unseasonable weather than the value of ten railroads like the New York Central. "Are our farmers along the northern Atlantic slope to be ruined? Have we an Agricultural Bureau? So intense was the cold during the past winter that the ground was frozen six feet deep. In digging graves gunpowder was used for blasting out. Millions of fruit trees have been killed. Science says that you cannot use electricity as we do without affecting the air, weather and climate. Must the people suffer to gratify the stupidity of certain corporations? A gentleman has just informed me that his orchard of fine trees has been ruined. The roots of the trees are as dead as though burned by fire. New England and New York State did not receive the tenth of a crop of yellow Indian corn last year. The Government should prevent the use of electricity on such a scale as is proposed by the New York Central now. What are the interests of all the railroads and all the manufacturing electricians as compared with the agricultural interests?" Unfortunately, Mr. Daggett does not set forth the "irrefutable facts," nor does he favor us with the source of his scientific inspiration—which would be interesting.

HIGH-SPEED CENTRIFUGAL PUMPS.—Prof. J. E. Denton and Mr. William Kent have recently made some exhaustive tests of a type of centrifugal pump made by the De Laval Steam Turbine Company, especially designed for use with De Laval steam turbines. Three pumps were tested as follows: 1. A single-stage centrifugal pump designed for delivery of 1,700 gallons per minute and a lift of 100 ft. when running at 1,545 r.p.m. This pump was direct-connected to the geared shaft of a 55-hp De Laval steam turbine. 2. A single-stage pump direct-connected to a 20-hp direct-current electric motor, designed for 1,200 gallons per minute against a lift of 45 ft. and at 2,000 r.p.m. 3. A two-stage pump designed for a delivery of 250 gallons at 700 ft. head; the large pump being driven at a speed of 2,205 r.p.m. by direct-connection to the geared shaft of a De Laval steam turbine, and the small pump driven at 20,500 r.p.m. by direct-connection with a high-speed shaft of the engine. The object of the tests was to determine the efficiency of the pumps. The efficiency of the first-mentioned pump was found to range from 74.3 to 75.6 per cent. for delivery between 1,398 and 1,860 gallons per minute, the efficiency representing the ratio of the water horse-power of the pumps to the brake horse-power of the driving motor. The steam per hour brake horse-power running condensing ranged from 24.06 to 20.53 pounds for these deliveries. The test of the electric motor-driven pump showed an efficiency of 71.4 per cent. for a maximum delivery of 1,403 gallons per minute to 75 per cent. for a delivery of 1,133 gallons, falling down to 68.3 per cent. for a maximum delivery of 790 gallons per minute at the highest heat of 59 ft. With throttle suction there was a decreased efficiency of only 2 per cent. The two-stage compound pump showed a consumption of steam per water horse-power-hour ranging from 40.5 pounds for the maximum horse-power and highest head to 106.2 pounds for the maximum delivery, lowest head and lowest horse-power.

LETTER TO THE EDITORS.

The Inventor's Point of View.

To the Editors of Electrical World and Engineer:

SIRS:—The rule in some foreign countries (but not in our kindred Great Britain) requiring the manufacture of an invention within a fixed limit of time is one of the greatest evils ever invented by a government. Former Commissioner of Patents Seymour has eloquently represented this disadvantage, and so have one or two others in reply to your editorial, which was valuable because of the vigorous discussion it is provoking and because of the new way of looking at the subject it brought forward. Besides, the majority may have agreed with you as far as I know.

The rule of three settles the whole question, I think. An invention is either ahead of time or just on time, or a little late. If the first the public will not accept it until they want it. To require manufacture before the public wants it, would be a severe penalty instead of an honor and reward for the inventor. The phonograph is an illustration. The broad patent became seventeen years old and therefore died a natural death before it was used as a popular substitute for the music box. The profits have come in to all except the inventor since the patent expired. Consequently, it is a punishment, financially and morally, to require "working" of inventions in advance of their day or to require several years to perfect sufficiently to be accepted by the public.

Secondly, if the invention "takes" from the start, the working requirement is useless. So also if the invention comes too late, as do many of the bicycle patents that would have brought big prices when the bicycle was popular.

Another manner of viewing the subject is to consider, as the law does, that seventeen years have been decided as a fair limit in absolutely every patent without exception. Now, if a thousand inventors have been thus rewarded, it is nobody's business whether they make $50,000 during the whole period gradually or during the first year, and none afterward, or during the last year and none before. The inventor who made the profit the first year would not be punished by the "working" requirement, whereas the other inventor would have lost his chance. In other words, the requirement would be an evil, because it would be unjust, and that argument points to the fundamental principle of the United States Government—justice to all alike. France and Germany are more arbitrary. It is so often beyond the power of an inventor to create a market for his invention that it would be cruel to try to force him to equip a $10,000 plant and manufacture and offer for sale a device which he knows is not wanted. However, it is possible for him to pay a nominal tax to test his faith in its probable future success, and this tax at the end of the fourth year, as in Great Britain, would not be very objectionable, but yet it would interfere with strict justice. Why should any citizen pay a tax on property that may not at the present amount to ten cents worth, and yet in the course of a few years may sell at sight for a small or large fortune. All real estate is taxed at a small per cent. of what it would bring at the time. All land will sell for something at an auction. Not so with all patents at any one date.

NEW YORK. EDWARD P. THOMPSON.

[Our correspondent appears to lose sight of the fact that a patent monopoly is not granted as a personal reward, but indirectly to encourage national prosperity by directly encouraging invention. Any public monopoly is in itself an evil, to which principle a patent monopoly is not an exception; but balancing good against evil experience in the past has shown that as a rule the good predominates in this particular kind of monopoly, thereby justifying the burden which its erection and enforcement lays on the public. To keep the balance, however, necessitates minimizing the evil; and while rules for safeguarding the public at times may bear hardly on individual inventors, it must be recognized that the other party to the compact —in our country, the sovereign people—have a right to condition its gift of monopoly. Any advantage taken of the monopoly granted which perverts its intention, that is—a final gain to the public—is an [illegible] that calls for suppression even though injury thereby be inflicted in exceptional cases. Unworked patents block the way of development along the lines they cover. and in the case of further and valuable invention along these lines, the original patentee can come forward and appropriate from the later inventor the fruits of his labor. But the greatest abuse in this connection is in the steady growth of the "paper" and "defensive" patent practice. which violates the fundamental principles justifying the grant of a patent monopoly, since the existence of such patents acts to restrict invention and places on the public a burden with no mitigating advantages to justify its imposition. Undoubtedly. when introducing into the constitution the principle of the patent monopoly. and subsequently in patent legislation. the lawgivers have had uppermost in mind the inventive genius represented by Watt as a type on the one hand, and on the other hand the devoted investigator and ingenious shop worker; and to-day we venture to say that the great mass of the American public consider that our patent system is erected and maintained for the encouragement of these types. In point of fact, however, except in the case of some great fundamental invention, the isolated, typical inventor is yearly becoming placed at greater and greater disadvantage, both within the Patent Office, where he has to meet "defensive" patents and "feeler" applications, and subsequently owing to the narrowing of the market for the patents of "outside" inventors.—Eds.]

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

Vertical Motor-Generator Groups.—A fully illustrated description of six motor-generators installed for an Austrian aluminum company. Their axles are arranged vertically, the commutators being about 5 ft. above the ground. The reason for this arrangement is that the various direct-current generators installed by the same company are also arranged with vertical axles coupled to vertical turbines. The attendants are well acquainted with this arrangement, which has proven very satisfactory since the care of the brushes is simpler and easier. The motors are built for 1,000 hp at a voltage of 1,000 and a frequency of 45, while the direct-current generators give 560 kw at 160 volts. The cast-iron magnetic field of every direct-current generator rests on the ground and on it the armature of the three-phase motor is directly placed. The two rotors are directly connected together. The dimensions of the machine are given with some curves of tests and detailed drawings.—*Zeit. f. Elek.*, March; (Potsdam), April 16.

References.

Construction of a Three-Phase Synchronizer.—Percy.—An article with dimension drawings on a useful synchronism indicator which may be produced by properly combining two small transformers, three incandescent lamps and a set of connecting lugs and sockets of the type commonly used for connecting up synchronizing lamps. One of the transformers must be three-phase and the other single-phase. The outfit is described in detail.—*Am. Elec.*, May.

Magnetic Stray Fields in Induction Motors.—Guilbert.—The first part of a long mathematical article with reference to a recent paper of Behn-Eschenburg, on this subject.—*L'Eclairage Elec.*, May 13.

Lights and Lighting.

Street Lighting by Nernst Lamps.—Joseph.—An article in which the author endeavors to show that under favorable conditions, with the use of Nernst lamps, it is possible to produce a better light than that given by incandescent gas mantles, at a smaller annual cost per lamp than is charged in most towns for gas lighting, and still show a small net profit, which, together with the improved load factor, will show a marked increase in the profits of the undertaking. He first endeavors to "slay the frequent renewals bogey," and then gives tables of cost.—Lond. *Elec. Rev.*, May 13.

Arc Between Mercury and Carbon.—Cassudo.—An account of tests of an arc between mercury and carbon. For the same current and the same distance of the electrodes, the voltage at the electrodes of the arc is greater if mercury is cathode and carbon anode, than if mercury is anode. The sum of the anode drop of voltage and the cathode drop of voltage is about the same for both directions of the current, but the drop in the column of the arc is greater if mercury is cathode than if it is anode.—*Phys. Zeit.*, May 15.

Power.

Electrically-Driven Rolling Mills.—Köttgen.—A long paper illustrated by diagrams in which the author first discusses merchant mills. Small mills, with motors from 300 [illegible] hp, have been in operation for several years, and that they have given satisfaction is evinced by the fact that five larger mills ranging from 1,000 up to 1,500 hp are now being arranged for electric driving. Motors for mill driving must be susceptible to two kinds of regulation: first, it must be possible to set them for a normal speed, acording to the desired circumferential speed of the rolls; secondly, they must slow down considerably as the load increases, in order that the energy stored in the fly-wheel may be utilized. This regulation is accomplished by various means. With direct current a compound winding is provided and the regulation is effected without any appreciable loss of efficiency. On the other hand, with alternating current it is necessary to introduce resistance in the armature; this is a course of loss which, however, remains comparatively small until the speed is materially reduced. The economy of such a motor depends upon the duration of the decreased speed. The problem of balancing the power needed is of great importance, in order that both dynamo and motor may be protected, and it is usually solved by heavy fly-wheels. The use of a motor-generator makes possible a simple method of regulating the speed of the mill by coupling direct to the shaft of the same a generator for each and every driving motor and raising or lowering its voltage by the shunt. This also obviates the necessity for a starter, as the driving motors can be started by lowering the voltage in the primaries. In most cases the use of either fly-wheel or battery will be unnecessary. The author then compares the relative advantages of electric driving and the use of gas engines coupled direct to the mill. The introduction of electric transmission from the power station (which is equipped with gas engines) will add to the first cost, but on the other hand larger and, therefore, less expensive engine units are used; moreover, since all mills will not be using their maximum power simultaneously, the capacity of the power house can be measured by the average of the power needed. Another great advantage is the facility which motor driving offers for measurement of the power used, affording a continuous control, not only over the condition of the mill, but also over the roll design. This will tend to a lower consumption of power and an improvement in quality of the product. He then discusses the electric driving or roll tables and finally takes up the subject of reversing mills. In designing the electric drive for a blooming mill there are two important points: first, the mechanism to be employed for starting and stopping, since reversing gears cannot be used for such powers; secondly, the balancing of the variations in load since variations which may exceed 6,000 hp cannot be carried by the generating station. Both problems are satisfactorily solved by Ilgner's system, hitherto mainly used for mine-hoisting engines. It consists of installing between generating station and motor a motor-generator set coupled to a very heavy fly-wheel. The dynamo of the set is always built for direct current and the mill is driven direct from the latter, and by simply regulating the small shunt current the voltage of the so-called starting dynamo is raised or lowered. If it is raised the speed of the mill motor increases; if lowered, electric breaking takes place because the motor is forced to decrease its speed, and thereby transmit energy through the dynamo into the attached fly-wheel. This interposed motor-generator not only obviates the necessity of a starting resistance and permits electric braking, but also keeps the large variations in load in the secondary system away from the primary station and circuits. Variations in load are carried by the fly-wheel.—*Iron Age*, May 19.

Power Station Design.—Merz and McLellan.—The conclusion of their paper on power station design. They deal with the switch gear and emphasize that, on account of the absolute crippling of the power station which takes place, if there be any serious failure of the switch gear, it is justifiable to take every protection even at the expense of capital expenditure. Oil switches are essential and all high-tension circuits should be broken in this way—if only for the reason that opening the circuit under oil puts so much less stress on the cables and on insulation generally. The switch chosen should be capable of breaking any current which may be met with in practice. This practically means, in emergency, breaking the whole short-circuit capacity of the station. One of the greatest dangers to reliability of supply is the excessive carelessness with which cables connecting machines or feeders to the switchboard have in the past been cramped together indiscriminately in a trench or tunnel. In the case of a power station it is unsafe to allow cables carrying large powers, whether high or low-tension, even spaced some inches apart in tunnels or manholes, unless each cable is in its own duct or in some other way protected from the properly earthed metal shield. All instruments should be worked through transformers. Automatic overload devices should be installed so as to operate the switches on each outgoing feeder. The automatic adjustable circuit-breakers should have a time lag inversely proportional to the magnitude of the overload. The authors add some remarks on measuring apparatus and records and urge that complete permanent apparatus should be provided for the taking of necessary tests, thus avoiding the unreliability and uncertainty of make-shift arrangements.—Lond. *Elec.*, May 13.

Superheated Steam.—SMITH.—An article on the thermal effect and the practical utility of superheated steam. He endeavors to show that its utility has no reason beyond that of keeping the engine cylinder walls, piston surfaces and valve seats and faces dry. This dryness is of immense utility. While superheating gives a thermodynamic advantage beyond the maintenance of dryness, yet it is so very slight as not at all to compensate the expense of the process. The practical conclusion is that superheating should be carried only to that degree sufficient to insure dryness.—Lond. *Elec. Rev.*, May 13.

British Power Station.—A fully illustrated description of the Central Electric Supply Company's power station which supplies current "in bulk" to the Westminster electric supply corporation and St. James & Pall Mall Electric Light Company. The three-phase system has been adopted at 6,000 volts with a frequency of 46. The output last year was over 2,600,000 kw-hours. The price charged was 6 cents per unit, and a much lower price will be charged during the current year. The most striking features of the station are the use of Climax boilers only, without economizers, and the absence of condensers and superheaters.—Lond. *Elec. Rev.*, May 6 and 13.

Cheap Supply "in Bulk."—The Hull municipal electric plant intends to offer to the Northeastern Railway for lighting and power purposes 1,000,000 kw-hours per year at 2½ cents per kw-hour on a basis of a 27 per cent. load factor. This figure of 2½ cents will be liable to an increment or decrement of ⅛ cent for each three per cent. decrease or increase in load factor.—Lond. *Elec.*, May 13.

REFERENCES.

Steam Engine Speed Regulation.—MCGUIRE.—An illustrated article treating of the perquisites of engine governors. After briefly explaining the general purposes which a governor is required to subserve, the author enumerates the advantages and disadvantages of the two principal classes, namely, those that throttle the steam and those that vary the point of cut off.—*Am. Elec.*, May.

The Zeuner Valve Diagram.—MAJOR.—An illustrrated description of the Zeuner valve diagram and explaining its utility in solving problems relating to valve gears.—*Am. Elec.*, May.

TRACTION.

Mountain Railroad.—ARMKNECHT.—The first part of an illustrated article of the mountain road to Hohensyburg in Westphalia, Germany. It is partly an adhesion road and partly a cable road. The length of the latter is 445 meters and the gauge one meter, the difference of level being 93 meters. While one car is going down, another is going up. The greatest tension in the cable occurs when the car going upwards and filled with passengers enters the heaviest grade. The greatest power is required from the motor when at the same time the car going downwards is on the place of smallest grade and carries no passengers. The greatest tension of the cable is 2,929 kg. For operating the cable two motors are provided, one of which is in action while the other is used as reserve. Both motors have a capacity of 72 hp and are shunt-wound, direct-current motors running at 390 to 410 revolutions at a voltage of 500 volts. The connections of the motors are shown in Fig. 1. In order to start one of the motors the switch, *J*, is closed by hand and the rheostat, *R* and R^1, are adjusted. Their levers are mechanically connected in such a way that the resistances of the armature circuit are not dis-

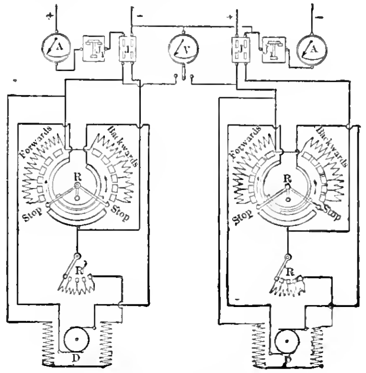


FIG. 1.—MOTOR CONNECTIONS.

connected before the exciting circuit has been closed. The attendant is thus able to send current into the armature only after the normal intensity of the magnetic field has been reached. The direction of rotation is determined by revolving the lever to the left or the right. In the circuit of each motor an automatic circuit-breaker, J_1, is inserted which is set into operation as soon as the current reaches a dangerous value. It is thus prevented that the current in the armature can get a dangerously high value, when the brake is actuated before the motor is disconnected.—*Elek. Zeit.*, May 12.

Interurban Railway Operation.—HERRICK.—A discussion of the new problems that have been brought on by the development of interurban lines from city systems. The author believes that the trolley is ill suited for heavy current collection at high speeds and that considerable improvement is possible in the present third-rail system. He suggests that the collector shoes be placed on the roof of the car and current collected from a light third rail placed on supports at a height of 2.5 meters above the surface of the road and far enough on the side to prevent accidents to passengers. He also states that the wires used on interurban cars are generally too small, as they are usually figured on the mean current taken by the motors, and that much trouble with motors and controllers is due to the fact that the voltage on the line near sub-stations is sometimes as high as 700 to 780 volts, whereas the equipment is designed for a 550 to 650-volt service. After taking up the question of multiple-unit control, distribution of feeders, and the danger of placing curves at the bottom of heavy grades, the author refers to electromagnetic signal systems and states that while ideal in theory they do not work out so well in practice, the reason being that the speed at which these magnets are required to work does not allow sufficient time to saturate the armatures, and if wound to operate when the car is running at a certain high speed they will be burned out if the same energy is applied if the car should happen to stand over a signal point. He suggests that where two trolley wires are used, each insulated from the other, a system of cut-outs can be devised so that when the car is taking current from one trolley wire the connection between the other and the feeder will be open, thus making head-on collisions between signaling points impossible.—*St. R'y Jour.*, May 21.

Rail Bonding.—SHEARDOWN.—The conclusion of his paper on tramway rails and rail bonding. He considers that the Falk system of cast welding has undoubtedly been a success in the United States; it was employed between 1896 and 1900, but since then the process has been apparently more or less ousted by the electric welding process. One of the drawbacks to the continued commercial success of the cast-welded joint appears to be the size of the equipment required and the fact that it came expensive unless a large number of joints could be poured at one time, which often proved to be inconvenient. The electric conductivity appears to be good, better than the usual allowance of copper bond. The welding process is quoted as a good example of the determination with which Americans will extend energy, time and money on any new process which they believe can be made a commercial success. The development of the electric welding process is briefly sketched. The thermit system of welding is "a most interesting process and one which would appear to have a great future before it, not only for the welding on street rails. In some of its other applications it is practically without a rival." Several rail joints made by this process are under test on their latest extension on the Drumcondra line and so far appear to have satisfied expectations. The conductivity of a length of rail with the joint appeared as good and in some cases better than a similar length of rail without joint.—Lond. *Elec.*, May 13.

Single-Phase Traction.—A note stating that Dawson, as a witness before the Royal Commission on London Traffic, recently advocated the use of single-phase alternating-current motors for suburban railways, with reference to the motors of Finzi and Lamme and to the great advantage of a 2,000 to 3,000 trolley wire. There will be no longer any necessity for the third rail with its cumbrous and dangerous fittings at ground level, while step-down and step-up transformers with rotary converters will be abandoned. With a single-phase system, the conductor is cheap to install, so that a trial can be made on a selected section of line without great expense and with very little disturbance of general traffic. Since we are not yet within sight of the electric driving of long-distance trains, any system to be adopted must permit of the continuous use of the locomotive on the same lines as the electric trains. Nothing lends itself to this so easily as the trolley wire.—Lond. *Eng'ing*, May 13.

REFERENCES.

High-Speed Railroads.—Peterson.—The conclusion of his article on railroads running at a speed as high as 200 km. per hour. He discusses the track and rail construction and arrives at a result that the obtainable speed is limited in first line by the degree of exactness to which the rails can be maintained true in position, and only in the second line by the strength of the track construction. He considers the single-rail suspended road as the most suitable one and recommends that further trials should be made.—*Elek. Bahnen*, No. 9, May.

Saint Louis.—An article on some features of the East St. Louis & Suburban Railway, directly opposite St. Louis. One of the two lines leading to Belleville is used almost entirely for hauling coal from the coal mines nearby. The city lines in East St. Louis are operated directly from direct-current generators, but the rest of the system is fed by sub-stations which receive alternating current transmitted at 13,000 volts. The transmission wires are of aluminum.—*St. R'y Jour.*, May 14.

Hanover.—Liebenberg.—A fully illustrated description of the new trolley system of Hanover. Accumulator traction was formerly used on this system, but the following disadvantages were found very troublesome: danger due to explosion of gases developed in the accumulators, no reliability of prompt service, the trouble and the expense of the attendance of the batteries. The trolley system has now been introduced and the system is described at great detail.—*Elek. Zeit.*, May 5.

New York Central.—An editorial discussion of the reasons for the use of electric locomotives for through trains on the New York Central Railroad within a zone in which the suburban trains will be operated by electricity. This zone is 34½ miles long on one division and 21 miles on another division. The use of electricity was required by law for only a short section, about 3½ miles in length. The discussion to use electricity for the entire distance is commended.—*St. R'y Jour.*, May 14.

Scarborough.—An illustrated description of the Scarborough electric tramways which use the trolley system. The power plant contains two 300-kw steam turbines.—Lond. *Elec. Times*, May 12.

Train Testing.—Ashe.—A description of the instruments used and the methods followed in making a series of train tests. A number of curves are presented showing speed, voltage, amperes, kilowatts, acceleration and distance.—*St. R'y Jour.*, May 21.

Installations, Systems and Appliances.

Charging for Electric Energy.—Schoenborn.—An article in which the author says that the theoretically most correct and most fair systems of charging for electrical energy can be introduced into practice only with great simplifications and have remained so imperfect that only very few plants have introduced them. If one abandons the idea of accomplishing what really is impossible, he thinks there are only left two systems which are practical: the double tariff and the tariff based of the hours of consumption. The latter tariff is based on the consideration that a consumer of electric light who uses 600 hours is more favorable than if he uses the light for only 300 hours, since in the former case he will consume some energy during the hours of relatively low load. This tariff, if supplied to lighting only, is, therefore, apt to flatten the peak of the load curve and make it broader. The same system, however, has not the same effect if applied to energy for power purposes. For the use of power the double tariff seems more advantageous. Fig. 2 shows the action of the two

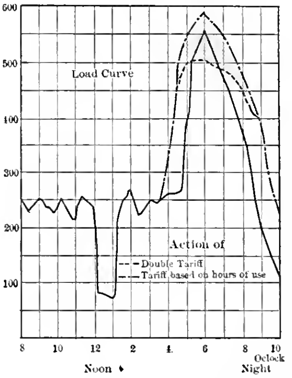


FIG. 2.—CHARGING FOR ENERGY.

systems on the load curve for a lighting system only. If one takes into account the cost of introduction of one of these systems into a plant which has not formerly used it, the general introduction of the tariff based on the hours of use is cheap and the introduction of the double tariff is expensive, because the meters so far used have to be removed and new meters must be installed. A small cost is involved in the introduction of the tariff based on the hours of use for lighting only and of the double tariff for power; in this case the meters for measuring power which are to be replaced by double tariff meters can be installed for new light consumers.—*Elek. Zeit.*, May 12.

REFERENCES.

Switchboard for Tramway Station.—A fully illustrated description of the switchboard for the London County Council tramway power house. It is on the "remote control" system which has been used in several plants in this country and is now being introduced in England.—Lond. *Elec.*, May 13.

Non-Arcing Lightning Arrester.—A description of a lightning arrester in which the discharge is led through a combination of carbon and mica plates having intervening air-gaps, the result being that the static discharge is broken up into infintesimal sparks and conducted to the ground.—*St. R'y Jour.*, May 14.

Electro-Physics and Magnetism.

Structure of Atom.—Nagaoka.—A mathematical paper on the "kinetics of a system of particles illustrating the line and the band spectrum and the phenomena of radioactivity." His model consists of a large number of particles of equal mass arranged in a circle at equal angular intervals and repelling each other with forces inversely proportional to the square of distance; at the center of the circle a particle of large mass is placed attracting the other particles according to the same law of force. If these repelling particles revolving with nearly the same velocity about the attracting center, the system will generally remain stable, for small disturbances, providing the attracting forces be sufficiently great. The system differs from the Saturian system, considered by Maxwell, in having repelling particles instead of attracting satellites. The model is approximately realized if these satellites are replaced by negative electrons, and the attracted center by a positively charged particle (this model differs from that recently described by J. J. Thomson, in so far as Thomson's uniformly electrified sphere is replaced by a positively charged particle in the center). This model is applied to a mathematical investigation of the line and bond spectrum and the author thinks that various other problems will possibly be capable of being attacked on the same hypothesis, such as chemical affinity and valency, electrolysis and other subjects connected with atoms and molecules. —*Phil. Mag.*, May.

Thomson Effect in Alloys of Bismuth and Tin.—LAWS.—An account of experiments which show a striking effect of the addition of a very small amount of tin to bismuth, the Thomson effect in the alloy containing 1 per cent. tin being more than twelve times as much as in pure bismuth. With the addition of more tin the value of the Thomson effect continues to increase until the alloy contains about 3 per cent. of tin when the effect is about fifteen times as much as for bismuth. When the percentage of tin is increased beyond this amount, the value of the specific heat of electricity begins to decrease and this diminution goes as the amount of tin becomes greater, until finally the Thomson effect in the case of pure tin has fallen to a value which is only about 1/300 part of that which holds in the case of bismuth.—*Phil. Mag.*, May.

Resistivity of Mercury.—GUILLAME.—A note referring to the elaborate tests of Smith on the variation of the resistivity, *R*, of mercury with temperature, *t*. Smith gives the following equation:

$$Rt = R_0\ (1 + 0.00088036\ t + 0.0000010309\ t^2).$$

The author formerly found the following equation to hold true:

$$Rt = R_0\ (1 + 0.00088090\ t + 0.0000009986\ t^2).$$

Both formulas are nearly the same, but the author thinks that his own formula is a little more exact.—*L'Ind. Elec.*, May 10.

REFERENCES.

Influence of Radium on the Electric Spark.—A note on experiments of Stefanini and Magri, who found that for discharges between two spheres, or between a positively charged point or sphere and a negative disc, the discharge is facilitated by radium for short sparking distances and impeded for longer ones. If the disc is positive and the sphere or point negative, the discharge is impeded at small sparking distances within a limited interval; in general the effect is nil. For certain sparking distances between a sphere and disc it is possible for radium to impede or facilitate discharge according to which electrode is positive.—Lond. *Elec.*, May 6.

Power Factor.—An illustrated didactic article treating of combined capacity and inductance and power factor.—*Am. Elec.*, May.

ELECTRO-CHEMISTRY AND BATTERIES.

Osmotic Pressure.—SEBOR.—An account of an investigation of the speed of diffusion of water through a semi-permeable diaphragm. The speed of diffusion is approximately directly proportional to the osmotic pressure of the dissolved substance. It seems possible to determine from the speed of diffusion the osmotic pressure and the molecular weight of the dissolved substance.—*Zeit. f. Elektrochemie*, May 13.

REFERENCES.

Electrolysis of Sulphites.—FRIESSNER.—An extended investigation of the electrolysis of sulphites. If neutral or alkaline sulphite of sodium or potassium is electrolyzed, the anodic reaction is the oxidation of the sulphite to sulphate and under certain conditions dithionate may be formed. The latter formation may be compared with persulphate and percarbonate formation. The conditions under which it takes place are investigated in detail.—*Zeit. f. Elektrochemie*, April 22.

Electrochemistry.—IZART.—A concise review of the present condition of the various electrochemical industries in the world.—*L'Ind. Elec.*, May 10.

Concentration of Hydrogen Ions.—SALM.—A paper on the possibility of determining the concentration of the hydrogen ions in a solution with the aid of indicators.—*Zeit. f. Elektrochemie*, May 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

System of Units.—EVERETT.—A communication on the completion of the practical system of units, with reference to recent suggestions of Robertson. The proposed changes involve the selection of units of mass, length, time and magnetic permeability that will give the ohm, volt, etc., without the introduction of arbitrary multipliers. This is accomplished by using the kilogram and meter as fundamental units and employing a unit of permeability 10^7 times the permeability of vacuum, and the permeability of vacuum equal to 10^{-7}. Secondly, it is suggested to so alter the units of permeability and permittivity as to make Heaviside's "rational" formulas applicable. The permittivity of vacuum then becomes $\frac{1}{36\pi} 10^{-9}$ and the permeability of vacuum $\frac{1}{4\pi} 10^{-7}$. When the rational values of permitivity and permeability are employed in conjunction with the kilogram, meter and second, the capacity of a condenser is area divided by thickness multiplied by permitivity; and the induction within a long helix carrying a current is ampere-turns per unit length multiplied by permeability. When the units used as fundamental are coulomb, meter, kilogram, second, there are fractional exponents in the dimensions of the electrical and magnetic units, and he inclines to the adoption of the coulomb rather than the ohm, because a specified number of grams of silver is a more matter-of-fact thing than a resistance. Moreover, it does not vary with temperature as a materialized resistance does. For kilogram he suggests the name kilog and for meter the abbreviation met.—Lond. *Elec.*, May 13.

Measuring the Phase Difference of Three-Phase Generators.—BAUCH.—In generator tests it is important to determine exactly the phase difference between the current and voltage. For this purpose the watts are measured with the wattmeter and voltage and current with a voltmeter and ammeter, respectively. This measurement may involve a considerable error, especially if the generator is star-connected, for the reason that the star voltage may have a wave form considerably different from the tension between the terminals. This is possible because the former may contain harmonics of the third order, which need not occur in the tension between the terminals. The author investigates mathematically how far it is possible with the usual methods of measuring to determine correctly the watts and the phase difference. Several connections are discussed for measuring the phase difference for different conditions of wave form and load. The author shows that there exists no means for measuring accuracy the wattless component of the current for inductive load by means of only one watt, current and voltage measurement.—*Zeit. f. Elek. u. Masch.* (Potsdam), April 16.

Utilizing Old Day Batteries.—HANCHETT.—A short article giving a few uses to which old dry batteries may be put in testing. The common expedient to obtain low voltage when only a high-voltage circuit is available, is to connect the circuit to be supplied in multiple with a suitable resistance which is connected in series with the line. This resistance is not always easy to obtain, and aside from being inconvenient, is a source of heat and requires more current from the line than is used in the derived circuit. A very convenient means of eliminating this difficulty is to use a sufficient number of dry battery cells in place of the resistance, selecting such a number as will give an open-circuit voltage equal to the desired voltage at the work circuit. If the apparatus is so arranged there will be practically no current flowing through the dry cells when the work circuit is closed, so that the dry cells will not be a source of heat or trouble and also have the advantage of being very compact and a convenient substitute for the resistance and one easy to secure. In the case of a three-wire system, where the neutral is grounded, a bell circuit might be supplied in shunt to a set of dry cells connected in series with a lamp circuit which was continuously alive and on the side next to the neutral wire. If the current in this lamp circuit is kept down to a reasonable amount, it is probable that very little trouble will be experienced in the battery in a number of years. The greatest value of the battery "resistance" is its convenience as a laboratory expedient. —*Am. Elec.*, May.

REFERENCES.

Alternating-Current Integrating Wattmeter.—An illustrated description of the Brush-Gutmann integrating wattmeter for alternating currents. It is of the induction motor type. The readings which are direct in watt-hours are stated to be true within 2 per cent. from the starting load to 50 per cent. overload for meters up to 50 amp. and in larger sizes within 3 per cent. from starting to 25 per cent. overload. Temperature changes are said to have no effect from 40 to 120° F. The construction of the meter is described. —Lond. *Elec.*, May 6.

Reichsanstalt.—An abstract of a long official report of the work of the German Reichsanstalt from the beginning of 1900 to the end of 1903. Since the account is very concise, it cannot well be abstracted.—*Elek. Zeit.*, May 12.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Four-Party Selective Ringing System.—O'BRIEN.—An illustrated description of the Leich system. Two instruments are connected to each side of the line and at the central office two generators are provided which furnish current at different frequencies. There are two types of instrument used with the system, the difference between them being entirely in the arrangement of the ringing circuit. Each type of instrument is equipped with a 1,000-ohm ringer, a retardation coil and a condenser. The circuit arrangement of this apparatus, however, differs materially in the two cases. In operating one of the two different sources of ringing current at the central office furnishes 60-cycle current and the other furnishes 20-cycle current. The division of the instruments into two types is due to the fact that one is designed to respond to a ringing current of low frequency while the other is intended for a high-frequency current. In the former instrument a two-microfarad condenser and a 2,000-ohm retardation coil are connected in series with a 1,000-ohm ringer, the free terminal of which is grounded. With this arrangement, the impedance of the ringing circuit for the low-frequency instrument will increase directly as the frequency of the ringing current increases, so that a point may be reached where the frequency of the ringing current has become so high and the impedance of the circuit so great that sufficient current cannot pass through the ringer to actuate it. With the high-frequency instrument, the arrangement of the ringing circuit consists in connecting a 0.3-microfarad condenser in series with a 1,000-ohm ringer, the free terminal of which is grounded, and bridging the ringer with a 1,000-ohm retardation coil. The action of a condenser in an alternating-current circuit is directly opposite to that of a retardation coil. The impedance offered to the flow of the alternating current by a condenser varies inversely with the frequency of the current, so that with the high-frequency instrument the impedance offered to a 60-cycle current is considerably less than that offered to the 20-cycle current. The particular impedance coil used with this system is designed so that its impedance may be varied to suit unusual line or switchboard conditions. For this purpose the core of the coil is made up of a number of E-shaped annealed iron punchings which can be readily inserted or withdrawn so as to adjust the impedance of the coil. Instruments equipped with this type of selective apparatus have been successfully operated over lines up to ten miles in length, without any adjustment whatever.—*Am. Elec.*, May.

Train Dispatching.—A description is given of the telephone dispatching system used by the Rochester & Eastern Rapid Railway Company. The dispatching line consists of a pair of copper wires carried on porcelain insulators on brackets below the high and low-tension feed wires. At switches and other convenient points jack boxes are fastened to the poles and connected by water-proof wires to the telephone line. Where connection is desired in emergencies and no pole box is near, a connecting hook pole is used, the bottom of which contains a socket into which the telephone plug can be inserted. —*St. R'y Jour.*, May 21.

Independent Telephone Development in the Northeast.—An illustrated description of the automatic telephone exchange of the Northeastern Telephone Company at Portland, Me. The underground system and aerial lines are sufficient to accommodate 5,000 subscribers on outside construction, and the ultimate exchange capacity will be for 10,000 subscribers; 2,500 automatic switches are already installed in the exchange and the full capacity limit for the switches already installed is expected to be reached during the year. The company has now 250 miles of rural pole line construction with about 175 miles of trunk line connecting between 60 and 70 towns, villages and cities in northeastern Maine, with 12 exchanges and 75 to 80 pay stations outside of Portland. It connects with several rural and farmer lines covering territory adjacent to the company's main lines. It is also under its licensee company's management, the Lewiston-Auburn Telephone Company, preparing to build an exchange for those two cities connecting by trunk line with the company's main exchange in Portland, 35 miles away.—*Am. Elec.*, May.

REFERENCE.

Wireless Telegraph Transmitter.—MENDELSTAM.—A mathematical article giving the fundamental equations of the theory of the Braun transmitter, that is the theory of two coupled electric systems.—*Phys. Zeit.*, May 1.

New Books.

RUBBER, GUTTA-PERCHA AND BALATA. By Franz Clouth. New York: D. Van Nostrand Co. 242 pages, illustrated. Price, $5.

This is an English version of the original German treatise, known for many years past to students of the subject treated. Good judgment has been shown in making the translation and in adding a quantity of new material. In each instance of the three substances the author deals with its history, habitat, properties, methods of handling in refinement, and commercial uses of the manufactured product. Unfortunately, there is no index, but the chapter contents give a summary of topics. We can heartily commend this work to all our readers—and they are not a few—specially interested in the important problems of electrical insulation.

ANWENDUNG UND ZUKNFT DER KONDENSATOREN IN DER WECHSELSTROMTECHNIK. By W. Von Bisicz. Berlin: Julius Springer. 88 pages, 26 illustrations. Price, 3 marks.

This is a compendium of quantitative information concerning condensers in alternating-current distribution circuits. The applications of condensers in telegraphy and telephony are not considered. The leading formulæ controlling condenser currents and pressures are clearly given and the bibliographical references are very numerous. In fact, the main value of the book lies in the copiousness of its references.

The book is divided into seven chapters. The first is introductory. The second and third deal with condensers in series and in parallel respectively. The fourth and fifth deal with particular arrangements of condensers. The sixth and seventh relate to practical considerations concerning the use of condensers.

It is shown, among other things, that the cost of a condenser varies directly as the capacity and as nearly the square of the impressed voltage. That is to say, the cost varies approximately as the energy storage capacity. The book is useful as a reference index for electrical engeineering students interested in condensers.

CYANID PROZESSE. Zur Goldgewinnung. By Manuel von Uslar and Dr. Georg Erlwein. Halle: Wilhelm Knapp. 100 pages, 32 illustrations. Price, 4 marks.

This is the seventh volume of the well-known German serial of monographs on applied chemistry. It gives a review of the cyanide processes for gold production and deals both with zinc precipitation and with electrolytic precipitation. The first chapter gives a description of the McArthur-Forrest and the Siemens & Halske processes. The second chapter contains examples from practice with cost sheets. In the third chapter the author discusses the chemical reactions during solution and during precipitation and in the fourth chapter he gives a review of the various modifications of the original McArthur-Forrest and Siemens & Halske processes, which have either been proposed or introduced into practice.

The compilation is well done and the statements and descriptions are concise and clear. The various processes which have been proposed are critically discussed, and the book appears to give complete information on the cyanide process up to about 1900 or 1901. In a later edition the more recent developments—and especially the interesting combination of electrolytic with zinc precipitation, due to Charles Butters—should be considered.

AMERICAN METER PRACTICE. By Lyman C. Reed. New York: McGraw Publishing Company. 196 pages, 78 illustrations. Price, $2.

Since substantially all electrical energy sold is measured by some form of meter, the subject of metering is one of much importance. Its literature, however, is surprisingly meagre, Mr Reed's book being almost the first on the subject. Great literary merit would perhaps be too much to expect in an extremely practical treatise by a busy "meterman" such as the author. A prominent editor, being asked whence came his remarkable facility of expression, replied "that is not as easy as it looks: I rewrite everything four times." The first chapter of "American Meter Practice" did not, apparently, receive sufficient revision, for some errors contained are evidently due to carelessness rather than to unfamiliarity with the subject. The intended meaning will, however, be obvious to the central station "meterman," for whose instruction the book seems to be especially written.

The chapter on meter selection is very satisfactory and that on torque and friction is especially so, due, perhaps, to its having benefited from the revision and criticism incident to previous publication in the technical press. The passing of the chemical meter is appropriately noted, and its successor, the "motormeter," in its various makes, is discussed at some length, but not exhaustively. Chapter XII on records and testing is perhaps more indicative of individual than general practice. With the avowed purpose of enabling the non-technical consumer of electric energy not only to read his meter but roughly to check its accuracy, full directions are given for so doing. On page 169 it is stated that the average meter underregistration causes a 15 per cent. loss of revenue to the supply company. This figure is, however, wide of the mark in the case of cities where the more modern bearings, friction compensating appliances, testing methods, etc., are employed. Differential rating is interestingly discussed, and the book closes with an excellent chapter on photometry, which is evidently "thrown in for good measure," as it is not covered by the title of the book. Persons engaged in the electric light and power industry will find the book as a whole especially valuable.

BOOKS RECEIVED.

THE THEORY OF THE LEAD ACCUMULATOR. By Dr. Friedrich Dolezalek. Translated from the German by Dr. Carl L. von Ende. New York: John Wiley & Sons. 241 pages, 30 illustrations. Price, $2.50.

N. E. L. A. International Congress Delegates.

Three papers will be presented at the International Electrical Congress at St. Louis on behalf of the National Electric Light Association, as follows: "American Practice in High-Tension Line Construction and Operation," by Dr. F. A. C. Perrine, Pittsfield, Mass. "American Meter Practice," by G. Ross Green, Philadelphia, Pa. "The Protection and Control of Large High-Tension Distribution Systems," by George N. Eastman, Chicago.

New York Central Electric Locomotives.

In our issue of May 21 we presented a review of the reasons that may be taken as those which have influenced the New York Central & Hudson River Railroad Company in adopting electric traction

The new electric locomotives which are being built for the New York Central & Hudson River Railroad Company at Schenectady, by the General Electric Company and the American Locomotive Company, differ radically in their electrical features from any electric locomotive hitherto constructed. The motors are bipolar gearless, the magnetic circuit, the field windings and the motor poles being integral with the locomotive frame and spring supported. The pole faces, which are laminated, are vertically tangential to the armature, thus providing for vertical movement of the locomotive frame with attached poles without affecting the armature air-gap. The armature is assembled on a quill which is pressed solidly on the axle. The dual weight of the assembled rotating part, including the armature, axle and wheels, is less than on many steam locomotives, and there being no uncompensated reciprocating parts there is a perfect rotative balance.

This design was submitted in accordance with specifications prepared by the Electric Traction Commission appointed by the railroad company, the members of which are Messrs. William J. Wilgus, fifth vice-president New York Central & Hudson River Railroad; John F. Deems, general superintendent of motive power of the railroad company; Bion J. Arnold, Frank J. Sprague and George Gibbs. The secretary to this commission is Mr. Edwin B. Katte, electrical engineer of the railroad company. This commission, after careful deliberation, had prescribed the conditions which must be fulfilled by electric locomotives taking the place of steam locomotives as far as Croton on the Hudson River line and as far as North White Plains on the Harlem Division, a distance of 34 miles and 24 miles respectively.

These conditions were, briefly, that the successful bidder should furnish an electric locomotive capable of making two regular successive trips of one hour each between Grand Central Station and Croton with a total train weight of 550 tons, a single stop in each direction, and a lay-over not to exceed twenty minutes. In addition to this it was provided that a similar schedule should be maintained with somewhat lighter trains making more frequent stops. Finally, it was provided that with a total train weight of 435 tons, the electric locomotive should be able to run from Grand Central Station to Croton without stop in forty-four minutes, and, with one hour lay-over, be able to keep up this service continuously. This last schedule is the equivalent of the present timing of the Empire State Express, though the latter has a somewhat lighter train.

Specifications embodying these conditions were prepared by the commission and sent to all the principal electrical manufacturing companies both here and abroad. It will be observed that no restriction was placed on bidders as to whether direct or alternating current was to be used. The successful bidders were the General

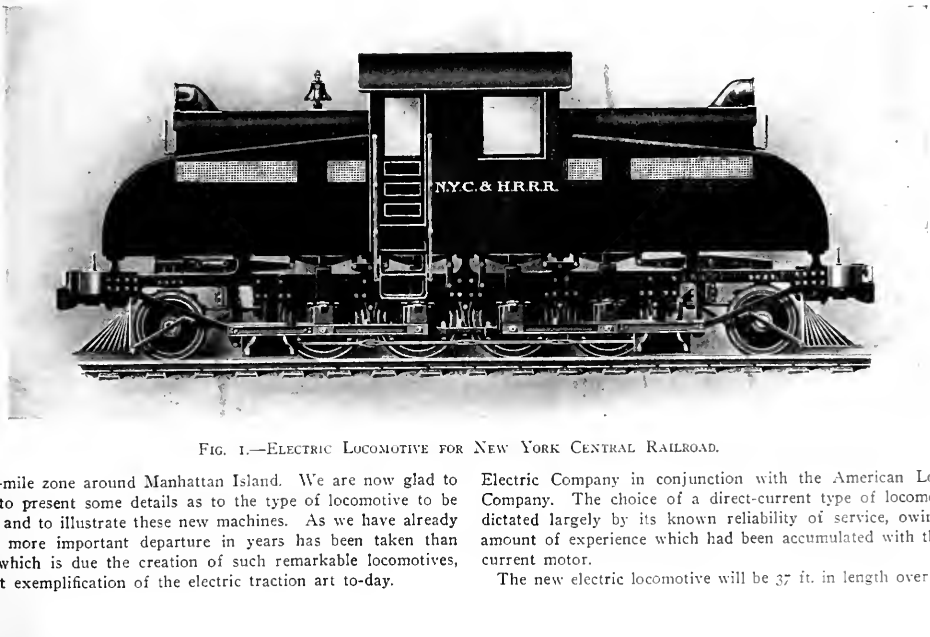


FIG. 1.—ELECTRIC LOCOMOTIVE FOR NEW YORK CENTRAL RAILROAD.

for a 40-mile zone around Manhattan Island. We are now glad to be able to present some details as to the type of locomotive to be adopted, and to illustrate these new machines. As we have already said, no more important departure in years has been taken than that to which is due the creation of such remarkable locomotives, the finest exemplification of the electric traction art to-day.

Electric Company in conjunction with the American Locomotive Company. The choice of a direct-current type of locomotive was dictated largely by its known reliability of service, owing to the amount of experience which had been accumulated with the direct-current motor.

The new electric locomotive will be 37 ft. in length over all. The wheel base will consist of four pairs of motor wheels and two pairs of pony truck wheels, the length of the total wheel base being 27 ft., and of the rigid wheel base consisting of the four pairs of motor wheels 13 ft. The diameter of the driving wheels will be 44 in. and of the truck wheels 36 in. The driving axles will be 8½ in. in diameter. It will be what is known as a double-ender and will weigh approximately 190,000 pounds.

The frame is of cast steel, the side and end frames being bolted together at machined surfaces and stiffened by cast-steel cross transoms. The journal boxes and axles are designed to permit sufficient lateral play to enable the locomotive to pass easily around curves of 230 ft. radius.

The superstructure of the locomotive is to be of steeple form so designed as to offer the least practicable wind resistance consistent with the adequate housing of the apparatus and its convenient operation. The cab is designed so as to afford a clear view of the track. The whole of the superstructure is to be of sheet steel with angle iron framing, and the doors and windows of the cab are to be fireproof.

The driving power of the locomotive is furnished by four 600-volt, direct-current, gearless motors, each of 550 hp. This will make the normal rating of the locomotive 2,200 hp with a maximum rating of about 2,800 hp, or about 50 per cent. greater than that of the largest steam passenger locomotives now in service. The armatures are mounted directly on the axles and will be centered between the

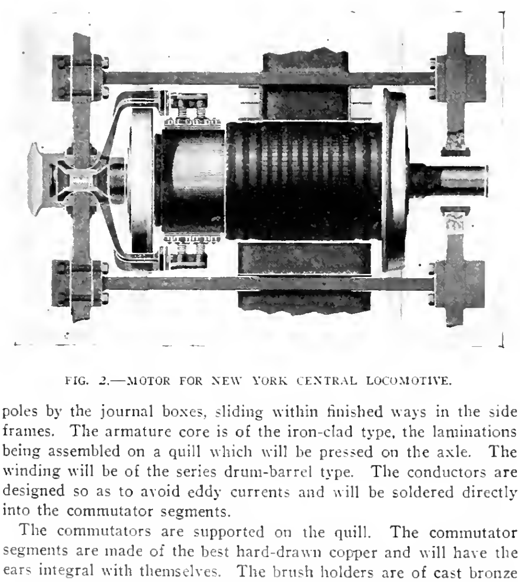


FIG. 2.—MOTOR FOR NEW YORK CENTRAL LOCOMOTIVE.

poles by the journal boxes, sliding within finished ways in the side frames. The armature core is of the iron-clad type, the laminations being assembled on a quill which will be pressed on the axle. The winding will be of the series drum-barrel type. The conductors are designed so as to avoid eddy currents and will be soldered directly into the commutator segments.

The commutators are supported on the quill. The commutator segments are made of the best hard-drawn copper and will have the ears integral with themselves. The brush holders are of cast bronze and mounted on insulated supports attached to the spring saddle over the journal, maintaining a fixed position of the brush holder in relation to the commutator.

Unlike the ordinary four-pole motor where the magnetic circuit is made through a separate box casting, the magnetic circuits in this type of electric locomotive are completed through the side and end frames. The pole pieces are cast in the end frames and there are also double-pole pieces between the armatures carried by bars which act as part of the magnetic circuit. The pole pieces are shaped so that the armature is free to move between them with ample clearance on the sides. As the poles move up and down with the riding of the frame on the springs, they will always clear the armature and provision is made so that the armature will not strike the pole pieces even if the springs are broken. The field coils will be wound on metal spools bolted to the pole pieces and will consist of flat copper ribbon.

The Sprague-General Electric multiple-unit control is to be used on this type of electric locomotive. There are two master controllers in the cab so placed that the operating engineer looking ahead will always have one of these under his hand. The control system permits two or three locomotives to be coupled together in any order in which they happen to come and to be operated as one unit by the engineer in the leading cab.

The control system is also semi-automatic in its action, as it provides check on the rate of acceleration of the train, which the engineer cannot exceed, while he may accelerate at any slower rate if he so desires. Should two locomotives break apart, the control current will be automatically and instantly cut off from the second locomotive without affecting the ability of the engineer in charge to control the front locomotive under his charge. The control system is designed for a minimum of 300 volts and a maximum of 750 volts.

The weight which rests upon each of the driving wheels of the electric locomotive will be about 17,000 pounds, proper distribution and division of the weight among axles being accomplished by swinging the main frames from a system of elliptical springs and equalizing levers of forged steel, the whole being so arranged as to cross equalize the lead and furnish three points of support. The locomotive is provided with all the usual accessories of a steam locomotive, including an electric air compressor to furnish air for the brakes, it will have whistles, a bell and an electro-pneumatic sanding device and electric headlights at each end. The interior of the cab will also be heated by electric coils.

In actual performance this locomotive is expected to give better results than any engine hitherto placed upon rails. With a light train the locomotive is expected to give speeds up to 75 miles an hour, and with heavier trains similar speeds can be attained by coupling two locomotives together and working them as a single unit. Its tractive force will be greater than that of any passenger locomotive now in existence, and it is believed that in the simplicity and accessibility of its parts and in the provision made in its design to insure continuous operation with the minimum chances of failure, that it marks an entirely new and successful type of electric locomotive.

A New Slip Meter.

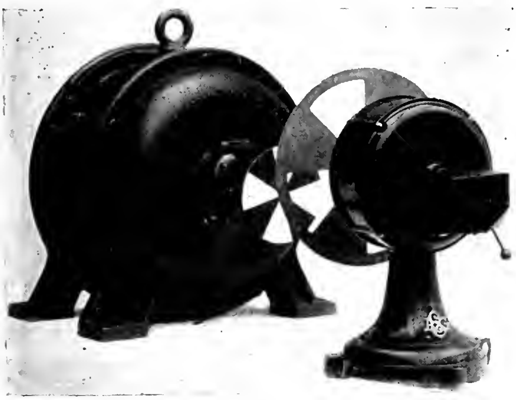
By Franz Welz.

At a recent meeting of the German Institute of Electrical Engineers, Mr. G. Benischke, chief electrician of the Allgemeine Elektrizitäts-Gesellschaft, gave a description of his new apparatus for measuring the slip of induction motors. This effect is determined by the formula, $s = \frac{n_1 - n_2}{n_1}$, where n_1 is the number of revolutions of the rotating field and n_2 the number of revolutions of the rotor. As the difference between these two values is generally very small, the correct determination of the slip is quite difficult, and small errors in taking the above-mentioned values affect the result very largely. Mr. Benischke had, therefore, indicated a method which allows a direct reading of the difference, $n_1 - n_2$, in making use of the so-called stroboscopic effect well known in physics.

According to this method, the shaft of the rotor is provided with a disc which is divided in several black and white segments. This disc is lighted by an arc lamp, which is fed through the same distribution system as the induction motor. The number of passages of these segments before a fixed point in a certain time allows the determination of the difference $n_1 - n_2$. But in addition it is still necessary to know the number of cycles of the current, or the number of revolutions of the generator. In many cases it is not advisable to use an arc lamp on the circuit, as it results in an unequal distribution of current in the three phases on account of its high amperages. In using an incandescent lamp, this stroboscopic effect is only visible in a darkened room.

From this method Mr. Benischke has developed a very simple apparatus which permits the determination of the slip in a convenient and absolutely accurate manner. No light source is necessary, nor is a record of the time to be made; neither does it require a special instrument for determining the number of revolutions. The apparatus (see illustration) consists of a small three-phase synchronous motor, which is self-starting and reaches synchronism very quickly. A disc, from which a number of segments is cut out, is attached at one end of the shaft and on the other end there is a counter, driven by rack and pinion, which can be thrown in and out by a little lever. A stroboscopic disc is attached by means of wax to the shaft of the induction motor to be tested. This disc consists of black and white segments of the same number as on the disc on the synchronous motor. The latter motor is put at a certain distance from the induction motor, and if both are running and the observer looks through the disc of the synchronous motor upon the other disc, the segments seem to rotate. The number of passages before a fixed point can be counted very easily, and this gives the difference $u_1 - u_2$; the number of revolutions of the rotating field, u_1, is given simultaneously by the counter. The value of the formula above given is not dependent on the time, and it is, therefore, of no importance for which period of time the values $u_1 - u_2$ and u_1 are taken; the only condition is that only values taken at the same time are to be compared. It is, therefore, not necessary, as in the case of the method of illuminating the disc or with other methods of counting the pulsations of current in the rotor, to record simultaneously the time, all that is necessary being to count the numbers of passages of the segments and read from the counter of the synchronous motor the number of revolutions during that time. The quotient of the first value by the latter gives the slip of the motor.

The simplest arrangement is that in which the disc of the synchronous motor and that of the induction motor have the same number of segments, and it is best to use for this number the number of poles of the induction motor to be tested. In order to get actually



SLIP METER.

the difference $u_1 - u_2$, it is necessary to divide the observed number of passages of the segments by the number of the segments on the disc of the induction motor. If the slip is very large, the segments turn too quickly to make it possible to count the number conveniently. In this case it is best to employ a disc with only one segment; the observed number of passages is then equal to the number of "slipped" revolutions. This involves another advantage compared with the method of counting the number of pulsations of current in the rotor. These pulsations follow each other so quickly in the case of a large slip (commencing at about 0.06) that they cannot be counted with any accuracy; with this new apparatus the number of slipped revolutions can be counted directly by employing discs with only one segment. In order to obtain good results it is necessary to place the synchronous motor at a greater distance from the induction motor than is shown in the illustration, as the stroboscopic effect is better visible in proportion as the distance increases.

Long Scale Portable Instruments.

Electrical engineers who employ the portable standard instruments in general use for the making of exact measurements of electrical quantities or in the conduct of tests, know how difficult it is to take accurate observations in those portions of the scale where the divisions are narrow, and the consequent uncertainty regarding results and difficulty in checking up a series of measurements taken with different instruments. The fact that only a portion of the scale is accurately legible and that it is not always possible to have at hand instruments of the proper range to cover all capacities properly, make it at times impossible to avoid the use of comparatively illegible divisions, and as a result the curve sheets of tests and tables of measurements show irregularities which rob the work of all value.

To obviate such troubles and the other embarrassments resulting from the use of imperfect standards, the Department of Standards of the Westinghouse Electric & Manufacturing Company has designed the portable instruments illustrated herewith. The assortment comprises voltmeters, ammeters and single-phase and polyphase wattmeters. Their principal characteristics are convenience in use, permanence of calibration, accuracy and mechanical excellence.

As shown by the illustration, the voltmeter is zero-reading, this form having been found most suitable for measurements for which

FIG. 1.—PORTABLE VOLTMETER.

a voltmeter is used. In this form the readings are determined by the deflection of the milled head required to bring the index pointer to zero. Each instrument is made in two capacities, which in connection with the very long, open scale enables the readings to be

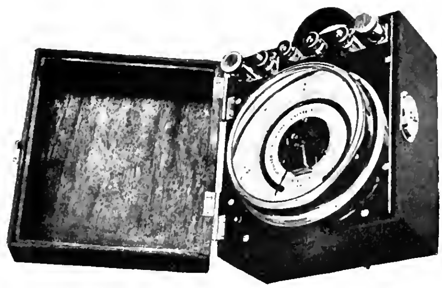


FIG. 2.—PORTABLE AMMETER.

taken over a wide range of voltage with great accuracy. It is astatic and, therefore, unaffected by external fields, and may be used on either alternating or direct currents without a change in calibra-

FIG. 3.—SINGLE-PHASE PORTABLE WATTMETER.

tion and without requiring "reverse" readings to be taken on the latter. It is regularly made in capacities up to 600 volts, but may be furnished for any higher range desired by the use of a multiplier. The action is entirely dead-beat.

The ammeter is similar in external appearance to the voltmeter, with the exception of the terminals, which are designed for the use of heavier connecting wires, and the absence of the knurled head with its indicating pointer, this instrument reading direct. It is furnished with coils wound in two sections, which, by means of small connectors on the top, may be connected in series or in parallel, thus greatly increasing the range of the instruments. The scale is very long and open, being similar to the voltmeter in this respect.

This instrument can be used on alternating currents only, but it is accurate over a very long range of frequencies and may be used on circuits varying from 3,000 to 8,000 alternations without appreciable error. It is also unaffected by changes of wave form on the circuit. The moving element is extremely light and being dead-beat will accurately follow any variation of current.

In the wattmeters the scheme of subdividing the coils as adopted for the ammeters is carried out for both the series and potential windings, thus giving in one instrument four ranges in capacity. In addition to this, as the scales are uniformly spaced from zero to maximum, readings may be taken at any point with equal accuracy, so that one instrument will give a range several times that of any other heretofore obtainable.

The wattmeters are suitable for use with alternating currents

FIG. 4.—POLYPHASE PORTABLE WATTMETER.

only, but like the ammeters, they may be used over a considerable range of frequency. The polyphase instrument consists of two single-phase mechanisms connected to one shaft, and indicating on a single dial the sum of the forces of the two mechanisms. It may be used for either two-phase or three-phase circuits and will indicate correctly the total energy of a polyphase circuit irrespective of power factor or any unbalancing of the different phases. As they are not affected by external fields or proximity to large masses of iron they afford a very convenient medium for making tests of polyphase motors or other devices of this nature under actual service conditions.

Some "Sarco" Specialties.

There is a tendency in this age of great and large achievement to ignore the smaller things, and yet it is the little inventions which often contribute more to the comfort of the human race and in the greater number of instances make it possible for the artisan and mechanic to do his work better. In the field of electrical apparatus these things have been peculiarly noticeable, the inventions which are handled every day by thousands receiving but small attention. It is along the lines of improving the electrical apparatus of every day use, especially that devoted to electric lighting, that the Sarco Company, of 906 Sixth Avenue, New York, has devoted its attention. All of its specialties have distinctly novel features, and include the "Noscru" bell push button, the parabolic aluminum reflector and the "Sarco" outlet boxes. Coupled with these are novelties in the nature of "Key-arm" switches. The "Sarco" two-light aluminum reflector is also of particular interest to those using incandescent lamps and wishing an increased light in two directions.

As a practical novelty the "Noscru" midget bell push button overcomes a difficulty with which those putting in electric bells have been confronted. As its name may be considered to imply, the wires are connected without screws. The face of the button has an appearance similar to those now on the market, being manufactured in the same size with celluloid and pearl centers; but the bottom of the button is one solid piece of hard rubber, two holes running horizontally through the rubber. The button is connected by simply threading two circuit wires through these horizontal holes and bending over the extended ends flat against the piece at the bottom, there being a projecting ridge of rubber to separate the wires. The method of contact is by a yielding plunger that makes direct scraping contact on the circuit wires themselves. These buttons can be connected in ten seconds, and they are readily taken apart for engraving and stamping, by unbending the two pins that are bent over on the bottom of the button. Dampness cannot affect the "Noscru" push button, since the contacts are enclosed entirely in rubber. It is made in various sizes, the smallest called the "Pee Wee" fitting a ⅜-in. hole, and having the advantage of being screwless, is perhaps the only solution to the practical working of a button of this size. Since these buttons, as well as key-arm switches, which are somewhat of the same type, all make direct contact on the wires, they cannot short-circuit or ground.

The "Sarco" parabolic aluminum reflectors can be applied to a lamp without regard to socket receptacle or "Fielding" receptacle, the lamp fitting perfectly into either. This enables a window or frame to be wired with regular fielding receptacles, and by having the "Sarco" reflector applied direct to the lamp, an even better reflecting power is acquired than by using an expensive mirror trough reflector. By its peculiar shell shape it gains at once in power of reflection. The deep-cone type of reflector brings the polished surface of the aluminum so close to the lamp that it is claimed an actual test with an 8-cp lamp will show as much light as an ordinary 16-cp lamp without the reflector. Like the "Noscru" button, simplicity is the keynote of this reflector's construction and it can be applied without shade holder wherever desired, as in factory lighting, show rooms and for large space. Being also of aluminum it has the advantage of being so light in weight that it adapts itself readily to the purposes of almost any kind of a desk lamp or portable. The finish of the reflectors is solid smooth green enamel, resembling in position a green sea shell. The styles manufactured give either a direct reflection or a wide diffusion of illumination, as desired.

The "Sarco" two-light reflector gives another effect in lighting. By applying it to an 8-cp incandescent lamp it is claimed the value of the light is twice multiplied. As the reflector is held part way down the lamp it gives a reflecting power to the light from the lamp and yet at the same time permits the lamp to light the space

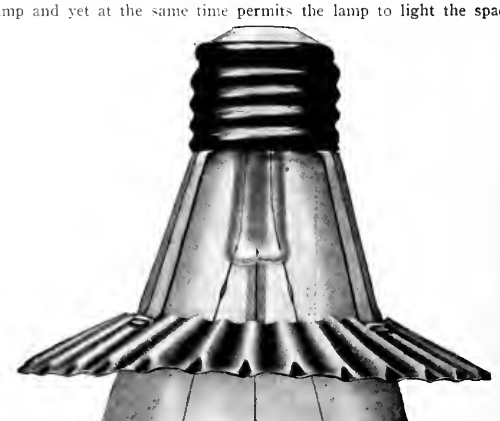


FIG. 1.—2-LIGHT ALUMINUM REFLECTOR.

around it. It is so fixed upon the lamp that it does not in any way interfere with the radiation of the light from all sides of the filament. The two-light reflector is also of polished aluminum and because of its novel construction can be placed inside the ordinary glass shade, thereby increasing the light of the lamp without casting a shadow.

By adapting the "Noscru" principle the "Sarco" company makes a canopy switch which is a real novelty and an entire bracket can be controlled by simply boring a 5/16-in. hole in the canopy, putting the

FIG. 2.—CANOPY SWITCH.

canopy switch in position, then fastening the nut tight, pushing the two wires through the holes and bending them over and replacing the cap—an operation that can be accomplished in ten seconds. Another

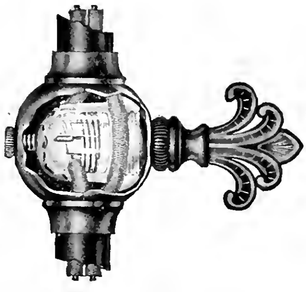


FIG. 3.—"NOSCRU" KEY-ARM SWITCH.

variation of the same idea is in the "Noscru" key-arm switch, which is claimed to be the smallest key-arm switch in the world, it being only one inch in diameter. This key-arm switch instantly makes direct contact on the wires and cannot short-circuit or ground, as all of the working parts are surrounded by porcelain, and underwriters approve nothing else.

Another of the Sarco specialties is known as a "Cast-iron Cinch" in the form of an outlet box. This box was specially designed to meet the latest requirements of the National Code rules, and takes a minimum of time to install as well as exemplifies the best class of workmanship. Styles are made for use with armored cable, and in addition it can be used as a junction box, in every way giving adequate satisfaction.

Fort Wayne Series Alternating Street Arc Lighting System.

The Fort Wayne series alternating-current system of street arc lighting consists in common with other alternating series arc lighting systems of a combination of a constant-current regulator and a number of arc lamps connected in series. The system includes the use of a Wood regulator mechanically different from any others on the market, and form "C" Wood arc lamps specially designed for this service.

The automatic regulator consists of an E-shaped laminated iron core and a reactance coil surrounding the center leg of the core. The coil and core are hung on levers supported on knife edges in such manner that they counterbalance each other, both being movable. The levers are so arranged that the coil moves over the greater portion of the distance, being required to lift the core only through a short distance.

The regulator coil is connected in series with the arc lamp circuit. The regulation is automatic, any change in the resistance of the arc lamp circuit tending to produce a corresponding change in the current in the circuit, since the line voltage remains constant. But any change in the current changes the relative position of the core and coil, an increasing current bringing them closer together, a decreasing current allowing them to move further apart.

As the core enters the coil when they approach each other due to an increase in current, the additional reactance caused by the magnetic condition thus created serves to counteract the decreasing resistance of the line and creates such an impedance that the current remains constant. Any decrease in the load tends to increase the current and draws the coil and core together, thus increasing the impedance in the circuit; while any increase in the load tends to decrease the current and allows the core and coil to separate, thus decreasing the impedance in the circuit. The result is that the current is maintained at its normal value automatically. So perfect are the mechanical construction and electrical proportions of the regulator that the load may be reduced gradually from full load to no load until the regulator is directly across the line in short-circuit without causing any marked change in the current. The load may also be changed from full load to short-circuit with but momentary current variation. This insures perfect protection to the system

FIG. 1.—REGULATOR.

against short-circuits due to failure of insulation of the outside lighting circuit.

When this regulator is intended for use on a small system of 25 lights or less, the lighting system may be connected directly to the machine circuit without the use of transformers. When, however, it is necessary to install the system on a machine supplying other circuits, a transformer is recommended. This transformer is connected between the machine and the series arc regulator circuit, thus insuring perfect separation of its circuit from any others supplied from the same machine. Transformers for this use are furnished of one-to-one ratio, or if higher voltages are required with the proper ratio to obtain the desired voltage for the arc circuit.

It is frequently necessary in installing arc lighting systems to consider extensions of the system to meet the growth of the community. The Fort Wayne series alternating system is designed to take care of extensions and at the same time to operate efficiently with the initial load. This is done by installing a regulator large enough to meet the maximum future demands and a transformer furnishing proper voltage to economically operate the regulator with this partial initial load. This lower voltage is obtained from a series of secondary taps, by means of which the arc circuit voltage may be varied

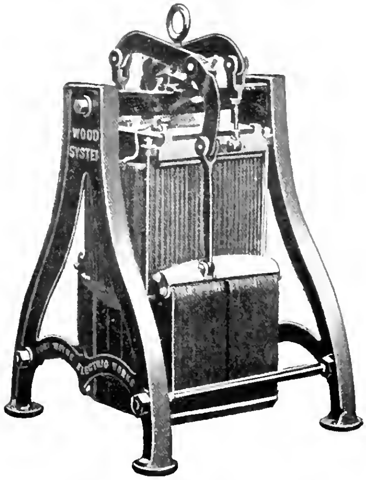


FIG. 2.—REGULATOR.

from 50 per cent. of full voltage up to maximum secondary voltage in steps of such value that the circuit will always be working at approximately full load efficiency. This method of transformation will allow a lighting plant to practically double its series arc lighting output without any increase in the regulating system or transformer, simply by changing the connections on the secondary taps of the transformer; and at all times it insures the highest economy and maximum power factor in the regulator circuit.

Figs. 1 and 2 show the Wood regulator mounted on a stand for station installation. The knife edges are mounted on a casting supported on two A-frames, between which the regulator is suspended. The joints in the levers furnish means for adjusting the regulator for the proper current.

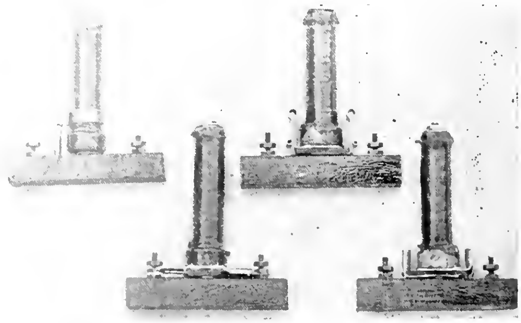
Gas Power Plant Extension.

A gas engine power plant which has attracted considerable notice within the last few years is that of the Union Switch & Signal Company, Swissvale, Pa. This plant at present contains 500 brake hp in Westinghouse three-cylinder vertical gas engines of the direct-connected type. The generators are of 220 volts, alternating current, and operate in parallel upon a common bus, with a widely fluctuating load due to manufacturing operations in the works of the company, for which power is furnished by the plant.

On account of the successful operation of the gas engine plant up to the present time, the Union Switch & Signal Company has decided to increase its capacity, and for that purpose has contracted with the Westinghouse Machine Company for a 300-hp horizontal double-acting engine of the type introduced in 1902 by the Westinghouse Machine Company. It has two cylinders 16½ in. in diameter, 24-in. stroke, arranged in tandem with single crank. The engine will drive a 210-kw Westinghouse alternator which will operate in parallel with the four generators now installed and furnishing 220-volt, two-phase, 60-cycle current for power and lighting throughout the works. The unit, which operates at the speed of 180 r.p.m., has an extended shaft for the reception of a pulley driving a small exciter generator. When the new plant is completed steam will be entirely dispensed with except for heating buildings and running steam hammers and riveters.

Interchangeable Enamel Resistance Units.

As there has been a considerable demand for enamelled resistance units so arranged that they can be conveniently mounted upon panels, switchboards, etc., being so designed that they are readily interchangeable, the Ward Leonard Electric Company, of Bronxville, New York, has designed and perfected the method of mounting

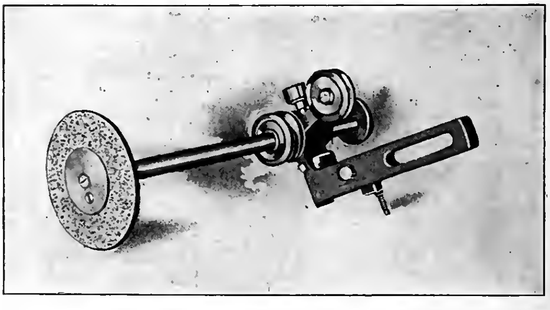


INTERCHANGEABLE RESISTANCES.

shown in the cut. The cut shows B size unit, but any of its different sized tubes can be arranged in the same manner. The tubes can be taken from the bases by hand without use of any tools—just as readily as panel cartridge fuses are removed. Different units of greater or lesser resistance can be used to replace each other and any desired result may be obtained. The Ward Leonard Company has sold over 2,000,000 of its enamelled resistance tubes (having the resistance wire hermetically sealed from the atmosphere) during the last four years, and its engineers, are busy daily accommodating the trade with various improved methods of mounting these devices.

Truing Commutators.

How best and easiest to true up commutators is always a problem for the manager of a plant, and it is universally recognized that the most desirable and proper way is to do it without removing the



DEVICE FOR TRUING COMMUTATORS.

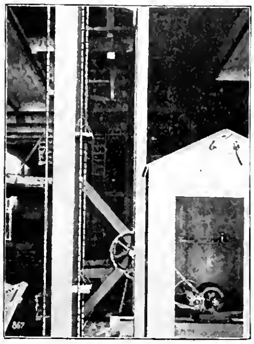
armature from the dynamo or motor needing attention. The device here shown is, as will be seen, very simple, and can be applied to the average machine without any trouble or difficulty. Its use avoids the necessity of removing the armature and placing it in the lathe, and also obviates the danger due to the use of diamond point tools, by digging into a commutator already in bad shape. When the work is done, the commutator is smooth and true. The apparatus is made by Jordan Bros., of 74 Beekman Street, New York City.

Massachusetts Technology at Niagara.

The Western alumni of Massachusetts Institute of Technology will go by special train to their great reunion at Boston this month and a visit to the electrical industries at Niagara Falls is to be given a day of the time en route.

Motor-Driven Contractor's Hoist.

As an indication of the economy of electric motor drive in industries temporary in character and also the adaptability of Northern direct-current apparatus the illustration below is of interest. The equipment shown was installed by a contractor in a metropolitan city, to do away with the cost of installing steam hoisting for the transportation of material required in finishing a building. The cost of current for this work, in this instance, was 50 cents per day, as against a charge of $2.50 to $3.00 per day wages for an engineer for



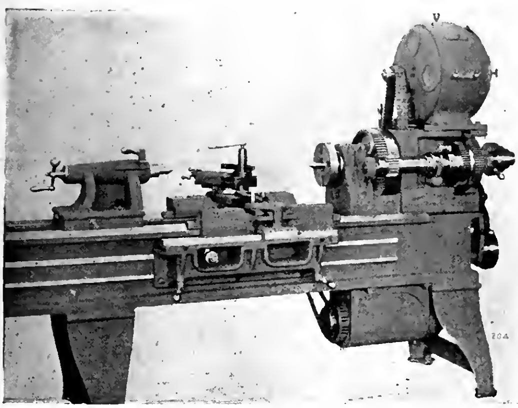
TEMPORARY ELECTRIC HOIST.

a steam hoist, as well as the cost of several hundred pounds of coal consumed each day by the steam equipment.

The motor used is a Northern back-geared motor built by the Northern Electrical Manufacturing Company, Madison, Wis. It is especially adapted to service of this nature owing to its great simplicity as well as rugged and simple character. The motor is a self-contained mechanism, the design and construction of which insures that motors operate with constant alignment of countershaft with armature pinion, thereby securing practically noiseless operation.

Motor-Driven 18-Inch Lathe.

While a great deal has been published recently illustrating and describing motor drives applied to standard machine tools, constant progress is being made in the designing of new tools to accommodate motor drives and in the modification of old tools for the same purpose. One of these latter instances is illustrated herewith, showing an 18-in. Le Blond screw-cutting lathe driven by a shunt-wound



MOTOR-DRIVEN LATHE.

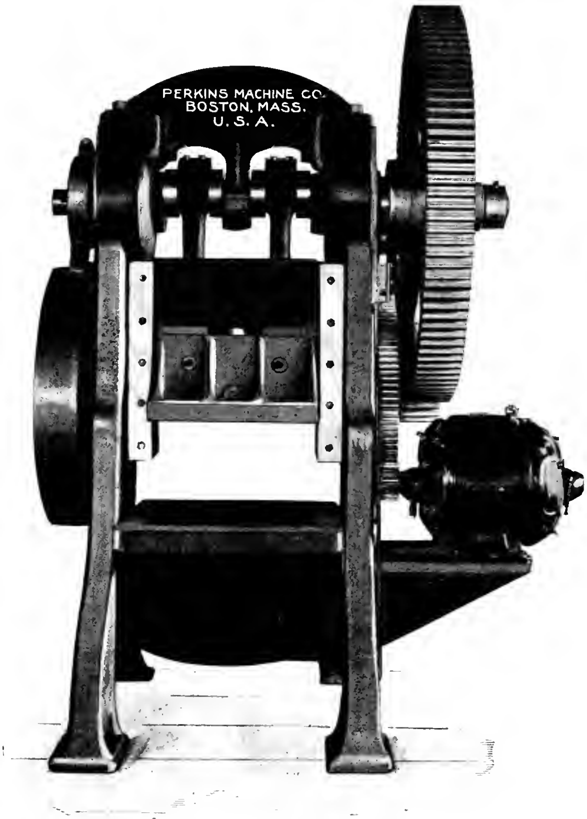
Crocker-Wheeler motor. The motor is supported on a special housing and the drive is by means of a Morse silent chain from the motor shaft to the main lathe spindle. The speed control is accomplished by the multiple system of the Crocker-Wheeler Company, using in this case a controller giving a range of twenty-one speeds. Only a portion of this range is used as working speeds, the entire range of the tool being increased by a double back-gear attachment which permits a total speed range of from 410 r.p.m. of the spindle to 5.75 r.p.m.

With this entire range three runs of gearing are provided, one being direct and the other two through back gears. Each of these various runs is controlled by a friction clutch, the lever for operating which is located in front of the head stock. About 40 speeds are provided with 2.8 hp, available at any speed between 20 and 410 r.p.m. of the spindle. For the heaviest working range of the tool, however, namely, 28 to 124 r.p.m., 3.4 hp is available.

The whole equipment is well laid out, the speed changes are accomplished quickly and easily, and the strength of the motor and gearing is sufficient to accommodate cutting speeds in cast iron and soft steel of 70 ft. per minute. One prominent feature of the Crocker-Wheeler multiple-voltage system is that it affords speeds to use these high cutting speeds properly, and gives ample power at all speeds without an excessively large motor.

Electrically-Driven Machine Tools.

One of the machine tools built recently by the Perkins Machine Company, of Warren, Mass., for the United States Government is herewith illustrated. It is driven by a fully enclosed 10-hp General Electric motor. The machine weighs 18,000 pounds, and has an 8-in.



MOTOR-DRIVEN PRESS.

main shaft bearing. The gear is 60 in. in diameter and weighs 1,800 pounds. Its teeth are cut in the solid metal. The adjustment of the pitmans is very accurate; and by simply turning an internal gear both pitmans are operated at the same time.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was exceedingly dull and trading was conducted on a very restricted basis, although there was a moderately firm tone. There were no features of importance, but the steadiness of the bond list and the demand for investment securities attracted attention. The United States Steel issues held firm at a moderate decline, notwithstanding the unfavorable reports of the iron trade. In the traction list Brooklyn Rapid Transit developed strength on favorable reports as to earnings and summer business outlook. Reports continue of the settlement of the litigation between the Amalgamated Copper Company and the Heinze interest, but the manipulation of the former was not of a very confident character. The industrial list as a whole was very quiet. Allis-Chalmers common closed at 7, being a net gain of 1 point; General Electric at 156, a gain of 1 point and Westinghouse Common 156, a net loss of ⅛ point. In the traction list Brooklyn Rapid Transit closed at 47½, a gain of 1½ point, and Metropolitan Street Railway at 110, a loss of 1 point. Western Union is off ¼ point, closing at 87. The curb market was very dull, and the volume of transactions was much decreased. Following are the closing quotations of May 31:

NEW YORK.

	May 24	May 31		May 24	May 31
Allis-Chalmers Co.	6½	7½	Electric Vehicle	5½	6⅞
Allis-Chalmers Co. pfd	39⅞	40	Electric Vehicle pfd	9	9¼
American Tel. & Cable	87	86¾	General Electric	156	155¼
American Tel. & Tel.	125	125	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	110⅛	109½
Brooklyn Rapid Transit	46⅜	46⅞	N. Y. & N. J. Tel.	..	..
Commercial Cable	180	180	Marconi Tel.	..	..
Electric Boat	25	25	Western Union Tel.	86½	85¾
Electric Boat pfd	60	60	Westinghouse com.	155	154½
Electric Lead Reduction	⅝	⅝	Westinghouse pfd	180	180

BOSTON.

	May 24	May 31		May 24	May 31
American Tel. & Tel	125	125	Western Tel. & Tel. pfd.	77	77
Cumberland Telephone	113	112¾	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	234	234	New England Telephone	*121¾	121
General Electric	155	154	Mass. Elec. Ry.	18	18
Western Tel. & Tel	*7	*7	Mass. Elec. Ry. pfd.	70⅝	72

PHILADELPHIA.

	May 24	May 31		May 24	May 31
American Railways	44½	44	Phila. Traction	95¾	95¾
Elec. Storage Battery	55	55	Phila. Electric	5½	5¼
Elec. Storage Battery pfd.	55	55	Phila. Rapid Trans.	12¾	12¼
Elec. Co. of America	8	8⅛			

CHICAGO

	May 24	May 31		May 24	May 31
Central Union Tel.	..	..	National Carbon pfd.	101¾	101¾
Chicago Edison	..	..	Metropolitan Elev. com.	16	18
Chicago City Ry.	156	165	Union Traction	5½	6
Chicago Tel. Co	..	..	Union Traction pfd.	29	29
National Carbon	29	29			

*Asked

MONTREAL LIGHT, HEAT AND POWER.—The annual statement of the Montreal Light, Heat and Power Company will show gross earnings for the year to be $2,589,000, as compared with $1,937,000 for the previous twelve months. The net revenue after deducting interest on bonds, fixed charges, and a large sum to make good the washing away of the dam at Chambly, amounts to $900,000, or 5¼ per cent. on the capital stock. The bonded indebtedness of this company, nearly $17,000,000, and bearing interest at the rate of 4½ per cent. and 5 per cent. is largely owned in New York and Boston. President H. S. Holt, in his annual report, says: "The increase in net profits for the year amounted to $165,346, notwithstanding the fact that in the gas department there was paid $61,000 additional for coal used, also an increase in wages in both gas and electrical departments of 20 per cent. There were issued during the year $16,000,000 5 per cent. bonds to pay for construction and redemption of bonds of subsidiary companies. The increase in the output of gas was 52,005,000 cubic feet (6 per cent.). The increase of shareholders amounted to 50 per cent."

LOCKPORT, N. Y., POWER ENTERPRISE.—It is reported that the Niagara, Lockport and Ontario Power Company, which is building the canal power from the Niagara River, will also submit a contract to the city to furnish Lockport with water at two cents per thousand gallons. The company agrees to deliver water by 1906. The low rate is offered to give the power company the right to eminent domain, which is considered to be in doubt

Commercial Intelligence.

THE WEEK IN TRADE.—The better weather has improved distributive trade in some sections, but the situation as a whole is more irregular, and trade is behind that of a year ago. Cereal crops, especially winter wheat, show improvement, but cotton reflects droughty conditions in the South Atlantic and Gulf states, while good reports come from west of the Mississippi. The industrial situation is not so satisfactory, a slowing down being noted in many industries. Current railway earnings are still on the decline from a year ago; clearings are running smaller, and prices tend downward. In the iron trade, finished products are rather quieter. Orders for 1,000 cars are reported placed at Chicago. At Pittsburg the iron trade is lifeless and milling operations are irregular. There is a congestion of soft coal at lake shipping points owing to the suspension of the up-lake transportation. Some concerns are buying in the open market, finding it cheaper to do so than to operate their own mines. Anthracite is in good demand. The railroads are laying off large numbers of men, the services of at least 30,000, it is said, having been discontinued since the first of the year. The strike on the Lakes is tying up the ore and coal traffic, rendering idle many thousand of ore and coal miners, and others. The labor situation is generally unsettled. Among the metals copper was very dull and weak, and prices have again been reduced. Lake is quoted at 13c @ 13⅛c; electrolytic, 12¾c @ 13c, and casting stock 12½c @ 12¾c. The exports thus far this month have aggregated 11,186 tons. It is estimated that at the end of May the exportation will amount to about 13,000 tons, which, while being large in comparison with the figures of a year ago, will show a decrease as compared to the extraordinary shipments of the last few months. *Bradstreet's* reports the number of business failures for the week ending May 26th as 184, against 215 the previous week and 181 the corresponding week last year.

PROGRESS IN STEAM TURBINES.—It has already been announced that the immense power station of the Pennsylvania, New York and Long Island Railroad, and the Philadelphia Rapid Transit Subway system of Philadelphia are being equipped with steam turbines aggregating at the start 33,000 kw. capacity; but of more immediate interest is the fact that the Interborough Rapid Transit Company of New York and the Brooklyn Rapid Transit system have both adopted steam turbines of the Westinghouse-Parsons type for extensions in power. The equipment of these systems will be in units of 5,500 kw. each, thus conforming to the precedent established by the Pennsylvania and Philadelphia systems in regard to the capacity of their largest main generating units. The Philadelphia Rapid Transit Company have also recently extended their original order for 16,500 kw. in Westinghouse-Parsons turbines by 6,000 kw. in four units of 1,500 kw. each. In the electric light and power field, the activity in steam turbine introduction still increases. Two 1,000-kw. Westinghouse-Parsons turbines will form the additional equipment to the present power system of the West Virginia Pulp and Paper Company at Piedmont, W. V. The United Electric Light Company of Springfield, Mass., have contracted for a 1,000-kw. unit for their power station at Springfield. A contract has been recently closed with the Merchants' Light, Heat and Power Company of Indianapolis, Ind., for two 750-kw. turbine units for general light and power service. The Iowa and Illinois Traction Company of Clinton, Ia., will shortly install two 400-kw. turbine units for furnishing additional power to their present railway system. An installation of peculiar interest as being the first to be placed in service in American mining work will be that of the Newhouse Mines and Smelter Company, who will install two 400-kw. units at their Cactus Mines, near Frisco, Utah. Turbines will furnish electric power for lighting the buildings and mines, and for all kinds of power throughout the entire property.

EXTENSIVE MEXICAN POWER PROJECTS.—Jose Maria Volasquez and Miguel S. Macedo, of Mexico City, the first named being a prominent engineer, have been accorded permission by the Mexican Government to establish an extensive electric power and irrigation system in the Iguala district, State of Guerrero. The waters of the Tuxpam, Lagoǒn, Amates and Tubpam rivers will be utilized. They have also applied for the necessary concession from the Mexican authorities in order to use 20,000 liters of water per second from the Tomatal River, State of Guerrero to operate an hydraulic plant for lighting purposes principally.

EXPORTS OF MANUFACTURERS in the fiscal year which ends with this month seem likely to exceed those of any preceding year. Ten months' figures just presented by the Department of Commerce and Labor through its Bureau of Statistics exceed those for the corresponding period of any preceding year. The fiscal year 1900 was the banner year in exports of manufactures, but the figures of ten months' exports of manufactures in the fiscal year 1904 exceed by nineteen million dollars those for the corresponding months of the fiscal year 1900. The total value of manufactures exported in the ten months ending with April, 1904, was $371,712,301, against $352,671,206 in the same period of the fiscal year 1900, which, as already indicated, made the highest record of manufactures exported prior to the fiscal year 1904. The fact that the present fiscal year has only two months' record to make and is nineteen millions ahead of the highest figure for the corresponding period in any preceding year (1900) seems to justify the prediction that the exports of manufactures in 1904 will be greater than those of any earlier year. The total value of manufactures exported in the full fiscal year 1900 was $433,851,756. Should the present excess of 1904 over 1900 continue during the remaining two months of the year it would bring the grand total of exports of manufactures up to $450,000,000. The export of manufactured products in ten months in 1894 was $153,466,065 or less than half what it is now.

THE STERLING COMPANY is building switchboards and additional switchboard equipment for Newark, Ohio; Francesville, Ind.; Janesville, Wis.; Waverly, Ohio; Flat Rock, Ill.; Broadhead, Wis.; Austinburg, Ohio; Newton, Ill.; Carson City, Mich. It is also furnishing its various types of combined cross connecting rack and protectors at Newark, Ohio; Centerburg, Ohio; Gambier, Ohio; Wilkshire, Ohio; Baltimore, Md.; Sheboygan, Wis.; Danville, Ill.; Lebanon, Ind.; Cleveland, Ohio; Wayne, Neb.; Coschocton, Ohio; Donora, Pa.; Louisville, Ky.; Ardmore, I. T.; Portland, Me.; Dexter, Mich, and Wessington Springs, S. D. The company has secured the contract to furnish the Standard Oil Company, of Albany, N. Y., with one of its latest type of private branch switchboards, and it isnow manufacturing a 5,000-capacity, 1,200-line multiple switchboard for the Home Telephone Company, at Tiffin, Ohio. This board is to be its new type of lamp signal magneto switchboard and will be among the first lamp signal multiple switchboards installed in the United States. The Sterling Company is, besides the above, furnishing additions and switchboard equipment for the following cities: St. John, Wash.; Wessington Springs, S. D.; Hamilton, Mo.; Chardon, Ohio; Roanoke, Va.; Johnson City, Ill.; Indianapolis, Ind.; Lorain, Ohio; Des Moines, Ia.; Hoopeston, Ill. They are also furnishing its different types of protector apparatus for the following cities: Warren, Pa.; St. Louis, Mo.; Spirit Lake, Ia.; Alexandria, Ohio; Butler, Pa.; Tampa, Fla.; Johnstown, Pa.; Chardon, Ohio; Pittsburg, Pa.; Sedalia, Mo.; Flushing, Ohio; Buckley, Ill.; Kansas City, Mo.; Superior, Wis.; New Bremen, Ohio; Utica, N. Y.

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty street, has secured a Canadian contract for nine motors varying in capacity from 5 hp. to 10 hp. to drive Hoe presses by means of Renold chains in a large Toronto lithographic plant. Various domestic orders have been received recently from Maryland, New Jersey, Pennsylvania and New York. The demand has been particularly good for small motors. The Baltimore *Sun* plant is to have two 35-hp. series parallel equipments for driving Hoe quadruple presses. The International Phosphate Company, of Cartaret, N. J., has ordered another 50-kw. belted generator. The Mauch Chunk (Pa.) Heat, Power and Electric Light Company has ordered twelve motors varying in size from 1 hp. to 10 hp. for its customers. A 50-kw. direct-connected generator has been ordered for the Brown Building, Wall Street. This is a repeat order. The engine will be Ball & Wood.

TURBINE PLANT FOR UNION METALLIC CARTRIDGE CO.—Westinghouse-Parsons steam turbines are to be installed in the new power station of the Union Metallic Cartridge Company at Bridgeport, Conn. The initial installation will consist of two turbogenerating units, each of 500 kw. capacity, to operate in parallel, and furnish 440-volt, 3-phase current at 60 cycles for general power and lighting purposes in the various shops located within three or four blocks of the power station. The turbines will operate under 150 pounds steam, 28 feet vacuum, and possibly superheat. The installation is in charge of Mr. Samuel M. Green, consulting engineer, Holyoke, Mass.

EQUIPMENT FOR MEXICAN COTTON MILLS.—The purchase is pending of a 750-hp. equipment for the water power plant of the Santa Gertrudes Cotton Mills, State of Orizaba, Mexico, owned by Sir Weetman D. Pearson. Mr. A. E. Worswick, formerly chief engineer of the Federal District Railway Company of Mexico City operating the Wernher Beit line, is now consulting electrical expert for the Pearson people, who have considerable electrical work in prospect in the Southern republic, notably in regard to the conversion of the Vera Cruz tramways, of which Sir Weetman is president. Mr. Worswick has his headquarters for the present in Mexico City.

WAGNER-BULLOCK APPARATUS.—The Washington and Oregon Water Power Company has closed contracts with the Wagner-Bullock Electric Company for three 500-kw., 3-phase Bullock generators to furnish power to operate their electric road and lighting business in the country surrounding Walla Walla, Wash. The power station will probably be located at Milton. There will be sub-stations at that point and also at Pendleton and Walla Walla.

MEXICAN ELECTRIC RAILWAY PROJECT.—An electric railway is to be constructed between Puebla Nueva and Navidad del Puerto, in the State of Jalisco, Mexico, the first port north of Manzanillo on the Pacific slope. The line will be built by the owners of the Puebla Nueva mines, who are European capitalists. The material, equipment, etc., will be practically all purchased in the United States. The road will develop considerable contiguous territory.

VERA CRUZ POWER TRANSMISSION.—Mexican advices state that Antonio A. Moll is primarily interested in a scheme to utilize the waters of the River Ozolonpam, in the Canton of Acayucan, southern part of the State of Vera Cruz, for generating electric energy for transmission to various plantations operated by Americans in that part of the world. Mr. Moll proposes to make use of 10,000 liters of water per second.

GERMAN-AMERICAN CABLE.—We are advised by Felten & Guillcaume, of Mulheim on Rhine, that the new German-American cable on the cable steamer "Stephan" recently in port at New York, was made by the company now laying it, viz., the North German Cable Works (Norddeutsche Seecabelwerke Actiengesellschaft) of Nordenham, Germany, which is under the technical direction of the firm first named.

GREAT NORTHERN POWER PLANT.—The Great Northern Power Company, Duluth, Minn., are to instal vertical turbines and other apparatus to operate at 250 revolutions per minute under a head of 365 feet. It is proposed to have a 35,000 hp. plant in operation in 1905. The plans provide for an increase in capacity up to 80,000 hp. Another hydraulic installation of 12,000 hp. at a 70-foot dam is also proposed.

EQUIPMENT FOR NEW MAIDEN LANE BUILDING.—Percival Robert Moses, consulting engineer, 35 Nassau street, will draw up the plans and let the contracts for the equipment to be installed for light and power purposes in the twelve-story office building to be erected at 48-50 Maiden Lane, New York, by Mr. S. F. Myers, of that address.

LIGHTING OUTFIT FOR AUSTRALIA.—The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty street, has secured an export order for a 60-hp Harrisburg standard engine to be direct connected to a 35-kw. Western Electric generator. The equipment is to be shipped to Australia for lighting purposes.

POWER EQUIPMENT ORDERED FOR GUADALAJARA MINES.—Westinghouse generators and Pelton wheels are to be installed in a plant on the Thomas River, Territory of Tepic, Western Mexico. The power is to be used for operating the Central Mining Company's mines located in the Guadalajara district.

EQUIPMENT FOR BATTLESHIP INDIANA.—The U. S. battleship Indiana now being overhauled at the Brooklyn Navy Yard is to be equipped with three 100-kw. C. & C. generators direct connected to Forbes engines of 150-hp. capacity each. This equipment is to be used chiefly for lighting purposes.

MORE LIGHTING EQUIPMENT FOR VERA CRUZ.—The lighting system in Vera Cruz, Mexico, is to be increased. The contract is held on behalf of the original concessionaries' estate by Francisco Hernandez. An additional 500 kilowatt equipment will be installed in the power house.

DURANGO LIGHT AND POWER SCHEME.—Miguel Morga, of Yopia, State of Durango, Mexico, has applied to the Mexican Government for a concession which will permit of the utilization of the waters of the Sobrices River for operating a large electric light and power plant which he will build.

EQUIPMENT FOR MEXICAN SUGAR PLANT.—The Eastwick Engineering Company, Limited, of 42 Broadway, has secured a contract for the construction of a 1,000-ton sugar plant in Mexico, which will be installed with considerable electrical equipment for light and power purposes.

CHIHUAHAN LIGHT AND POWER PROJECT.—An extensive electric light and power plant is to be built at Guaynopita, State of Chihuahua, Mexico. The current will be generated by water power. Mr. J. W. Taylor, of El Paso, Texas, is primarily concerned in the enterprise.

CONDENSERS FOR TOKIO PLANT.—The Wheeler Condenser and Engineering Company, 42 Broadway, has secured a substantial contract for condensing equipment to be installed in the power station of the Tokio (Japan) Street Railway Company.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary S. S. Stadtler, 39 S. 10th St., Philadelphia. Next meeting, St. Louis, Sept. 12-17, 1904.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next meeting St. Louis, Mo., Oct. 12 and 13, 1904.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Indianapolis, Ind., June 15 and 16, 1904.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., June 15, 16 and 17, 1904.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, D. Fleming, Harrisburg, Pa.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y. Next meeting, Utica, July 19, 1904.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, LaSalle, Ill.

INDIANA INDEPENDENT MUTUAL TELEPHONE ASSOCIATION. Next meeting, Lafayette, June 28 and 29, 1904.

INDIANA PUBLIC UTILITIES ASSOCIATION. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Pichardt, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, St. Louis, Sept. 13 and 14, 1904.

INTERNATIONAL ELECTRICAL CONGRESS. General secretary, Dr. A. E. Kennelly, Cambridge, Mass. Meeting, St. Louis, Sept. 12-17, 1904.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Dubuque, Ia., April, 1905.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Ia. Next meeting, second Tuesday, March, 1905.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ind.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Dudley Farrand, Newark, N. J.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept., 1904.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Sandusky, Ohio, Aug. 16, 17 and 18, 1904.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, Canton, Ohio.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next annual meeting June 21, 1904.

SOUTHWESTERN ELECTRICAL ASSOCIATION. Secretary, J. L. Ellis, Oklahoma City, Okla.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSOCIATION. Secretary, Frank E. Scovill, Austin, Texas.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, Sept. 21 and 22, 1904.

WESTERN SOCIETY OF ENGINEERS, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

General News.

THE TELEPHONE.

MONTGOMERY, ALA.—The Eastern Shore Telephone Company has been incorporated at Fairhope.

BIRMINGHAM, ALA.—The Smith County Telephone Company has been incorporated with headquarters at Taylorville. The capital stock is $30,000.

RED BLUFF, CAL.—The Red Bluff & Paskenta Telephone Company has been incorporated, the capital stock being $5000. The incorporators are Albert, R. O. Snelling, E. D. Gardner and others.

SAN LUIS OBISPO, CAL.—The Sunset Telephone Company is rebuilding its entire system in this place involving an expenditure of about $20,000. A new multiple, central-energy switchboard will be installed in the exchange in place of the old-fashioned one now in use.

BOISE, IDA.—The Grangeville & Salmon River Telephone Company has been incorporated with a capital stock of $12,000. The directors are L. Hollingshead, J. O. Levander and others.

MANLIUS, ILL.—The Bureau County Mutual Telephone Company has increased its capital from $2500 to $20,000.

SAVANNAH, ILL.—The Carroll County Independent Telephone Company has increased its capital from $75,000 to $150,000.

ASSUMPTION, ILL.—The Assumption Telephone Company has been incorporated with a capital stock of $2400. The directors are S. S. Shafer, S. J. Long and others.

DELPHI, IND.—The Flora Bringhurst Telephone Company has been organized with W. G. Calene as president.

BLOOMFIELD, IND.—The New Home Telephone Company has authorized the issue of $100,000 preferred stock.

SEELEYVILLE, IND.—The Loss Creek Mutual Telephone Company has been incorporated with a capital stock of $3500. F. H. Felling, F. Conoway and M. Modesitt are directors.

EVANSVILLE, IND.—A resolution was introduced in the council at its last meeting that no action be taken on the telephone franchise question until the court's decision is handed down. This means that the Cumberland Company's claim must be removed before the franchise can be let to advantage—which means to the highest bidder.

COLUMBUS, IND.—The rivalry between the Hope and the Hartsville Telephone Companies is now at an end. Formerly each town had an exchange and the Hope line, owned by Frank Bowman, ran to Hartsville and the Hartsville line owned by A. J. Cottle, ran to Hope, Mr. Bowman has purchased the Hartsville line, and the two have been consolidated.

EVANSVILLE, IND.—The "Anti-Monopoly Telephone Company" has been organized in this city by manufacturers with a capital stock of $500,000. The company will ask for a 30-year franchise in a few days and will agree to pay the city a bonus of $125,000 in that time. The following well-known manufacturers were elected officers: B. F. Von Behren, president; R. Manheimer, vice-president; Henry Cook, secretary; E. Lyon, trasurer; A. L. Flickner, Joseph Kohlmeyer, E. Wile, W. S. Flickner and Fred Elmendorf, directors.

EVANSVILLE, IND.—In a meeting held here it developed that the way in which the Citizens' Telephone Company is to pay the debts of the old municipal scheme is through the purchase of the plans of the latter company. For a year employees were at work on plans for the plant to be installed by the municipal company. These are now held to be the chief assets and it is believed they can be sold for a sum sufficient to wipe out the indebtedness, and of course the only company that would need them would be the new concern coming into the field.

INDIANAPOLIS, IND.—The telephone capitalists from Pennsylvania and Ohio, headed by J. G. Splane, of Pittsburg, who have been inspecting the independent plants in the middle west and perfecting plans whereby an independent long-distance line from St. Louis to the Atlantic coast is to be constructed spent two days in Indianapolis inspecting the exchanges of the Indianapolis company and conferring with the officers of the New Long-Distance Telephone Company. Mr. Splane said that the arrangements had been completed and that the service would be given to the people as soon as a few short connecting lines can be constructed. He said no separate company will be capitalized for the long-distance line, but each of the large companies will construct and control the lines in its territory. The New Long-Distance Company will complete the lines in Indiana, the Kinloch in Illinois and Missouri, the United States in Ohio, the Independent Long-Distance Telephone & Telegraph Company of Louisville in Kentucky, and the Western Company in Kansas and Missouri. The plan of operation will be similar to the traffic arrangements between the railroads of the country.

WEBSTER CITY, IA.—The E. H. Martin Telephone Company has bought $10,000 worth of telephone cable from the Stromberg-Carlson Company.

KEOKUK, IA.—The Iowa Telephone Company will soon construct conduits for the wires in the downtown district. A site has been purchased for a new exchange building.

FRANKFORT, KY.—The Brandenburg & Big Bend Telephone Company, of Meade County, has filed articles of incorporation with a capital stock of $1050. The principal stockholders are S. B. Crecelius, William Green and M. J. Bennett.

EASTON, MD.—The Cecil Farmers' Telephone Company has been granted a charter to operate a system in Cecil County.

BANCROFT, MINN.—A new telephone company has been organized here with A. H. Henry as president.

ST. PETER, MINN.—Farmers of Lake Prairie and Lavasse have formed a company to build 18 miles of rural telephone line.

BILLINGS, MO.—The Billings Telephone Company has been incorporated with a capital stock of $10,000. The directors are J. Schmill, C. A. Dewitt and others.

ST. LOUIS, MO.—Financial arrangements have been completed by the Kinloch Long Distance Telephone Company of Missouri with a St. Louis banking syndicate whereby it, together with other leading independent companies of the country, will be enabled to perfect a trans-continental long-distance system. The Kinloch Company will shortly file a first mortgage deed of trust to the Mississippi Valley Trust Company, of St. Louis, trustee, covering all of the suburban and interurban properties embraced in the long distance service, to provide additional capital for extra outlays needed for additions, extensions and other like improvements. Rate agreements have been formed between all of the various independent telephone companies, situated between Pittsburg and Kansas City, whereby the service will be in operation within the next few months.

BILLINGS, MONT.—The Billings Mutual Telephone Company and the Montana Telephone Company, which will operate here and in eastern Montana, have filed articles of incorporation. The former has a capitalization of $40,000 and the latter $10,000.

WAYNE, NEB.—The Wayne Independent Telephone Company has filed articles of incorporation, the capitalization being $15,000. The officers are: President, Thomas H. Fritz, vice-president, Irving E. Huff; secretary, Frank E. Bell, and treasurer, Andrew N. Matheny.

CONCORD, N. H.—The Independent Telephone Company will install a system in Claremont, Newport and Sunapee.

ROCHESTER, N. Y.—The Hamlin Rural Telephone Company has filed articles of incorporation with a capital stock of $5000.

COOPERSTOWN, N. Y.—The Otsego Home Telephone Company has been incorporated with a capital stock of $40,000. F. C. and A. A. Ward are the directors.

GLENS FALLS, N. Y.—The stockholders of the new Union Telephone Company of this place have voted to consolidate with the Troy and Saratoga independent companies.

POTSDAM, N. Y.—The Northern Union Telephone & Telegraph Company has been incorporated with a capital stock of $50,000. The directors are A. B. Thompson and others.

ALBANY, N. Y.—The South Bethlehem Telephone Company has been incorporated with a capital stock of $2000 to establish a telephone line between South Bethlehem, Selkirk and Cedar Hill. The directors are E. C. Palmer, Charles D. Niver, J. R. Davidson, of South Bethlehem; Newton B. Vanderzee, John W. Mosher, John B. Mosher and John F. Vrooman, of Selkirk.

STRYKER, OHIO.—The Stryker Telephone Company has increased its capital from $10,000 to $15,000.

CLEVELAND, OHIO.—The Citizens' Telephone Company, of Cleveland, has increased its capital stock from $40,000 to $50,000. Mr. H. W. Bolles is president.

OTTAWA, OHIO.—The Ottawa Mutual Telephone Company has been incorporated with a capital stock of $1000 by C. O. Beardsley, J. H. Purnell, F. E. Smith, E. L. Tapper and George Fritz.

SUMMERFIELD, OHIO.—The Summerfield Telephone Company has been incorporated with a capital stock of $5000. The directors of the company are J. H. Sparling, William Simmons and others.

GILBERT, OHIO.—The Gilbert Telephone Company, with a capital stock of $2000, has been incorporated by E. L. Roe, Chalmer Menafee, H. L. Nye, J. B. Rhodes, W. M. Bateman and S. W. Wipn.

COLUMBUS, OHIO.—The Alvordton Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are A. L. Bigelow, D. C. Lord, C. F. Poulson, P. C. Bigelow and V. E. Cunningham.

COLUMBUS, OHIO.—The Citizens' Telephone Company is extending its service and expects to install 4000 new telephones during the summer. The company expects to have its automatic switchboard installed the first of next year.

CINCINNATI, OHIO.—It is reported that a combination may be effected of all the independent telephone companies seeking to establish systems in Cincinnati, except the Queen City Telephone Company, whose application is now being heard in the Probate Court. The proposed combination will include the Interstate Telephone Company, the Fitzsimmons Telephone Company and the Cincinnati Telephone Company.

ORWELL, PA.—The People's Co-operative Telephone Company, of Orwell, has recently been organized with the following-named officers: President, E. D. Chaffee; vice-president, J. C. Petts; secretary, H. G. Newell; treasurer, E. B. Arnold.

COOKEVILLE, TENN.—The Gainesboro Telephone Company has petitioned for a franchise to establish an electric light plant in Cookeville.

GREEN BAY, VA.—The South Side Telephone Company has completed its line between this place and Farmville.

SPOKANE, WASH.—The Interstate Telephone Company contemplates building a line from this city to Harrison, Idaho, a distance of 200 miles.

OSHKOSH, WIS.—The Kirchhayne & Cedarburg Telephone Company, of Washington County, has increased its capital stock from $500 to $1500. Mr. William Tischerson is president, and W. P. Jocham, secretary.

PETERBORO, ONT.—The council for the city of Peterboro has granted to the Canadian Machine Telephone Company a ten years' franchise. The price for telephones must not exceed $15 per year for residences, and $20 per year for business. The wires and cables must be placed underground on the principal streets.

WALKERVILLE, ONT.—The town council of Walkerville has refused to renew the franchise of the Bell Telephone Company unless the company pays more money for its privilege. The town of Sandwich, Ont., some time ago also refused to renew its franchise to the company on precisely the same grounds.

Electric Light and Power.

LEWISVILLE, ARK.—The Lewisville Light & Water Company, of Lewisville, has been incorporated. Capital, $25,000. E. B. Daniel is president, and G. W. Dobson, secretary.

LOS ANGELES, CAL.—John Johnson, Jr., representing Los Angeles parties, has asked for franchises for gas and electric plants at Oceanside and Escondido.

FRESNO, CAL.—The San Joaquin Power Company is figuring on two more water power plants in the mountains and additional steam capacity in Fresno of about 1500 kw. The company will also build an additional pole line to the power houses from Fresno, a distance of 36 or 40 miles.

SANTA CRUZ, CAL.—Articles of incorporation of the Watsonville Light & Power Company have been filed with the County Clerk. The stockholders are Fish M. Ray, Oakland; Joseph C. Love, Berkeley; David H. Foote, San Francisco; Charles W. Waller, San Francisco; A. W. Linforth, San Francisco.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company will vote on June 15 on a proposition to create a bonded indebtedness of $4,000,000, to be secured by a deed of trust on all the properties of the corporation, which is the result of the recent consolidation of the Los Angeles Lighting Company and the Los Angeles Electric Company.

HARTFORD, CONN.—The Hartford Electric Light Company has secured the contract for lighting the city at $70 for each lamp per year for a period of 5 years.

KISSIMMEE, FLA.—The Kissimmee electric light plant will install a 120-hp engine and a dynamo of 1500 lights capacity.

TIFTON, GA.—The Tifton Ice & Power Company contemplates installing a large engine and dynamo in its plant at this place.

BLUE RIDGE, GA.—The Blue Ridge Electric Light & Power Company will enlarge its plant during the summer. Water power will be used for the operation of the plant.

WASHINGTON, GA.—It is expected that a 100-kw alternating current two-phase generator will be installed in the municipal electric light plant in this place. An electric pump will also be installed at the water works.

GRIFFIN, GA.—This town will issue $40,000 bonds in two or three months for the improvement of the electric light and power plant. Full information can be obtained by addressing J. M. Browner, Chairman of the Light, Water and Sewerage Commission.

GOLCONDA, ILL.—A franchise has been granted for an electric light plant, to cost $4000. J. O. Williamson is manager.

MT. VERNON, IND.—It is reported that the Mt. Vernon Electric Light Company will soon ask for bids for the construction of a plant.

ELKHART, IND.—The St. Joseph & Elkhart Power Company is said to be considering the extension of its system to Goshen, Laporte, Wakarusa and Syracuse.

MT. VERNON, IND.—The Mount Vernon Electric Light & Power Company has filed articles of incorporation with the Secretary of State. The capital stock is $15,000. R. D. Morris, G. V. Menzies and others are the incorporators.

WABASH, IND.—The Wabash Water & Light Company has incorporated with a capital stock of $160,000. Thos. W. McNamee, of Wabash, W. G. Snow, Montclair, N. J., and Edmond Le B. Gardner, of Ridgewood, N. J., are directors.

BOONEVILLE, IND.—The City Light & Power Company has been awarded the contract to light the city. The company's new plant will be pushed to completion. The contract accepted is liberal, in that it gives the city complete control, thus avoiding any possibility of excessive prices in the future. The city reserves the right to lease or purchase the plant at its option.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company will improve and enlarge its plant, increasing its capacity at least 150 per cent. The improvements will cost $250,000 or $300,000. The present powerhouse will be doubled in size and the new equipment will include 2500-hp, additional boiler capacity and two new Westinghouse turbine engines of 1150-hp each. The boilers will be equipped with the automatic chain grates.

WILTON, IA.—Bonds of $5250 have been voted to improve the electric light plant at this place.

DANVILLE, KY.—The City Council has decided to offer for sale a franchise to light this town by electricity.

CALDWELL, KY.—The Caldwell Electric Light & Power Company has been incorporated with a capital of $15,000.

STURGIS, KY.—J. M. Cartwright, Town Clerk, writes that the town would like some one to take a franchise and construct and operate an electric light plant here. The population is 1400.

BRANDON, MAN.—The Western Electric Light & Power Company, of Brandon, has been granted a charter. The company is to install an electric plant on the Assiniboine River, about 9 miles below Brandon. The capital of the company is fixed at $300,000, the provisional directors being J. M. Robinson, William Currie, William Alexander, B. Smith and John Russell, of Brandon. The company in the near future will establish a telephone system as well.

BALTIMORE, MD.—The Board of Awards has approved the specifications of the Electrical Commission for 1,000,000 feet of duct material and 250,000 feet of special duct pipe.

BALTIMORE, MD.—The Maryland Telephone & Telegraph Company has a force of men at work drawing cables through the conduits for the purpose of supplying electric light and power, the ordinance giving it this privilege having been passed and signed by the Mayor. At present the company will supply current from the Purnell plant, which it has purchased. The company intends to build a new central station at a cost of $1,500,000, and it is stated that it has options on waterfront property for this purpose.

MATTAPAN, BOSTON, MASS.—The Mattapan Gas & Electric Light Company, of Boston, has been incorporated, with a capital of $10,000. John H. Doherty is president.

EXCELSIOR, MINN.—Dr. F. B. Kramer has petitioned for a franchise for an electric light plant and water works.

BAY ST. LOUIS, MISS.—Mr. A. L. Stoker, owner of the electric light plant here, intends to put in a new engine and direct connected generator.

BATESVILLE, MISS.—The Panola Electric Light & Power Company contemplates building a line to Sardis at an early date, and lighting this town from the Sardis plant. The distance between the two places is nine miles.

SEDALIA, MO.—A charter has been granted the United Water, Gas and Electric Company, of Sedalia, with a capital of $1,000,000. The company has consolidated the Sedalia water, gas and electric companies.

ADDISON, N. Y.—The electric light plant owned by F. H. Wheaton was destroyed by fire May 13.

GRANVILLE, N. Y.—The Granville Gas & Electric Light Company is surveying for the construction of its dam at Lake St. Catherine.

HUNTER, N. Y.—The Tannersville Electric Light & Power Company has been organized with a capital of $20,000. Incorporators: Jacob Fromer, Geo. Haner, and Cyrus Showers, all of Tannersville.

KINGSTON, N. Y.—A corps of surveyors headed by Mr. Denman, of Ellenville, is engaged in locating the line for the poles and wires to bring electrical power from the Honk Falls power plant to this city for the Honk Falls Power Company.

ORRVILLE, OHIO.—The Orrville Light, Heat & Power Company will extend its street lighting system.

NEW CASTLE, PA.—The finance committee has recommended the issue of $85,000 bonds for a municipal electric light plant.

ELWOOD CITY, PA.—The Elwood Power Company contemplates establishing sub-stations at West Pittsburg and Zelenopile, and will complete 24 miles of high tension pole line.

MEMPHIS, TENN.—The North Arkansas Electric Railroad & Power Company, of Mount Hersey, Newton County, has filed articles of incorporation. Capital stock, $150,000, of which $30,000 has been subscribed. The officers are Griff Glover, Bloomfield, Mo., president; E. K. Eby, Jasper, Ark., vice-president; S. J. Norman, Jasper, secretary and treasurer.

DE LEON, TEX.—C. L. Rocker will install an electric light and power plant at De Leon.

NEW BRAUNFELS, TEX.—The Landa Electric Light & Power Company contemplates rebuilding one of its lines and otherwise improving its system at an early date. Mr. Louis A. Voigt is electrician.

BROWNSVILLE, TEX.—The city council of Brownsville has revoked the franchise which it granted several months ago to J. W. Macy, of Houston, for the establishment of an electric light plant and water works system here, and has granted a similar franchise to Judge James B. Wells, of Brownsville. Judge Wells says that he will soon commence the installation of the electric light and power plant and that he will also install a similar plant in Matamoros, Mexico, situated opposite Brownsville.

OGDEN, UTAH.—A recent electrical storm here caused damage to transformers and other machinery of the Utah Light & Railway Company to the extent of $15,000.

SALT LAKE CITY, UTAH.—The Gold Development Company has filed on the waters of Bullion canyon, as the first step towards the establishment of a power plant at that point.

OGDEN, UTAH.—It is reported that the Utah Light & Railway Company will establish a sub-station near the center of city for the betterment of electric lighting and power supply service.

SALT LAKE CITY, UTAH.—The Pan Power & Electric Company, of Utah, has been organized in Salt Lake City, with a capital of $10,000. Wm. D. Cameron is president; Jas. A. Mahon, secretary.

SALT LAKE CITY, UTAH.—The city council has under consideration a proposition submitted by Garff & Son, of Logan, Utah, to establish a large power plant here for the lighting of the city, with the understanding that in ten years the entire plant is to be deeded over to the city. The company estimated that $200,000 will cover the cost of the plant.

DANVILLE, VA.—A new electric light plant established by the municipality is now in operation and this place is now for the first time lighted by electricity. The plant is so arranged that it is possible to use either water or steam power alone or both together. The maximum capacity of the water power plant is 170-hp and this is reinforced by the steam plant, according to the requirements.

LADYSMITH, WIS.—The Ladysmith Light & Power Company contemplates the installation of series arc lights and the development of a water power.

MARSHFIELD, WIS.—R. L. Kraus is interested in forming a stock company to develop electric power at the dam of the Consolidated Water Power & Paper Company.

ST. MARYS, ONT. The St. Marys Corporation expects to install new machinery next fall.

OTTAWA, ONT.—The city of Ottawa, some two years ago, voted for a civic lighting system, but at a recent meeting of the city council, in spite of the voice of the citizens, the Ottawa Electric Company was given a contract for street lighting for a period of ten years at $52 per light. Although this is a very favorable contract and a reduction of some $13 per lamp, yet there is much indignation manifested by the ratepayers that their wishes have been disregarded. The report of experts showed that the city could do its own lighting for $38 per lamp per year. Ottawa, therefore, stands to lose $80,000 over the ten years which the contract is to run.

THE ELECTRIC RAILWAY.

OPELIKA, ALA.—The organization of the Opelika Railway, Light & Power Company was effected a few days since by the election of the following officers: J. B. Green, president; Rush Taylor, first vice-president; Bartow Smith, second vice-president; W. C. Robinson, secretary and treasurer. The plan is to build an electric railway from Opelika to Auburn and furnish light and power for both places. The capital stock is to be $300,000.

ALTON, ILL.—The merger of the Alton Light & Traction Company and the Granite City Electric Street Railway Company has been effected. This will unite several hundred miles of street railway and will connect Alton to St. Louis and intermediate points. Work will be commenced at once toward connecting the two systems of street railways. A called meeting of the directors of the two companies has been asked for on June 14, at which propositions will be considered for increasing the capital stock of the two companies from $1,000,000 each to $3,000,000 jointly.

CHICAGO, ILL.—What promises to be one of the most important enterprises yet undertaken in the way of electric railway building in Indiana was put under way the other day, when the Chicago and Northern Indiana Railroad Company filed articles of incorporation. This company purposes to build an electric railway from Chicago to Indianapolis, through Lake, Porter, Jasper, Pulaski, White, Cass, Howard, Clinton, Tipton, Hamilton and Marion counties into Indianapolis over a private right of way. The directors of the company are Lester Soule, A. L. Wheeler and Senator Charles N. Thompson, of this city; Henderson E. Davenport, Sheridan; James G. Kemp, Kempton; Martin W. Eikenbury, Russiaville, and Luther McDowell, Young America. The nominal capital stock is $25,000, of which Mr. Soule holds $15,000. It is said, however, that millions are back of the project, and that it has the support of several wealthy men of the State who are not among the incorporators. Mr. Soule is president and general manager of the Globe Construction Company, of Des Moines, Iowa, which holds the contract for building the Indianapolis and Logansport steam road. An official of the company says that the road will operate in competition with all steam roads covering the territory; that freight and passenger traffic will be carried on just the same as on steam roads, and that the line will be equipped with standard passenger cars and Pullman sleepers.

PRINCETON, IND.—The Evansville & Princeton Traction Company has completed a survey of an extension from Princeton to Vincennes. White River will have to be crossed near Hazleton. When this line is built only one gap will remain to be closed up to afford through service between Evansville and Indianapolis. This gap is one of 30 miles between Brazil and Danville.

LAWRENCEBURG, IND.—The Cincinnati, Lawrenceburg & Aurora Electric Street Railway Company has increased its capital stock from $750,000 to $1,000,000, in order to obtain funds to complete the betterments, extensions and changes of route necessary for the successful operation of the business of the company, and for the purpose of increasing its working capital. J. C. Hoover is president and Stanley Shaffer, secretary.

TERRE HAUTE, IND.—The Terre Haute Electric Traction Company has changed its name to Terre Haute Traction & Light Company. The company has also filed amended articles of incorporation thereby enlarging the purposes for which the corporation was formed, and naming additional cities and towns in which, and in the vicinities of which, it is proposed to carry on operations. In short, the company will extend its lines through Clay, Vermillion, Clinton and Greene Counties.

MUSKOGEE, I. T.—The City Council has granted a street car franchise to Capt. Ira L. Reeves and N. A. Gibson.

LEXINGTON, KY.—The Blue Grass Traction Company, operating from Lexington to Paris, Ky., and from Lexington to Georgetown, Ky., has sold $700,000 of 5 per cent. bonds, a considerable portion of which were taken in Cleveland and the balance in Cincinnati and Lexington, Ky. The Cleveland Trust Company is trustee for the mortgage.

BILOXI, MISS.—Capt. W. K. Penny has been granted a charter for the construction of an electric railway between Biloxi and Pass Christian.

PHILADELPHIA, PA.—The directors of the Public Service Corporation have declared the semi-annual dividend on the stock of the South Jersey Gas, Electric & Traction Company and confirmed the lease of the Camden & Suburban Company.

POTTSTOWN, PA.—Application for a charter has been made by the Pottstown & West Chester Improvement Company, which has been formed with a capital stock of $400,000. This is the company of which C. Wesley Talbot, ex-Burgess of West Chester, is president. The plant is to build an electric railway between Pottstown and West Chester.

JOHNSTOWN, PA.—It is reported that the Johnstown Coal & Coke Company, owning mines at Moss Creek, has become interested in the plan to build an electric railway from Johnstown to Spangler and Moss Creek. The mines of the company are at present very inaccessible, and it is said that the company, in connection with local people, will go into the project and finance the deal.

NEW CASTLE, PA.—A complete reorganization has been effected of the Pennsylvania & Mahoning Valley Electric Railway Company, which controls the local and Youngstown systems and about 100 miles of tracks throughout Eastern Ohio. Superintendent M. E. McCaskey is made second vice-president and general manager of the entire system. W. C. Smith, of Youngstown, is now general manager under Vice-President McCaskey. The local offices are made the general offices, and the Youngstown clerical force will be brought here.

WELLSBURG, W. VA.—H. G. Lazear, of Wellsburg, promoter of the proposed electric railway between Wellsburg and Bethany, is now in New York negotiating with the Westinghouse Company for the construction of the line.

NEW INDUSTRIAL COMPANIES.

THE ARNOLD ELECTRIC MANUFACTURING COMPANY has been incorporated with a capital stock of $3000, by G. L. Clegg, C. H. Crawford and Leon Stroh.

THE GENEVA ELECTRIC COMPANY has been incorporated in Geneva, Ohio, with a capital stock of $5000, by Homer Hood, Marcus Westerman, Lewis H. Young, Abner G. Webb and Harry B. Gregory.

THE CATARACT ELECTRIC SUPPLY COMPANY, with a capital stock of $100,000, has been incorporated at Buffalo, N. Y., the directors being N. S. Hallett, F. T. McDonald and E. B. Collister, Buffalo.

THE PRESSED STEEL POLE COMPANY, of Jersey City, has been incorporated with a capital stock of $125,000. The names of the incorporators are C. L. Wilson, John Roland, N. B. Neaghy and E. A. Kelly.

THE AMERICAN GARAGE & MAINTENANCE COMPANY, of New York, has been incorporated with a capital stock of $100,000. The incorporators are J. T. Rainier, P. N. Lineberger and H. U. Kibbe, New York.

THE COMMONWEALTH ELECTRIC COMPANY, of Jersey City, has been incorporated in New Jersey with a capital stock of $100,000. The incorporators are Graham Sumner, Ross A. Mackay and Mark Hyman.

THE F. C. THOMPSON COMPANY has been incorporated in New York for the purpose of manufacturing scientific instruments. The capital stock is $25,000 and the incorporators are F. C. Thompson, F. M. Ashley and Hattie A. Dean, New York.

THE CONSTANT DYNAMO COMPANY has been incorporated at Portland, Me., to manufacture electrical apparatus. The capital stock is $5,000,000, of which $250 is paid in. The officers are: President, Harry L. Cram, of Portland; treasurer, Charles Howard Weston, of Boston.

THE ELECTRIC CONSTRUCTION COMPANY has incorporated at Elkhart, Ind., with a capital stock of $25,000. The company will establish its principal office and plant in Elkhart for the purpose of manufacturing electric batteries and electrical appliances and other mechanical devices. Ernesto Sassenhoff, L. B. Hornbeek and B. R. Reid are the incorporators.

LEGAL.

CLEVELAND FIVE-CENT FARES.—Justice White, of the United States Supreme Court, has handed down a decision affirming the decision of the United States Circuit Court for Northern District of Ohio in the Cleveland (Ohio) Street Railway fare cases. The opinion was favorable to the railway. The cases involved the validity of the ordinance passed by the City Council of Cleveland in 1898, fixing the rate of fare on the street railways at 4 cents cash, or seven tickets for 25 cents. The Supreme Court held that the consolidation ordinance of 1885, fixing fares at 5 cents, constituted a contract binding both on the city and the railway companies.

TELEPHONES IN POOL ROOMS.—Some of the lawyers for the poolroom men have made demands upon the New York & New Jersey Telephone Comapny to replace the telephones which were ripped out of poolrooms by the police recently. The telephone company stated that the matter would be referred to the law department of the company and the contracts examined. Many of the poolroom men had made contracts with the company for a year, and declare that the company must replace the instruments which the police seized or stand suit for damages. It is the intention of the poolroom men to bring such suits, not in the guise of poolroom owners, but as regular subscribers whose contracts have been broken.

CHICAGO TROLLEY FRANCHISES.—A decision, which in effect upohlds the so-called ninety-nine-year act, but restricts application, was announced in Chicago last month by Judges Grosscup and Jenkins in the United States Circuit Court. The decision says the act applies to all ordinances and grants made by the City of Chicago up to the adoption of the city charter in 1875, but does not apply to grants after that date. Mayor Harrison said the city would appeal so as to get a final decision from the United States Supreme Court. The "Ninety-nine-Year Act" is a statute passed by the Illinois Legislature many years ago granting the street car companies in Chicago practically a free hand if the contentions of the companies were accepted. The validity of the act and the scope claimed have been bitterly contested by the city, one of the grounds of attack being the allegation that the enactment was obtained dishonestly.

SECOND-HAND LAMPS ENJOINED.—In the United States Circuit Court for the District of New Jersey the following injunction was granted on May 16th, 1904, by Judge Archbald, in the case of the General Electric Company vs. McKeon et al. "This motion having come on to be heard on the sixteenth day of May, 1904, upon the pleadings and affidavits of both parties filed herein, and having been argued by Charles Neave, Esq., on behalf of the complainant and by William J. Kearns, Esq., on behalf of the defendants, and due consideration having been had, it is ordered that a preliminary injunction issue out of and under the seal of this court directed to the defendants, William F. McKeon and Joseph Conning, strictly enjoining and restraining them and each of them and their servants, employees, agents and workmen from directly or indirectly selling or otherwise disposing of any old or second-hand "Edison" incandescent electric lamps without plainly and unmistakably marking them and each of them with the words "Used and Second-hand," until the further order of this court." It appears that two other preliminary injunctions of similar character have been issued against other persons.

NEGLECT OF ELECTRIC LIGHTING COMPANY.—The Supreme Court of Pennsylvania has recently handed down a decision in the suit of Daltry vs. Media Electric Light, Heat & Power Company, holding as follows: 1. An electric light company is bound to use the highest degree of care practicable to avoid injury to any one liable to come accidentally or otherwise in contact with its wires. 2. Where an electric light company negligently permits its wires to come in contact with the wire of another, thereby causing an accident, it is responsible for the injury resulting. 3. Where an owner of a house procured defendant electric light company, at his own expense, to introduce electric light into the house by running a wire from its line at the gateway across the lawn to the building, and on the removal of such person from the house the company cut off electric connection, but left the wire hanging in connection with the feeder line to the street, it was not relieved from liability to a boy injured by coming in contact with such wire by the fact that it was not the owner. 4. Where an electric light company left a wire connected with its plant hanging from a pole in the lawn of another to within a few inches of the ground, and a boy was injured by coming in contact therewith, it was no defense that the boy was a trespasser on the land at the time of the accident. 5. Evidence in an action against an electric light company to recover for injuries received by coming in contact with a wire of the company is held to sustain verdict for plaintiff.

OBITUARY.

DR. ADOLPHO ASCHOFF, of the Brazilian electrical engineering and contracting firm of Aschoff & Guinle, of Rio de Janeiro, which concern represented the interests in that part of the world of a score of leading American electrical manufacturing firms, including the General Electric Company, is dead. When last in this country, where he had many warm friends and admirers, Dr. Aschoff was in very poor health. His first visit to the United States was made in 1893 when he was attached to the Brazilian Commission at the Chicago Exposition. He leaves a wife and one daughter.

WILLIAM WALLACE.—Mr. William Wallace, who was one of the founders of the firm of Wallace & Sons, at Ansonia, Conn., died at his home in Washington, May 20, in the eightieth year of his age. Mr. Wallace was a native of England, where he was born in 1825. He was at one time associated with Professor Moses G. Farmer, and in 1876, at the Centennial Exposition, he brought out the Farmer-Wallace dynamo machine with which the buildings were successfully lighted, this being one of the earliest applications of electric lighting in this country. He made several improvements in arc lighting apparatus. Mr. Wallace was greatly interested in scientific matters and had a laboratory fitted up in his house for experimental work. For some years he lived quietly in Washington. He is survived by a son, who lives in Rochester, N. Y., and a daughter who has been his companion for several years. In February, 1893, Mr. W. J. Hammer contributed to the columns of THE ELECTRICAL ENGINEER, of which this journal is the successor, a brilliant series of articles on Mr. Wallace's work, profusely illustrated with original photographs and other material. In these articles the interesting fact is mentioned that Mr. Wallace was an Englishman, having been born in Manchester, March 16, 1825, and coming to America with his parents in 1832. His people were among the early settlers of Ansonia, Conn., where they developed pioneer branches of the copper and brass industry. It was out of such work that grew the connection of Mr. Wallace with electrical affairs and his close intimacy with such men as Farmer, Edison, Sprague, Prof. Barker and many other celebrities. The first Wallace dynamo machine dated back to 1874, and at the Centennial Exposition as well as at later exhibitions several interesting pioneer types of such machinery produced at the Wallace works were shown. In 1875 Mr. Wallace began making arc dynamos and some of his arc lamps, among the earliest known in the country, were used at the Centennial. In fact, Mr. Wallace invented and constructed the first arc lamp made in this country, with plate carbons adjustable by hand. Mr. Wallace also was the first here to run arc lamps in series, and one of the first four operated in this manner is now among the relics in the possession of Columbia University, New York City. The experimenting done by Mr. Wallace with arc lamps and with other kindred apparatus would fill a volume. The great electro-magnets made for West Point and for the Stevens Institute of Technology were of his construction. Another branch of work carried out by Mr. William Wallace with his brother, Thomas, was the construction and operation of a huge electro-deposition plant for making the compound copper-plated steel wire used by the Postal Telegraph Company between New York, Washington, Chicago and St. Louis for Elisha Gray's harmonic telegraph. In these baths over 100 miles of steel wire was treated at the time. Mr. Wallace was himself very much interested in electrical history and development and was a collector of its relics and literature. He was a delightful man to know.

EDUCATIONAL.

CASE SCHOOL OF APPLIED SCIENCE.—The inauguration of Dr. Chas. Sumner Howe as president of Case School of Applied Science, of Cleveland, Ohio, was held in that city May 10 and 11. The inaugural exercises were attended by more than a hundred delegates from over seventy-five leading colleges, technical schools, universities, engineering societies and scientific journals. Euclid Avenue Congregational Church, where the exercises were held, was filled to overflowing. Dr. Worcester R. Warner, representing the Board of Trustees, made the opening address and was followed by President Henry Churchill King, of Oberlin College; President Ira Remsen, of Johns Hopkins University; President H. S. Pritchett, of the Massachusetts Institute of Technology; Mr. John R. Freeman, of the American Society of Mechanical Engineers, and President Charles F. Thwing, of the Western Reserve University. In his inaugural address Dr. Howe spoke on "Does a Technical Course Educate." After an informal luncheon the Case School Laboratories and Shops were opened for the inspection of delegates. An inauguration banquet was held at the Hollenden Hotel in the evening. Case School of Applied Science is one of the most progressive and best equipped technical schools in the Central West. It was founded by Leonard Case, Feb. 24, 1877, and the present school was opened for instruction September 15, 1881. At the inauguration exercises it was announced that Mr. John D. Rockefeller had presented the school with $200,000 to be used in improving its facilities.

PERSONAL.

E. H. DAVIS.

MR. ERNEST H. DAVIS, whose portrait we present herewith, was elected president of the National Electric Light Association at Boston last week, as already noted in these pages. Mr. Davis was born in Philadelphia Nov. 13, 1859. He was educated at the public schools of that city and was admitted to practice at the bar. He had always had a taste, however, for industrial and transportation enterprises, and, after securing some railroad experience, became, in 1894, connected with the Lycoming Electric Company and the Williamsport Passenger Railway Company, of Williamsport, Pa. More latterly he became associated with the Edison Electric Illuminating Company and remains active in the management of all these various enterprises. For the last few years, Mr. Davis has filled with remarkable success and efficiency the secretaryship of the Association. Each incoming president has found in him an official posted as to its affairs and enthusiastic for its advance, and the Association has never enjoyed greater prosperity and growth than during the term of Mr. Davis' incumbency. In a post of responsibility and delicacy he has made innumerable friends by his tact, energy and kindly disposition, and his election to the presidency, while quite unexepected, has been hailed everywhere with marked approval.

D. FARRAND.

MR. DUDLEY FARRAND, the new secretary of the National Electric Light Association, whose election to that position was gazetted in these pages last week, is prominently known in the electric light affairs of the State of New Jersey, where he was born at Bloomfield in 1869, a member of the old Farrand family of that State, Michigan and Pennsylvania. After education in the Bloomfield public schools he attended the Newark Academy, graduated in 1887, and then entered Princeton University for the class of '91, but owing to circumstances beyond his control was compelled to abandon his college plans. He then became connected with the Newark Electric Light and Power Company, and with Mr. P. N. Jackson was one of the mainsprings of that large enterprise. While still a young fellow of only twenty-one, he was made a director in the company, and given responsibility for a large part of the work. In 1896 he was made assistant general manager of the People's Light and Power Company and general manager in 1897, controlling directly all the concerns which constituted the People's Light and Power Company. In the spring of 1899 the United Electric Company of New Jersey was formed, of which again Mr. Farrand became general manager, with a territory including several counties of the State, and embracing latterly scores of municipalities. More lately the Public Service Corporation of New Jersey consolidated the lighting enterprises of that region, with the street railway enterprises, and Mr. Farrand has again continued in the direction of that entire department, which embraces also the generation of current for a large trolley network. Mr. Farrand is a man of considerable public spirit, and outside his official connection with other electrical enterprises is a member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineeers. While his leisure is limited, his nearness to New York will enable him to give a good deal of time to the duties of the office, which will still be carried on directly under the active and highly efficient charge of Miss Harriet Billings, assistant secretary.

MR. W. K. PALMER, M. E., consulting engineer, Kansas City, Mo., has removed his office from 402 Lyceum Building to 718 Dwight Building.

MR. G. B. LELAND, who was formerly with the Norwich, Conn., Gas & Electric Company, has assumed the management of the Stamford, Conn., Gas & Electric Company.

MR. S. R. BOTTONE has written for Macmillan Company a pamphlet all about radium, which they have recently issued. It deals with the properties and uses of the new "element."

MR. MARK A. REPLOGLE, having very recently perfected his new differential water-wheel governor, has been retained by the Replogle Governor Works as chief engineer, and the manufacture and sale of this new machine will begin at once.

MR. GEORGE GREENWOOD, for several years resident engineer of the Jalapa Railway & Power Company, Mexico, has been appointed to represent the interests of the General Electric Company on the Pacific coast of the Southern Republic.

MR. J. G. SPLANE, president of the Pittsburgh and Allegheny Telephone Company, writes to the effect that he is not responsible for the recent public utterances attributed to him as to an impending big independent telephone consolidation.

J. B. ALLAN.

MR. JOHN B. ALLAN, formerly vice-president and general manager of the Allis-Chalmers Company, will shortly commence his duties as Western manager of the Westinghouse Machine Company with headquarters at 171 LaSalle Street, Chicago, having direct charge of entire Western district. Mr. Allan has been prominently associated with the Allis-Chalmers Company for the past twenty-four years and has filled positions of progressively increasing importance, including those of sales manager, general manager and vice-president. Mr. Allan was born in 1860 at Davenport, Ia., and received a common high school education in his native city, followed by a course at the Wooster Polytechnic Institute, from which he graduated in 1880 as a mechanical engineer. He immediately commenced practical work, entering the service of the Edward P. Allis Company, shortly after leaving college, wherein he was successively employed as draughtsman, machinist and erecting superintendent. During this time, Mr. Allan also had charge of making economy tests of engine and steam plants. In January, 1895, the company opened a general sales office in Chicago, of which Mr. Allan was made manager, the engineering as well as the selling departments coming under his supervision. Mr. Allan's subsequent career has been one of continuous advancement, and his wide acquaintance and popularity in the field to which he has devoted his main efforts peculiarly fit him for assuming his new duties in this same field. He is a prominent member of the American Society of Mechanical Engineers and the Engineers' Club of New York.

MR. C. O. BAKER, president of Baker & Company, of Newark, N. J., and New York City, N. Y., the well-known refiners and artisans in platinum, gold and silver, sailed on Wednesday, May 18th, on the White Star steamship *Cedric*, for his annual trip abroad.

MR. J. B. WHITE, of the British electrical engineering and contracting firm of J. G. White & Company, Limited, London, is to be married early this month. The bride will be Miss Harriet Stevens, of Brooklyn. The ceremony will take place in the British metropolis.

MESSRS. T. F. MANVILLE, president of H. W. Johns-Manville Company, New York, E. B. Hatch, president of Johns-Pratt Company, Hartford, and J. W. Perry, manager of the electrical department of the former company, sailed for England on April 26th and will return about June 10th.

MR. J. W. F. BENNETT, formerly associated with the Thompson-Starrett Company, has been appointed to a responsible position in the new building department recently established by the electrical engineering and contracting firm of J. G. White & Company, Limited, of London, England, under the management of Mr. R. A. Denell, lately manager of the D. H. Burnham Company, of Chicago, Ill.

DR. ELVIO SOLERI, assistant to Prof. Morelli, professor of machine design at the Museo Industrialeo of Turin, has arrived in the United States and will represent the Italian government at the World's Fair in the capacity of technical delegate. Dr. Soleri will also represent at the Fair the Museo Industrialeo, two Italian technical journals, and make reports to several important Italian manufacturing companies on technical exhibits.

MR. FRANCIS S. THAYER, superintendent of the Westerly Gas & Electric Light Company, has been selected as superintendent of the Norwich, Conn., municipal lighting plant, by the board of commissioners. He was for 13 years with the Narragansett Electric Company, nine years of which period he was superintendent of their gas and electric plants at Warren and Bristol. Mr. Thayer is about 37 years of age. He is succeeded at Westerly by Mr. F. N. Clark, who has been with the plant there for seven years past.

MR. G. MARCONI made recently an interesting statement to the *Wall Street Journal*, resuming his recent work, especially with regard to the proposed system of marine news on the Atlantic. He said also: "The Italian government has detailed an officer of the navy to attend the St. Louis Exposition, and there give an account and exhibit of the long distance work accomplished on the voyage of the *Carlo Alberto*. He will have with him the original messages, the tape and the records. On that voyage we transmitted messages to Poldhu, to Kronstadt, Russia; Naples and Spezia, Italy, and to Cape Breton. He has been instructed to thoroughly explain to representatives of the American government the results of our experiments on that voyage."

MR. ARTHUR WEST, formerly engineer with the Allis-Chalmers Company, has joined the staff of the Westinghouse Machine Company as chief engineer, with headquarters at East Pittsburg. Mr. West is eminently fitted for his new position by his experience with the Allis-Chalmers Company, with whom he has been associated for about seventeen years in various positions. For several years past he has had full charge of their entire pumping station work. Mr. West was born at Milwaukee, Wisconsin, in March, 1867, and received a common school education at Milwaukee public schools, supplementing this by a technical course at the University of Wisconsin, from which he graduated in the class of 1887. This was followed by post-graduate work at the same institution, and he then entered the employment of the Edward P. Allis Company as a machinist, and his career with that concern has been one of continuous advancement. Some of the positions which he has filled are those of erecting engineer, assistant to shop superintendent, assistant superintendent, private engineer for Edwin Reynolds in his special work, general trouble engineer on all steam engine work, salesman in pump department, engineer of tests, manager of pump department, and finally assistant chief engineer. He is a member of the American Society of Mechanical Engineers and the Engineers' Club, of New York. Mr. West recently started for Europe to investigate the most recent practice of British and Continental engine builders.

Trade Notes.

THE J-E-M SHADE-HOLDER COMPANY has removed its office from 503 Fifth Ave., to 13 East Thirtieth Street, New York.

THE WESTINGHOUSE ELECTRIC & MFG. COMPANY has opened a sub-office at Room No. 1110 Hibernia Bank & Trust Building, New Orleans, La.

HOTEL TELEPHONES.—The Lambert Schmidt Telephone Mfg. Company, Weehawken, N. J., has just shipped a 270-drop central energy switchboard and telephones to the Grand Hotel at Grand Hotel Station, N. Y.

STANDARD TELEPHONE & ELEC. COMPANY, of Milwaukee, has removed its offices and factory from Madison to that city to secure better facilities generally. It has most advantageous quarters at Michigan and Jefferson Streets, with larger plant and new machinery.

AMERICAN STONE CONDUIT COMPANY, of 94 LaSalle Street, Chicago, has issued a neat little brochure as to stone pipe for underground conduits. It describes and illustrates a large variety of work for electrical purposes, and shows how the thing is done, in general and in detail.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising as headquarters for heating apparatus and is claiming that the central stations may make one blade of business grow where none grew before by pushing such appliances. There is a good deal of truth in this assertion.

NERNST LAMPS.—A recent publication of the Nernst Lamp Company is a handsome little pamphlet entitled "44 and 55-watt Nernst Lamps for Alternating-Current Circuits." Some excellent illustrations show the details of the lamp, which is of the single-glower, helical-heater type.

TEMPERING AND ANNEALING FURNACE.—F. W. Braun & Co., Los Angeles, Cal., have issued a pamphlet devoted to the Braun portable forge and tempering furnace which contains some excellent practical information on the subjects of annealing, tempering and case-hardening of value to those interested in these processes.

ONE FAD in electric lighting is to take advantage of the decorative effects possible with the Packard Zenith lamps. The rush of business at the present time is partly the result of orders for dining-room, pavilion and porch lighting at summer resorts. The Electric Appliance Company, Chicago, general western agents, has special circulars on these lamps.

DUNCAN METERS.—The latest bulletin of the Duncan Electric Mfg. Co., Lafayette, Ind., is devoted to the Duncan integrating wattmeter for direct currents, which is illustrated by excellent cuts showing every detail. Among the points brought out especially are the new means employed for friction compensation, the visual bearing and non-oxidizing commutator.

COLUMBIA INCANDESCENT LAMP CO., St. Louis, Mo., has issued in very neat and tasteful form a little brochure entitled "A Wallet Full of Wisdom." It is made up in wallet form as to cover, and the contents deal with the qualities of the Columbia lamp. Views are given of various departments of the factory, and there are illustrations also of different types and sizes of lamps.

FAIRBANKS, MORSE & COMPANY, Franklin and Monroe Streets, Chicago, have just issued their pumping machinery catalogue No. 480. It represents marked and consistent advance and improvement in pump design, and shows apparatus competent to fill the wants of a wide range of users in the field of power equipment, etc. Copies of this valuable catalogue can be obtained upon application by all interested.

PERKINS POWER PRESSES are the subject of a handsome and elaborate catalogue issued by the Perkins Machine Company, of Warren, Mass. It has an ornamental cover in stiff boards, and its 176 pages embrace a large variety of presses, which are shown in all their details, many of the products being also exemplified. The descriptions are in many instances full and elaborate to a degree, and specifications are also given.

WORLD'S FAIR LITERATURE.—The Electric Controller & Supply Company, Cleveland, Ohio, has prepared for distribution at the World's Fair nine bulletins describing some of its more important specialties, namely, magnetic switches and clutches, lifting magnets, solenoids and electromagnets, controllers, brakes, resistance units and electrical fittings. The pamphlets are bound in tinted covers, presenting an unusually attractive appearance.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has taken a residence at 4472 Forest Park Boulevard, St. Louis, for the use of members of its staff attending the Louisiana Purchase Exposition. The Company's exhibit, which is the largest and most comprehensive that has ever been made by a storage battery company, is practically complete. It contains many interesting features, showing the recent developments in storage battery practice.

THE JOHN H. McGOWAN COMPANY, Cincinnati, Ohio, reports a brisk trade, especially in the municipal work. It now has on its books orders for pumping machinery aggregating a total of nearly 100,000,000 gallons capacity, from the following cities: Ottawa, Ohio; Vermillion, Ohio; Johnstown, Ohio; Murray City, Ohio; Bardstown, Ky.; Pemberton, S. C.; Winston-Salem, N. C.; Kinston, N. C.; Hawkinsville, Ga.; Dalton, Ga.; Winona, Miss.; Columbus, Miss.

HAZARD MFG. COMPANY, of Wilkesbarre, Pa., has now headquarters at 71-73 West Adams Street, Chicago, and Mr. Robert H. Peet, who for three years past has had charge of the sale of insulated wires and cables made by the concern, has been made sales agent for its entire product in Chicago and Western territory. With him will be associated as assistant Mr. Homer A. Wessel, Jr., from the factory. A large stock will be carried. The Hazard products have a fine reputation in the West.

FREDERICK PEARCE, 18 and 20 Rose Street, New York City, has just issued catalogue No. 11 on telegraph and electrical apparatus and supplies. It is very complete in all the departments of telegraphy, telephony, light and power, giving special attention to the Pearce specialties in knife switches, panel boards, etc. A number of views of the offices and factory are given, and the 377 pages are profusely illustrated. It is altogether a handsome and useful publication for the industry and trade.

THE F. BISSELL COMPANY, Toledo, Ohio, builders of switchboards for lighting and power, reports that its trade in these boards has increased so largely that it has become necessary to extend its facilities and that it has recently placed large orders for additional stocks of marble and slate. The Bissell Company has found such a large demand for information on its switchboards that it has prepared a new handbook on switchboards which will be sent free of expense to anyone interested in switchboards.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY has settled in its new building, 184 Lake St., Chicago. Its prominent location and its fine new store and sales room, with increased shipping facilities enable it to take care of a largely increasing business with very much better satisfaction to customers. This company must be reckoned as a factor in the electrical supply business. Its customers are found all over the country and in foreign lands. It has quite a line of first-class specialties such as Eureka flexible conduit, Toerring arc lamps, Shedd oscillating fans, etc., etc. It is carrying a very large stock of general supplies and is increasing its line constantly by putting in new specialties as fast as perfected.

DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., has issued in its general catalogue No. 4 of electrical supplies one of the most comprehensive volumes as to electrical apparatus given to the trade of late years. It is a massive volume of 1068 pages printed on good paper in clear type and profusely illustrated with cuts of every class of electrical apparatus for which there is a market. This apparatus does not merely include the smaller varieties of electrical supplies, but ranges into the larger material, such as generators and motors, and includes even gas engines. The information given is well classified and is remarkably complete and specific, including sizes, prices, code words, descriptive matter, etc. In some of the instances the text is very full and useful. The owner of this catalogue is fortunate. To see it is to want it, and to obtain it means daily use for any busy central station manager, superintendent of isolated plants, telephone man or telegrapher.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 24, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

758,701. ELECTRIC BURGLAR AND FIRE ALARM; Solomon Schwarzchild, Rochester, N. Y. App. filed Feb. 24, 1902.

759,237. CIRCUIT CHANGER; Charles C. Cadden, Cleveland, Ohio. App. filed June 15, 1903. (See page 1088.)

759,796. LIGHTNING-ARRESTER; John C. Barclay, New York, N. Y. App. filed Sept. 9, 1903. (See page 1088.)

760,399. SELECTIVE SIGNAL SYSTEM; Fred C. Penfield and Olin Templin, Lawrence, Kan. App. filed March 17, 1902. (See page 1088.)

760,426. ALTERNATING CURRENT WATTMETER; Frank Conrad, Edgewood Park, Pa. App. filed Feb. 20, 1903. The meter is provided with two quadrature adjusting coils connected together in parallel and means for transferring resistance from the circuit of either of said coils to that of the other.

760,480. SYSTEM OF ELECTRICAL DISTRIBUTION; John S. Peck, Pittsburg, and Joseph W. Farley, East Pittsburg, Pa. App. filed July 3, 1903. Means for varying and regulating the voltage delivered to the three-phase side of a system in which transformers are employed for transforming two-phase energy into three-phase energy.

760,539. PROCESS OF RECOVERING METALS FROM ORES OR SANDS; William J. Jory and Joseph H. Jory, San Francisco, Cal. App. filed April 7, 1903.

760,549. PLUG AND SPRING JACK SWITCH; Frank B. McBerty, Evanston, Ill. App. filed Jan. 6, 1900. Improvements in the details of construction.

760,554. MANUFACTURE OF SULFID OF ALUMINUM AND ALLOYS OF ALUMINUM; Miyagoro Onda, Nagoya, Japan. App. filed Oct. 14, 1903.

760,556. MOTOR CAR; Alexander Palmros, Columbus, Ohio. App. filed Sept. 5, 1900. An electric locomotive in which the side frames are chambered out to accommodate the wheel-suspension devices.

760,561. PROCESS OF MANUFACTURING HARD POROUS ELECTRODES FOR BATTERIES; Heinrich Paul Rudolf Ludwig Porske and Gustav Adolph Wedekind, Hamburg, Germany. App. filed Nov. 18, 1903.

760,565. ELECTRICAL SWITCHING APPARATUS; Walter J. Richards, Milwaukee, Wis. App. filed April 29, 1903. Details in the switching apparatus for stopping and starting the motor driving an air compressor.

760,568. ELECTRIC INDICATOR; Edward Sadler, Upper Tooting, England. App. filed May 16, 1903. An annunciator in which a disk previously set is restored upon the sending of another signal to operate a different disk.

760,573. TELEPHONE-EXCHANGE SYSTEM; Charles E. Scribner, Jericho, Vt. App. filed Sept. 15, 1902. (See page 1088.)

760,574. ELECTRIC POLE CHANGER; Charles E. Scribner, Jericho, Vt. App. filed Sept. 15, 1902. A pole changer for ringing current in telephone exchanges arranged so that a resistance will be included in the circuit at the time contacts are broken, to prevent sparking.

760,577. CLUTCH MECHANISM; Severn D. Sprong, New York, N. Y. App. filed Oct. 29, 1903. A magnetic clutching apparatus automatically ensuring a moderate advancing movement of a planer and the automatic reversal and more rapid return movement.

760,591. FAN MOTOR SUPPORT; Ernest P. Warner, Chicago, Ill. App. filed Sept. 8, 1902. A construction of ball and socket joint whereby the motor and fan can be set at any angle.

760,598. POLE CLAMP OR COUPLINGS; Clyde B. Wynegar, Greenwood, Ind. App. filed March 7, 1904. A coupling for a trolley pole, permitting the latter to be twisted, so as to bring the wheel into the plane of the wire.

760,601. HIGH TENSION OIL SWITCH; Henry P. Ball, New York, N. Y. App. filed Feb. 25, 1902. A switch designed for safely handling high tension, large quantity currents and which under ordinary conditions of service will not be injuriously affected by the arc produced upon breaking the circuit or if injured by an excessive arc, may be readily and quickly repaired.

760,602. OIL SWITCH; Henry P. Ball, New York, N. Y. App. filed March 10, 1902. Consists essentially in locating in separate insulated oil-wells, the terminals of a conductor forming a leg of a polyphase distribution system.

760,603. ELECTRIC SWITCH; Henry P. Ball, New York, N. Y. App. filed July 5, 1902. Improvements in various features of construction, the mechanism for controlling the switch from a distance and the mechanism for shifting the circuit connections of the switch slightly before the opening or closing of the switch.

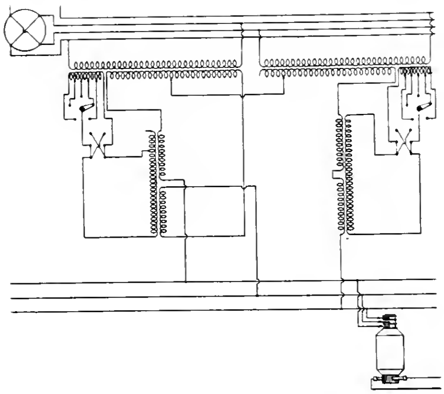
760,611. PRINTING TELEGRAPH RECEIVER; George A. Cardwell, New York, N. Y. App. filed April 11, 1903. General improvements in page printers.

760,620. INSULATOR BRACKET; Francis J. Grant, Chicago, Ill. App. filed Aug. 15, 1903. Details.

760,641. TROLLEY POLE; Alfred W. Morgan, Longbeach, Cal. App. filed Nov. 16, 1903. Details.

760,643. THIRD RAIL GUARD FOR ELECTRIC RAILWAYS; Vincent M. Newman, Bayside, N. Y. App. filed Feb. 16, 1904. The plow enters a slot in the guard to engage the third rail and sections of one side of the guard are hinged to permit the removal of the plow when necessary.

760,656. ELECTRIC TRACK SWITCH OPERATING MECHANISM; Charles W. Squires and James B. Squires, Springfield, Mass. App. filed Jan. 20, 1903. Supplemental switch mechanism for determining which of a pair of solenoids shall be energized to actuate the switch tongue.



760,480.—System of Electrical Distribution.

760,657. PORTABLE ELECTRIC HAND LAMP; George Stein, New York, N. Y. App. filed July 18, 1903. A cylindrical casing containing battery and lamp with details of a circuit controller.

760,679. CIRCUIT BREAKER; John Burry, Ridgefield Park, N. J. App. filed Aug. 30, 1902. A telegraph line circuit breaker consisting of two springs under tension to press normally against each other, an electromagnet for operating one spring to open the circuit and a pointed key past whose point the circuit may be remade or be broken by operating the key.

760,711. AUTOMATIC TELEPHONE SYSTEM; James C. Slater, St. Louis, Mo. App. filed March 10, 1902. (See page 1088.)

760,712. STORAGE BATTERY PLATE; Edward Wanton Smith, Philadelphia, Pa. App. filed Sept. 10, 1903.

760,713. AUTOMATIC REGULATOR FOR ELECTRIC GENERATORS; William A. Turbayne, Lancaster, N. Y. App. filed Sept. 8, 1903. In railway car lighting where the dynamo is driven from the axle, the dynamo is mounted upon a carriage to be adjustable bodily for altering the tension of the belt. The carriage is moved automatically and also by hand when necessary.

760,714. SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Lancaster, N. Y. App. filed Nov. 2, 1903. Improvements for automatically varying the strength of the field of the dynamo to regulate its output, in a car lighting system.

760,736. TROLLEY POLE HEAD; John E. Greenwood, Utica, N. Y. App. filed Sept. 25, 1903. Two wheels mounted in tandem on independent pivoted frames.

760,737. SAFETY CLAMP FOR RAILS; Thomas J. Harleman, Packerton, Pa. App. filed March 28, 1904. A bar having special connecting clamps at each end for electrically bridging the rails of a railway when safety signals are to be set.

760,740. MEANS FOR SAFELY CONDUCTING ELECTRICAL CURRENTS; Edward A. Jarvis, Port Richmond, N. Y. App. filed Dec. 16, 1903. A third rail is housed in a conduit having a sectional metal roof and connecting armatures are arranged to be moved by a magnet on the vehicle, so as to connect the rail with the roof, whence the current is taken by the shoe.

760,787. ELECTRIC MAIL AND PACKAGE CARRYING DEVICE; Edward G. Hamilton, Richmond, Ind. App. filed July 28, 1902. An electric mail and package carrying device adapted to travel automatically in either direction upon a pair of track wires.

760,794. ELECTRICAL BATHING APPARATUS; Robert S. Lawrence, Boston, Mass. App. filed Aug. 3, 1903. The tub is provided with electrodes so placed as to direct the current through the body of water.

760,798. CIRCUIT BREAKER; Andrew C. Miller, Corona, Cal. App. filed May 19, 1902. Details of a device intended to give a signal when the rotation of a shaft ceases.

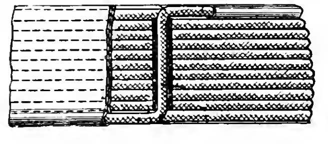
760,801. AUTOMATIC TROLLEY CONTROLLING DEVICE; Horace W. Nichols, Philadelphia, Pa. App. filed Sept. 1, 1903. A winding drum and ratchet arrangement controlling the cord.

760,810. MOTOR VEHICLE; Semple S. Scott, St. Louis, Mo. App. filed Aug. 5, 1903. A chair or small vehicle electrically operated and provided with means for stopping the motor automatically in case of a collision with any object.

760,813. ELECTRIC PRINTING MACHINE; David G. Smyth, Hartford, Conn. App. filed Feb. 16, 1903. Details.

760,815. ELECTRIC SWITCH; Frank Stevens, Philadelphia, Pa. App. filed Dec. 30, 1903. A two-button push switch contained in a box adapted to be set flush in the wall.

760,822. CLUTCH; Walter S. Timmis, Brooklyn, N. Y. App. filed Dec. 9, 1902. A clutch used in connection with a machine for producing, assembling or printing a line of characters; the clutch automatically disconnects the driven shaft from the main shaft at the end of each line, whereby the mechanism for printing will be at rest during the return of the paper carriage to commence a new line.



761,039.—Insulation for Transformer Coils.

760,828. TROLLEY; John S. Weckman and Robert J. Millard, Carnegie, Pa. App. filed Oct. 17, 1903. Details.

760,846. ELECTRIC RAILWAY SWITCH; Rupert L. Border, Pittsburg, Pa. App. filed Oct. 15, 1903. Details.

760,850. BLOW OUT CHUTE; Fred B. Corey, Schenectady, N. Y. App. filed Oct. 16, 1902. Metal plates contained within a passage in which the fuse is located are magnetized by the current traversing the fuse and furnish a field to destroy any arc that might form on the blowing of the fuse.

760,895. ELECTRIC CLOCK STRIKING MECHANISM; Emil Meyer, Swissvale, Pa. App. filed Sept. 24, 1903. Details.

760,897. STORAGE-BATTERY PLATE; Achille Meygretm, Paris, France. App. filed June 29, 1903.

760,947. ELECTRIC BOND FOR RAILWAY RAILS OR OTHER CONDUCTORS; John S. Alexander, New York, N. Y. App. filed Feb. 25, 1903. Two recesses in the abutting ends of the rails together form a chamber having a contracted opening at the surface of the rail; a spreader is placed in the chamber and a forked conductor is then driven through the narrow opening and forced into good contact with the rails by the spreader.

760,955. ELECTRIC SIGNALING SYSTEM AND APPARATUS EMPLOYED THEREIN; Robert G. Callum, Washington, D. C. App. filed Oct. 11, 1902. The object is to automatically notify central office of the breakage of a spring in any of the signaling instruments.

760,970. MEANS FOR CONTROLLING ELECTRIC CURRENTS; Isidor Deutsch, Montreal, Canada. App. filed April 30, 1902. Improvements in various features of a train lighting system.

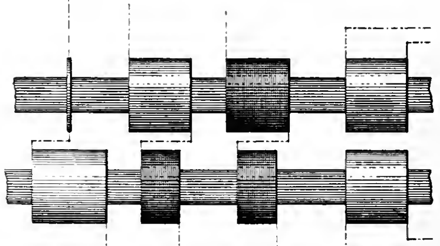
760,976. ELECTRIC SIGNAL SYSTEM; Otto Ernst, Larchmont, N. Y. App. filed Sept. 22, 1903. Details.

760,988. ELECTRICALLY CONTROLLED SWITCH; William H. Hillyer, Atlanta, Ga. App. filed Jan. 21, 1903. Details of the circuit mechanism whereby the car automatically takes current from the trolley wire to actuate the magnets which control the switch tongue.

761,000. TROLLEY; James A. Lavery, New York, N. Y. App. filed Nov. 7, 1903. Two spring-actuated guard-fingers for retaining the wheel upon the wire are controlled by a cord.

761,003. CONTROLLING MEANS FOR ELECTRIC CIRCUITS; Julius K. Lux, St. Louis, Mo. App. filed June 25, 1903. Details.

761,012. AUTOMATIC REGULATOR FOR ELECTRIC GENERATORS; Marcellus R. Shedd, Lancaster, N. Y. App. filed Sept. 8, 1903. Improvements in the regulator described in U. S. Patent 705,487.



12,223.—Alternating Current Transformation.

761,026. CALL BOX; John C. Barclay, New York, N. Y. App. filed Jan. 27, 1904. The object is to adapt ordinary messenger call boxes for use both as alarm boxes and as watchman signal boxes; this is done by a simple attachment to the call box.

761,029. APPARATUS FOR THERAPEUTICAL PURPOSES; Fred H. Brown, Los Angeles, Cal. App. filed March 28, 1904. A belt having two or more electrically energized vibrators relatively attuned to give off harmonic vibrations to the body of the wearer.

761,039. INSULATION FOR TRANSFORMER COILS; Charles Le G. Fortescue, Wilkinsburg, Pa. App. filed Sept. 29, 1903. The lead at the end of one layer which passes across the turns to begin the next layer, is inclosed in an insulating sleeve.

761,044. METHOD OF PURIFYING WATER; Virgil M. George, Youngstown, Ohio. App. filed Jan. 8, 1904.

12,223. ALTERNATING CURRENT TRANSFORMATION; Maurice Hutin and Maurice Leblanc, Paris, France. App. filed April 20, 1904. A method of generating electrical energy which consists in producing two separate alternating magnetic fluxes in quadrature and generating by the inductive influence of these fluxes three or more alternating working currents, dephased with reference to each other.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JUNE 11. 1904. No. 24.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, JUNE 11, 1904.

CONTENTS.

GOVERNMENT AND WIRELESS.

Elsewhere we print a newspaper account of the Government wireless situation at the present moment, which is illuminating as to the bureaucratic spirit that would have full play in case the Government should decide to assume complete control of a coast line wireless service. It appears that four of the cabinet departments has each its pet wireless system; that three of these are in a struggle to obtain control of the coast line service, and that at least one—the Navy Department—demands exclusive control to the elimination of any stations established by private enterprise. The plan of the latter department is, it seems, to divide the coast into zonal districts of 240 miles, yet according to the correspondent, the system which it champions—that of the German Emperor's court jester—is effective over only 70 miles. The pretence put forth—evidently to appeal to the jingo spirit—is that in time of war national defence will demand that the coastwise wireless service shall be under military control, and that this emergency must be provided for through the organization and administration in times of peace of such service on a military basis. That wireless telegraphy will in future wars play a leading part is undoubtedly true, and for that very reason the art should be permitted the freest possible development in order that it may prove of the greatest possible service when called to war duty. That such development would occur under military domination none, we believe, will seriously assert; and assuming that war periods are to continue to be short in comparison with intervening times of peace, the only proper course open is to encourage in every possible way the inventor, and to place no trammels on development through commercial enterprise, the only limitation being such restrictions as the matter of ethereal interference calls for. And the administration of such restrictions as may be necessary on account of this latter feature of wireless telegraphy would undoubtedly come more naturally under the cognizance of the Department of Commerce and Labor than under any of the departments now battling for that privilege. Under conditions of untrammeled development a wireless coastwise service would, in time of peace, grow up normally, and in time of war could temporarily, with its personnel, be turned over to one of the military departments, and give infinitely better service than an organization fostered as proposed. As to the probable result of naval control, we need only point to the humiliating rank the Naval Observatory holds among similar establishments in this country and throughout the world.

NEW SUBMARINE CABLES.

Whatever may be the ultimate results with wireless telegraphy, it is evident that submarine cable managers and promoters are pursuing their way unterrified. The Frankfurter *Zeitung* now announces that German and Dutch capitalists are to do the financing of a cable from the Dutch Island of Menado Tua, off the coast of Celebes, East Indies, to the American Island of Guam, and thence to Shanghai. Through a connection with the American cable, it is intended to eliminate British influence over the German and Dutch cable business with East Asia. A company for laying the cable is being formed. with a capital of $1,750,000, the German and Dutch Governments giving large subsidies. It is also intended to issue a 4 per cent. loan of $1,875,000, which will be taken by the Dresdner Bank, the Schaaffhausen Bank, the Disconto Gesellschaft, and the Darmstaedter Bank of Berlin, and two Dutch banks. This new announcement comes just after the completion of the second cable between this country and Germany, and gives force to our remark as to the apparent indifference of cable people to wireless progress. We do not quite understand all this Teutonic activity in the submarine cable field, but possibly in dull times the cable manufacturers are willing to help push things a bit with the financiers so as to keep their factories employed. There are, of course, political and strategic reasons to be considered and at such a hint is pointed in the advices from Frankfort.

MOTOR DRIVE AND ROPE DRIVE.

Lest our motor friends should think that they are going to have it all their own way in factories under the régime of universal electric power, we venture to call their attention to a challenge which may perhaps jog their complacency and apathy this sultry weather. The cudgels have lately been taken up strongly for rope drive and discussions of the subject by the New England and Southern Cotton Manufacturers' Associations have led to the action to which we now call notice. The American Manufacturing Company, of New York City, manufacturers of transmission rope and other cordage, agrees to furnish the necessary rope sheaves, rope and driven head for the main drives of any cotton or woolen mill in the United States, using 500 or more horse-power, which is developed at the mill site, at one-quarter the price for which any responsible company furnishing electrical apparatus will agree to install the generators, motors, motor shafts, switchboard, wiring and other appliances necessary to electrically transmit the same power. Where the power is generated at a distance, if the mill will install one central motor, the company will agree to distribute the power from the motor to the main line shafts with rope drives for one-half the cost of electrical apparatus to distribute the same power. We confess our utter inability to see how this proposition is going to prove that electric power is not all that is claimed for it, but we should be glad to see the bases upon which such an offer is taken up as economically sound and best—if it is accepted by anybody. Meantime, our motor friends will observe that they still have a good deal of missionary work to do.

OIL FOR INSULATING PURPOSES.

Among the papers read at the recent convention of the National Electric Light Association was one by Mr. C. E. Skinner, entitled as above, which contains an excellent résume of the principal data relating to transformer oil and switch oil. With steam turbines busily engaged in reducing the opportunities for the use of mineral oil, there is comfort for the central station engineer in the reflection that many hundreds of thousands of gallons of oil are being used annually for the insulation of transformers and similar apparatus. If the adoption of electric lighting sets a limit to the classical cry for oil because our lamps have burned out, at least it sets up partial restitution by the modern cry for oil because our transformers have burned out. We must have oil to insulate with, even though we do not have oil to burn. The paper points out two very significant facts in connection with mineral transformer oil, namely, that one-thirtieth of one per cent. of water in the oil markedly reduces the dielectric resistivity, and, moreover, that after one-fifteenth of one per cent. of water is present, the further reasonable increase in the quantity of water does not reduce the dielectric resistivity much further. Thus, according to certain tests cited, a sample of dry oil showed that 9.5 kilovolts were required to disrupt a gap of 75 mils, or 1.9 mm., between brass balls ½ inch, or 1¼ cm., in diameter. The effect of 1/50th of 1 per cent. of water mingled with the oil appears to have brought the disruptive voltage for this gap down to 5 kilovolts, or nearly one-half. On the other hand, about ¼ of 1 per cent. of water only reduced the voltage to 3.6 kilovolts. The moral of this tale is "keep your oil dry", like the old watchword of the flint-lock age, "keep your powder dry."

Fortunately, the heat liberated within transformers when in use promotes evaporation of moisture, and thus tends to maintain high dielectric resistivity. It would seem likely for the same reason that high-tension transformers would be more apt to break down, tensionally, after some weeks or months disuse, when moisture had somehow succeeded in condensing into the oil. The paper also shows how misconceived and erroneous are the ordinary notions concerning the inflammability of oil. The popular idea is that oil is highly inflammable, derived from observations of conditions in which oil is spread out into thin layers, readily capable of being heated to the burning point. In bulk, it is shown that oil is almost like water in its non-inflammability. The author of the paper describes experiments that demonstrate this property, and alludes to a recent case in which a blazing transformer was dropped into an oil tank to put out the fire. This is a case of adding fuel to a flame, too suddenly for the existence of the flame. The paper is both valuable and timely. It would seem that the main dependence of the electrical engineer for insulation in dealing with high tensions must be, among fluids, upon oil and air. Of these oil is incomparably the superior, and air by far the more plentiful. In the buildings, oil is being used. In the transmission lines air is relied upon. The better we can depend upon oil within doors, the better we can face the problems of air out of doors.

EFFICIENCY CURVES OF CONVERTERS.

Prof. A. S. McAllister, in his article printed last week, pointed out that in the ordinary converter the loss of power at any load may be fairly well represented as the sum of a constant or friction term and a variable which is proportional to the square of the load current. On the assumption that this statement of the losses is strictly correct, the efficiency curve with respect to load would be a hyperbola, the maximum point of which would mark the equality between the two terms referred to; i. e., equal constant and variable losses. This result is pointed out as being a close approximation. Nearly all dynamo-electric apparatus is subject to the general rule of having a substantially constant loss, and also a loss increasing with the square of the current. In so far as the proposition is correct, it has been shown that the efficiency curve is an acute hyperbola, with its maximum at equal constant and varying losses, and with the percentage drop in the apparatus equal to half the drop in efficiency below 100 per cent. Even when, owing to secondary effects of loading, the frictional losses do not remain constant, the departure from constancy is rarely so great that advantage cannot be gained in practice from the application of these propositions to the efficiency curve of a machine. For example, if the efficiency curve is still rising at full load, then either the frictional losses may be regarded as unduly heavy, or the I^2R losses are not up to their ordinary magnitude. As a rule, designers aim at making the efficiency a maximum at the average load of operation, and this is often in the neighborhood of three-quarters load.

EXPERIMENTS WITH THE MAGNETIC DETECTOR.

Our esteemed contemporary, *The Physical Review*, is always welcome, and is given an honored place on the shelves we devote to more erudite, but less immediately utilitarian, scientific literature. It is now more welcome than ever, since it has within the last two months adopted the sensible practice of issuing its pages cut. Physics is long and life is short, and no man should be compelled to do badly and laboriously by hand that which a machine can do well and easily by power. To issue a periodical, with pages uncut, is to tempt Providence and the winsome reader not to read. Although the paper knife is bloodless, yet its use excites more profanity than the sword. On page 1120 of our issue this week is an abstract of an article on some experiments by Prof. Arthur J Foley, published in the May number of *The Physical Review*, on the magnetic wave detector. The theory of action of this wave detector is that the Ewing hysteretic diagram is not shaped like a parallelogram, but something like the *f*-hole of a fiddle. The permeability of iron or steel undergoing cyclic magnetization may be defined by the expression, $\frac{d\mathfrak{B}}{d\mathfrak{H}}$ or as the gradient of magnetic flux density, when plotted with respect to magnetic force. When the curve is steep a very small change in magnetic force is accompanied by a large change in flux density; whereas, when the curve flattens, the same small change in magnetic force is accompanied by but a small change in flux density.

If now a primary and secondary winding are associated on an iron core, *small* electric reversals in the primary circuit will set up electric reversals in the secondary circuit, the magnitude of which depends, among other things, upon the permeability of the iron core; for the magnitude of the secondary impulses depends upon the extent of the change of magnetic flux linked therewith, and the greater the permeability of the iron core, the greater will be the flux changes, for a given range of magnetic variation produced by the electric reversals in the primary winding. Consequently, the permeability curve has to be as steep as possible. The Ewing diagram shows that in feeble cyclic magnetizations, the curve of $\mathfrak{B}$ becomes very steep in ascending and descending, near the mean vertical through the center of the diagram. This is the best condition of the iron core for sensitiveness in the transformer. The permeability in this steep and sensitive part of the *f* may be twenty times greater than the average permeability of the iron taken throughout the cycle. Steps must be taken, however, to renew the magnetic youth of the core, at regular intervals, by cyclic demagnetization. The function of the permanent horseshoe magnet is to bring the iron core to the brink of the sudden declivity, and then allow the feeble received electric impulse to push it over the precipice. For this reason the sensitiveness of the transformer rapidly dwindles as the magnetization becomes effected in each reversal. The sensitiveness, on the other hand, is great just when the last polarity is being wiped out and when the iron is nearly passive. Then a little disturbance in the primary coil, with a small resulting variation in $\mathfrak{H}$ will make a relatively large oscillation in $\mathfrak{B}$. All of the observations described in the article appear to be consistent with the above hypothesis.

AUXILIARY BUSINESS FOR CENTRAL STATIONS.

Two of the papers at the recent convention dealt with the much-mooted subject of "side lines" of business for central stations. One of them was an analysis of the results obtained from district heating, the other a suggestion of a new field of endeavor in the manufacture of artificial ice. Last year one of the convention papers dealt with salt works as an auxiliary source of revenue, and there is a steady tendency to study more and more these outlying fields of activity. Broadly, the situation is this: Every central station suffers from inability to utilize fully its investment in the production of its ordinary output, and besides there is in the operation of engines a thermal loss which is present at all loads. The task of dealing with these two conditions is not an easy one, and the conditions themselves are essentially distinct. The heat loss in exhaust steam and in condenser water is one which is greatest at full load, and save in stations with a large load factor, is very difficult to utilize to advantage. The loss by idle investment and by running at uneconomical load falls most heavily on stations with poor load factors, and can be avoided only by forms of utilization which in time do not coincide with the peak. Obviously, if the heat rejected by the engines could be utilized to carry on work which at times of low load could be handled directly from the unused capacity of the plant, the theoretical result would be good; but in practice the very different temperatures of the rejected and the deliberately produced heats hinder their use for a common purpose.

As regards the use of exhaust steam for heating, there is no doubt whatever that its sale is an additional source of revenue which is at times important, but as we have many times remarked, the presence of exhaust steam in an electric plant is in the vast majority of cases irrefutable evidence that electrical energy is being produced uneconomically. Unquestionably, part of the loss may be stopped by selling the steam which ought to have been better utilized in the engines, but we do not believe that it is generally and broadly an economic policy. Under exceptional circumstances, exhaust steam at extremely light pressure or even condenser water can be utilized locally for heating with admirable results. In other cases the local conditions are such that a central heating plant in itself would pay a fair return upon the investment required, and under these circumstances an electric plant can utilize its spare boiler capacity to some advantage, though as a rule the boilers fitted for use with modern high-pressure engines do not work to the best advantage for heating alone. Each plant must work out its own salvation in its own place and way as regards these heating problems. The one common error to be avoided is the supposition that exhaust steam costs nothing to speak of, and that a little back pressure is of no account. If the manager of a station with first-class condensing engines will cut out the condensers, choke the exhaust and then do a little work with the indicator after inviting in a few non-condensing friends, he will do a good bit of missionary work. Where the fuel and other costs are such that there is but little saving in condensation, exhaust steam may be worth more for heating than for power.

To our mind the auxiliary business which utilizes the spare capacity of a plant without injury to the efficiency of power production is far more interesting and satisfactory. The practical problem is as follows: A given plant being unable to build up its load factor beyond a certain point, to what uses can it apply its spare capacity taken at the times and in the amounts in which it becomes available? Clearly, the use must be discontinuous or at least not essentially steady in its demands for power, as otherwise there will be trouble at the peak. And also the business thus taken up should require power if possible all the year round with a maximum in summer. The ice plant as suggested in Mr. Wakefield's paper meets these conditions rather well. In the warmer parts of the country there is a fair demand all the year round, but most in summer when the lighting load is small. Also, if the process be properly worked, the call for power may be very greatly reduced over the peak of the load or even temporarily suspended. Search should be made for other lines of business which can be worked during hours of light electrical load without too serious investment. Any simple business in which there is a large demand for power can be profitably utilized if it can be kept clear of the peak of the load. It is even conceivable that a station able to furnish power cheaply might operate a manufacturing process with a working day deliberately arranged to begin abnormally early and to close before the peak. In fact, in Montreal this latter condition has been realized during the winter months in connection with electric power supply to factories. Certainly, it could often afford to give unusual inducements to a customer who would agree thus to arrange his hours of operation. Water power plants whose cost of operation varies very little with the load could build up their load curves in this way to great advantage, and might get material aid from industries which, like certain electrochemical ones, must get power cheaply and use it in large amounts.

A. I. E. E. High Tension Transmission Meeting.

As previously noted in these columns, a special meeting of the American Institute of Electrical Engineers will be held at Chicago June 21 and 22, the proceedings of which will be confined to a consideration of subjects relating to high-tension electric transmission. The meeting will be conducted by the Transmission Committee, of which Mr. Ralph D. Mershon is chairman, assisted by the Chicago branch of the Institute. There will be a morning and afternoon session each day. Six papers, or introductions to discussions, are on the programme, which will be considered during three of the four sessions. At the fourth session the Committee on Transmission Data will report, and there will be a general discussion on the topics presented at the meeting. The papers are printed in the May issue of the *Transactions* of the Institute, and it is requested that contributions for the discussion of the same be mailed to Mr. Ralph D. Mershon, 29 Broadway, New York, so that they may be received not later than June 17, 1904.

Mr. W. G. Carlton will contribute a paper entitled "Protection of Cables from Arcs Due to the Failure of Adjacent Cables." The paper refers particularly to the protection of cables operated at from 5,000 to 15,000 volts, these nearly always being three-conductor cables. One method of protection noted is to wrap the cables with asbestos paper or tape about one inch thick, using two layers and binding on the asbestos by means of steel or brass tape, which is applied either in an open spiral, leaving an inch or more between the turns, or with edges touching, leaving no open space. While this protection has been found adequate by several large companies, its life is uncertain on underground work and a disadvantage is that heat is less easily radiated on account of the asbestos covering. Another method of protecting cables consists in providing separate chases or runaways for them, and a third method consists in the use of a covering of vitrified clay tile. All of these methods apply more particularly to protection of cables outside of ducts. The experience of one company in Chicago has been that nearly all the trouble on high-pressure cables has been due to defective joints, moisture in the cables near the joints or to sharp bends in the cable. Some burn-outs have occurred due to the lead sheathing of the cables being damaged by electrolysis, but trouble from this source can be prevented by grounding the sheathing at intervals.

Mr. B. G. Lamme contributed a paper entitled "The Synchronous Motor for Regulation of Power Factor and Line Pressure." The conclusions of the paper are as follows:

1. A synchronous motor can be used to establish leading or lagging currents in its supply system by suitable field adjustment, and can thus affect or control power factor or phase relations of the current in the alternating-current system. 2. A synchronous motor will set up leading or lagging currents in its supply system if its field strength is held constant, and the pressure of the supply system is varied above or below that generated by the synchronous motor. Such leading or lagging currents in the supply system will tend to vary the pressure of the system. A synchronous motor can thus act as a regulator of the pressure of its supply system. 3. This regulating action is greatest with synchronous motors, which have the closest true inherent regulation (as indicated by high field magnetomotive force compared with the armature magnetomotive force) in distinction from machines which have close apparent regulation obtained by saturation of the magnetic circuit. 4. If the synchronous motor is used both for regulating the power factor for neutralizing the effect of other apparatus on the circuit, and for regulating or steadying the pressure of the supply system, its normal capacity for regulating will be diminished. 5. The most suitable speeds for best electrical conditions will in general be considerably below highest possible speeds as limited by mechanical conditions. 6. Heavy dampers will increase the effectiveness of the regulating tendency. 7. If the synchronous motor can be used for power purposes as well as for regulation, its apparent capacity is increased. This is due to the fact that the regulation is obtained by means of a wattless component and the power from the energy component, and the algebraic sum of these two is greater than their resultant which fixes the current capacity of the machine. 8. Synchronous converters in general are not suited for regulating the pressure or controlling the power factor for an alternating-current system. 9. The cost of synchronous motors for regulating purposes will, in general, be lower than for alternating-current motors or generators of customary speeds, and will approach more nearly to turbo-generator practice.

In a paper entitled "Long Spans for Transmission Lines," Mr. F. O. Blackwell considers the subject under the heads of cost of towers, strength of conductor, elasticity, strain in conductors, sag of wire, height of towers, insulators and pins, cross arms and construction of towers. The paper includes span and sag curves for aluminum and copper wire.

Mr. M. H. Gerry, Jr., in a paper, will discuss the conditions of continuous service over lines operated in parallel, under the heads of normal operating conditions and accidental conditions. Since little work can be done on high-pressure circuits, while in service, this implies that adequate switching devices must be provided, and the paper considers in detail the matter of such devices.

In a paper entitled "The Use of Ground Shields in Transformers," Mr. J. S. Peck criticises the use of such shields. His conclusions are that since the ground shield does not offer absolute protection, while it increases the cost and reduces the efficiency of the transformer and introduces mechanical and electrical difficulties, its use for high-pressure transformers is a theoretical rather than a practical means of protection. He considers that the grounding of the low-pressure winding at the neutral is a safer, more practical and cheaper method of protection than is the use of the ground shield.

Mr. H. C. Wirt will have for the subject of a paper, "The Protection of High-Pressure Transmission Lines from Static Discharges," which will be considered under the heads of ground wires and reactive coils. Mr. Wirt expresses the opinion that a transmission line can be protected from lightning discharges by suitable apparatus placed in the stations, and that it is not necessary to use ground wires, though possibly an exception should be made in cases where poles are shattered with great frequency. As to the use of reactance coils, he considers there can be no question that such coils are effective and, therefore, should always be used.

A Government Wireless Mix-up.

According to the New York *Evening Post*, the proposed government operation of coast line wireless stations has led to considerable friction between the Navy, Army, Treasury and Agricultural Departments, with the Department of Commerce and Labor yet to be heard from, and Congress, at its next session, will be called upon to deal with the imbroglio.

According to the *Post* correspondent, the Navy Department desires to abolish all shore line stations in competition with the Slaby-Arco system, and to make that exclusive within zones of 240 miles, though it is stated that this system has proved effective only over a radius of 70 miles. Meanwhile, the ocean-going steamers have installed the Marconi instruments, and that company refuses to exchange with the Slaby-Arco system, or any modification of it.

Gen. Greely regards the navy scheme as impracticable, and says that while all but one company may be driven from the coasts of the United States, continental and insular, so long as steamship companies prefer and employ another system, there is no redress, and the adoption of one scheme to the exclusion of all others is a detriment to the country, unless by means of it ships may be reached. Moreover, beyond a three-mile limit lie the high seas, where no one country can hope successfully to control.

The several departments are using various wireless systems, each under bonds protecting the United States from possible complications from patent infringements. The army is experimenting with a combination of the De Forest and the Signal Corps, or Wildman system, having purchased apparatus in the open market whenever it was considered by the Signal Corps reasonable in price. The extreme test of its efficiency is to be made in Alaska, where it is hoped to cover 107 miles. This is across a bay where ice for three successive winters has swept away the cable. The department has been driven to use a wireless system or go without communication. The army claims that its system is the best for practical purposes, and that having experimented in this line long before the navy began, it ought to have the weight of authority.

In the customs collection district of Puget Sound the Treasury Department is employing what is termed by both the army and navy experts a nondescript service, which these experts say is of use for a distance of only twelve miles. The Agricultural Department is in a tangle with Fessenden and claims to own the system which bears his name, because he developed it while he was employed by the department.

Hudson River Power in the General Electric Works.

TRANSMITTED water power from Spier Falls on the Hudson River is used in the General Electric Works more than 30 miles away. Electric power from the Hudson has operated parts of the machinery at Schenectady since 1898, the first supply having been from the water power plant at Mechanicville, some 15 miles distant. Within the past year, however, the great station at Spier Falls has been started, new transmission lines have been strung and now both of these water powers are delivering energy for use in the greatest electric manufacturing plant in the world. As the generating equipment at the Spier Falls plant is still incomplete, the maximum amount of power covered by the contract between the Hudson River Water Power Company and the General Electric Company is not yet delivered at the works of the latter company. This contract is said to call for a maximum delivery of 10,000 hp under certain conditions, and the General Electric Works have already received as much as 6,000 kw.

Between Spier Falls and the General Electric Works there are two three-phase, 40-cycle, 30,000-volt circuits. Both of these circuits are composed of medium hard bare copper wires, the size of wire in one circuit being 1/0 and in the other circuit 3/000 B. & S. gauge. At Alplaus switch house through which these lines pass at a point about five miles north of the General Electric Works, they are joined by a three-phase circuit of No. 3/0 wire from the Mechanicville water power station. By connections at this switch house energy from Spier Falls may pass to the General Electric Works over one of the two circuits, and energy from Mechanicville over the other, or both circuits may transmit the Spier Falls power.

After crossing the Mohawk River and the Erie Canal the two circuits of bare wires from Alplaus switch house enter a terminal house of special design that stands between the Erie Canal and a branch of the New York Central & Hudson River Railroad, on land of the General Electric Company. From this terminal house the two 30,000-volt circuits cross River Road, Schenectady, by means of six insulated cables, and enter the tower on a transformer house that stands in the yard of the electric works. In this house are located transformers that lower the pressure of the transmitted energy to 10,000 volts, and from these transformers the secondary circuits pass at once to the switchboard in what is known as power station No. 13, which is nearby.

At this switchboard the 10,000-volt current is distributed through transformers to four rotary converters, to a motor-generator, to a shop-testing circuit, and through several cables to the new Dock Street sub-station of the Schenectady Railway Company. From this sub-station both the railway system of this company extending to Albany and Troy, and also the local system of light and power in Schenectady are supplied with current, as described in the ELECTRICAL WORLD AND ENGINEER of May 14, 1904. The lines to the sub-stations at Colone and Latham's Corner on the Schenectady railway system formerly ran back to the switchboard at the General Electric Works, but these lines now enter the Dock Street sub-station.

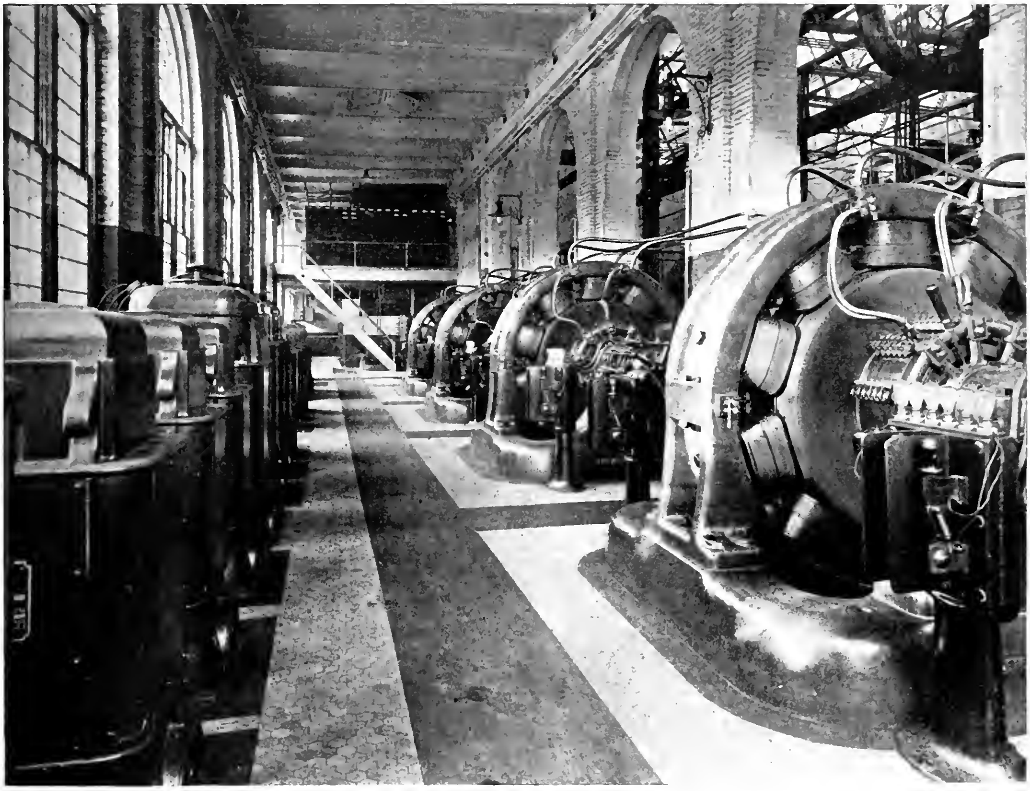


FIG. 1.—POWER STATION AT GENERAL ELECTRIC WORKS, WHERE CURRENT FROM SPIER FALLS IS CONVERTED.

The terminal house of the Hudson River Water Power Company on the General Electric property, where the bare 30,000-volt circuits from Spier Falls and Mechanicville enter, is a two-story building with brick outside walls resting on a concrete foundation. A layer of concrete 6 in. thick forms the ground floor of this house, its second floor is concrete supported by steel beams, and the roof is composed of 2¾-in. hemlock planks covered with tar and gravel. In outside dimensions at its first floor level the building measures 6 by 30 ft., and the center of the roof is 23 ft. 6 in. above the ground floor. From the ground floor to the ceiling of the second floor the distance is 10 ft. For the height of the first story the outside brick walls are 12 in. thick, and for the second story their thickness is 8 in. An 8-in. brick wall running parallel with the longer sides of the terminal house divides its first story into two parts, one of which is 5 ft., and the other 4 ft. 4 in. wide. At each end of the house there is a door to each of the apartments thus formed.

The second floor of the house forms a single room and this is entered by a door at each end that opens onto an iron platform,

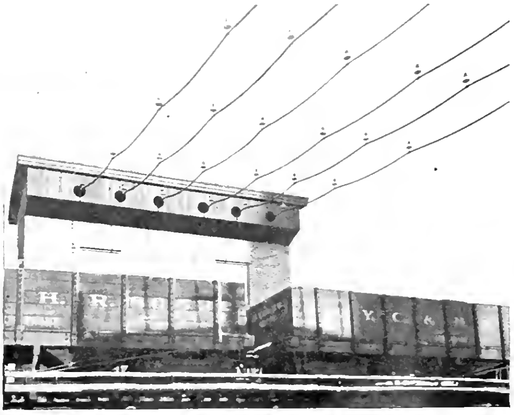


FIG. 2.—30,000-VOLT LINES OVER RIVER ROAD AT GENERAL ELECTRIC WORKS.

from which an iron ladder leads to the ground. Besides small windows in the doors, each floor is lighted through two windows in the River Road side. The upper story of this terminal house contains knife switches on one side, and oil switches on the other side for the circuits that enter it.

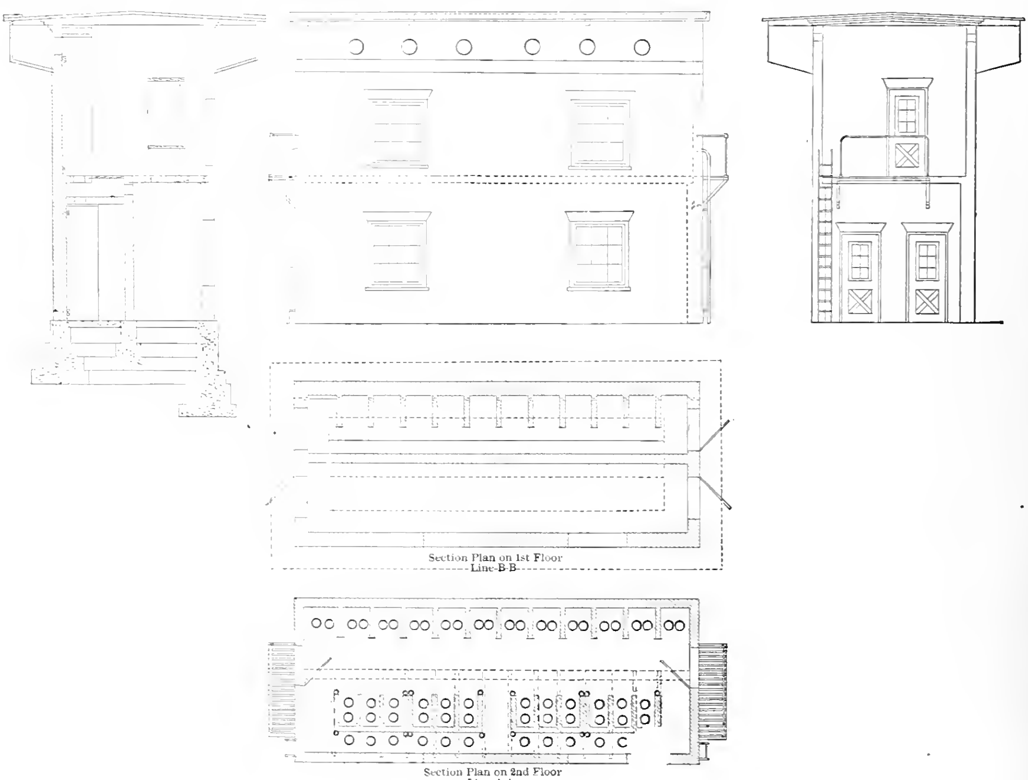


Fig. 3.—Elevations and Plans of Terminal House at Schenectady.

In the apartment on one side of the first floor there are the lightning arrester cells, and in the apartment on the other side there are instrument transformers and recording wattmeters. Along each of its longer sides the roof extends beyond the wall of the terminal house, and from the roof a weather shield made of boards drops down and turns in toward the wall, so that its lower edge is distant 3 in. from the wall and 19 ft. 1½ in. from the level of the ground floor. In the long side of each wooden wind shield there are six circular openings of 15 in. diameter each, and the brick wall next to each wind shield contains six circular openings of the same diameter and directly in line with the corresponding holes in the shield. The centers of all of these circular openings are 19 ft. 10½ in. above the level of the first floor.

On the canal side of the terminal house the six bare wires of the two, three-phase circuits from Spier Falls enter through the six circular openings on that side to the second story. On the River Road side of the house the six insulated cables representing these circuits leave through the six openings there, and cross the road to the tower of the transformer building. Directly in front of each 15-in. circular opening in the brick walls of the terminal house, and with its axis distant about 10½ in. from the inside surface of the wall there is a porcelain insulator mounted on an iron rod that passes entirely through it. The length of this insulator is about 14 in., and the diameter of each of its four petticoats is 9 in. At a point midway of the length of each insulator and with two petticoats above, and two below, the conductor is secured that passes through the adjacent opening.

Each of the six conductors that enter the terminal house from Spier Falls passes directly to a three-point, double-blade knife switch after leaving the insulator just mentioned. One blade of this knife switch connects the incoming conductor with a bank of lightning arresters in the first story, and the other blade of this switch connects with one pole of an oil switch on the second floor. The circuit of the conductor just mentioned, after passing through the oil switch, enters a single-blade knife switch where a tap is taken from an instrument transformer, and then rises to an insulator in front of one of the circular openings on the side of the terminal house next to the River Road. Near the insulator last mentioned a rubber-cov-

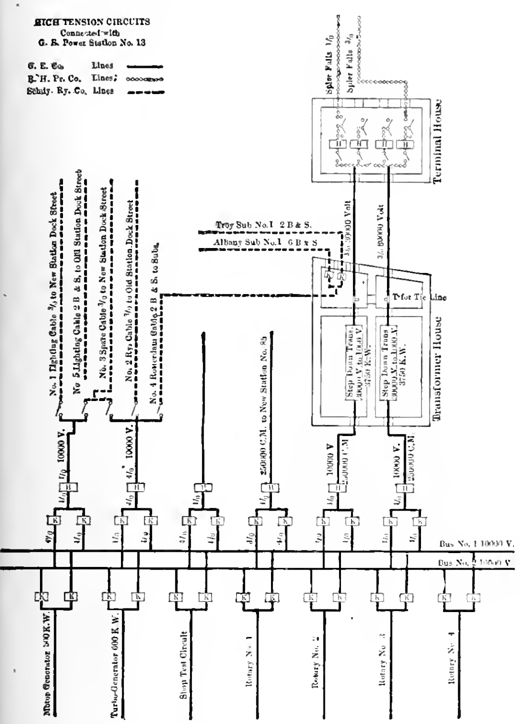


FIG. 4.—DIAGRAM OF HIGH-TENSION CIRCUITS.

ered cable is connected to the conductor in question, and this cable passes out through the 15-in. opening and across the River Road to the tower on the transformer house. Each of the six insulated cables in. deep from back to front, and 24¾ in. wide, except as to the end cells. The walls between these cells and also their roofs are 4 in. thick. Each of these cells is intended to contain one of the double-blade knife switches already mentioned, but at present only six of the cells are occupied because only two three-phase circuits now enter the terminal house from Spier Falls. The terminals of each double-blade lever switch are mounted in large iron caps carried on porcelain insulators, and these insulators are supported by large wooden pins that enter a wooden frame in each cell.

On the first floor of the terminal house and directly beneath the twelve cells just described on the second floor, there are twelve other cells like those above. These cells on the first floor are intended to receive the banks of lightning arresters for the several conductors of the entering transmission circuits, and six of the cells are now so occupied. In each of these six cells there is a wooden frame on which are mounted 42 of the brass cylinder type of lightning arresters. Each arrester carries five small brass cylinders on a porcelain base, and between the sides of these cylinders there are four air-gaps each about 1/32 in. in length. The group of 42 arresters

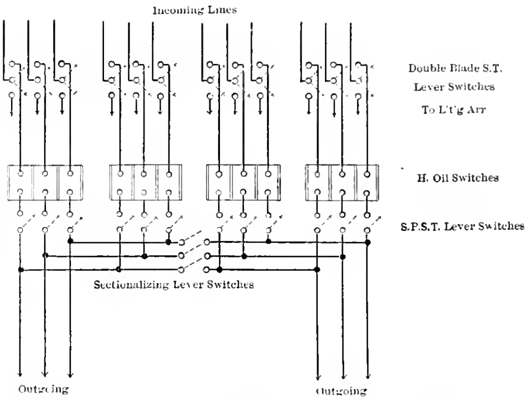


FIG. 6.—DIAGRAM OF MAIN CONNECTIONS, SCHENECTADY SWITCH HOUSE.

joined in series connects one conductor of a circuit with the ground, so that any discharge over the arresters must jump 168 of the 1/32-in. air-gaps.

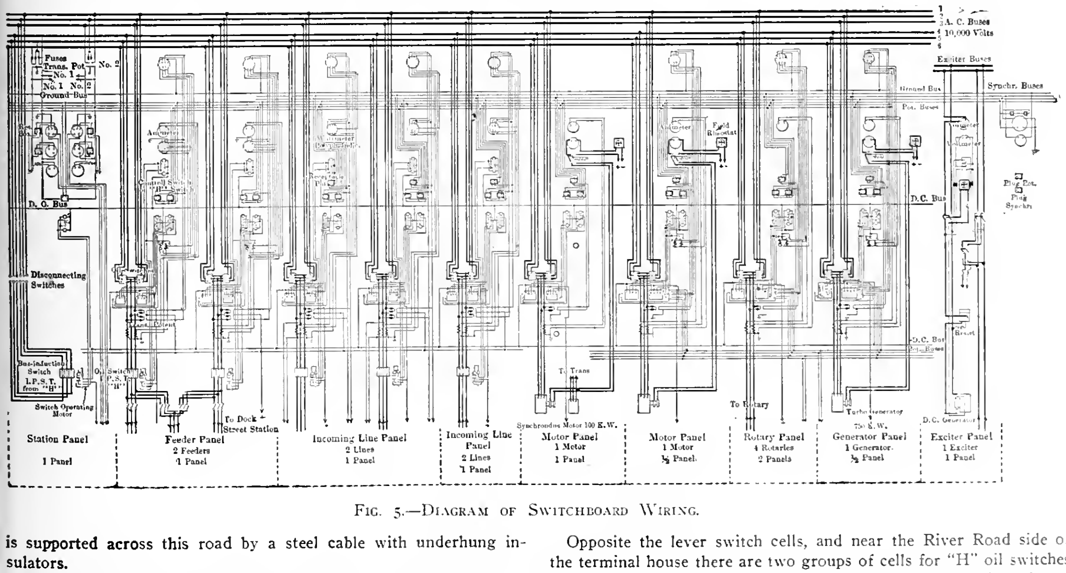


FIG. 5.—DIAGRAM OF SWITCHBOARD WIRING.

is supported across this road by a steel cable with underhung insulators.

Each of the twelve circular holes, that pierce the outer brick wall of the terminal house for the circuits from Spier Falls to enter, opens into a brick cell on the second floor that is 10 ft. 9 in. high, 27

Opposite the lever switch cells, and near the River Road side of the terminal house there are two groups of cells for "H" oil switches of General Electric make. Each group consists of six cells and provides for two three-pole switches of the type just named. The six cells for two switches occupy a space 10 ft. 9 in. long, 2 ft. 9 in. wide and 7 ft. 4¾ in. high above the floor. The back and end walls of these cells are of brick 4 in. thick; the side walls between different poles of the same switch are also 4 in. thick, and the soapstone tops and inside shelves have a thickness of 2 in. each. From front to back each cell is 29 in. deep, its width is 16 or 17 in., and its height from interior shelf to top is 5 ft. ¾ in. The three adjacent cells at each end of each group are designed to contain the three sets of double-break contact parts that go to make up a triple-pole, 200-amp., 30,000-volt oil switch, form H, there being one pole in each cell. On the soapstone tops of the cells there is mounted the electrically-operated mechanism of the switches.

As only two circuits now enter the terminal house from Spier Falls, only two of these 200-amp., 30,000-volt switches have been installed. When the two other circuits from water power plants for which provision has been made enter the terminal house and connect with switches like those just named, two of the four entering circuits will connect through lever switches with each of the two circuits that pass from the terminal house to the tower of the transformer house. At the present time each of the two circuits from Spier Falls connects through its oil and lever switches with one of the two circuits that go to the transformer house, but these last-named circuits may be put into multiple by means of lever switches. These electrically-operated, 200-amp., 30,000-volt oil switches in the terminal house are controlled at the switchboard in power station No. 13 of the General Electric Company.

The six conductors of the two three-phase circuits from the terminal house enter the tower of the transformer house through six circular openings in the brick wall, each of which is 15 in. in diameter, and the three openings for each circuit are spaced with their centers 4 ft. apart. An interior brick wall divides this tower into two compartments, and the wires of each circuit enter one compartment. Within these compartments each conductor of the two circuits has a T for a tie line connection, and openings through the wall that separates the two compartments permit three jumpers or tie lines to pass between the two circuits and thus put them in multiple, when desired. From its tower compartment each circuit passes into a separate transformer room, and the two tower and two transformer rooms take up the entire transformer building.

This building was not especially constructed for its present purpose, but it has been remodeled to fit it for a transformer house. Except as to its tower at one end this building is one story in height, and its four sides have lengths of 29 ft. 5 in., 48 ft. 11 in., 30 ft. and 42 ft. 11 in. on the outside, respectively. The external walls of this transformer house are of brick, and are 12 to 16 in. thick; a 12-in. internal brick wall separates the tower from the one-story part, and a 16-in. wall divides the one-story portion into two nearly equal rooms. In both rooms there are wooden floors laid over 6-in. beds of concrete, and the roof is laid with slag on 1¾-in. plank. In that part of the roof over each room there are two 30-in. circular ventilators of sheet iron.

Beneath each of the two transformer rooms there is a compressed-air pit 33 ft. long, 7 ft. deep, 3 ft. 4 in. wide in the one case and 4 ft. 2 in. wide in the other. Three transformers and a motor-driven blower are located over one of these pits, and four transformers and a like blower over the other pit. Three of these transformers are regularly connected to one of the transmission circuits and three others to the other circuit, and the seventh transformer is a spare. Each of these air-blast transformers is rated at 1,200 kw, 40 cycles and 15,030 to 9,700 volts. The three-phase transmission circuits that leave the step-up transformers at Spier Falls with a voltage of 30,000 have about 26,500 volts between each two conductors in the transformer house just described. Each group of the 1,200-kw transformers have their three primary coils connected to one of the 26,500-volt circuits in the Y form, and three secondary coils are connected in the Δ form, so that the transformation is from 26,500 to 9,700 volts, or thereabouts. The nominal rating of these six main step-down transformers is thus 7,200 kw, and on them depends the supply of transmitted water power for a large amount of machinery at the General Electric Works, the entire load of lamps and stationary motors on the electrical supply system at Schenectady, and the railway lines of that city with the branches to Albany and Troy.

From the secondary coils of each of the two banks of transformers just considered, an underground cable carrying three conductors of 250,000 cm. cross-section each passes to a 10,000-volt, 500-amp., three-pole, oil switch in power station No. 13. Two circuits connect this H switch with two sets of 10,000-volt, three-phase bus-bars, each circuit passing through a 10,000-volt, 300-amp., three-pole, K oil switch on the way. By the arrangement of switches in the terminal house either transmission line from Spier Falls may be connected to either set of the 10,000-volt bus-bars in the power station through either bank of transformers in the transformer house, or both transmission lines and both banks of transformers may be joined in multiple. These two sets of 10,000-volt, three-phase bus-bars distribute current to a shop-testing circuit, to the Dock Street sub-station, and to a motor-generator and from rotary converters in the old power station. The shop-testing circuit is supplied through a 250-kw, 40-cycle transformer that reduces the pressure from 10,000 to 120 volts. This transformer may be connected to either set of bus-bars through one of two K oil switches. Current to the motor-generator goes from either set of bus-bars through a K oil switch. The motor of this generating set is rated at 600 kw, 10,000 volts and 40 cycles, and is direct-connected to a 500-volt, direct-current generator of equal capacity, which operates at 480 r.p.m.

A bank of three transformers for each of the four rotary converters can be connected to either of the two sets of 10,000-volt bus-bars through one of two 300-amp. K oil switches that are provided for the purpose. Each of these four banks of transformers reduces the 10,000-volt alternating pressure so that each rotary converter delivers direct current of 250 volts at its commutators. The indi-

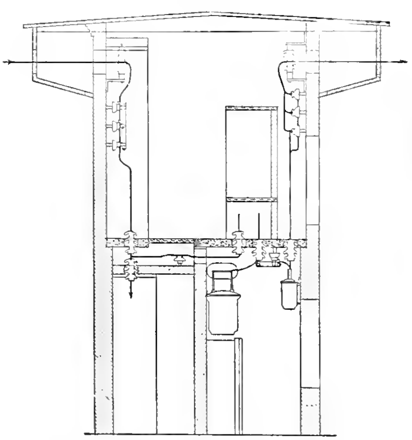


FIG. 7.—ELEVATION OF APPARATUS IN SCHENECTADY SWITCH HOUSE.

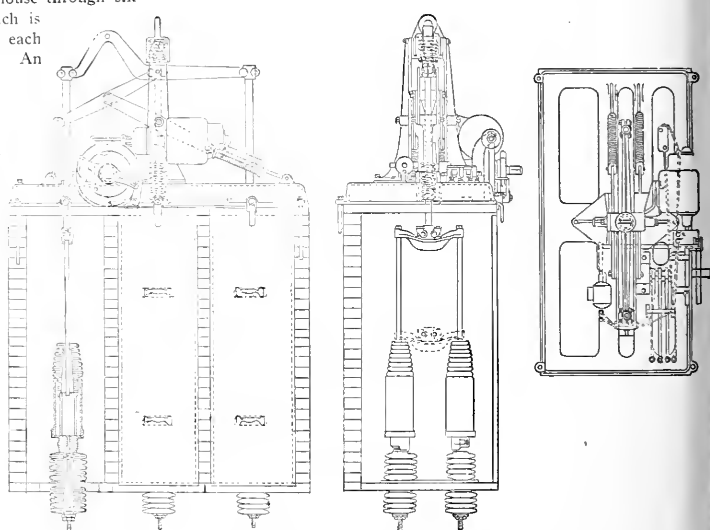
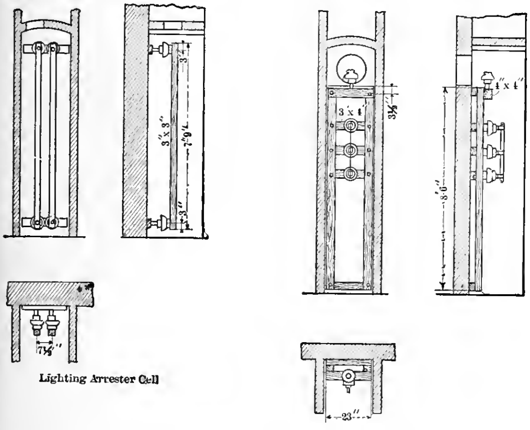


FIG. 8.—SECTIONS AND PLAN OF OIL SWITCH IN SCHENECTADY TERMINAL HOUSE.

vidual rating of these four rotary converters is 600 kw; they operate at 480 r.p.m., and the armature of each is double-wound and has two commutators. By connecting the two commutators of any converter in series, a voltage of 500 is obtained when desired. Current from these, from rotary converters and also from the 600-kw, 500-volt generator driven by the 10,000-volt motor is distributed to 250-volt and 500-volt motors in various parts of the General Electric works.

Two groups of switches are employed to connect the two sets of 10,000-volt bus-bars with underground cables that run to the Dock Street sub-station. Each of these groups consists of two three-pole, 300-amp. K oil switches that join respectively the two sets of bus-bars with a type H oil switch. Lever switches connect each H oil switch with one or two underground cables for the Dock Street sub-station. There are three of these cables each containing three 3-0 stranded copper conductors. One cable is devoted to the railway apparatus, and another to the lighting apparatus in the Dock Street sub-station, and each of these cables joins one of the type H oil switches at the power station through a lever switch. The third of these underground cables may be connected through either of two lever switches with the form H oil switch that carries the lighting cable, or the corresponding switch that carries the railway cable, as desired.

The cable from the power station that formerly ran to the Albany



Lever Switch Cell

FIG. 9.—CELL EQUIPMENTS, SCHENECTADY SWITCH HOUSE.

and Troy sub-stations of the railway has been discontinued, and these sub-stations now take current from that at Dock Street. At the Dock Street sub-station the total capacity of rotary converters is 1,800 kw, of motor-generators 1,550 kw, and of both 3,350 kw. In No. 13 power station at the General Electric works the combined rating of the motor-generator, the four rotary converters and the transformer for the testing circuit amounts to 3,250 kw, so that the capacity of the apparatus connected to the transmission system at this station and at that on Dock Street is 6,600 kw, as a total. To this must be added the rotary converters at the Albany and Troy sub-stations of the Schenectady railway system.

Current for all the foregoing apparatus flows through the two sets of 10,000-volt, three-phase bus-bars in No. 13 power plant, and is normally delivered by the transmission lines from Spier Falls through the six transformers of 7,200-kw capacity that reduce the pressure from 26,500 to 9,700 volts. If the supply of energy from Spier Falls fails, the bus-bars just named may be connected to a single 600-kw, 10,000-volt, 40-cycle, three-phase turbine generator at the General Electric works, or either or all of four 1,500-kw, 10,000-volt, 40-cycle, three-phase turbine generators now located there in new power station No. 85. This power station is designed to contain six of these 1,500-kw turbines, and they will all take steam at 160 pounds pressure and operate at 800 r.p.m.

The facts as to this delivery of transmitted water power to the General Electric works, probably the largest delivery of its kind to a manufacturing plant anywhere in the world, have been secured through the kindness of Mr. A. L. Rohrer, of the General Electric Company.

New Engineering Building at the University of Colorado.

The University of Colorado, located at Boulder, thirty miles northeast of Denver, has recently completed a noteworthy addition to its engineering equipment in the form of an extension of the main building devoted to applied science. The old building has been supplied with new equipment, so that the whole structure now represents in every respect a thoroughly modern piece of educational machinery.

The engineering building is a two-story brick structure, 175 ft. long by 85 ft. wide, and is situated at the eastern end of the quadrangle, close to the track of the Colorado & Southern Railway. The entire first floor of the original structure is devoted to the shops, power plant and electrical laboratories, while the hydraulic, cement and mechanical laboratories are located in the basement.

On the first floor are located the office of Prof. Dates, dean of the engineering school, a department reading room for electrical students, recitation, drafting and photometer rooms, an electrical measurement laboratory, dynamo room, machine shop, forge shop and boiler room. The engineering building, in common with all other buildings on the campus, is lighted by electricity and heated from the central boiler plant. The second floor of the entire building, with the exception of the wood-working shop, which is just above the machine shop, is occupied by class rooms, drawing rooms and the studies of the professors of civil and mechanical engineering, superintendent of shops, etc. The electrical recitation room on the first floor contains an instrument case holding about $3,000 worth of apparatus, and an interesting exhibit of samples of wire and cables, rail bonds, the various parts of an incandescent lamp arranged in the order of their assembling in manufacture, and a dissected dynamo which shows every part of the machine in single pieces. There is also a collection of armored conduit, fuses and high-potential insulators.

The photometer room is large and well ventilated, containing a Reichsantalt photometer with a two-meter scale, Bunsen and Lummer Brodhun screens, standards of lamps, etc. The electrical measuring laboratory is well equipped with wattmeters, synchronizers, voltmeters, ammeters, balances, lamp banks, transformers and water rheostats. In the dynamo room are located a 50-hp Ames engine and a Harrisburg engine of the same capacity, a jack shaft with pulleys and a 30-kw, 125-volt, 4-pole, compound-wound, 250-r.p.m. Westinghouse direct-current generator, a 35-kw, 110-volt Akron generator, a General Electric bipolar generator, rotary converter, induction and synchronous motors. A 10-kw Westinghouse rotary is soon to be added to the equipment. There are also water rheostats for taking up loads, lamp banks and switchboards.

The civil engineering laboratory is well equipped with surveying instruments of the various standard makers, transits with solar attachments, mining transits, levels, compasses, plane tables, a sextant, barometers and a good collection of drawings and models used in design work. The cement laboratory is equipped with a 200-pound Fairbanks shot machine, a 100,000-pound Olsen testing machine, molds and tanks. About 1,600 sq. ft. are occupied by the hydraulic laboratory. The equipment consists of a tank in the third story of the building, affording a constant head, and in the laboratory, tanks supplied with various shaped notches and orifices for discharge measurements, channels of various shapes, benturi meters and other pieces of hydraulic apparatus.

The mechanical laboratory uses the testing machine above mentioned, and is equipped with a great variety of oil testing apparatus, calorimeters, injectors, meters, burettes, thermometers, pyrometers, micrometers, steam gauges, anemometers and indicators. The University power plant contains three boilers of 200-hp capacity, pumps, traps, etc., so that tests of fuse economy are arranged with great ease.

While there is ample room in the new building for the installation of much more apparatus, it is gratifying to note that nearly all the equipment thus far purchased is of excellent quality, and of sufficient variety to enable a wide range of experimental work to be carried on. One does not expect to find such complete equipment in the Rocky Mountain States as is here in evidence. All the machinery in the building is driven by electric motors. The foundry contains a Newton cupola furnace, capable of melting two tons of iron per hour, and the forges and cupola are served by three centrifugal fans, operated by a 10-hp motor.

Experiments With the Magnetic Detector.

In the May number of the *Physical Review*, Prof. Arthur L. Foley gives the results of some experiments on the magnetic detector of electric waves which formed the subject of a Royal Society communication made in 1902 by Marconi, which has also been known as the Rutherford detector. The instrument as used and described by Marconi, consisted of a "core or rod of thin iron wires on which were wound one or two layers of thin insulated copper wire. Over this winding insulating material was placed, and over this again another longer winding of thin copper wire contained in a narrow bobbin." One terminal of the inside winding was connected to earth, the other to an elevated conductor. The ends of the outside winding were connected to a telephone. A horseshoe magnet, suitably placed, was moved by clockwork so as to cause a continuous change or successive reversals, of the magnetism of the iron core. Electric oscillations appeared to reduce the effects of magnetic hysteresis, hence the magnetism of the iron core increased or decreased suddenly with each spark of the transmitter, inducing a current in the outer winding connected to the telephone.

Marconi noticed that "the signals in the telephone are weakest when the poles of the rotating magnet have just passed the core and are increasing their distance from it, whilst they are strongest when the magnet poles are approaching the core." To obtain more definite results, Prof. Foley arranged to use a ballistic galvanometer instead of a telephone, and to take readings for various determined positions of the magnet and core.

The core, which was 5 cm. long, consisted of twenty-six pieces of annealed piano wire, .063 cm. in diameter. Over this was wound a single layer of 200 turns of No. 36 silk-insulated copper wire. One end of the coil was connected to a vertical wire 200 cm. long, the other end was put to earth. The terminals of the outer or secondary coil of 1,000 turns of No. 30 copper wire were connected to a Rowland D'Arsonval galvanometer through a key arranged to short-circuit the galvanometer after each throw of the needle. This brought the needle to rest very quickly, and permitted the position of the magnet to be changed without affecting the galvanometer.

The induction coil (one inch) of the transmitter was adjusted to give a 2-mm. spark between two small brass spheres, one connected to a vertical wire 200 cm. long, the other to earth. The distance between the transmitter and receiver was varied from two meters to twenty meters. No effort was made to "tune" the circuits. The primary and secondary coils were fastened in place on a board

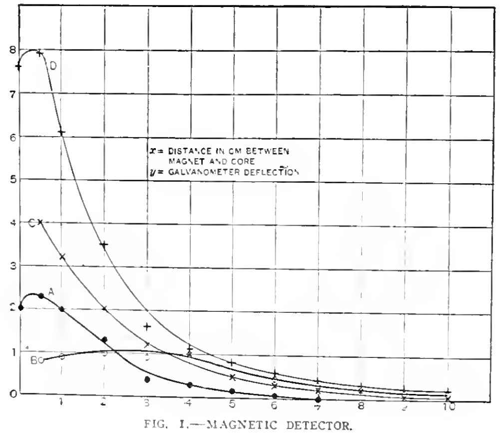


FIG. 1.—MAGNETIC DETECTOR.

grooved and graduated so that a horseshoe magnet could be slid back and forth in the same horizontal plane with, and in a direction at right angles to, the iron core, and placed at any desired distance from it. To get a reading the galvenometer was first short-circuited and the magnet placed in position. The short-circuit was then broken, the transmitter operated as long as the deflection of the needle was increasing, and the throw observed.

The curves in Fig. 1 give the throws of the galvanometer for the given distances between the magnet and core as follows:

A. When the magnet is placed 10 cm. from the core and moved one space nearer each successive reading. *B*. When the magnet is placed in contact with the core and is moved one space farther from it each reading. *C*. When the magnet is removed and the transmitter operated between readings. *D*. When the magnet is turned over (the field reversed) between readings.

A comparison of curves *A* and *B* shows that the sensitiveness of the magnetic detector depends upon both the distance and direction of motion of the moving magnet. When the magnet is near the core the detector is more sensitive when the magnet is approaching,

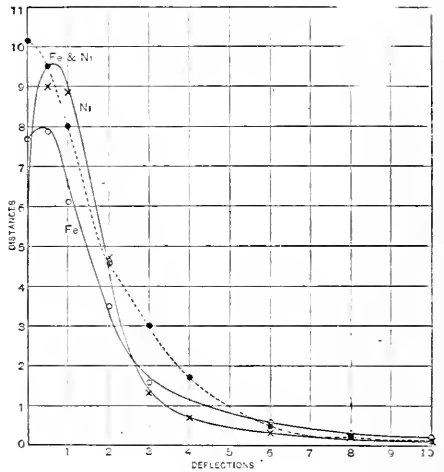


FIG. 2.—MAGNETIC DETECTOR.

but when some distance from the core the detector is more sensitive when the magnet is receding. Both curves indicate a maximum of sensitiveness at a distance from the core, the distance being less when the magnet is approaching. Since nickel is more susceptible than iron in weak magnetic fields, and less susceptible in strong fields, Prof. Foley concluded that a more uniform sensibility for varying distances between the moving magnet and core might be obtained by making the core of nickel.

Four cores were made, each one being 5 cm. long, approximately .4 cm. in diameter and being wound with 200 turns of No. 36 copper wire. Core 1 consisted of 26 pieces of piano wire .063 cm. in diameter. Core 2 of 10 pieces of piano wire and 10 pieces of nickel wire, .082 cm. in diameter. Core 3 of 2 pieces of piano wire and 13 pieces of nickel wire. Core 4 of 14 pieces of nickel wire. The curves of Fig. 2 give the deflections at various distances between the magnet and each of the four cores, the magnet being moved one space at a time and having its poles reversed after each reading.

The sensitiveness of the detector with a nickel core was not very different from the sensitiveness when an iron core was used. Contrary to expectations, however, the sensitiveness with the nickel core appeared to be the greater in strong fields and with the iron core in weak fields. Both showed a maximum of sensitiveness at a short distance from the magnet, the maximum for nickel being the farther removed. The nickel core proved to be more sensitive than the iron core for distances up to 2.5 cm.

When the detector was worked with the mixed core of iron and nickel wires the deflections of the galvanometer increased as the magnet approached the core, even up to the point of contact. The curve (*Fe* and *Ni*, Fig. 2) lies above the *Fe* curve at all points and above the *Ni* curve at most points, showing that a mixed core consisting of annealed piano wire and hard drawn nickel wire, produced a more sensitive detector than was obtained by using a core of piano wire only. The detector gave small deflections of the galvanometer when I used an antimony core; also when a core of iron filings was used contained in a thin walled glass tube. A core of bismuth gave no deflection.

The form of the curves of Figs. 1 and 2 probably depends upon other points than those here considered, as for instance the frequency and intensity of the oscillations of the transmitter, and the annealing of the steel wires used in the core.

Some Telephone Problems in Farming Communities.

By HOWARD S. KNOWLTON.

THE growth of the telephone industry in the United States presents a remarkable evolution of apparatus and methods. It would be difficult to express in a single paragraph the revolutions which the technical side of the art has passed through in its advance from the crude mechanism of the early days to the highly-developed and organized appliances of the present. Although the common-battery, lamp signal, multiple switchboard is one of the latest additions to standard practice, involving many operating and maintenance problems unfamiliar in the first part of the closing decade of the nineteenth century, it is a logical and scientific outcome of all that came before it, and a notable illustration of the pursuit of economy in the modern industrial fabric. There is scarcely a piece of telephone apparatus in existence to-day which may not be improved in some detail but a single year hence, although its fundamental principle may be utilized long after this page has yellowed with age. Even the familiar Bell receiver has been tremendously increased in power by doubling the magnet poles and employing a closed magnetic circuit. Permanence is yet to be printed in the dictionary of telephony.

Urban communities reaped the benefit of the invention of the telephone long before the agricultural districts could avail themselves of it. The experience of the electric railway is a close parallel. For almost twenty years after the electrical transmission of speech was an accomplished fact the farmer had little conception of its possibilities when installed in his home, and still less expectation of being offered a rate within his means. Step by step, however, the telephone system reached out beyond the city, until to-day the market has been brought to the farmer's very door by its agency, and the exploitation of the rural district is increasing by leaps and bounds.

With the extension of the telephone into the country regions has come a serious problem. The cost of construction per subscriber served is unavoidably high, in view of the low density of population, long lines to be built, remoteness of railway or river transportation facilities and expense of maintaining the construction force away from home. The physical obstacles offered by huge mountain ranges and other rough country may easily rise to alarming proportions. Maintenance likewise is a heavy expense, after the lines are placed in operation over extended territory. The adoption of a rate which shall be fair to both company and farmer is, therefore, a question of the first magnitude in importance. Telephone companies the country over are face to face with this pressing problem.

The manner in which the question has been met in the West by one of the most progressive Bell companies in that part of the country is full of suggestion. The writer takes a leaf from the record of the Colorado Telephone Company as the concrete example.

For some time past there has been a feeling among the ranchmen of Colorado that lower telephone rates would be much appreciated. Party line ranch service at a distance of two and one-half miles radially from the local exchange centers has been charged at the rate of $30 per subscriber's station per year, with the exception of ranches located near larger centers of population like Denver, Colorado Springs, Pueblo, etc. This rate, $30, did not increase as the distance from the central office became greater. In the vicinity of Ouray and Silverton higher rates were necessary, in view of the extraordinary wildness and roughness of the mountains in this portion of the State. The region around these two places is called the San Juan country, and while it is famous for stupendous scenery it is no easy place to maintain telephone lines.

The Colorado company, therefore, made a careful study of ranch service, with a view toward meeting the situation. An example of the thoroughness with which this work was done is evidenced by an exhaustive study which the engineering department made in January of the cost of service on the group of lines extending northeast of the town of Longmont, supplying ranches in the region adjacent to Highland Lake. This inquiry involved a careful inventory of every pole, insulator, cross arm, wire, guy and telephone instrument on a lead about 50 miles long; a traffic record extending over a period of one month, in which every originating call on this lead was counted, day and night; and a close examination of all receipts and expenses in connection with the Longmont exchange which had a bearing upon this group of lines.

After the ranch problem had been thoroughly gone over by the officials of the company, conferences were held with prominent ranchmen, and the question of rates gone into afresh. The upshot of the matter was the issuing of a circular letter by the president of the Colorado Telephone Company, Mr. E. B. Field, a copy of which was sent to every ranch subscriber in the State.

Mr. Field entitled his circular "Facts, not Promoter's Promises, Regarding Ranch Telephone Service," and succeeded in making therein a remarkably plain statement of the telephone company's attitude and propositions in regard to the whole matter. Certain portions of this circular are of so much interest to managers of electric properties that I have no hesitation in quoting them, wholly or in part:

"The Colorado Telephone Company wants to furnish the ranchmen of the State with telephone service. The ranchmen in the State want to be furnished with telephone service by someone. It is to be regretted that there has grown up, not only in Colorado, but in the entire United States, a very unfortunate misunderstanding upon both the part of the telephone companies and the farmers as to the attitude of each other on this question. When two intelligent persons, or bodies of men, have a wrong opinion of each other, it usually turns out that neither understands the real position of the other, and it is to try in a business-like manner to clearly and fairly state the facts on both sides that this paper is written."

Mr. Field then made the point that as most people know their own business best, it is safe to say that the employees of the telephone company do not have a skilled knowledge of ranching, and that the ranchmen, on the other hand, are not experts in the telephone business. It is fair to presume that each class of men understand their own business, or they would not long remain in it. A ranchman may have run a telephone line from his barn to his house and bought two telephone instruments, but for this reason he does not necessarily know any more about the question of telephone service than the telephone man knows about farming, because he has raised a few potatoes in his garden.

One of the misunderstandings that has arisen is the farmer's idea that telephone companies are grinding monopolies, intent on fleecing the farmers by extortionate rates to the extent of their ability to do so. "There are people all over the United States who want to sell telephone apparatus, who are constantly catering to and fostering this feeling on the part of the farmers. There is also in every section some sharp, shrewd local man, who will go in with the fellow who wants to sell his telephones and supplies, and advise his fellow towsmen to go into the scheme and then receive a commission himself on the sales, or an interest in any scheme carried out." Mr. Field then quoted an example from the advertising matter which is constantly being sent to the farmers by manufacturers, which advised the farmer "not to be fooled with the sugar-coated pill that telephone companies offer," saying that if the farmer will look closely he "will see the grinning skeleton behind the pill and not be fooled by the blood-thirsty monopoly." The pamphlet quoted then goes on to sing a wonderful song about how much better it will be for the farmer and the entire universe if he will only buy the apparatus of this particular company, and how much better it will be for the farmer if he has no dealings with the local company in his immediate neighborhood. It is astonishing that any intelligent farmer can be caught by such arguments, but "that a certain portion of the farming community do listen to continued assertions like the above is unfortunately true."

"On the other hand, the telephone companies, when met by this spirit on the part of the farmer have also come to the conclusion upon their part that the farmer does not want to pay a reasonable telephone rate for their service, but that they are insistent upon getting something for nothing, and it has been an unfortunate misunderstanding all around." The circular letter then states that the telephone company does not believe that the Colorado ranchman wants something for nothing, neither is he willing to give something for nothing; that the company wants to give the farmers fair rates, and that it has a better, fairer and in the end a cheaper proposition to make than any outsider can offer.

"The price at which anyone can afford to sell a thing is based upon what it costs to raise or produce it. The farmer bases the price of his live stock upon his crops, upon the labor and investment involved up to the day when he offers the stock in market. In the case of alfalfa or sugar beets, for instance, he knows what his product costs him; he knows what it costs to bring water upon the land, the cost of his fences, farm houses, implements, etc.; he must reckon the price of seed, the cost of sowing, weeding, cultivating and haresting; and then he considers the cost of hauling to market. If the crop does not give him a fair profit (and the most profit that the Colorado Telephone Company hopes to make on its business in a year is 6 per cent.) he drops that crop for something better. To the buyer who comes to the ranch and offers to take his alfalfa as it stands stacked in the field, he will sell for less than to the merchant in town who expects him to deliver it to his store, baled and ready for shipment. Were a beet sugar factory to agree to weed, cultivate and come and get his beets, relieving the farmer of all that risk and care, he would sell them for less than he would to a factory that did not do so. The same principles exist in connection with telephone companies.

"What is ranch telephone service? It is not having a telephone, for you can buy one outright for $10 or $15. Telephone service involves a telephone instrument and its care; it means also the digging of holes, buying of poles of suitable timber which will stand up under heavy storms; of first-class insulators, high-grade wire, etc. Then it involves the expense of sending out at any hour of the day, with the cost of livery, a man to repair breaks and set poles, and many times it costs the company $10 to repair a simple trouble on your circuit. You must bear in mind that the best telephone line depreciates and rots continually, and must be entirely replaced at least once in every seven to ten years, so that out of every $100 that we put into line, 10 per cent., or $10, rots away every year. Further, the telephone and the lines are not telephone service, for then comes the town investment and the investment throughout the State, and the operating labor, which enables you to communicate with hundreds of other subscribers; this means a switchboard, taxes, office rent, light and heat; it means the salaries of operators who must be on duty for you night and day, of linemen, and competent men to superintend the business to see that you are properly served."

The propositions of new rates are as follows:

1. Within one mile of the central office the company will furnish the farmer with instruments and care for the same, build all the lines, do all the work, assume entire responsibility and furnish him service inside the district in which the central office is located, at $18 per year. And beyond one mile the following rate will be charged in a small increasing amount, as the distance from the office becomes greater, all distances being measured in a "bee" line, although the distance by road is sometimes far greater: From 1 mile to 1¼ miles, $20; between 1¼ and 1½ miles, $22; between 1½ and up to a 6-mile limit, $24; between the 6 and 9-mile limits, $27; between 9 miles and 12 miles, $30; from 12 to 15 miles, $33; between 15 and 18 miles, $36, and so on. Under this plan the nearer the central office the lower the rate charged. The equity of charging an increased rental as the distance from the office increases should be apparent, because the investment in poles and wire grows greater and greater as the length of line to be built and maintained increases.

"Now, just as you will sell your alfalfa for less to the company that will buy it as it stands stacked in the field, the telephone company has various propositions to offer you if you will relieve it of some of its investment expenses and labor by furnishing part of them." It is assumed that during certain seasons of the year ranchmen have the time to perform the labor of constructing a telephone line, and it is to provide cheaper plans for telephone service, in which the company has the co-operation of the ranchman by his doing certain portions of the necessary labor, and himself owning certain portions of the plant that the following propositions are submitted:

2. This proposition gives a rate of only $12 per annum per station if one or more ranchmen will construct and take care of their line at their own expense, the company furnishing the telephones, taking care of them and giving exchange service.

3. If the farmer will not only construct his line, but also buy his own telephone and take care of it, the company will give him its switching service—exactly the same service which it gives every other subscriber—for 50 cents per month, $6 per year. The company does not ask the farmer to buy a complete telephone instrument, but will loan the subscriber a Bell receiver and transmitter, so that he will only need to buy the balance of the set, either of the telephone company for $10, or wherever else the farmer pleases. The receiver and transmitter will be loaned on a deposit of $3, which will be returned when the apparatus is given back. In case the farmers are so far from town that it would not be practicable to build to the exchange, the company will arrange to place a switchboard at some ranch, centrally located; the company furnishing the switchboard free, and the farmers furnishing the ranch operator at their own expense. The farmers would then build their lines, which would be short, and also maintain them; but the company will keep the switchboard in order, build and maintain the connecting lines from its own central office to the farmers' switchboard, the rental being $12 per annum per station.

4. This proposition provides for a switchboard in the farmer's section, furnished free by the company; maintenance and an operator to be provided by the farmers, who will build their own lines, take care of them and each pay the company $5 per year for the complete telephone instrument; or the farmers may each rent the receiver and transmitter from the company for $2 per year per set, and buy the rest of the telephone instrument; the farmers would then build and take care of the trunk line between their switchboard and the telephone office, and pay 5 cents per talk to the subscribers in the company's exchange.

These propositions cannot be called exorbitant, and are believed to cover any kind of demand which a farmer has for telephone service. The company expects a fair profit if it sells the farmer any of its commodity, and asks him to meet it in exactly the same spirit.

"One of the most seductive songs that is sung to the farmers by telephone supply sellers," Mr. Field states, "is the co-operative idea. These people ask you to form co-operative companies and want you to take a few shares each of the stock so that the farmer may share in any profits that may be made. The Colorado Telephone Company has exactly the same proposition to make to you. The only difference is that you do not have to wait for the success of a doubtful enterprise before you participate in the profits, but can, if you buy stock in our company, buy a stock that has been paying 6 per cent. dividends per annum, and is likely to do so, because our stock has paid 6 per cent. dividends for years. The price of the stock is its par value, $50 per share, and the standing of any purchaser in the company is exactly the same as that of the others who have their money invested in the business." There can be no possible reasonable antagonism between the company and the ranchman after each understands the other's position.

The Colorado Telephone Company earns upon its entire investment from 8 per cent. to 10 per cent. per annum, and reserves the difference between 6 per cent. and its 8 to 10 per cent. as a contingent fund to provide for the havoc that sleet, storms, wind, etc., play with its plant annually. It has no bonded indebtedness, and, therefore, no fixed charges to pay out for interest. This ratio of profit is made upon the existing rates. Mr. Field offers to send a copy of the annual report of the president to stockholders to any ranchman requesting it, and then states that although the business is in the nature of a monopoly, the company has the good sense to know that anything like blood-thirsty or extortionate practices would be business suicide. The argument has been made over and over again by the telephone supply promoter that the company could give lower rates if it did not have to pay such excessive royalties to the Bell Telephone Company for the use of their instruments. Since the expiration of the patents no royalties whatever have been paid. Instead, the payment is a small annual rental for the hand telephone and transmitter, which is actually less than the interest, maintenance and depreciation on the cost of hand telephones and transmitters were these to be manufactured or purchased outright. This rental is in fact an absolute saving to the Colorado company rather than a serious or extraordinary expense. "The promoter has so frequently asserted that he could build telephone lines so much cheaper than the Colorado company that an idea may have gotten into the minds of the ranchmen that we are extravagant in spending our money in telephone construction. The best telephone engineers in the world have stated that the entire plant of the company in the whole State of Colorado, irrespective of sections, could not be replaced to-day at the figure at which it stands upon the books and covering which cost of construction the capital stock has been issued. First-class lines such as this company constructs cannot be built cheaper in this State."

Mr. Field closes by asking the ranchman to choose between the statements of the Colorado Telephone Company and the promoters.

It is evident from the foregoing that the farmer has been met far more than half way by the particular company quoted. Certain it is that the days of concealment are past, if corporations expect to give to and receive fair dealing from their patrons. If the farmer can be made to see just what a company can do he will be much less likely to wage unreasonable war upon it. If the farmer is to secure the greatest benefit from telephone service, including all the advances which so constantly improve the quality of transmission, speed of connection, etc., he must at least approach the company in an unprejudiced spirit, and the company on its part must be frank and above board in all its dealings. This applies as much to independent companies as to those of the Bell organization. Candor, plain speaking, openness and a sense of mutual positions will go a long way toward solving the vexing problem of rates.

The Zoelly Steam Turbine.

For a number of years Messrs. Escher, Wyss & Co., of Zurich, Switzerland, well known in this country from the use at Niagara of their water turbines, have been engaged on the development of a steam turbine, of which the accompanying illustration shows the general design.

The turbine, which is manufactured under the Zoelly patents, is of the multi-stage impulse type, in which the expansion of the steam takes place in the passages in the stationary parts of the apparatus. Its main point of difference from others of the type is in the construction of the rotors or bucket wheels, which are intended for high peripheral velocities and require correspondingly few stages. The accompanying elevation of a compound turbine shows its general features. The high and low-pressure ends are mounted independently on a single base. The housings are of cast iron or cast steel, divided on the horizontal plane through their axes so that the upper half can be readily lifted off, and the flanges are fitted so closely that no packing is needed. The details of the mounting have been worked out with a special view to avoiding any appreciable displacement of the axis through temperature changes. The housings are covered with non-conductors and steel lagging.

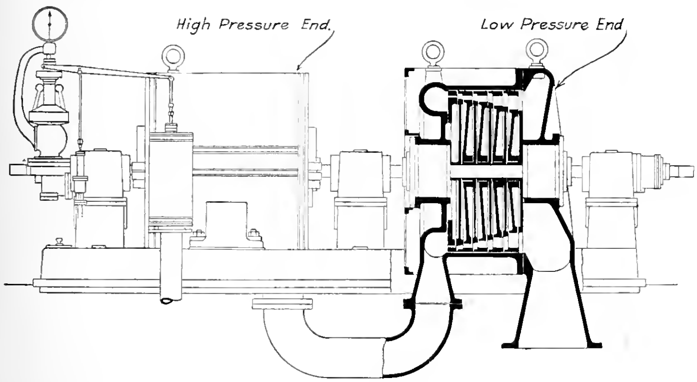


FIG. 1.—ZOELLY STEAM TURBINE.

The three main bearings are supported directly by the frame, and are thus independent of the housings. This arrangement was adopted to prevent any heating of the bearings by the steam or by conduction from the housings, thus keeping them uninfluenced by the condition of other parts of the turbine. They are readily accessible and easily inspected.

A rotary pump placed on the frame and driven from the main shaft by worm wearing supplies lubricating oil to the bearings. The oil from the bearings is piped to a reservoir in the base, where it is purified and cooled in a coil if necessary, and is then ready for use again. In this way, although the lubrication is profuse, the consumption of oil is kept very low.

The discs of the rotors, of the best Siemens-Martin steel, are keyed to the shaft and have fastened on one side of their periphery a thin ring. This ring forms with the periphery of the wheel a dovetail groove in which the buckets and their spacers are held. The radially located buckets are made of nickel steel, polished to reduce friction to a minimum. Nickel steel is employed on account of its resistance to rust. The discs of the wheels are also highly polished to keep down frictional losses.

It is considered of great importance to have the cross section of the blades decrease from their inner to their outer ends. In this way there is correspondingly small tension due to centrifugal action in the roots of the blades, even with high rotative velocity. In other words, with the same stresses the gradually thinning blades can be made much longer than those of uniform section. The resistance to bending, due to the impact of the steam, is greatest where the bending moment is greatest. The strength of the rotor, in consequence of this design, is so great that a high peripheral speed can be attained, and the number of stages correspondingly reduced, as before stated. This enables the length of the turbine to be diminished and its cost reduced. The steel spacing pieces between the blades have their tops coinciding with the curved surface corresponding to the widening of the steam passage between the blades and consequently form an inner limit for the steam jet. The rotors are carefully balanced and tested at speeds above their nominal rates before they are put in place.

Between each rotor there is a guide wheel or diaphragm in which the guide blades are held. Since the expansion of the steam takes place in these diaphragms between the blades and there is a corresponding excess of pressure on one side of them, each must be steam tight in the housing as well as strong enough to resist the one-sided pressure. Cast steel is used, and the guide blades are arranged in groups in the rim, as shown in the illustrations. Between the groups are thick projecting pieces to which a wrought-iron ring or tire is attached. Th diaphragms are placed close together, the rims touching, and in this way the pressure is transmitted to the end wall of the housing. The hubs of the bucket wheels fit with slight play in holes in the bosses of the diaphragms, the construction being evident from the cuts. The blades have small ears which slip into slots in both the rim of the diaphragm and the outside tire. When they have been slipped into place they are held there by two rings screwed on the low-pressure face, as illustrated. These diaphragms are made in halves, with tight-fitting surfaces, and the upper halves are screwed to the top part of the housing so as to be lifted with it. The shaft passes into and from the housing in stuffing boxes fitted with metal packing.

The governor is a slight modification of the well-known Escher-Wyss regulator used in many water turbine installations. It consists of a ball governor which operates a pilot valve controlling the motion of a plunger directly over the main steam valve and mounted on the same rod. The pilot valve and the chamber of the plunger are connected by two small pipes and the various operations are produced by the discharge of water under pressure through one or the other of the pipes. As this governor is one of the best-known water wheel regulators, it is unnecessary to describe it in detail. The pressure water, or oil, in the case of the steam turbine, is furnished by a rotary pump driven from the main shaft by worm gearing. According to Mr. J. Weishäupl, chief engineer of the company, the regulator has behaved excellently in this new service and the variation in rotative speed, even with the maximum fluctuation in the load, is very slight. Regulation by throttling the steam was chosen as being the simplest method for the purpose. In addition it has the great advantage of not influencing the steam consumption unfavorably at different loads.

If it becomes necessary to furnish more than the rated power of the turbine, the governor operates a valve which admits a part of the steam at the throttle pressure directly into the second and third stages. There is also a safety governor which shuts off the steam in case the number of revolutions rises above the normal to a predetermined limit, such as ten per cent.

In impulse wheels the play of the rotating parts in the casing can be made as great as seems desirable, and for the same reason the axial play between the rotors and diaphragms may be made very large without affecting the working of the turbine. Hence, there need be no fear that in consequence of temperature changes or wear the running and stationary parts may rub against each other. It should be stated that a corrugated bearing like a thrust bearing is employed to keep this free play unchanged.

A ten-stage turbine of this type was put in operation at the works of Escher, Wyss & Co. last fall. It is rated at 500 hp per minute at 3,000 r.p.m., with steam at 147 pounds. It is directly coupled to a Siemens & Halske dynamo. A surface condenser driven by an independent steam engine is used. Part of the water for the condenser was taken from the city mains and part was pumped electrically from the works well. This renders it very difficult to determine the power needed for the condensing plant. The unit has

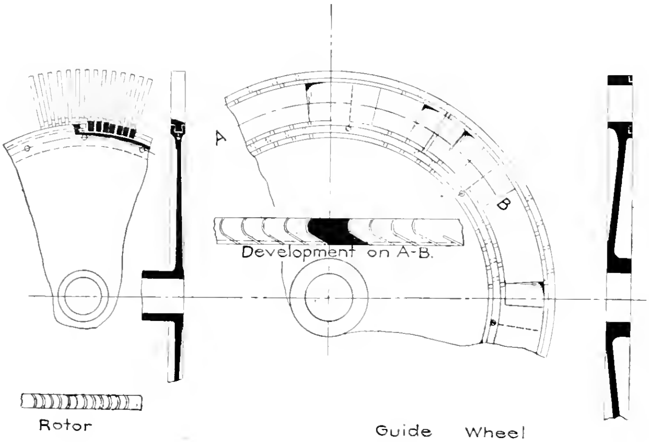


FIG. 2.—ZOELLY STEAM TURBINE.

been tested by Prof. Stodola and Director Wagner of the municipal electric station. They made no attempt to determine the steam consumption of the condenser, and the output of the turbine was figured from the current delivered by the generator. The following statements concerning the test and its results are condensed from their report:

The pressure and temperature of the steam were observed in the main in front of the separator, which is close to the turbine. During the tests with superheating a thermometer was also placed in front of the throttle valve. The pressure and temperature were also measured immediately in front of the first diaphragm and the pressure behind the first rotor was observed, from which data a check on the feed water determinations was obtained. The pressure in the pipe connecting the two halves of the turbine and the pressure and temperature at the entrance to the exhaust main were also observed. The temperature of the cooling water entering and leaving the condenser and the temperature of the discharge from the air pump were measured. The cooling water was only occasionally measured, while the circulating pump was stopped and the supply obtained through a meter from the city mains. The pressures were determined by manometers which, like the thermometers, were calibrated at the mechanical laboratory of the Federal Polytechnic Institute. The vacuum was measured directly by a mercury column, and the heights reduced to their equivalents at 32° F., a correction which seemed necessary on account of the high temperature of the housings. The revolutions were measured every few minutes by a tachometer. Owing to other uses of the steam from the boiler a measurement of the feed water was useless. In consequence, such determinations were limited to weighing the condensed water delivered by the air pump. This was discharged into an elevated reservoir with inclined bottom, from which it flowed to the scales. The net weight of the apparatus was determined after each emptying, since the readings were restricted to ten-minute intervals. On account of the large capacity of the air pump, more frequent weighing would have resulted in less uniform readings. That a steady operating condition had been reached during the tests was shown by the uniform amount of condensation and the constant temperature of different parts of the turbine.

The electrical measurements were made with instruments calibrated by Prof. Weiss, of the physical department of the Federal Polytechnic Institute. A water rheostat was used.

The turbine was first run with a mixture of moderately superheated steam from one source and saturated steam from another. In front of the separator it showed a few degrees of superheat, but this had practically disappeared in front of the throttle valve. The results of the tests are given in the accompanying table. The first eight are with decreasing loads but a constant speed and steam pressure. The tests were at first arranged in the opposite order, beginning with no load, but the temperature readings of different parts of the turbine showed that a steady operating condition would not be reached for hours. The observations made during the eighth of the tabulated tests show this clearly. In this run the unit was first operated at half load for about twenty minutes in order to warm it up, and two hours afterward the temperatures of the exhaust and of the base of the high-pressure housing were still falling. On this account the computation of the steam consumption is based only on the results of the last thirty-five minutes. With heavy loads, a preliminary run of fifteen minutes was sufficient. The last three tests were made with superheated steam. In all of these eleven runs the turbine operated with very litle shaking of the shaft. The oil for the bearings was delivered at a temperature of 86 to 95° F. and came from them at 104 to 122°.

CONDENSED TABLE OF TESTS OF A FIVE-HUNDRED HORSE-POWER ZOELLY STEAM TURBINE.

Date	Dec. 12, '03	Jan. 25, '04	Jan. 25, '04	Jan. 25, '04	Jan. 25, '04	Jan. 18, '04	Jan. 25, '04	Jan. 25, '04	Feb. 5, '04.	Feb. 5, '04.	Feb. 5, '04.
Length, minutes	180	80	50	50	50	60	60	35	70	20	80
Current, kilowatts	363	388	335	240	182	86	....	....	392	390	390
Revolutions per minute	2967	2967	2977	2983	2984	2995	2995	3000	2972	2973	2968
Before separator:											
Pressure, pounds	149	149	145	147	146	147	147	149	173	178	150
Temperature, degrees Fahr.	369	370	364	366	365	365	365	366	477	497	440
Before first diaphragm:											
Pressure, pounds	133	134	118	87	66	31	3	7.5*	128	128	129
Temperature, degrees Fahr.	356	356	347	329	314	277	228	217	422	427	422
Exhaust:											
Vacuum, ins. mercury	27.7	27.7	27.9	27.9	27.9	28.4	28.4	28.4	27.9	27.9	27.8
Temperature, degrees Fahr.	102	104	102	99	98	91	90	108	100	102	100
Steam consumed per hour, lbs.	7887	8308	7411	5766	4673	2644	1023	650	7438	7319	7712
Steam consumed per kw-hour, lbs.	21.7	21.4	22.1	24.0	25.6	33.0	....	....	19.0	18.8	19.7

* Ins. of mercury.

Iowa State College Branch of A. I. E. E.

In accordance with the desire of the Land and Building Fund Committee of the American Institute of Electrical Engineers that local committees in different parts of the country assist in the work of soliciting subscriptions from Institute members, a committee was appointed by the Iowa State College Branch of the Institute to take up the work in Ames. The committee consists of Messrs. B. S. Lanphear, G. W. Bissell and F. A. Pielsticker. It was decided that each member of the local branch should be asked to contribute something to a joint subscription which should be known as the subscription of the Iowa State College Branch of the A. I. E. E. to the Institute Building Fund.

The committee has been very successful, having raised $700, with several of the local members yet to be interviewed. It is thought that the interest which has thus been aroused in the work of the Institute will materially strengthen the local organization and thus eventually prove of even greater benefit to the local branch than to the Institute Building Fund.

The Iowa State College Branch of the Institute is in a most prosperous condition. The local membership (which includes "students" of the Institute) now numbers 66. The fact that twelve men have made application for admission as associate members of the Institute since the organization of the branch in the spring of 1903 is a measure of the value of this line of Institute activity.

Recent Electrochemical Developments.

ELECTROMETALLURGY.

The amalgamation process is one of the oldest means for winning gold from ores or sands. In its principle it is a purely mechanical operation. An interesting combination of the amalgamation process with electrolytic extraction is described in a patent granted to W. J. and J. J. Jory (May 24). The inventors introduce with the ore to be crushed a solution of mercuric chloride and sodium chloride into the mortars of the stamp batteries; the pulverized mixture is then carried directly through the screens onto the amalgamating tables by a current of water and there subjected to electrolytic action, the amalgamating plates being connected to the negative pole of the supply circuit. The inventors describe in detail apparatus for this purpose and some modifications of this general principle.

An electric furnace process for making aluminum sulphide simultaneously with an aluminum alloy is patented by M. Onda (May 24). The ore containing aluminum oxide is well mixed with charcoal or coke and a metallic sulphide or sulphate whose heat of formation is lower than that of the corresponding aluminum salts. This mixture is subjected in an electric furnace to heat of about 2,000° C. and the aluminum is converted into the sulphide, while the other metal is desulphurized and absorbs a certain quantity of the aluminum which is not sulphurized, producing an aluminum alloy, while the carbon goes off as carbon monoxide. The inventor describes the application of this principle to the treatment of Arkansas bauxite and iron sulphide for the production of aluminum sulphide and a rich aluminum-iron alloy.

ELECTROCHEMICAL METHODS IN ORGANIC CHEMISTRY.

The application of electrochemical methods for the cheaper and often more direct production of organic compounds has been a favorite subject of investigation during recent years, especially in the research laboratories of the larger German chemical works. Two patents of this class were issued on May 31, both being assigned to Boehringer & Soehne in Mannheim.

M. Buchner formerly described a process of electrolytic reduction of nitro compounds, in which the latter were placed in the cathode compartment of the cell and reduced in an acid solution in presence of tin. The tin acts here as a catalyser. He has now found that lead may be substituted for tin, and describes the following two applications: reduction of nitrobenzine to analine by the addition of lead chloride to the catholyte; and reduction of nitrobenzine to analine by addition of metallic lead to the catholyte.

W. Loeb has studied the preparation of azo dyes. Azo compounds are generally prepared by dissolving or suspending an amine in acid solution, diazotizing the same at a low temperature by means of a nitrite, and mixing the diazotized solution with the solution of a "coupling" compound. Loeb has now succeeded in preparing azo dyes electrolytically in one process by combining diazotation and coupling of the amine with a compound of acid character in the same solution under the influence of the current.

BATTERY INVENTION.

There are again quite a number of new patents on batteries; as usual they refer to details. E. W. Smith, of the Electric Storage Battery Company, of Philadelphia, patents a grid having the faces of its respective openings covered by a perforated sheet and describes in detail means for securing the perforated cover plate to the grid.

A. Meygret patents a grid made of an end piece to which various strips are secured, definitely separated one from the other a small distance apart. Each strip has on each outer face a receiving surface for the active material, the receiving surfaces running parallel with the outer side faces of the end piece of the plate.

T. A. Willard patents details of construction of sheaths or envelopes for containing and separating the plates of a battery.

H. P. R. L. Poerscke and G. A. Wedekind patent the following method of making a hard porous metallic (copper) electrode, which is claimed to be insoluble in an alkaline solution. The inventors mix pure oxide of copper and finely pulverized copper with a solution of protochloride of copper without the addition of foreign substances. The pasty mass thus obtained is placed in a mold and heated until dry. The electrode is then reduced to metallic copper in an alkaline solution until all the bound chlorine is set free, whereupon the substance is again oxidized by heating or electrolysis.

New Telephone Patents.

The telephone field is represented by but two patents this week. Of these one covers a receiver support and the other an improvement in a certain form of step-by-step selective system.

The receiver support is the invention of G. A. Cowgill, of Euphemia, Ohio. The supporting arm is hinged so that when the receiver is not in use it will be naturally folded back out of the way. This folding back of the receiver automatically depresses the switch hook; the rearward portion of the supporting arm is pivoted and linked to the switch arm and the position of the center of gravity of the system is shifted across and above the pivot as the receiver is thrown back out of the way.

The selective system improvement refers to a step-by-step system in which automatic return of the selectors at all stations is accomplished by electrical means as soon as the receiver of the last selected station is returned to the hook. With this system as previously designed it has been found that when two party lines have been connected together, the current impulses upon one line might become effective upon the other in a manner to defeat the whole system. For example, suppose *A* of a five-party line connected to *D* of a second five-party line. Both restore the receivers to the hook switches, when upon each line automatically a series of impulses begins, each such impulse moving the selective devices one step toward the zero position. The series of impulses upon each line should decrease when the zero joint of the selector is reached. If, however, there is overlapping from line to line then one selector will be moved past its zero, due to impulses received from the other line. To overcome this certain short-circuiting devices are introduced in the cord circuit as soon as restoration to zero begins. A. J. Springborn, of Cleveland, Ohio, has obtained the patent for this arrangement, which is applicable to a selective system previously invented by him.

CURRENT NEWS AND NOTES.

A LONG TELEPHONE LINE.—The Bell Telephone Company, of Kansas City, has begun preparations for a long-distance line between Kansas City and Joplin, to connect with a new line that is being built from St. Louis to Joplin, and thence through the Indian Territory into central Texas. Over $1,000,000 has been appropriated for these extensions, which, with the Bell connections east of St. Louis, will make the longest telephone line in the world.

MILEAGE OF CANADIAN RAILWAYS.—The report of the Dominion Minister of Railways gives the length of the railways in Canada on June 30, 1903, as 19,836 miles. Of this 19,077 miles were operated by steam and 759 by electricity. The latter includes the street as well as the suburban and general lines, which are growing with rapidity. More than two-thirds of the railways of the country are owned and operated by the government and four companies.

WIRELESS TELEGRAPHY ON THE PACIFIC.—A telegram from San Francisco May 23 says: "For the first time on the Pacific coast communication has been had by wireless telegraphy between a ship at sea and points on shore. The United States hospital ship *Solace* sailed from this port Saturday, and until she was 70 miles out messages were sent between the *Solace* and the Weather Bureau's station at Point Reyes on the mainland and on the Farallone Islands, which lie off this city. Conditions were very favorable, and communication was continued without a break for five hours."

[illegible] WIRELESS TELEGRAPH SYSTEM.—It is stated that Prof. William Hamill, of the Normal Industrial College, at Greensboro, N. C., has invented a simple and practical system of wireless telegraphy, and that it has been tested at the Johns Hopkins Hospital in Baltimore. It is to be installed at the Normal College.

ELECTRIC RAILWAY TESTS.—A comprehensive series of tests is being conducted at the power house of the Lexington (Ky.) Street Railway Company on a storage battery auxiliary recently installed. Prof. W. E. Goldsborough has supervision of the tests, which are being conducted by Prof. A. N. Tapping, of Purdue University, assisted by Messrs. West, Waldron, Hinsley and Goodspeed, students of Purdue. Mr. W. W. Donaldson is present as representative of the manufacturers of the battery, the Gould Storage Battery Company.

IN THE HOSPITAL.—Patients in a hospital often have to endure long, weary hours, and an experiment made recently at the Samaritan Hospital, Philadelphia, suggests a means of beguiling pain and tedium. Through a combination of telephones with megaphones attached to the receivers patients throughout the hospital were enabled to hear the hymns sung at the service in the Baptist Temple, many squares away. The sermon of the pastor was also transmitted to the hospital and was heard as distinctly there as by the people who were occupying pews in the church.

WIRELESS TELEGRAPHY AT THE SEAT OF WAR.—Following the recent manifesto of the Russians regarding wireless telegraphy at the seat of war, a special dispatch from Tokio to the New York *Sun*, a copy of which follows, will naturally excite some curiosity: "It is suspected that the Russians at Port Arthur are communicating with Chinese territory by means of wireless telegraphy, their instruments probably being on some small islands off the coast. The Japanese cruiser *Chitose* discovered four masts showing above Liaotishan, but they were out of range of her guns."

SECOND GERMAN-AMERICAN CABLE.—The laying of the second German cable from Borkum to New York by way of the Azores was completed on Wednesday last week. The cable was laid by the steamer *Stephan*, which left New York on May 10 with 2,100 nautical miles of cable on board. She began to pay out on May 11 from a point off Fire Island. The shore end between Fire Island and Coney Island, where the American end of the cable is landed, had already been laid. The final splice was made off Fayal. The cable was manufactured at Nordenham by the Norddeutsche Seekabelwerke. The total length is 4,200 nautical miles. The first German cable was laid five years ago.

I. E. E. AMERICAN TRIP.—Circulars have been issued to the members of the British Institution of Electrical Engineers outlining the American trip this summer. At present the proposed delegation is not less than 100. It is intended that the party shall leave Liverpool on the White Star steamer *Republic* August 25 for Boston, at which port she is due on Friday, September 2. The party is to reach New York September 4 and start out by special train for the St. Louis Electrical Congress September 6. The total cost, including ordinary extras, is put at $450. A large party from Italy is to arrive directly in New York about August 31. Generous provision is being made on this side at various points for the reception of the visitors from abroad, of whatever nationality. The Congress bids fair to be a great success in attendance and papers.

UNIVERSITY OF MINNESOTA GRADUATING CLASS.—Nearly all of the class graduating from the electrical engineering course at the University of Minnesota are located, many of them being already at work. E. J. Cheney, V. E. Goodwin and F. C. Helms enter the engineering apprenticeship course with the General Electric Company at Schenectady. J. Howatt, F. A. Otto and R. B. Taplin enter the engineering apprenticeship course with the Westinghouse Electric & Manufacturing Company at Pittsburg. L. C. Tomlinson and J. Wicks go with the Automatic Electric Company at Chicago. G. Crahbe goes with the Otis Elevator Company at Yonkers. H. G Morton goes with the Northwestern Telephone Exchange Company at Minneapolis. B. M. Bouman will enter the telephone field P. M. Rosok goes with the Missouri River Power Company at Helena.

NON-RESIDENT ELECTRICAL ENGINEERING LECTURES, UNIVERSITY OF MINNESOTA.—Following is a list of the lectures by practicing electrical engineers, delivered at the University of Minnesota during the college year just closing: Edward P. Burch, consulting engineer, Minneapolis, "Speed Torque Characteristics of Steam and Electric Locomotives"; Lee M. Coleman, electrical engineer, Minneapolis, "Experiences of an Installing Engineer"; Jake Danner, telephone engineer, Western Electrical Company, Chicago, "Telephone Cables"; Charles E. Downton, foreman of apprentices, Westinghouse Electric & Manufacturing Company, Pittsburg, "The Training of Engineering Apprentices in an Electrical Manufacturing Plant"; Locke Etheridge, district engineer, Stanley Electric Manufacturing Company, Chicago, "The Engineer Salesman"; Truman Hibbard, chief engineer, Electric Machinery Company, Minneapolis, "Commercial Features of Dynamo Design"; Charles L. Pillsbury, consulting engineer, St. Paul, "Design and Construction of the Municipal Electric Lighting Plant at New Ulm."

TRACKLESS TROLLEYS IN GERMANY.—Mr. C. L. Cole, United States Consul-General at Dresden, Germany, says: "For several years experiments have been made in Germany with railless electric roads. Among the lines which have come to my notice are several in Westphalia and two in the vicinity of Dresden—the so-called "Haidebahn," connecting with an electric tramway terminus at the outskirts of the town, and the "Königsstein" road starting from Königsstein, a town lying on the Elbe about 12 miles above Dresden. A large proportion of the passengers carried by both lines are tourists or Sunday strollers. The Haidebahn covers a distance of 3.1 miles. Wagons run every half hour, the fares being 10 pfennigs (2.38 cents) for the shortest ride and 20 pfennigs (4.76 cents) for the full distance. The Haidebahn runs over a slightly undulating road, while the one at Königsstein covers about two miles of hilly highway. The speed of coaches varies considerably with the slope of the road, not, it seems, because of a lack of motor force, but for the sake of the comfort of passengers and the reduction of wear and tear on the machinery. It seems that neither of these two lines has proved a marked success from a financial point of view, partly because of the expense in operating. The electric energy required to move cars over dirt roads exceeds by 100 per cent. the power necessary to draw cars over iron rails, and this difficulty should be carefully considered by parties in the United States who contemplate similar enterprises." Another line of this general character, the first in Prussia, is being built between Monnheim and Langenfeld, 2½ miles in length.

Letters to the Editors.

The Metric System.

To the Editors of Electrical World and Engineer:

Sirs:—I have noticed the articles that have appeared in your journal concerning the metric system, and I wish to express my approval of the stand that you have taken in regard to this matter. I am sure that there are many readers of your paper who agree in this statement. Among the older engineers there are of course those who have not learned much about the metric system and who will not favor its adoption; but as sure as the law of the "survival of the fittest" is true, the time is not far off when the system will be adopted in the United States.

Stephenville, Texas. John D. Boon.

Phenomena of the Electric Arc.

To the Editors of Electrical World and Engineer:

Sirs:—I have read with much interest the article appearing in your issue of May 21, 1904, by Prof. Charles Proteus Steinmetz on the new magnetite arc lamp, and the interesting discovery by the General Electric Company at its electrochemical laboratory that the arc is fed by material from the negative electrode and not from the positive, as appearances have heretofore led us to suppose.

In carrying out extended experiments for some months past on my current interrupter, illustrated and described in your columns in November last, I have also observed that the arc flame is fed by the vapors from the negative electrode. I find by replacing the negative carbon electrode by other conducting substances, that the main current does not always readily follow the condenser discharge, while on reversing the current without altering the adjustment of the apparatus in the least, the current follows instantly. Varying the effective area of the negative pole causes a corresponding variation in the current through the gap.

The article in question also states that the great temperature at the positive electrode is due to its being struck by the material from the negative electrode, which issues therefrom at a high velocity. There is a possibility of this statement not being entirely correct, as on this theory the temperature of the negative electrode should equal, if not exceed, that of the positive electrode; for it is reasonable to assume that the negative particles have not acquired any added velocity during their passage through the gap, and also that the greatest temperature is always at the positive pole, no matter what the distances between the electrodes may be.

My theory of the high temperature generated at the positive pole in the ordinary arc is that it is due to local currents set up in the crater by the presence therein of the negatively charged material thrown off or otherwise detached from the negative electrode. I intend in the near future to contribute an article on my experimental observations of the electric arc, but for the present will make this letter suffice.

NEW YORK. THOMAS J. MURPHY.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo.—WINKELMANN.—An illustrated account of a test of a direct-current dynamo, the feature of which is the construction of the armature. It is shown in Fig. 1. The armature

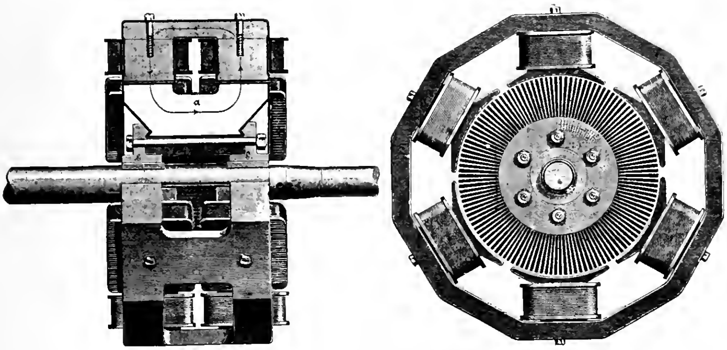


FIG. 1.—DIRECT-CURRENT DYNAMO.

consists of radially-arranged packages of iron sheets, *a*, which are pressed together by means of *b*. The direction of the fluxes in the armature, which is indicated by the arrow, is essentially parallel to the axle and is produced by two neighboring magnet cores. On account of the construction of the armature there are small spaces, δ, which are partly filled by the armature copper. According to the size of the machine, four or more pairs of poles are used. The author thinks that this type has some advantages over the usual type. He tested the machine as motor, the continuous load being 37 kw; the armature current was 151 amp. and the increase of the temperature of the armature 28.7° C. The machine was excited separately with 601 watts and the temperature of the exciting coils was increased by 59°. The voltage at the terminals was 244.5 at 607.7 revolutions. The efficiency was 89.2 per cent. The self-induction of the armature is comparatively low on account of the numerous air-gaps in it. For this reason the commutation was very good, without any sparks either at no load or at full load. There was no shifting of the brushes which were placed in the neutral zone. The author says that the machine could be loaded continuously with 190 amp. without reaching a dangerous temperature, and without sparks at the brushes. The weight per kilowatt was 32 kg. for 33 kilowatts load and 25.2 kg. for 41.8 kw load. The author thinks that this construction of the armature, which was devised by Koppelmann, could be also used for alternators.—*Elek. Zeit.*, May 19.

Repulsion Motor.—HANCHETT.—An article giving from a non-mathematical standpoint the characteristic features of the repulsion motor. Since the repulsion motor is somewhat like a transformer, commutation difficulties can be minimized by winding a motor for as low a secondary voltage as practicable and by the introduction of leads having sensible resistance between the commutator bars and the coils with which they are connected. As one of the best features of the repulsion motor he considers the fact that the speed can be controlled simply by adjustment of the brushes.—*St. R'y Jour.*, May 28.

POWER.

Electric Power in Metallurgical Plants.—The first part of a profusely-illustrated article on electric aerial suspended tramways for quickly transporting materials from one part of a metallurgical plant to another. The system described is that of Kolben & Co. for special use in iron and steel works.—*Elek. Bahnen.*, May, No. 10.

Electricity for Mine Hoists.—An illustrated article on electrically-operated versus steam-driven mine hoists. Some examples from various plants are described. The losses in steam pipes, operating pumps, ventilators, hoists and other mining machinery by engines of small capacity, as well as the low efficiency of these engines, make it desirable to utilize electric power wherever possible.—*Scient. Am.*, June 4.

Lifting Magnets.—PERKINS.—An illustrated article on the construction of Belgian and American electromagnets for lifting heavy pieces of iron and steel.—*Scient. Am.*, June 4.

Steam Turbines.—DRIN.—The first part of an illustrated summary of the development of steam turbines. In the present installment he gives a short history of the subject and then classifies various types of steam turbines.—*La Revue Elec.*, May 15.

TRACTION.

Storage Battery Locomotive.—PASSAUER.—An illustrated article on the use of storage battery locomotives. They are specially useful in switch yards where a trolley line would be difficult and expensive. Compared with a steam locomotive, the storage battery locomotive has the advantage of being always ready for service, and its cost of operation is smaller if the locomotive is used at irregular and longer intervals. The high weight of the batteries is an advantage, since a considerable weight is necessary for adhesion. The author describes the first storage battery locomotive which has been built for such purposes for the Prussian State railways. The battery consists of 200 cells with a capacity of 184 amp.-hours, if discharged in two hours. It is charged once a day. Twenty cells are placed together in a wooden box, which is covered with an acid-proof insulating coating. These wooden boxes are well insulated from each other and from the locomotive by means of porcelain rolls. For charging the battery at 110 volts, the cells are connected in five groups, each of 40 cells in parallel. After the charge is completed the cells are all connected in series, so that an average discharge voltage of 300 to 410 is available. The charge takes place with constant current and with resistance regulation. The controller is arranged for series parallel control. The total weight of the locomotive is 20,840 kg., of which 10,000 kg. is the weight of the battery and 4,340 that of the other electric apparatus.—*Elek. Bahnen.*, May, No. 10.

Berlin.—An illustrated article on recent elevated railway practice in Berlin. He states that the cost of the ornamental Berlin elevated railway was less than $200,000 per km. and describes various experiments which have been made to reduce the noise. Felt was first tried under the rails, then the car wheels were filled with wood; felt was placed on each side of the rails; then experiments were made with ties of steel and wood which rested on fine sand in transverse steel troughs; then the floor planks were lined with cork blocks. None of these methods, however, was so effective as when low rails laid on deep wooden stringers were employed. He gives some particulars on the last track construction and on the car design. —*St. R'y Jour.*, June 4.

Circuit-Breakers on Double-End Cars.—Gough.—An illustrated discussion of the methods available in wiring circuit-breakers. He believes that the parallel connection is the simplest, although requiring two circuit-breakers and two choke coils. The series connection is popular where non-automatic circuit-breakers are used. The trolley connection would not be countenanced in practice, because the motorman on the front end would have no assurance that by throwing the breaker at his end the power would be cut off, as the breaker at the other end of the car might have been left in.—*St. R'y Jour.*, May 28.

Sub-Station.—An illustrated description of a new sub-station of the Denver & Northwestern Railway at Clear Creek Junction, Colo., where two branches of the system join. Current is transmitted to this sub-station at 2,200 volts, three-phase, from Denver, about 9 km. distant. The sub-station is furnished with two six-phase, 25-cycle, 600-volt, 500-kw, 500-r.p.m. rotary converters. The 2,300 to 430-volt transformers are of the air-blast type and are arranged in two banks of three each, delta-connected. Each transformer is rated at 185 kw.—*St. R'y Jour.*, May 28.

REFERENCES.

Mountain Railway.—Armknecht.—The conclusion of his illustrated description of the mountain railway to Hohensyburg, which was already noticed in the Digest. He discusses the rolling stock and gives a description of the electric signal apparatus used.—*Elek. Zeit.*, May 19.

Locomotive Repair Shop Practice.—A communication in which the writer refers to his visit to a large locomotive repair shop. He calls attention to the fact that with the general introduction of electric locomotives much of the complicated machinery now required in railway shops will be unnecessary. He also refers to the matter of fire protection and states that in the shop visited several electric motors were allowed to run exposed to dust, shavings and chips, despite the danger of fire from sparking.—*St. R'y Jour.*, May 28.

Emergency Car Lighting Equipment.—An illustrated description of an auxiliary car lighting system consisting of a number of extra lamps, a storage battery and an automatic switch. The switch and battery are in series with and usually receive current from the regular 500-volt circuit. When the trolley current is interrupted from any cause the switch automatically throws the storage battery into the auxiliary circuit, and as soon as the trolley circuit is restored automatically throws off the current from the auxiliary lighting circuit.—*St. R'y Jour.*, May 28.

Peru.—An article on the first electric railway in Peru, which is about 32 km. in length. Current is supplied from the local lighting station, to which power is transmitted from a hydraulic plant 56 km. distant.—*St. R'y Jour.*, June 4.

Installations, Systems and Appliances.

REFERENCES.

Protection Against Danger from Breaking Overhead Conductors. —Montpellier.—An illustrated description of apparatus, devised by Giraud to prevent the danger from the rupture of overhead electric conductors. He utilizes the mechanical tension set up during rupture in order to set in action a device which makes a short circuit either with the earth or with another conductor, with the result that this short-circuit acts immediately on an automatic interrupter installed at the beginning of the line or of the section. Various applications of this principle are described.—*L'Elec.*, May 21.

Power Station Design.—The first part of a full account of the extended discussion of Merz and McLellan's paper on power station design which was recently abstracted in the Digest. Diagrams are given of the general arrangement of power stations in Edinburgh and Marylebone.—Lond. *Elec.*, May 20.

Wires, Wiring and Conduits.

Eddy Currents in Cable Sheaths.—Addenbrooke.—In the discussion of Field's recent paper on this subject he describes some experiments made by him and intended chiefly to go into the question of dielectric hysteresis. One set of cables had a bare lead sheath and was coiled on drums. An attempt was made to measure the dielectric losses in this concentric cable between the inner conductor and the lead sheath. The losses were, however, so considerable that it was useless to continue the experiment in this form; the lead acted as the secondary of a transformer to a degree that heavy and considerable losses took place in it. This shows that lead-covered cables carrying alternating currents should not be laid in metallic connection with conductors which may form a return circuit. Another observation was as follows: Several measurements having been made on lengths of cable which were unarmored, an armored length was substituted, and in this the losses were uniformly higher than in similar cable made of the same materials, but which was unarmored, the cables being concentric in both cases and the tests taking place between two conductors. At 3,000 volts the power factor was 1.45 per cent., while with armored cable it is 1.62 per cent. In these experiments the current flowing through the cable was merely the current used for electrostatically charging it, and consequently the effect would be very small. With the actual currents flowing in practice through the cable it is quite possible that the effects might be very appreciable. The only way to determine them would be to take a length of cable having a non-inductive resistance at one end in which the energy of the current passed through the cable would be dissipated. If then a steady alternating current was passed through the cable and simultaneous measurements could be taken at both ends, both of the current and watts lost, deducting the calculable loss in the conductor of the cable it ought to be possible to arrive at any other losses which may take place.—Lond. *Elec.*, May 20.

REFERENCE.

Power Transmission Cables.—Schmidt.—The conclusion of his long illustrated serial on the construction and manufacture of power transmission cables. He gives some diagrams showing the increase of the total weight and of the cross-section of cables with increased voltage of supply.—*Elek. Anz.*, May 19.

Electro-Physics and Magnetism.

Secondary Röntgen Radiation.—Barkla.—An account of an experimental investigation of the energy of secondary Röntgen radiation. The character of secondary X-radiation from gases differs slightly from that of the primary producing it (from air the secondary has a great ionizing power in air). The penetrating rays are transformed to a greater extent than the more absorbable rays. The energy of secondary radiation from a given gas through which a primary beam of given intensity is passing is independent of the character of the primary radiation. The energy of secondary radiation from gases and those light solids which are the source of the radiation differing little in character from the primary, is proportional to the quantity of matter through which the primary beam of given intensity passes. In the passage of X-radiation through air at zero degrees C. and at 76 cm. of pressure, the diminution of intensity due to secondary radiation is of the order of magnitude 0.02 per cent. per centimeter; this is a large fraction of the total loss of intensity due to all causes for fairly penetrating rays. Applying the experimental results to the explanation given by J. J. Thomson for the loss of energy per centimeter (due to radiation) in passing through a medium containing ions, and taking the negative corpuscles with $e/m = 7 \times 10^6$ and $e = 10^{-20}$ as the sources of the radiation, the number of these corpuscles per c.c. for air under normal conditions is of the order 10^{22}. Quantitative results show that the secondary radiation for metals, though of different penetrative power, is of the same nature as the primary X-radiation.—*Phil. Mag.*, May.

ELECTRO-CHEMISTRY AND BATTERIES.

Metallurgy of Gold in South Africa.—DIXON AND TORRENTE.—A very complete account of the development of the metallurgy of gold on the Rand gold fields. The first mill, consisting of only five stamps, was installed in 1887; in 1890 the chlorination process and the MacArthur-Forrest cyanide process were introduced. The introduction of the latter revolutionized the whole aspect of the industry and enabled many low-grade propositions which could otherwise never have been worked at all to pay handsome dividends. The authors give a review of the treatment of sands and slimes and deal at length with the problem of precipitation. In 1894, when the Siemens & Halske electrolytic process was introduced, its main advantages were that a 2 per cent. royalty was charged and that very weak cyanide solutions could be used, while for the zinc precipitation process a 10 per cent. royalty was charged and very strong solutions were used. Later, however, the MacArthur-Forrest patents were upset and the consideration of a 10 per cent. royalty was no longer a factor in the case. The great rivalry between the advocates of both processes resulted in many improvements. The zinc precipitation process was especially improved by the introduction of the zinc-lead couple with the addition of a strong free cyanide solution at the head of the precipitation boxes, according to Betty's suggestion. The authors then give a great many details on the working of the Siemens & Halske electrolytic process by which in 1903 were treated 239,385 tons of sands or tailings which produced 54,794 ounces fine gold; and 129,137 tons of slimes which produced 17,370 ounces fine gold. At present the zinc process seems to have slight advantages, but even now the variations in costs and results between the two processes are very slight, and although at present the zinc process shows a slightly better average in precipitation, the opportunities for losing gold throughout the various operations before eventually producing a lead bullion for cupelling (which is obtained first hand in the electrolytic method) must go a long way toward counterbalancing its advantages. The ideal process which is still sought is one that will precipitate gold from its solution down to say 4 grains per ton with a moderate-sized plant, will produce no by-products, and a bullion bar must be obtained in a simple manner and of a high standard of fineness. The authors then discuss the treatment of the by-products.—*Electrochem. Ind.*, June.

REFERENCE.

Electrolytic Process for Winning Copper from the Ores.—THOMPSON.—A full account of an extended investigation of the Siemens electrolytic process for winning copper from the ores. He first discusses the dissolving action of ferric sulphate on various copper compounds; he describes experiments made with cupric oxide, cuprous oxide, cuprous sulphide, iron oxide and a natural copper ore. He finds that copper pyrite is not appreciably attacked by ferric sulphate; roasting so changes the ore that nearly all the copper can be extracted either by sulphuric acid or by ferric sulphate; this makes it seem probable that roasting changes the copper largely over to the oxide. He then discusses the electrolytic part of the process and deals separately with the reduction of the copper on the cathode and the oxidation of the iron at the anode. The results are given in diagrams and tables.—*Electrochem. Ind.*, June.

UNITS, MEASUREMENTS AND INSTRUMENTS.

System of Units.—KENNELLY.—A communication referring to the recent suggestion of Robertson. He first remarks that it is open to question whether the c.g.s. electromagnetic system is really based, as assumed by Robertson, upon four fundamental quantities, namely, length, mass, time and magnetic permeability. The c.g.s. system is rather based only upon length, mass and time, while permeability is thrown in at present because its dimensions in terms of the other three quantities are not yet determined. As soon as the dimensions of permeability are realized, the term will disappear in the modification of the dimensions of the units where now it comes in evidence. He also thinks that it is now too late to uproot the c.g.s. system and replace it with the meter-kilogram-second system.—Lond. *Elec.*, May 20.

Fessenden.—A communication in which he expresses himself strongly in favor of rationalizing the units by taking the ampere current as the unit difference of magnetic potential and the magnetic line as the unit of magnetic quantity. This will give a rational system and will entirely eliminate irrational quantities from our present calculations. He pleads that every effort should be made at present to rationalize the units; if this should be impossible, no effort must be spared to prevent the establishment of legal units of magnetic potential and of magnetic quantity. If the present theoretical units—i. e., 4π magnetic lines—be made the unit of quantity, the $\frac{1}{4}\pi$ ampere-turns be made the unit difference of magnetic potential, we will cut ourselves off absolutely for several hundred years from having a set of rational units. There is no necessity of manufacturing names for the physical quantities, because if we write these physical quantities in terms of their dimensions, with a suitable prefix to denote whether the quantity is an electric, magnetic or a gravitational one, we get names which have the advantage that they not only uniquely describe the quantity, but also give its dimensions.—Lond. *Elec.*, May 20.

Thermal Instruments for the Measurement of Large and Small Alternating Currents.—DUDDELL.—A British Physical Society paper describing three thermal instruments. The first is essentially a sensitive Ayrton-Perry twisted strip ammeter which is very quick in action for a thermal instrument and has been used for observing and recording potential differences and currents which varied as rapidly as one per second. It is compensated for change in the surrounding temperature by forming the sides of the frame which holds the twisted strip with the same wire that the strip itself is made from. He exhibited an instrument which for a current of 22 milliamperes gave a deflection of one-quarter of the scale distance, i. e., 250 mm. at one meter scale distance. The mechanical periodic time is only about $\frac{1}{5}$ second. Using this instrument in series with a high resistance, he has made observations on the variations in the voltages of alternators caused by cyclic irregularity of the engine. By working to a false zero it is easy to obtain 10 mm. change in deflection for one per cent. change in the potential difference. The second instrument described by him is called a thermogalvanometer. It consists of the combination of a ratiomicrometer of the Boys type with a very small resistance which is heated by the current to be measured, and which in turn heats the thermojunction of the radiomicrometer by radiation and convection. The principle of its action is as follows: A loop of wire has its two ends fixed to the two bars of a single thermojunction, a mirror is fixed to the loop and the whole is suspended in a magnetic field by means of a quartz fibre. The heat from the resistance raises the temperature of the thermojunction and causes the current to flow round the loop, which is deflected by the magnetic field. The sensibility of the instrument depends upon the resistance of the heater. Using a heater having a resistance of 13,910 ohms, a deflection of 250 mm. at a scale distance of one meter is obtained with a current of 31 microamperes; a heater having 18 ohms resistance required 800 microamperes to give the same deflection. To illustrate the high sensibility of this instrument, the author showed the large deflections produced by the currents through a telephone receiver even when the source of sound was many feet distant from the microphone. He also showed that if the thermogalvanometer was placed in series with the vertical receiver wire in spark telegraphy over a short distance, large reflections were produced. The third instrument described is a switchboard instrument which works on the same principle as the last, only that the moving part is pivoted in the usual way. He exhibited one of these instruments arranged to give the whole scale deflection for only 0.15 volt, which can be used in connection with shunts to measure large currents; for instance, to measure 1,000 amperes the power lost in the shunt would only be 150 watts. Transformers can also be used, as the power to produce the whole scale deflection is only 0.3 watt. A similar instrument with a high resistance heater was also exhibited, giving the whole scale deflection for 0.1 amp., which can be used as a voltmeter by putting resistance in series with it.—Lond. *Elec.*, May 20.

REFERENCE.

Induction Coils.—CODD.—The first part of an illustrated article in which the author discusses various details of induction coil design.—Lond. *Elec. Rev.*, May 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephony.—BENNETT.—A paper on corporation telephones in which the author gives a review of his work in this direction, together with a report of the extended discussion which followed the reading of the paper.—Lond. *Elec.*, April 22, May 20. An editorial with reference to this paper gives a comparison of telephone systems. Concerning the central battery system, it is said that its one doubtful feature is its complexity; numbers of relays have to be employed and the efficiency of the service depends to a large extent on the proper working of a chain of automatic devices. From remarks of Gill in the discussion it appears that no serious troubles arise from relay faults in practice. The writer thinks that there is much to say in favor of the simple magneto system with branching multiple switchboards, for exchanges of small and moderate size. Automatic calling and clearing introduces a considerable complication, but for some reason it has come to be regarded as an essential to modern exchange systems. Even Bennett considers it of such importance that he introduces into his simple "ring-through" system the automatic feature with the aid of a "passing contact" in the subscriber's instrument. Then comes the substitution of an incandescent lamp and a relay for the drop indicator, which is justified by the saving of space on the switchboard, and still more by the increased facility for supervision. After one has gone so far as to make provision for automatic calling and clearing, and for lamp signals, very little more is required to make the system a complete central battery system, with central battery speaking, as well as central battery signaling. The writer thinks that for small exchanges these refinements are certainly not necessary, but a uniform system throughout is very desirable. The old principle that an endeavor should be made to lessen the operator's work by making the subscriber do part of the operating, as on a call-wire and ring-through system, has not been found to work out well in practice. The greatest drawback is with junction working, in case of a failure to ring off.—Lond. *Elec.*, May 20.

Alarm Bells Tuned to the Strength of Direct Current.—BAUMANN. —An illustrated description of various devices of this kind, which appear to be specially suitable for calling up only the one party desired out of a number of parties connected to the same telephone wire on a "party line." The simplest arrangement is shown in Fig. 2. The electromagnet, *a*, has two windings, *b* and *c*; *b* is connected

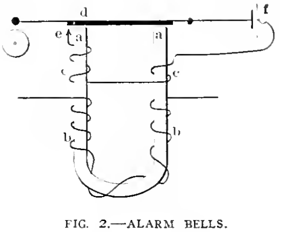


FIG. 2.—ALARM BELLS.

to the line while *c* is connected to a circuit containing a battery, *f*, and the armature, *d*, of the electromagnet as soon as the contact, *e*, is closed. The two windings, *b* and *c*, are so arranged that the magnetic fluxes due to them counteract each other. When a current of sufficient strength passes through *b* the armature, *d*, is attracted and the contact, *e*, is closed; then the magnetism is annihilated, due to the counteracting ampere-turns of *c*, and the armature is released. Then *b* acts again, and so on. The armature bears at its terminal a clapper which strikes the bell so that it will ring. No ringing of the bell will take place if the current through *b* is too small to attract the armature, *d*. On the other hand, in the case that the current is beyond a certain limit, the armature will be attracted by the current passing through *b*, but *c* will not be able to produce a sufficient counteracting magnetic flux and the armature will not be released. There will, therefore, be a single click, but no real ringing of the bell. If one connects four of such devices in series in the line and four more, identical to the first four, in such a way that the current passes through them in the opposite direction, it is possible to operate without difficulty eight bells in the same line with say 30, 60, 90 and 120 milliamperes. A considerable number of such devices is in use in German party lines for telephony. It is stated that the devices are not very sensitive against variations in the insulation of the line. One disadvantage of this device is that when, for instance, the one bell tuned to 120 milliamperes is set into action, the armatures of the others are also attracted and produce a click on the bell. While the bell does not ring, yet the click is a disadvantage. To prevent that another arrangement is used, the principle of which is shown in Fig. 3. The principal point is that each electromagnet has two armatures, *d* and *f*, which together form a contact. In Fig. 3 three such devices are connected in series, *c* representing the electromagnets, *h* batteries and *i* galvanometers. The springs, *e* and *g*, hold the armatures *d* and *f* in the position shown in the illustration. If a current of strength one passes through the line, it will attract in the first elec-

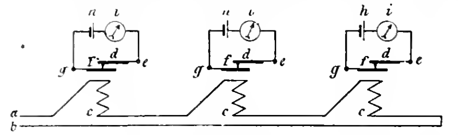


FIG. 3.—ALARM BELLS.

tromagnet the armature *f* and will disconnect *f* from *d*, but will not be sufficient to attract the armatures, in the other devices. If a current of a greater strength 2 passes through the line, the armature, *f*, in the second device will be attracted and the contact between *d* and *f* will be broken. On the other hand, in the third device the current is not strong enough to attract *f*, while for the first device the current is so strong that both armatures, *f* and *d*,

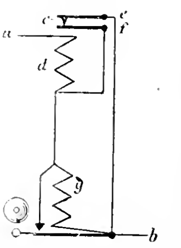


FIG. 4.—ALARM BELLS.

are attracted. Neither in the first nor in the third device the contacts between *d* and *f* are, therefore, broken so that only in the second device, which is tuned to the current sent through the line the contact between *d* and *f* is broken. This principle is applied as shown in Fig. 4. *a b* is the line, *d* is the electromagnet with a double armature mounted on the springs, *e* and *f*, and forming the contact *c*, while *g* is an electromagnet which when magnetized acts on a bell. If the current in *d* is too small the double armature, *c f*, remains unmoved and the current passes along the path *a d c e b*. If the current becomes sronger, the armature, *f*, is attracted and the current passes along *a d g b* and the bell rings. If the current is strong enough to attract both armatures, *e* and *f*, the current passes along *a c e* and *b*.—*Zeit. f. Elek.* (Vienna), May 15.

New Books.

ELEKTRO-AKUSTISCHE UNTERSUCHUNGEN. By Robert Hartmann-Kempf. Frankfurt: Gebruder Knauer. 255 pages, 105 illustrations.

This volume is remarkable as a book, for its clear type, good paper, careful proofreading and singularly beautiful photographic plate reproductions. It contains the results of the author's researches set forth as a doctorate thesis on the physical subject recited in the sub-title, namely, the influence of amplitude upon the pitch and decrement of tuning forks and tongue-shaped steel strips. The entire work bears the impression of careful experimenting and faithful recording.

A number of interesting physical data are developed from the experiments set forth in detail. The effect of the atmospheric pressure in lowering both the pitch and sustenance of both strip springs and tuning forks is abundantly evident. The change in pitch or frequency was in the neighborhood of one-tenth of one per cent. between full atmospheric pressure and a good vacuum, while the logarithmic decrement was reduced by the vacuum about three times.

The sharpness of the mechanical resonance to electromagnetic excitation was also well demonstrated. The application of this principle to the purpose of frequency measurement in the well-known apparatus of this type is immediately evident. The book will be of great value to the student of electromechanical resonance or of acoustics.

Electrical Interests in Panama.

The government of Panama has granted the United Fruit Company a fifteen-year concession for the operation of a system of wireless telegraphy between Panama, Colon, Bocas del Toro and the Bay of Limon and the Central and South American nations. The concession is now being discussed in the legislature, and will probably be approved.

The electric light and tramway plants and the telephone system in the Panama Canal zone have been bought by a syndicate, in which American capital is interested.

St. Louis Exhibits of the Westinghouse Companies.

The main service plant at the Louisiana Purchase Exposition, for which the Westinghouse Electric & Manufacturing Company received the general contract, is naturally a notable feature of the Westinghouse exhibits, and one which appeals, because of the commanding size of the four big electric generating units, each of 2,000-kw capacity, and their location in the central aisle of Machinery Hall, to practically all visitors to the Fair. These generators operate at a speed of 83½ r.p.m. and deliver 25-cycle, three-phase current at 6,600 volts. Entrance to the service plant exhibit is through a large 35-ft. plaster ring molded in close representation and in exact duplicate size of the stationary armature of the 5,000-kw alternating-current Westinghouse generators constructed for the elevated and subway train service in New York City. In this connection it may be said that 10,000-kw generators for the Ontario Power Company are now being constructed in the East Pittsburg works of the Westinghouse Electric & Manufacturing Company.

There is little in common in the Westinghouse Chicago service plant of 1893 and the St. Louis service plant of 1904, save the name of the manufacturer. At Chicago six of the twelve 750-kw generators there used were driven direct by Westinghouse-Columbina steeple engines, the other six being belt-driven to various types of engines, the space occupied by the smallest of the belt-driven generating units complete being about 65 by 27 ft. The units at St. Louis, almost three times as large, are direct-driven, of course, and the space occupied by each over all, with the 36-in. by 76-in. by 54-in. Westinghouse Corliss vertical cross-compound engines, is only about 35 by 15 ft., and 32½ ft. in height, the fly-wheels being 23 ft. in diameter.

The total space devoted to the service electric plant in Machinery Hall, with the exciter units, condensers, cooling towers and the 35-panel switchboard, is 26,260 sq. ft. The entire steam and electric station was designed and equipped by Westinghouse, Church, Kerr & Co., and all the motive power apparatus in connection with the generators, and in the steam generating plant in the nearby boiler house, was furnished by the Westinghouse Machine Company. The electric plant, although within the Westinghouse walls at the west end of Machinery Hall, has not been laid out on elaborate lines to combine the diverse characteristics of exhibition and service, and is an exhibit plant only in so far as it is representative of thoroughly modern practice at minimum cost. The various organizations associated with the Westinghouse name, which have united in representation at St. Louis under the title of the "Westinghouse Companies at Louisiana Purchase Exposition," have additional adjoining exhibit space in Machinery Hall of 26,260 sq. ft., space in the Palace of Electricity of 10,100 sq. ft., where Baldwin-Westinghouse electric trucks and locomotives also are shown, and space in the Palace of Transportation of 3,000 sq. ft., a total of 65,620 sq. ft., or nearly ten times the space occupied by the same interests at the Pan-American Exposition at Buffalo in 1901. The organizations associated in these joint exhibits, which represent an army of 30,000 employees, and occupy a total workshop floor space of over 140 acres, more than is found in all of the twelve great exhibition palaces of the St. Louis Exposition, are as follows:

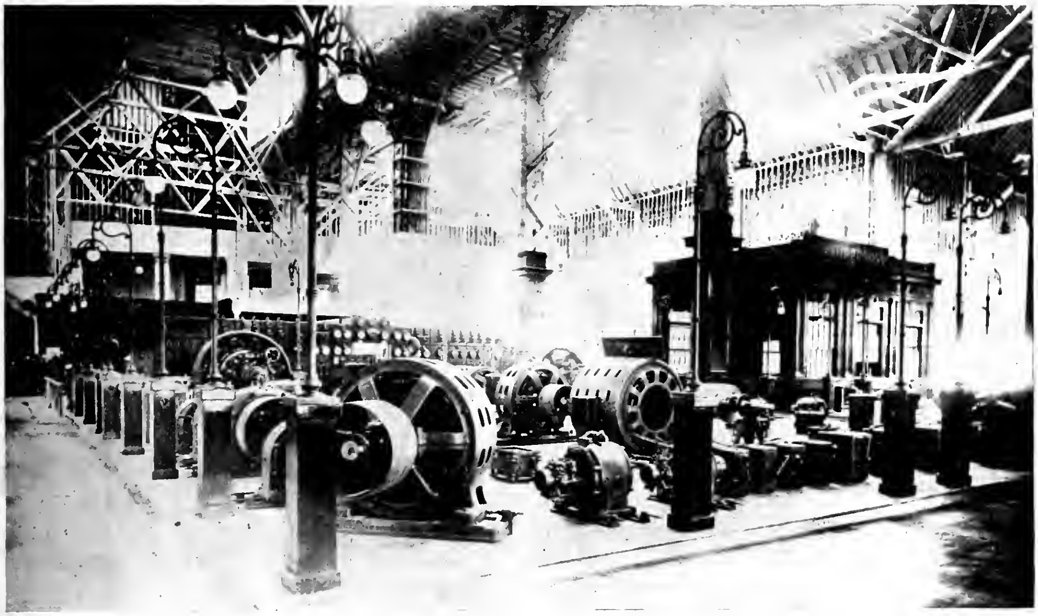


FIG. 1.—CORNER VIEW—PART OF WESTINGHOUSE ELECTRIC EXHIBIT, PALACE OF ELECTRICITY.

Westinghouse Electric & Manufacturing Company, Westinghouse Machine Company, Westinghouse Air Brake Company, Westinghouse, Church, Kerr & Co., Westinghouse Brake Company, Limited, London, Paris and Hanover; British Westinghouse Electric & Manufacturing Company, Limited, Westinghouse Automatic Air & Steam Coupler Company, Westinghouse Traction Brake Company, Canadian Westinghouse Company, Limited, Société Anonyme Westinghouse, Havre, France; Société Anonyme Westinghouse, St. Petersburg, Russia: Westinghouse Electricitäts-Actiengesellschaft, Berlin; Sawyer-Man Electric Company, Union Switch & Signal Company, American Brake Company, Nernst Lamp Company, Pittsburg Meter Company, R. D. Nuttall Company, Cooper Hewitt Electric Company, Bryant Electric Company, Perkins Electrical Switch Manufacturing Company.

In Machinery Hall, in addition to the electric service plant and the main exhibit of Westinghouse gas engines, turbo-generators, rotaries, exciters and motors in operation, all enclosed within ornamental staff walls and columned entrances of classic design, is the

Westinghouse auditorium, which seats 350 persons, in which are displayed at regular hours through the day the biograph and mutoscope pictures of scenes in and about the various Westinghouse works in the Pittsburg district, including the first interior photography of the kind ever taken by means of the Cooper Hewitt mercury vapor lamp. Through the courtesy of the companies, this auditorium, which is of ornate architectural design, rendered cool and comfortable at all times by a ventilating system which provides a continual supply of pure air and brilliantly lighted by the four principal systems of electric illumination, will be used throughout the Fair as a meeting place for scientific societies and technical congresses. The lighting of the hall is with the incandescent lamps of the Sawyer-Man Electric Company, Bremer arc lamps, Cooper Hewitt mercury vapor lamps and the Nernst glowers, all of which are used extensively throughout the Westinghouse display.

The Cooper Hewitt lamps, which made possible the Westinghouse mutoscope shop views, one of the distinct novelties of the Fair, are shown in the booths in Machinery Hall and in the Palace of Electricity, as designed for use in general illuminating, photographing and photo-engraving, with samples of work by some of the best operators in the latter lines. Demonstrations of the lamps will be given for the benefit of the National Photo-Engravers' Association at its June convention, and for the convention of the National Photographers' Association in October. The lamps are in use on the grounds by the official photographer, and in an illuminated sign of the Robbins Conveying Belt Company, in the Pike shows, "Over and Under the Sea" and the "German Tyrolean Alps"; and in various exhibits, and never fail to excite comment. The most striking use of the lamp, however, is in the eight-foot tubes which are hung over the entrance to the Westinghouse auditorium, and over the entrance to the Cooper Hewitt booth in the Palace of Electricity.

There are in all about 10,000 Nernst glowers in use in the exhibition buildings, 6,000 of them in the Fine Arts Museum, where they effectively solve the problem of artistic illumination. The handsome Illinois State Building is lighted by them, the National Cash Register Company uses the glowers in its three displays in the Liberal Arts, Electricity and Education Buildings, and the Westinghouse Companies use 300 big street glowers in their exhibits. Westinghouse generators are supplying current to the Nernst glowers throughout the Fair, as well as to the 200,000 incandescent lamps which outline the capitals, towers and general architectural design of the buildings in the charming night illumination. On exhibition or in service the Westinghouse Companies have installed within the Exposition grounds 14,000 hp in generating machinery and 30,000 hp in other apparatus.

The Sawyer-Man Company's display of various types and sizes of its well-known incandescent lamps is in the general Westinghouse exhibit space in the Palace of Electricity. There, also, the Bryant Electric Company shows a variety of lamp sockets, receptacles, switches and other products, including details manufactured by the Perkins Electrical Switch Manufacturing Company. The R. D. Nuttall Company's exhibit of cut and planed gears, trolleys, trolley gears and pinions, for electric railway, mine and industrial haulage motors, is in Machinery Hall, near the Westinghouse headquarters.

The Pittsburg Meter Company has a separate booth in block 35 of Machinery Hall. There the Keystone water meters and parts, with Westinghouse fish traps; Westinghouse gas meters, water meter provers, and a Westinghouse proportional 12-in. gas meter of the new straight-line type, with a capacity of 100,000 cu. ft. an hour, are shown. A graduated assortment of Keystone water meters on a revolving pyramid frame, with a 6-in. meter at the base and a ½-in. meter at the apex, constitutes the moving feature of the display.

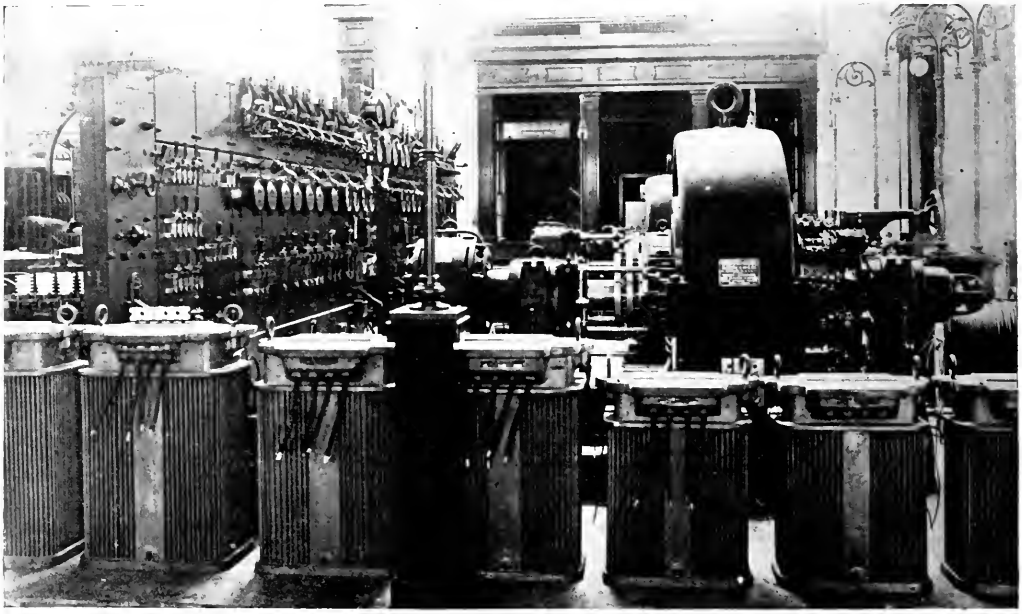


FIG. 2.—PART OF WESTINGHOUSE EXHIBIT, PALACE OF ELECTRICITY —SERVICE TRANSFORMERS, SWITCHBOARD AND ROTARY CONVERTERS.

Steam for the Westinghouse electric service plant is piped from the boiler house, known as the Steam and Fuels Building, nearby, in which there has been installed under the direction of the same engineers and contractors, a large battery of Babcock & Wilcox water tube boilers built into a single setting, with a total capacity of 6,400 hp. Equipment here includes also Roney mechanical stokers at the furnaces, operated by Westinghouse standard steam engines, a complete coal-conveying system furnished by the Link Belt Engineering Company, Cochrane feed water heaters, Worthington steam pumps, mechanical draft condensers, cooling towers and other apparatus to be found in a model station of the present day. The auxiliary apparatus in the electric plant includes three 80-kw, direct-current, 125-volt, direct-connected engine-driven exciter units, two of which are sufficient to operate the entire plant and adjacent auxiliary machinery in the exhibit sections. Each of the four chief generating units receives steam from a separate line, supplied by a separate battery, the entire plant thus consisting of two sections which may be operated independently or together.

The exhibit service plant, immediately west of the companies' headquarters, is utilized to furnish power for various purposes, and includes a Westinghouse-Parsons steam turbine generating set of 400-kw capacity, operating at a speed of 3,600 r.p.m., and delivering three-phase, 60-cycle currents at a potential of 440 volts. The unit selected for exhibit is of a size that has met with most extended introduction by reason of its applicability to power stations of moderate size, and at the present time is the smallest turbine unit built by the Westinghouse Machine Company, a number now nearing completion being of 7,500-hp capacity. The construction of the rotating field of the generator shown in connection with the turbine on exhibition may best be studied in the Westinghouse exhibit in the Palace of Electricity, where one of similar type is set up, but not in operation. The exhibit service plant contains also a 125-hp vertical and a 225-hp horizontal gas engine, the first direct-connected to standard two-wire, the second to standard three-wire, double-voltage, direct-current generators. Both single-acting and double-acting types of gas engines at present manufactured by the Westinghouse Machine Company are here represented in their latest form. The horizontal engine may be regarded as strictly representative of the modern internal combustion motor in its most recent development. Here, again, the gas engine unit on exhibition is one of the smallest built in its particular type, engines up to 3,000 hp now being under construction in the Westinghouse shops.

An important part of the Westinghouse installation which is seen by few is the pumping apparatus under the beautiful Cascades in front of Festival Hall. This equipment was designed to supply 90,000 gallons of water a minute for these Cascades, by three large centrifugal pumps each driven by a 2,000-hp Westinghouse induction motor, probably the largest motors ever constructed. The famous "Jumbo" engine which alone operated all the machinery of the Philadelphia Centennial Exposition in 1876, was rated at 1,000 hp. Here,

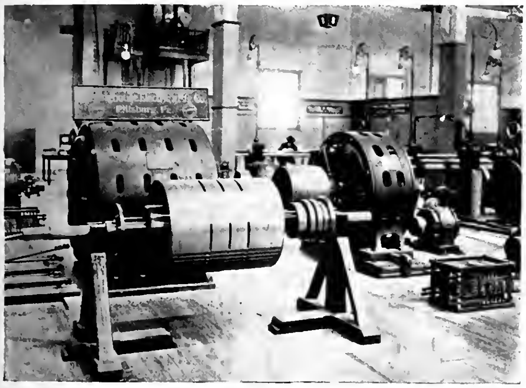


FIG. 3.—REVOLVING FIELD AND STATIONARY ARMATURE OF TURBO-GENERATOR SET, PALACE OF ELECTRICITY.

in a single plant, operating but one feature of the St. Louis Fair, is machinery with six times that capacity.

In the Palace of Electricity the Westinghouse Electric & Manufacturing Company occupies a space of over 10,000 sq. ft., including 1,600 sq. ft. devoted to the display of electric trucks and locomotives constructed in conjunction with the Baldwin Locomotive Works. Two locomotives built for mine service are shown, one weighing 20,000 and the other 30,000 pounds, each equipped with two No. 79 motors at 500 volts. Another 20,000-pound locomotive, for switching, is equipped with two No. 75 motors at 220 volts. In the regular electrical equipment display are a 400-kw turbine type generator, typical generators for direct and alternating currents, for belt or direct connection; rotary converters, motor-generator sets, oil-insulated and air-blast transformers, direct-current and alternating-current railway motors and controllers, single and polyphase induction motors of constant and variable speeds, direct-current motors of many types, including motors for variable-speed service from single and double-voltage circuits, switchboard apparatus, ammeters, voltmeters, wattmeters, synchroscopes, power factor meters, circuit-breakers and switches, many of them electrically operated; portable instruments, instruments of precision, potential regulators, and innumerable other forms of auxiliary apparatus and instruments. The alternating-current, series-wound, single-phase crane motors, similar in type and general construction to the single-phase railway motors exhibited in the Transportation Building, and the new "Westinghouse Unit Switch System of Multiple Control" are also to be seen in this section. The spectacular high-tension sign, using a potential of 50,000 volts, which spells the name "Westinghouse" in lightning-like discharges radiating from large letters over a plate glass surface—one of the attractions at the Pan-American Exposition—is to be seen in the Westinghouse auditorium.

The combined exhibit of the various Westinghouse brake companies extends for 150 ft. down the aisle from the turn table in the Transportation Building. At the end nearest the turn table is a reception room for guests, and at the other end is a booth fitted up

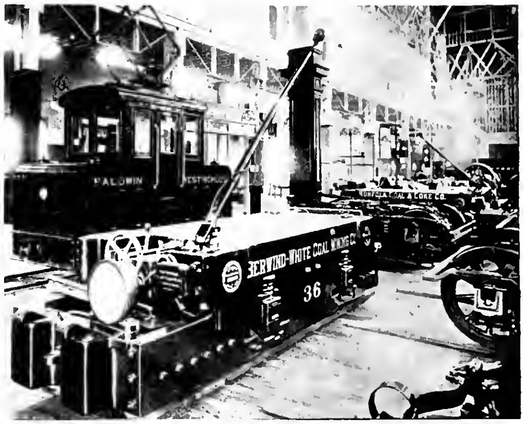


FIG. 4.—BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVES, PALACE OF ELECTRICITY.

as a Russian kiosk by the Westinghouse Company, Limited, of St. Petersburg, to be used as a rendezvous for Russian visitors to the Fair. Included in this operating exhibit is the display of the Westinghouse Electric & Manufacturing Company's alternating-current, single-phase railway motors, now so prominently before the engineering world, and which are introducing radical changes in present railway practice.

The Westinghouse Air Brake Company's exhibit shows a rack made up of apparatus constituting the equipment for a six-coach passenger train with engine and tender, all fitted throughout with the high-speed brake and signal equipment. The engine and tender are equipped also with the combination automatic and straight air

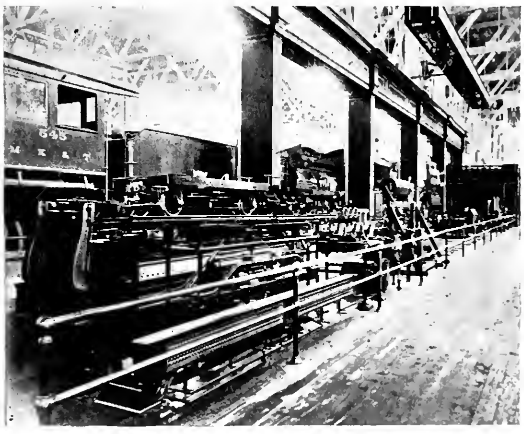


FIG. 5.—BRAKE EXHIBITS, TRANSPORTATION BUILDING.

brake which is now so much in use. The method at present generally adopted when two pumps are used on one locomotive is shown, and one of the novel features of the rack is that all valves are placed in duplicate, one sectioned so as to show the internal working mechanism, and connected to the valve in use in such a manner that it moves as the regular valve is operated. The operation of the various valves is thus readily studied.

The Westinghouse friction draft gear also is shown in section, with a machine especially designed for testing it in operation. The available power which can be exerted on the draft gear approximates 2,000 pounds. A triple valve testing rack is presented to show the manner in which this device is now being installed in many railroad shops. Sectional parts also are shown of the other apparatus of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company. The latter's exhibit consists of the magnetic brake and car-heating apparatus and the straight air brake for both motor-driven and axle-driven compressors. The magnetic brake is applied to a truck operated on a track 45 ft. long, the truck being equipped on both ends with friction draft gear buffers, showing the use of this device which has become extensively adapted to this kind of service. In this connection also is shown the separate brake controller for use with the magnetic brake when it is decided to add the latter to street railway equipment having the ordinary controller for the motor.

The straight air brake rack shows the equipment now used in the straight air outfit on electric cars that are operated by one of their standard compressors. The compressors shown are of the axle and motor-driven types, in section for inspection of their internal working parts. One of the sectional compressors is fitted to move with a regular compressor in operation.

Swinging picture frames are hung from a pipe frame to show photographs and colored instruction charts which adequately portray the equipment made by the Westinghouse Traction Brake Company, the colors representing the different pressures during the operation of the brake. In the exhibit of the American Brake Company is shown a model of the outside equalizing brake for locomotives, and the American automatic slack adjuster. The Westinghouse Automatic Air & Steam Coupler Company shows the ends of two freight cars fitted as movable models to show the operation of the device in actual practice. This also is shown on two small models fitted with air and steam and signal coupler. Under this model is another working model of the magnetic brake, arranged to show the operation of the device.

The Union Switch & Signal Company's exhibit is a group of signals, full size and in working condition, erected in the Transportation Building. The company shows also examples of electrical apparatus for the operation and control of signals, photographs of various installations, and a signal designed for use in the tunnels of the Pennsylvania Railroad under the Hudson River to New York City shown in position in a full-size model of one of the tunnel tubes. The company's most important exhibit at St. Louis, however, is in installations in actual service, including the Westinghouse electro-pneumatic interlocking system at the big union station, which controls all of the passenger yard movements, and is much the largest interlocking apparatus ever built.

A brief guide pamphlet to the Westinghouse exhibits may be secured at the headquarters and exhibits office, in the form of a neat folder which includes maps of St. Louis and the Exposition, and a list of typical Westinghouse installations in St. Louis. Red lines on the St. Louis map show street railways using Westinghouse apparatus. In the city of St. Louis to carry the visitor to the Fair grounds, are 1,000 street cars equipped with Westinghouse air brakes, driven by Westinghouse motors, and operated from stations in which are installed Westinghouse generators with a total capacity of 20,000 hp.

A Two-Belt Conveyor System.

We do not know whether any figures exist showing how much material is now conveyed by belt, motor-driven or otherwise, but in the aggregate the quantities must be enormous, and they would probably keep a fine steam railroad very busy. This field of work is inviting to inventive genius, and it has seen some remarkable improvements and developments. We now illustrate and describe a system that has just been introduced by which a great advance in the art is said to have been made. We refer to the two-belt conveyor system designed by the Ridgway Belt Conveying Company, of New York, in which an interior troughing and supporting belt runs over its individual head and tail pulleys, having separate take-ups, and is entirely independent of the conveying belt proper. The conveying belt is threaded over its head and tail pulleys in the usual manner, and has its separate take-up, so that the two belts, although moving together in the same direction at the same speed, are entirely separate and distinct. This enables the conveying belt to be lifted off the supporting belt and out of the troughing blocks and passed through either a stationary dumper or a moving tripper.

The conveying belt has no work put upon it other than that required to drive the lower carriers and its own head and tail pulleys, all the carriers on the upper line, which comprise two-thirds of the total number used, being revolved by the inner supporting belt.

FIG. 1.—CARRIERS USED IN TWO-BELT CONVEYOR.

The strains, therefore, are divided, the belt revolving two-thirds of the moving parts not being subject to the wear and tear of carrying the load, and the belt carrying the load being relieved of the strains and wear and tear of revolving the greater part of the moving parts of the machine. This produces a divided labor in wear and tear which enables both belts combined only to represent in strength what would be required of one belt in any one-belt system.

The interior belt is driven by a roller or block chain sprocket drive from the main driving shaft, and with the two belts in tension just sufficient to prevent slip on their driving pulleys; both belts move at exactly the same speed in the same direction, and there is no rub

FIG. 2.—INTERIOR TROUGHING AND CARRYING BELT.

of the conveying belt on the troughing blocks. At the points where the conveying belt meets the interior supporting belt, to prevent the rub and wear caused by the troughing blocks moving in a larger radius (the conveying belt being at the same height as the center of the supporting belt) a pair of concentrating rolls lifts the edge of the belt and drops it into the troughing blocks. The same method is used where the conveying belt leaves the troughing blocks at the opposite end.

Fig. 1 shows the carriers used in the two-belt system. They are straight rollers fastened to steel shafts revolving in babbitted boxes, the boxes being ball and socket, ring-oiling, felt-washered and dust-proof. In the two-belt system the conveying belt proper lies in a natural position, a true segment of a circle, with the strains distributed over its whole width uniformly. This increases the life of the belt from 75 per cent. to 100 per cent. over any type of pulley troughing belt. In Fig. 2 is seen the interior troughing and carrying belt with its troughing blocks attached. This interior belt, by a compensating drive, is driven at the same speed as the upper carrying belt, and the two move together through their entire travel on both the upper and lower sides. The conveyor belt proper for the two-belt system is a machine-made belt with a protective cover of average good material. The special belts, which are made to conform to the hard conditions of continuous flexing, are hand-made belts, and to give satisfactory service must be made of the highest grade of material to stand the wear and tear of angular bending.

The inner or troughing belt carries the outer or conveying belt through the upper line of working travel and the outer belt carries the inner belt on its return and through its travel in the lower line. The ability to use straight rollers, all strains being compression strains and not bending or breaking strains, enables the use of the lightest castings that can be machined and finished. This reduces the weight, cost and power required. Only a clean belt comes in contact with the upper carriers, which comprise two-thirds of the total number used. When the conveying belt proper, the only one necessary to be renewed, gives out, the cost of its renewal is stated to be approximately one-half in the two-belt system of what similar material would cost in any type of single belt conveyor. This system has, we are informed, already been put into successful use. Its application to light, power and railway plants is obvious.

A New Three-Point Auto-Starter.

The necessity for gradually applying to a motor the full line voltage of the circuit to which it is connected, in order that the starting torque may be developed by degrees and the starting current reduced, has given rise to a number of appliances suited to the different kinds of service and especially adapted to the motors with which they are to be used. One of such devices, known as the Westinghouse oil-immersed auto-starter, designed for use with Westinghouse type C induction motors, is shown in the accompanying illustration. It is used for motors of 5 to 50 hp; smaller motors of this type being started by closing the circuit with an ordinary switch, and starting

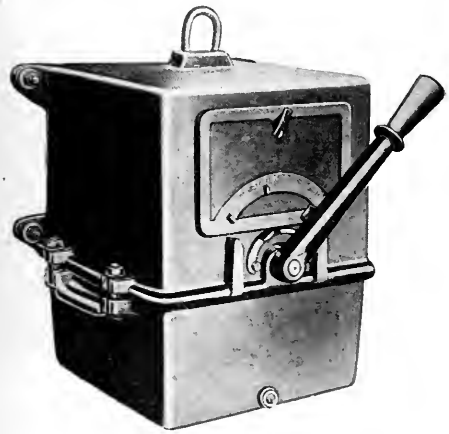


FIG. 1.—AUTO-STARTER.

controllers of another type being used for motors larger than 50 hp.

In effect, the auto-starter described consists of an oil-submerged drum switch used in connection with a pair of auto-transformers which have loops so arranged that a choice of two of several starting voltages is given. It thus combines the functions of a line switch in opening and closing the circuit with those of a controller or starting rheostat with two reduced starting voltages.

The switch, which is of the horizontal drum type, is placed in the oil tank with all live parts submerged, the handle and drum being so connected by gearing that the handle shaft is brought out above the level of the oil. In the style used with 5 to 15-hp motors, the switch is a simple drum on which the fingers bear directly, but in the 20 to 50-hp sizes, which carry larger currents, blades on the drums slide through jaws, giving superior contact. The drum contacts and contact fingers can be easily renewed, and if desired the entire drum can be detached. The absence of flexible leads is of advantage here, as it facilitates the removal of the drum and insures durability.

The drum is so arranged that the movement of the handle is progressive, passing in succession from the off position through the two starting notches to the running position. There is no possibility of moving the handle directly to the running position without first applying the starting voltages, as is frequently done by mistake when

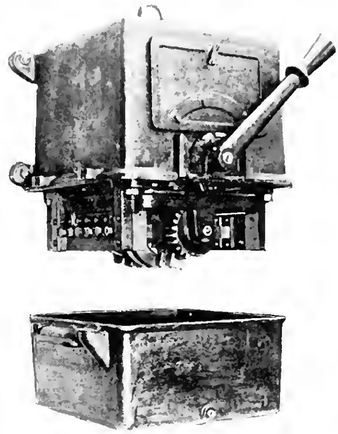


FIG. 2.—AUTO-STARTER.

the off position is placed between the starting and running positions and the handle is thrown first in one direction and then in the other. Nor is the operator so liable to leave the handle in a starting position and ruin the auto-starter by overheating the transformer. The handle is usually placed as shown, but if desired it can be reversed, so that the hand moves below the shaft.

The connections between the drum switch and the auto-transformers are arranged to give the best starting voltages and are adjustable, to suit the conditions of service. Each of the transformers has five taps, giving respectively 30, 40, 50, 60 and 85 per cent. of the full line voltage, and by changing the connections between the transformers, the starting voltage can be changed to give the torque desired. When the handle is in the running position connection is made directly between the motor and the line, the transformer being cut out. When the handle is in the off position both the transformer and motor leads are disconnected, the only live parts being the leads from the generator, a fact of distinct advantage when it is desired to change the transformer connections.

Changing the connections is also facilitated by bringing the transformer taps to the front of the case, where they can be readily reached by removing the hand-hole cover shown in the illustration.

It will be noted that especial attention has been paid throughout to convenience and adaptability to different conditions. In addition to the features mentioned, there are a number of others in which the convenience to the user has been consulted. Access to the drum is facilitated by slotting the lugs through which the bolts pass, so that when the nuts are loosened the bolts can be withdrawn sidewise and the tank lowered. The proper oil level is distinctly marked and drainage and filling tubes are conveniently located. The tank is tightly fitted to the upper portion of the case, and by providing the main hole cover with an air-tight gasket the interior can be protected against acid fumes or dangerous gases. This feature, together with the submersion of all live parts in oil, makes it possible to use the auto-starter where there are inflammable gases or combustible floating particles in the air. As a precautionary measure, the handle is locked in each of the four positions, being released by a pressure upon a button on the end of the handle, this provision preventing a too sudden starting of the motor. The fact that the auto-starter may be placed at any distance from the motor is also an advantage, when motors are suspended from ceilings or placed in other convenient locations.

Thermometer-Thermostat.

The Bristol Company, of Waterbury, Conn., is placing a new instrument upon the market to which has been given the compound name above, since it is a combination thermometer and thermostat. The instrument will give correct indications of the temperature of the atmosphere, gases or liquids at all times, and also serve as a thermostat to make electric connection at any predetermined limits of temperature for the purpose of operating controlling apparatus, alarms and the like.

Fig. 1 shows an external view of the instrument, which is provided with a six-in. scale graduated in degrees Fahrenheit. The construction and capabilities of this instrument will be best understood by referring to the interior view, Fig. 2, in which *A* is an arm

FIG. 1.—THERMOMETER-THERMOSTAT.

pivoted at lower portion of the case, terminating in a point resting on the arc of the graduated scale, and is held by friction at whatever point it may happen to be set. Two adjustable contact pieces, *B* and *C*, are carried by this arm. These contact pieces are capable of adjustment by means of a screw, *D*, which is threaded so as to cause the contact pieces *B* and *C* to approach or recede at equal rates and distance from the center line of the arm, *A*, upon which they are supported. They are also connected to binding posts, as shown, which are used for making outside connections. These binding posts are located within the case to avoid any possibility of the wires or connections being disturbed without detection. Three holes with insulating eyelets are provided in the lower portion of the case, as shown, for the insertion of connecting wires. The high and low contacts can be placed on a single or on independent circuits. The arm, *E*, moving over the graduated scale, indicates the changes of

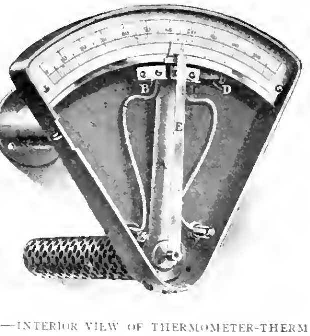


FIG. 2.—INTERIOR VIEW OF THERMOMETER-THERMOSTAT.

temperature where the instrument is located. This arm is operated by one of Bristol's recording thermometer tubes placed in the perforated protecting projection extending from the back of the case, as shown in the illustration. On the back of the indicating pointer, *E*, there is a raised portion which makes electric connection with the contact pieces.

A novel feature of the instrument is that the temperature indicating arm *E* is not restrained by the thermometer-thermostatic contacts. Thus it will be seen that the controlling effect of the thermostat is perfectly adjustable as to position on the scale of the thermometer, and also as to high and low limits of operation, without in any way interfering with the correct indications of the thermometer in case the temperature does not remain, or is not controlled, within the limits for which contact pieces may be set.

The instrument may be readily applied to liquids, as for instance to indicate the temperature and set into operation controlling apparatus for the brine in a refrigerating system or tank.

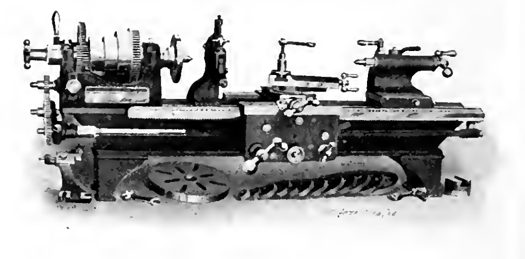
For temperatures above the atmosphere, as that occurring in ovens, kilns, closed spaces, or of liquids in pipes under pressure, a small bulb is located within the closed space or pipe. This bulb is connected with the thermometer-thermostat by a capillary tube filled with alcohol. The temperature at the bulb is communicated to the instrument, which may be located at any convenient point for observation. The electric wires connecting with the adjustable thermostatic contacts may be carried to any point where the controlling apparatus may be located or where it is desired that an alarm shall be given.

New Screw-Cutting Bench Lathe.

There is said to be a growing demand for an accurate and reliable bench lathe than can be bought at a moderate price and at the same time is a complete screw-cutting engine lathe, suitable for laboratory, electrical, optical and experimental work; tool, model scientific instrument making, etc.—in short, for profitable use in all lines of fine, accurate manufacturing and precision service. The "Star Special" screw-cutting bench lathe shown by the accompanying half-tone has been built to supply this demand. The head stock has a large hollow spindle, made from a crucible steel forging, with draw-in chuck for split collets up to ½ in. capacity, and phosphor-bronze boxes with improved end-thrust ball bearings. The cone pulley has three steps for wide belt and with strong back gears gives six changes of speed. A push pin on the head gear allows the cone to be instantly locked or unlocked without using a wrench. The tail stock is the curved or cut-under pattern, which allows the compound rest to swing around parallel with the ways and over the base of the tail stock with room to operate the feed screw handle. The spindle has an improved locking device, and the tail stock is provided with side adjusting screws for turning tapers. There is a long bearing on the bed and it is locked in such a manner as to render it firm and rigid.

The carriage has a long bearing on the ways and is gibbed to the bed both front and rear. A cam-locking device locks the carriage to the bed when using the cross feed. The cross feed screw has a graduated collar which reads in thousandths of an inch and can be set at zero in any position. Plain and compound rests are regularly furnished and easily interchanged. The base is graduated 180° and renders the compound rest capable of fine adjustment. The tool post has a patented collar and shoe which exclude all dirt and chips and admit of quick, easy and secure adjustment of the tool.

The automatic cross and longitudinal feeds are actuated by a



SCREW-CUTTING BENCH LATHE.

phosphor-bronze worm on the lead screw, receiving its power from the head spindle through spur gears. The lead screw is splined and simply acts as a feed rod, hence the only wear on the threads is in screw-cutting. The automatic feeds are almost indispensable for a large variety of work, as they secure more accurate and smoother surfaces. The range of feeds is very large. The range for screw-cutting is extra large, cutting all standard threads, right or left (including 11½ in. and 27 in.), from 3 to 64 without compounding the gears and nearly all threads by compounding. Patented spring nuts are used in connection with split washers to hold the change gears in place. They are easy and convenient to operate and allow quick shifts of the change gears.

The bed is 46 in. long, broad, deep, thoroughly well braced and accurately proportioned throughout. The rated swing is 9 in., but it has an actual swing of 10⅓ in. over bed and 24 in. between centers. The countershaft has friction clutch pulleys easy to operate, strong and durable, and self-aligning and self-oiling shaft bearings. The pulleys and friction bands are provided with self-closing oil cups.

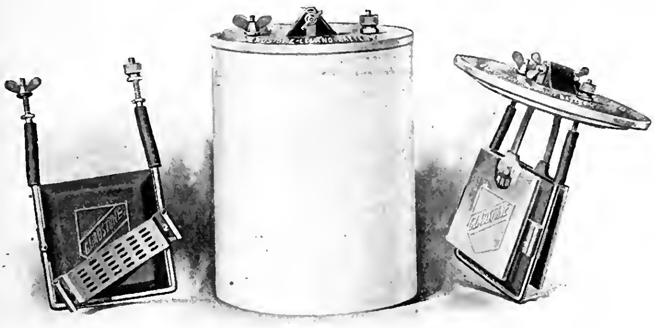
The "Star Special" screw-cutting bench lathe is made by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y., makers of the well-known foot and power "Star" lathes.

The Gladstone-Lalande Primary Battery.

The battery shown in the accompanying illustration is an improvement on the type of battery invented by De Lalande & Chaperon, of which there are several modifications on the market at the present time. In the Gladstone-Lalande battery the negative electrode is composed of a plate of agglomerated oxide of copper, having its surfaces reduced to the metallic state. This copper oxide plate is carried in a supporting hanger, made of copper rod formed into a U-shaped frame, the two free ends of which are threaded to receive clamping nuts, by which it is fastened to the porcelain cover of the battery. This supporting hanger is provided with two perforated flat spring copper clamps, attached to the opposite sides of the hanger. One of these spring clamps is riveted at each end to the hanger, and the other is detachable, having slotted eyelet holes at each end which fit over the two rivet heads on the sides of the hanger; the clamp is locked in position by being pulled slightly in a downward direction. The copper oxide plate is so placed in the hanger that one of its flat surfaces bears against the fixed spring clamp. The detachable spring clamp is then locked to the hanger, as described above, so that it bears against the other flat surface of the oxide plate, which is held firmly between the two spring clamps.

The advantages possessed by this form of construction are that when the battery needs to be recharged the exhausted oxide of copper plate can be removed from the hanger and a new one substituted with the least possible loss of time, and without soiling the fingers. The wide surfaces of contact presented by the perforated spring clamps render it unnecessary for any cleaning or sandpapering of these parts when recharging the battery.

The positive electrode consists in all cases of two flat plates, composed of an alloy of zinc and mercury, which are suspended from the cover. In some models these flat zinc plates are cast on an inverted U-shaped hanger, having a threaded extension which passes through a hole in the cover, to which it is clamped by a suitable nut. In other models (as shown in the illustration) the two zinc plates



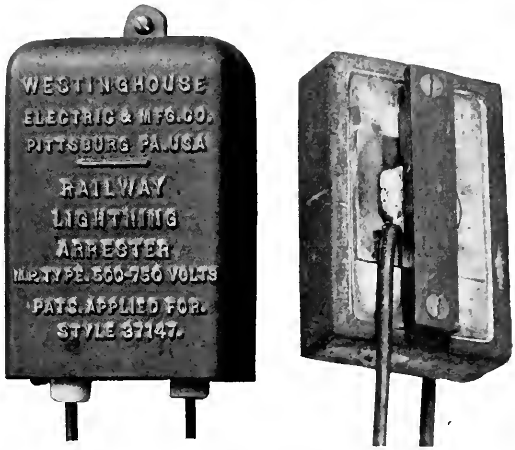
PRIMARY BATTERY.

are cast on separate stems, having a hole at the upper extremity which allows them to be bolted to the projecting knob on the top of the cover, which is provided with a horizontal hole to receive a threaded bolt for this purpose.

The electrolyte in all cases is a 20 per cent. solution of pure caustic soda, and a layer of pure mineral oil is poured on the top of solution to prevent evaporation and creeping. These batteries are manufactured by the Battery Supplies Company, Avon Avenue and Jelliff Avenue, Newark, N. J., the proprietor of which, Mr. J. W. Gladstone, is the inventor.

Multipath Lightning Arrester.

During his extended investigations of static phenomena and the protection of apparatus from lightning discharges, it became evident to Mr. P. H. Thomas that to successfully protect apparatus operated on low-voltage circuits, such for example as railway motors and generators, it would be necessary to produce an arrester which would offer a much easier and more open discharge path to earth than could be found in any arrester previously devised. To protect the arrester from damage, due to the line voltage holding over, was also an essential requirement. As the result of experiments carried



LIGHTNING ARRESTER.

on continuously for several years, both in the laboratory and under actual service conditions, the Westinghouse Electric & Manufacturing Company has placed on the market a new type of lightning arrester, devised along the lines of two general principles, as follows:

1. There is a minimum voltage, below which an arc cannot be maintained across an air-gap, no matter how small that gap may be.
2. Under proper conditions a static discharge will distribute itself over a great number of parallel paths, so that the amount passing over any one path will be very small, producing practically no heating or disintegrating effect. From this second principle the arrester takes its name, multipath (M.P.).

The arrester consists essentially of a specially prepared block of carbon, in which the area offered for discharges is very great as compared to the length of path through which the discharges pass. In this block there are a great number of separate conducting paths, and the discharge passing through the block divides and takes simultaneously many different ones. Each of these paths is broken up by a large number of minute air-gaps, so that the voltage across each gap is very small and the line voltage cannot maintain an arc across them. Thus the arrester is non-arcing, since the line current does not follow the static discharge.

In series with the carbon is a small air-gap rigidly maintained between two metal surfaces. This air-gap keeps the arrester insulated from the line, except at the instant of a discharge. The active parts of the arrester are enclosed in a cast-iron box which is filled with a water-proof compound.

The arrester is weather-proof and fire-proof. It may be used indoors or outdoors and may be located in practically any position desired. Its weight is from ⅓ to ½ that of any other arrester on the market, it is small and compact and has absolutely no moving parts to stick and get out of order. Some of the advantages claimed for the new type of arrester are as follows:

1. Great protective power (low resistance to static discharges). 2. Non-arcing. 3. No moving parts. 4. Fire-proof construction. 5. Light weight. 6. Neat appearance and ease of installation. 7. Simplicity and compactness.

Of the illustrations, the one on the left hand shows the lightning arrester complete, and that on the right shows the interior of it.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was exceedingly dull and lifeless. The public is doing nothing, and the operations by professional traders are conducted on a restricted scale. The uncertainty as to the crop situation and the coming political campaign are the supposed principal causes of the lack of interest and inactivity. The decreased railroad earnings did not seem to affect perceptibly the standard railroad stocks, although some little pressure developed in some of the minor railroad specialties. Steel issues were also under some pressure owing to the adverse accounts of the iron industry, although some remarkable prophecies are to be noted as to the enormous business to be done in 1905-6. Preferred declined somewhat, but easily recovered at the end of the week., Brooklyn Rapid Transit was sensitive to further talk regarding increased traffic and earnings. There was a fairly brisk trade in this stock, the sales for the week aggregating 27,670 shares, the closing price being 47⅛, a net gain of ⅜ point. Metropolitan Street Railway closed at 110, the sales amounting to 5,800 shares. General Electric was quiet and weak, only 600 shares having changed hands, at prices ranging between 155 and 156, the closing price being 155 and a net loss of 1 point. Westinghouse closed at 156⅛, and thus gained ⅛ point net. In the telegraph group Bell Telephone lost 1⅛ points, closing at 125¼; Western Union closed at 86¼, this being a loss of ¾, and American Telegraph and Cable gained ¾, closing at 88. There were no features in the curb market, which was quiet. Following are the closing quotations of June 7:

NEW YORK.

	May 31	June 7		May 31	June 7
Allis-Chalmers Co.	7½	7½	Electric Vehicle	6⅞	7¼
Allis-Chalmers Co. pfd	40	40	Electric Vehicle pfd	9¼	10¼
American Tel. & Cable	86¾	86	General Electric	155¼	155
American Tel. & Tel	125	125	Hudson River Tel.	..	
American Dist. Tel	22	22	Metropolitan St. Ry	109½	110⅝
Brooklyn Rapid Transit	46⅞	47	N. Y. & N. J. Tel	..	..
Commercial Cable	180	180	Marconi Tel	..	..
Electric Boat	25	25	Western Union Tel	85¾	86¼
Electric Boat pfd	60	66	Westinghouse com	154½	154
Electric Lead Reduction	⅝	*⅝	Westinghouse pfd	180	180

BOSTON.

	May 31	June 7		May 31	June 7
American Tel. & Tel	125	125	Western Tel. & Tel. pfd	77	77
Cumberland Telephone	112¼	112	Mexican Telephone	1¼	1¼
Edison Elec. Illum	234	*235	New England Telephone	121	118
General Electric	154	155	Mass. Elec. Ry	18	18¼
Western Tel. & Tel	..	*72	Mass. Elec. Ry. pfd	72	..

PHILADELPHIA.

	May 31	June 7		May 31	June 7
American Railways	44	43	Phila. Traction	95¾	96
Elec. Storage Battery	55	55	Phila. Electric	5⅝	6⅜
Elec. Storage Battery pfd.	55	55	Phila. Rapid Trans	12¾	12¼
Elec. Co. of America	8⅛	8¼			

CHICAGO

	May 31	June 7		May 31	June
Central Union Tel	..	..	National Carbon pfd	101¾	101
Chicago Edison	..	144	Metropolitan Elev. com	18	21
Chicago City Ry	165	170	Union Traction	6	*6¾
Chicago Tel. Co	..	118	Union Traction pfd	29	28
National Carbon	29	26¼			

*Asked

BELL TELEPHONE AND CENSUS.—The recently published census figures on the telephone industry have created much comment in telephone circles in Boston, as they constitute practically the first intelligent effort to secure authentic statistical information regarding this important industry. An official of the American Telephone and Telegraph Company is quoted as saying: "The Government deserves much credit for the figures prepared by the census bureau regarding the telephone. While they were not strictly accurate in all particulars, the figures were as nearly correct as could be secured. The census figures showing 5,000,000,000 telephone 'talks' during 1902 must be accepted with a grain of salt. While the Bell system of recording such figures is as nearly perfect as human ingenuity can make it, our records are likely to be 3 per cent. to 5 per cent. out of the way. We figure that the Bell 'talks' during 1902 were 3,000,000,000, which, according to the census figures, would leave over 2,000,000,000 'talks' for the independents. These latter figures are too large. With the Bell telephones outstanding numbering 1,575,160 (in 1902), there were left for the independents about 750,000. It is absurd to credit the independents with two-thirds as many 'talks' as the Bell companies when we had twice as many telephones outstanding. The statement that the independent companies now have a larger number of telephones outstanding than the Bell companies is incorrect. I do not believe the ratio to-day is more in favor of the independents than it was in 1902, and I have reason to believe that the percentage is steadily increasing in favor of the Bell companies."

NEW ENGLAND TELEPHONE.—The annual report of the New England Telephone Company for last year, already noted in this column, showed share earnings of $1,415,139, equal to 6.5 per cent. on the $21,616,700 capital stock outstanding at the close of the year. As compared with 1903, gross earnings increased $668,255, or 11 per cent.; operating expenses increased $421,884, or 8½ per cent.; and net earnings increased $246,370, or 21 per cent. The percentage of operating expenses to gross earnings was as follows: Gross earnings $6,692,864; operating expenses, $5,277,295; per cent. of expenses to gross earnings, 78.7 per cent. Operating expenses included $288,547 paid in royalties and $208,348 for interest on the funded debt, the former absorbing 4.3 per cent. of gross earnings, and the latter 3.1 per cent.; a total for the two items of 7.4 per cent. It is evident, therefore, that the remaining items of operating expenses absorbed 71.3 per cent. of the gross earnings. The proportion of maintenance expenses to gross earnings is shown as follows: Gross earnings, $6,692,846; maintenance, $2,156,217; per cent. of maintenance to gross earnings, $32.2 per cent. This is a little higher than the average appropriation for maintenance by the Bell companies, which, according to President Fish, is about 30 per cent. of gross.

STREET RAILWAY GROSS EARNINGS.—The *Street Railway Journal* contains a summary of the gross earnings of 310 street railway companies of the United States for 1903, as shown by the figures in its annual valuable "Red Book" issued by the McGraw Publishing Company. The gross receipts of 42 companies having gross receipts of over $1,000,000 each amounted to $169,394,001, against $158,165,809 in 1902; 26 companies having gross receipts between $1,000,000 and $500,000 aggregated $18,019,575, against $16,279,419 in 1902; 100 companies with gross receipts between $500,000 and $100,000 totaled $22,875,139, against $19,638,636 in 1902; 91 companies with receipts between $100,000 and $50,000 amounted to $6,428,053, against $5,873,042 in 1902, and 51 companies with receipts between $50,000 and $25,000 aggregated $1,871,719, against $1,636,423 in 1902. The number of companies in the highest class, that is, those reporting receipts of over $1,000,000, has increased from 38 to 42, and all of these companies record an increase in gross receipts with one exception, where the decrease is due to local causes. The general average increase for 1903 over 1902 by the 310 companies compared is 8.5 per cent.

MEXICAN TROLLEY REPORT.—The report of the Mexico Electric Tramways, Ltd., for 1903 states that the result of the company's operations for the year, after charging interest on the debentures of the "Compania de Ferrocarriles del Distrito Federal de Mexico," and after payment of the 3½ per cent. guaranteed on the share capital of that company, shows a net profit of $135,785. The interest received on the debentures of the "Compania de Ferrocarriles del Distrito Federal de Mexico" and the dividend declared by the "Compania de Ferrocarriles del Distrito Federal de Mexico" on its share capital are then added, and after charging expenses and obligations, etc., a net balance is shown to the credit of profit and loss account of $77,725, which added to the balance brought forward gives the sum of $168,640. Out of this sum the usual dividend of 6 per cent. has been paid on the preference shares, amounting to $150,000, leaving a balance of $18,640 to be carried forward. The increase in the rates of exchange has resulted in a credit of $12,980, which has been placed to exchange suspense account.

INTERNATIONAL NICKEL.—Mr. Charles M. Schwab and his brother, Mr. Joseph H. Schwab, have sold their holdings in the International Nickel Company, according to information in Wall Street. The Schwab brothers were among the largest holders of the securities of the company, and were believed to be practically in control. It is understood that they sold their holdings to a syndicate and that their getting out of the company is only another proof of the desire of Mr. Schwab to reduce his outstanding interests in various concerns. The International Nickel Company was organized in 1902 with a capital stock of $12,000,000 preferred and $12,000,000 common stock. The funded debt of the company was $10,000,000. The company was a consolidation of a number of American and foreign nickel manufacturers, and it was claimed that it practically controlled the nickel output of the world. The president of the company is Ambrose Monell, formerly one of the right-hand men of Mr. Schwab in the Carnegie Steel Company.

DIVIDENDS.—The directors of the Massachusetts Electric Companies have declared the regular semi-annual dividend of 2 per cent. on the preferred stock. The Western Union executive committee has recommended the payment of the regular quarterly dividend of 1¼ per cent. A dividend of 1½ per cent. has been declared on Philadelphia

Union Traction stock, payable July 1. A dividend of $5 a share has been declared on West Philadelphia Passenger stock, payable July 1. A dividend of $4.75 has been declared on Philadelphia Union Passenger stock, payable July 1.

INCREASE OF STROMBERG-CARLSON CAPITAL.—The Stromberg-Carlson Telephone Manufacturing Company has decided to increase its capital stock from $4,500,000 to $6,000,000. It is stated that the Chicago factory will be closed and that all the manufacturing will be done at the company's factory in Rochester, N. Y. The common stock will be increased to 45,000 shares.

Commercial Intelligence.

THE WEEK IN TRADE.—The general situation is quiet and dull. The crop situation is still irregular, reports of improvement coming from some sections, while from others complaints are made. The volume of wholesale and retail business during May, *Bradstreet's* says, was disappointing, confirmation of this being found in decreases in bank clearings and in railroad earnings from a year ago, while failures were more numerous, though less costly than in recent months, but showing increases as compared with last year. There is, however, an underlying confidence in future trade, as is indicated by better inquiry for fall goods. Collections partake of trade irregularity, but are still fair. Among the industries iron and steel and bituminous coal are particularly depressed. Many furnaces are going out of blast, and curtailment continues. Finished products are generally quiet. Export business is expanding, the April shipments being double those of the same month last year. The lake tie-up is still unsettled. This affects shipments and general industry from Buffalo to Duluth. The market for copper was easy and ⅛c. lower at New York. Quotations are 12¾ @ 13c. for Lake, 12⅝ @ 12⅞c. for electrolytic, 12⅜ @ 12½c. for casting stock. The London copper market was lower. According to *Bradstreet's* statistics, there were 194 business failures during the week ending June 2d, as against 184 the previous week, and 157 the corresponding week last year.

ENGINE AND BOAT BUILDERS' ASSOCIATION.—The National Association of Engine and Boat Manufacturers has been formally organized this week in New York City. The membership roll was signed by forty-four of the leading manufacturers in these lines from all parts of the country. The charter of the association, under the laws of the State of New York, was received, and the constitution and by-laws were adopted. H. A. Lozier, of the Lozier Motor Company, presided, and E. W. Graef acted as secretary. It was decided to postpone the election of officers and an executive committee until the next meeting, which will be held at the Manhattan Hotel on June 27th. In the meantime Mr. Graef will communicate with the members and ask all who cannot attend to signify their choice for these offices. The objects of the association are in part as follows: To get special freight rates; to establish a bureau of information; to make special arrangements in regard to and to participate in the profits of shows, to protect its members against adverse legislation and questionable advertising schemes; to bring forward the new and improved methods in construction, and to take such action as will be in the interests of its members as regards alcohol as fuel. The membership of the association is as follows: The Lozier Motor Company, the Standard Machine Construction Company, the Bridgeport Motor Company, the Gas Engine and Power Company, the American Iron Works Company, the Buffalo Gas Machine Company, the Charles A. Strehlinger Company, the Toquet Motor Company, Panhard & Levassor, the Matthews Boat Company, the Isham Company, Fred Hock, the Delaware River Motor Company, Pilmer Brothers, the Standard Boat Company, the E. Gerry Emmons Corporation, Norwood Brothers & Co., the Eagle Bicycle Company, the Cushman Motor Company, the Wolverine Motor Works, Lacey Brothers, the Chase Pulley Company, A. Barrett's Sons, the Pearson Boat Construction Company, Termadt & Monahan, the Truscott Motor Company, the Pierce Engine Company, the White Craft and Power Company, Charles Durkee & Co., the Smalley Motor Company, the Miamus Motor Company, the Outing Boat Company, the Remy Electric Company, William Roche, the Stanford Motor Company, E. W. Graef, the Smith & Mabley Manufacturing Company, the Milton's Point Shipyards, T. S. & A. D. Negus, the Electric Launch Company, A. Paterson, the Motor Boat, Motoring and Boating, and the Automobile.

EQUIPMENT FOR BARBOUR FLAX MILLS.—The Barbour Flax Spinning Company, of Paterson, N. J., has awarded the important contract for the electrical equipment of its new shops to the Crocker-Wheeler Company. The equipment will comprise a 600-kw engine type, 110 r.p.m., 250 volts, direct-current generator, which will be direct connected to a 1,000-hp Corliss engine. There will be 25 standard motors, ranging in size from 5 hp to 25 hp each. Eighteen will have a capacity of 25 hp; two will be 15 hp; three will be 10 hp and two will be of 5 hp each—520 hp in all. The Crocker-Wheeler people have also secured the order for the switchboard.

MOTOR EQUIPMENT FOR LONG ISLAND MARBLE PLANT.—An extensive motor equipment has just been ordered for installation in the plant at Ravenswood, L. I., operated by the Traitel Marble Company. There will be 24 Crocker-Wheeler motors, practically all of which will be individual drive. The equipment will aggregate 275 hp in capacity. The motors will range from 2 hp to 35 hp. The machines will include standard, fully enclosed and semi-enclosed types. There will also be four grinders, built by the Bridgeport (Conn.) Safety Emery Wheel Company, Inc., which will be driven by Crocker-Wheeler motors.

EQUIPMENT FOR MEXICAN SUGAR PLANT.—The San Juan Sugar Corporation, of which Mr. E. V. Weems, of Winchester, W. Va., is president, will shortly let contracts through Mr. George T. Anderton, consulting engineer, 120 Liberty street, for a quantity of electric equipment to be used for lighting and largely operating a 1,000-ton sugar plant to be built on the Miller Plantation Company's property, State of Vera Cruz, Mexico. The contract for the boilers, 1,200 hp in four units, has already been awarded to the Sterling Co., 114 Liberty street, New York.

THREE THOUSAND HP NEW ZEALAND HYDRAULIC PLANT.—The Waipari Electric Power Company is to construct a plant on the Waipari River near Dunedin for generating current to operate the municipal electric traction system of that New Zealand city, whose lines are now worked from a steam plant. The initial capacity of the Waipari plant will be about 3,000 hp. The Pelton Water Wheel Company, 143 Liberty street, has been allotted the contract for the water wheels. The General Electric Company will build the generators.

EQUIPMENT FOR ABRAHAM & STRAUSS.—The contracts for the additional lighting equipment to be installed in the Abraham & Strauss store, Brooklyn, have just been awarded through Mr. C. O Mailloux, consulting engineer. There will be a 400-kw, 115-volt generator, which will be built by the General Electric Company and direct connected to a tandem non-condensing compound Corliss engine of 600 hp capacity. The engine contract went to the C. & G. Cooper Co., Havemeyer Building, New York City.

EQUIPMENT FOR NEW YORK BUTCHERS' DRESSED MEAT PLANT.—Contracts are about to be let for several motors, varying in capacity from 1 hp to 40 hp, wiring, coal handling machinery, etc., for installation in the New York Butchers' Dressed Meat Company's plant, New York City. The generators—two 400 kw and one 200 kw—will be built by the General Electric Company. The engines will be built by the Fitchburg (Mass.) Engine Company. Hogan & Slattery are letting the contracts.

MOTORS, ETC., FOR NEW GORHAM BUILDING.—It has been decided that the electric current to be used in the new Gorham Manufacturing Company Building, Thirty-sixth street and Sixth avenue, New York, will be taken from the Edison mains. About 200 hp of motors for ventilating apparatus will, however, be ordered very shortly through Mr. C. O. Mailloux, consulting engineer. There will be 2,400 16-cp incandescent lamps and a number of arcs used to light the premises.

TELPHERAGE FOR JAPAN.—The Imperial Government of Japan has just ordered from the United Telpherage Company, of 20 Broad Street, New York City, a second telpherage plant. The company some time ago installed one complete plant, and the Japanese were so well pleased with it that the second plant was ordered by cable. Shipment is to be made of complete plant in thirty days, which order the Telpherage Company with its increased facilities can promptly fill.

EQUIPMENT FOR PROCTOR & GAMBLE PLANTS.—A considerable quantity of electrical equipment is to be installed in the new soap making plant of Proctor & Gamble, at Kansas City. Robert W. Woodward, the mechanical superintendent of the company's chief plants at Cincinnati, Ohio, will let the contracts for the Kansas City equipment. The installation of further equipment in the Cincinnati works is also contemplated.

THE AMERICAN ELECTRIC TELEPHONE COMPANY of Chicago reports that its exchanges recently installed at Hot Springs, Ark., and Fort Worth, Tex., are operating very satisfactorily. Both exchanges are equipped with four party-line selective apparatus throughout. The adoption of the American Company's four-party selective system is held largely responsible for the immense success of the new company.

FANS FOR MONTEREY.—The Wesco Electrical Supply Co., of St. Louis, Mo., has secured a large contract for fans to be shipped to Monterey, Mexico.

General News.

THE TELEPHONE.

REDDING, CAL.—The Northern Trinity Telephone Company is to build a telephone line between Delta and Carrville, a distance of 25 miles. Mr. Carr is interested in the company.

EMMET, IDA.—The Rocky Mountain Bell Telephone Company plans the early construction of a line between this city and Roosevelt, in Thunder Mountain. The distance is 160 miles, and on account of the mountainous nature of the country the cost is estimated at about $100,000.

DECATUR, ILL.—The capital of the Macon County Telephone Company has been increased from $20,000 to $75,000.

GOLDEN, ILL.—The German Telephone Company has been incorporated with a capital stock of $5000. The directors are A. Baryell, D. G. Buss and others.

REDDICK, ILL.—The Reddick Mutual Telephone Company has been incorporated with a capital stock of $5000. The directors are James Reilly, I. G. McLane and others.

JOHNSTON CITY, ILL.—The Johnston City Telephone Company has been incorporated with a capital stock of $8000. The directors are C. E. McLintock, W. A. Roberts and others.

HARMONY, IND.—A new telephone exchange is being installed at this place, which will be connected with the Citizens' exchange of Brazil.

FLORA, IND.—The Flora & Bringhurst Co-operative Telephone Company has been incorporated with a capital stock of $13,000. The directors are W. F. Wagener, J. H. Coplin and others.

INDIANAPOLIS, IND.—The Stampers Creek & Orleans Telephone Company, of Orange County, has been incorporated with a capital stock of $200. The directors are B. F. Williams, H. McCoy and others.

INDIANAPOLIS, IND.—The New Telephone Company is preparing to extend its underground conduit system. When this work is completed a large area of the central portion of the city will be occupied by the conduits.

NEWCASTLE, IND.—Improvements calling for an expenditure of $25,000 are to be made by the two telephone companies here—the Central Union and the Independent. Several miles of new cable are to be put in and extensions of lines into the country in different directions are to be made. The extensive work marked out will require all summer to complete. Several of the toll lines are being doubled on account of heavy business.

INDIANAPOLIS, IND.—A peculiar telephone suit has been brought by Ashjian Brothers, a manufacturing firm of this city, against the Indianapolis Telephone company, to recover $5000 damages on account of the company having failed to place their name and number in the latest issue of its directory. Plaintiffs allege that the business of the firm has suffered great loss by the omission, and aside from the damages it is asked that the defendant company be required to issue a new directory.

ELWOOD, IND.—In an exciting race against time between the Central Union Telephone Company and the Delaware & Madison County Company, whereby the first in the field was likely to get the new suburban line from Elwood to Curtisville, the independent company won. The Delaware & Madison County Company had teams employed hauling poles all night and started three gangs of men to work erecting them at daybreak. All the farmers along the line and many of the Curtisville residents will be on the new system.

PORTLAND, IND.—The war between the city authorities and the Central Union Telephone Company has been waged for some time and the bitterness was increased by the city council passing a resolution ordering the arrest of any employe of the company found at work on the streets. The city authorities contend that the company has no franchise. The company disregarded the resolution and put its men to work and they were promptly arrested and charged with obstructing the streets. The city has brought quo warranto proceedings against the company to compel it to show by what right it seeks to plant poles in the streets. The company claims that a franchise was granted it in 1882, but has not produced the instrument.

EVANSVILLE, IND.—The telephone situation grows more interesting every day. The Home Telephone Company, recently organized, has applied to the Board of Public Works for a franchise and agrees to pay the city $4000 annually for 30 years and suggests allowing this money to remain in the hands of the telephone company at 3 per cent. interest, to be applied on the purchase price of the exchange by the city at any five-year period after the first ten years. Otherwise the city has the right to purchase the plant by paying one-half of the price stipulated in cash and the remainder in four annual installments. The company agrees to file a bond of $10,000 to have the plant completed and in operation within one year after granting of the franchise. The company also agrees not to assign to any company now in the field, or that shall be allowed to operate in the city, the franchise or contract granted to it by the city. The charges asked are as follows: Business telephones, $4; residence, $2; party line, $1. After 6000 subscribers are secured the company is given the right to increase the price 25 cents for each additional thousand. Immediately upon information that the Home Telephone Company had applied for a franchise the Citizens Telephone Company sent a communication to the council asking that it grant to the Home Telephone Company the franchise submitted by it, provided only that such conditions be imposed as will secure to the city the establishment of a system under that franchise within a reasonable time and the payment at once to the city of a sum sufficiently large to secure it from loss in case of any failure to establish such plant within such reasonable time. Also that conditions be imposed which will require and secure connection with independent long-distance telephones and that the maximum charges be no higher than those asked by the Citizens Company. The granting of a franchise upon such conditions will be sufficient to warrant the Citizens Company to withdraw its application for a franchise; for, if in good faith any other company offers better terms to the city, the Citizens Company does not care to intervene. The council has taken no action as yet upon the application of the Home Company or the withdrawal of the Citizens Company. The Home Company is composed of wealthy manufacturers, and it will not be surprising if this company does not yet build the new exchange in Evansville.

BONAPARTE, IA.—The Farmers' Connective Telephone Company has been incorporated with $10,000 capital stock.

SOUTH McALESTER, I. T.—Articles of incorporation have been issued to the Goodwater Telephone Company, of Goodwater, Okla. The capital stock of the company is $2000, and the incorporators are W. J. Whitemore, president; B. S. Harris, vice-president; W. H. McBrayer, secretary-treasurer.

CONCORDIA, KAN.—The Farmers' Central Telephone Company has been incorporated with a capital stock of $10,000.

HOME CITY, KAN.—The Home City Farmers' Mutual Telephone Company has been incorporated with a capital stock of $2100.

THIBODEAUX, LA.—The Cumberland Telegraph & Telephone Company is installing a new 400-line multiple board in its exchange here. It is also making other improvements to its system.

TRAVERSE, MINN.—The Farmers' Co-operative Telephone Company has been incorporated with a capital stock of $12,000.

WATERTOWN, MINN.—The Watertown Telephone Company has been incorporated with a capital stock of $25,000. F. A. Barth is president.

WINONA, MINN.—The Farmers' Co-operative Telephone Company has been incorporated with a capital stock of $12,000. The directors of the company are C. L. Nelson, F. E. Briggs and others.

HOPKINS, MISS.—The Rural Telephone Company, of Hopkins, has been chartered with $500 capital. W. N. Bailey and others are stockholders.

YAZOO CITY, MISS.—Both the Mutual and Cumberland telephone exchanges were destroyed by the recent fire at this place.

CLINTON, MO.—The Clinton Mutual Telephone Company has increased its capital stock from $20,000 to $50,000.

ST. LOUIS, MO.—The assessed valuation of the telegraph and telephone companies' properties in St. Louis County has been fixed by the County Court as follows: Bell Telephone Company, 110.33 miles of poles, $6619.80; 511.45 miles of wire, $5114.50, exclusive of incorporated towns, where it was valued at $60 a mile for poles and $10 a mile for wires. American Telegraph & Telephone Company, 42.65 miles of poles at $60 a mile; 314.74 miles of wire at $10 a mile, and 1029 feet of cable, $110. Kinloch Long-Distance Telephone Company, 15 miles of poles at $60 a mile, and 391 miles of wire at $15 per mile. Pacific Mutual Telephone Company 27.55 miles of poles at $60 a mile and 218 miles of wire at $10 per mile.

ODELL, NEB.—The Odell Independent Telephone Company has been incorporated with a capital stock of $10,000.

ARAPAHOE, NEB.—The Arapahoe Independent Telephone Company has been organized in this place by local capitalists. The company has an authorized capital stock of $20,000. The company has recently started business with 64 telephones connected.

NORTH WEARE, N. H.—The Weare Telephone Company has been organized. Frank Simmons and S. B. Herbert are among the directors.

BATAVIA, N. Y.—The village trustees have granted a perpetual franchise to the Bell Telephone Company for the operation of an exchange in this village. The company agrees in return to give the village $250 worth of service annually.

WALDO, OHIO.—The Waldo Bell Telephone Company has been incorporated with a capital stock of $5000. The directors of the company are J. D. Bower, W. F. Groll and others.

GREENVILLE, OHIO.—The Eldorado & West Manchester Telephone Company has been incorporated with a capital stock of $40,000. The directors of the company are W. D. Rush, R. S. Conkling and others.

OTTAWA, OHIO.—The Ottawa Mutual Telephone Company has been incorporated with a capital stock of $1000. The incorporators are C. O. Beardsley, J. H. Purnell, F. E. Smith, E. L. Tupper and George Fritz.

CINCINNATI, OHIO.—The Probate Court has decided that the Queen City Telephone Company is entitled to the use of the streets of Cincinnati for its wires, and prescribes the manner in which the franchise should be exercised. An appeal is to be taken.

BAKER CITY, ORE.—The Snake River Telephone & Telegraph Company will construct a telephone line down the Snake River to the Iron Duke mine and connect with other mining and agricultural systems in that region.

UNIONTOWN, PA.—The telephone line to connect Uniontown with Pittsburg over the lines of the Tri-State and Pittsburg & Allegheny Telephone Companies has been completed. The Tri-State Company has 2000 subscribers in Lafayette County and covers practically the entire county.

SCHULENBERG, TEX.—The Schulenberg Telephone Company has been incorporated with a capital stock of $5000. The directors are W. E. Perlitz, John Schumacher and others.

SEATTLE, WASH.—An organization of all the independent telephone companies in Washington is being proposed by the Independent Telephone Company of this city. This would give them a long distance service and enable them to compete effectively with the Rocky Mountain Bell system.

PRAIRIE DU CHIEN, WIS.—The Star Telephone Company has been incorporated with a capital stock of $14,000. The directors are M. Menges, J. A. Haggerty and others.

ELECTRIC LIGHT AND POWER.

SEWARD, ALASKA.—Albert Higginson, George Bohus, Harry Kennedy and W. E. Catzdanner have secured a franchise for an electric light plant in this place. They will soon start work on a plant of 1700 lights capacity.

CAMDEN, ARK.—The Fensenthal Land & Townsite Company, Camden, proposes constructing water works, an electric light plant and telephone system, but no definite plans have yet been made.

OCEANSIDE, CAL.—Bids are wanted July 5 for a gas and electric light franchise. H. D. Brodie is City Clerk.

EUREKA, CAL.—John M. Vance, president of the Humboldt County Bank, is reported interested in the construction of a power plant and the transmitting of power to this city.

SAN FRANCISCO, CAL.—The Merced Falls Power Company, controlled by the Crocker Estate, has ordered through the Wagner-Bullock Electric Company, a 225-kw polyphase Bullock generator.

IMPERIAL, CAL.—The Holton Power Company, of Imperial, has closed a contract with the Wagner-Bullock Electric Company for an 800-hp Bullock railway generator to operate an electric road.

RIVERSIDE, CAL.—W. D. Woolwine, of Los Angeles, has been appointed receiver for the Riverside Power Company. This action grows out of the foreclosure suit of the Mercantile Trust Company of San Francisco.

ALAMEDA, CAL.—The monthly report of the Municipal Electric Light Department shows expenses for April to have been $22,006 and the earnings $1223. These earnings, it is said, are almost $300 in excess of those of the corresponding period last year.

SAN FRANCISCO, CAL.—The new board of directors of the California Gas & Electric Corporation, organized by re-electing the following officers: E. J. de Sabla, Jr., president; John Martin, first vice-president; F. G. Drum, second vice-president; R. M. Hotaling, treasurer, and C. W. Conlisk, secretary. John A. Britton is manager and G. Baum remains superintendent.

ETNA, CAL.—The Siskiyou Electric Power Company on June 1 took over the electric plant of the Etna Development Company. The Siskiyou Company, which has a capacity of 3500-hp at its plants, located at Fall Creek, and elsewhere, lights Ashland, Ore., Fort Jones and other California towns. A line will be constructed to Salmon River to furnish power for the quartz mills.

SANTA MARIA, CAL.—The Santa Maria Power & Lighting Company has filed articles of incorporation to furnish electric light and power in this city. The capital stock is $50,000, nearly all of which is held by Los Angeles and Pasadena men. The first board of directors is composed of H. T. Duff, W. F. Gibbs, R. H. Pallard and F. C. Armstrong, of Los Angeles, and B. E. Page, of Pasadena.

SAN FRANCISCO, CAL.—The Mt. Lassen Water Power Company, which has been incorporated by Archibald Barnard, L. M. Robbins, A. G. Sheath, M. A. Kenney and A. E. Bennett, has a capital stock of $500,000. The principal place of business is San Francisco. Harry L. Shannon has secured the necessary money to purchase machinery for the water power electric plant, which this company was organized to construct in Shasta County, Cal. It will be in a position to compete with the Northern California Power Company, which transmits to Redding and many other points. The initial installation will include a 1500-hp direct connected 3-phase generator, the water wheel operating under a head of 1500 feet. Water will be taken from Flat Creek, just below Mt. Lassen, and carried six miles to Bear Creek by ditch and flume. Thence a pipe line will supply water to the power house near Bear Creek Falls. The plant is to be in operation Jan. 1, 1905. A second unit will be installed later.

SAN FRANCISCO, CAL.—The North Mountain Power Company has closed contracts through the Wagner-Bullock Electric Company of San Francisco for two 75-kw, 3-phase Bullock generators, arranged for direct connection to Stilwell-Bierce water wheels. A third unit will soon be ordered. The 25-cycle machines will generate 2200-volt current at 500 r.p.m. Transformers for the generating capacity have been ordered in 300-kw units, with one spare bank. There will be several sub-stations. The power station will be built at a point 40 miles west of Redding in Humboldt County, and energy will be transmitted 75 miles to Eureka at 33,000 volts. Current for lights, power and electric railways will be supplied. This plant will be only a beginning and the system will be developed until 25,000-hp or more will be available for transmission to all of the important towns, mines and manufactories of Northwestern California. Early deliveries of machinery will be made and the initial plant installed in time to open for business before Jan. 1, 1905. An available head of 600 feet of water will be utilized. The North Mountain Power Company has a capitalization of $500,000. John M. Vance and Wm. Carson, of Eureka; John L. Koster, F. J. Koster, D. G. Schofield and R. J. Tyson, of San Francisco, are stockholders. J. C. Ralston, chief engineer, has commenced work at both ends of the proposed transmission line. For several years the company has been examining the mountain streams of Humboldt, Mendocino, Trinity, Del Norte and Siskiyou counties. The water rights and ditches of the Compagnie Francaise, doing business in Trinity County, have been purchased and an electric power plant will be installed in that mining district.

CHESHIRE, CONN.—The large transforming station of the Connecticut Railway & Lighting Company in this place is now completed. The main station is at Bull's Bridge, near New Milford, where there is a hydraulic plant. Electrical energy is transmitted to Cheshire at a pressure of 30,000 volts.

SEYMOUR, CONN.—W. H. H. Wooster and George E. Matthies, who control the Seymour Mfg. Company, Seymour, Conn., have bought the property of the Seymour Electric Light Company. Both industries depend upon water privileges one above the other on the Naugatuck River, and the best economy and results can only be obtained by working the plants in harmony.

KEY WEST, FLA.—The Key West Electric Light Company has absorbed the Electric Light & Power Company of this city. For the present both the plants will be operated. New machinery has been ordered and as soon as it is installed the power will be furnished from the Key West Electric Company's plant. The Electric Light & Power Company will continue the manufacture of ice.

MILLEDGEVILLE, GA.—Chas. F. Howe, manager of the Oconee Electric Light & Power Company, states that it is proposed to expend from $500,000 to $750,000 in improvements. The company will do the work itself.

MACON, GA.—An application for a charter for the Piedmont Power Company has been filed. The company proposes to generate power from the water streams of the State; also utilize the Oconee and the Ocmulgee for the generation of electricity for power, lighting and heating plants and for the operation of street cars. The capital is $2,000,000. Robt. L. Park, F. M. Marriot and Wm. A. Carlisle are the incorporators.

QUINCY, ILL.—The Quincy Gas & Electric Company has perfected plans which will require an expenditure of $50,000 for improvements during the coming summer.

MT. VERNON, IND.—The Mt. Vernon Electric Light & Power Company has been incorporated; capital, $5000. Directors: Jesse H. Purdy, Geo. E. Hoffmaister, Harry B. Rhine and others.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company will improve and enlarge its plant at New Jersey and Pearl Streets this summer. James B. Nelson is general manager.

FORT WAYNE, IND.—It is stated that the Fort Wayne Electric Light & Power Company has been sold to Eastern capitalists at a price a trifle over $500,000. It is further stated that the new owners will consolidate the company with the traction interests of the Fort Wayne & Wabash Valley lines. Mr. Randall Morgan, of Philadelphia, is interested in the deal.

WEST POINT, IA.—The council is securing estimates of cost for an electric light plant.

WILTON JUNCTION, IA.—The proposition to issue $5000 electric light improvement bonds was carried at a recent election.

FT. MADISON, IA.—Samuel Atlee is reported to have purchased the franchises recently granted F. C. Wood for an electric light plant and interurban railway system and for a gas plant.

WICKLIFFE, KY.—R. E. Gannon, of Cairo, has secured the contract for an electric light plant for Wickliffe, at $6042.

HOPKINSVILLE, KY.—The electric light plant owned by the Hopkinsville Gas & Lighting Company was destroyed by fire May 22, entailing a loss of $30,000.

INDIAN ORCHARD, MASS.—An electric light and power plant will be installed in the works of the Massachusetts Fiberloid Company of this place. The plant will have a capacity of 1000-hp, and 1000 incandescent lights will be installed.

MANTON, MICH.—The citizens have voted to issue $8000 electric light and water bonds.

SCHOOLCRAFT, MICH.—The electric light plant at this place was destroyed by fire on May 15.

SAULT STE. MARIE, MICH.—The Sault Edison Company is preparing to construct an electric light plant.

JANESVILLE, MINN.—It was voted May 16 to issue $25,000 bonds for the construction of water works and an electric light plant.

OXFORD, MISS.—The citizens voted May 20 to make improvements to the electric light plant.

HATTIESBURG, MISS.—The City Clerk writes that the matter of constructing an electric light plant, for which $60,000 bonds were to have been issued, has been postponed indefinitely.

LOUISIANA, MO.—The Louisiana Gas & Electric Light Company is contemplating improvements in its plant.

SEDALIA, MO.—A charter has been granted the United Water, Gas & Electric Company, of Sedalia, with a capital of $1,000,000. This concern is a consolidation of the companies formerly doing business in this place.

TEKAMAH, NEB.—The electric light plant at this place was damaged by a tornado on June 2, and the town is in total darkness.

CAMBRIDGE, NEB.—The Cambridge electric light plant, which has been operated under the management of P. B. Cole, has been organized as the Cambridge Electric Light Company with a capital of $10,000. Directors: W. H. Faling, J. H. Rosenfelt, E. C. Rodwell and others.

VIRGINIA CITY, NEV.—The Truckee River General Electric Company will install an addition to its present plant of between 2000 and 3000-hp, and will build a new 35-mile line and a sub-station during the present summer. Surveys are now under way, the plant to be driven by water power.

TRENTON, N. J.—Richard Stockton, of this city, has been named as receiver for the Freehold Electric Light, Heat & Power Company on the complaint of Mr. Charles P. Fitch, of Beverly.

JERSEY CITY, N. J.—The Commonwealth Electric Company has been incorporated with a capital of $100,000, to furnish light, heat and power. Registered office, 15 Exchange Place, Jersey City.

CAMDEN, N. J.—The Lighting Committee has awarded a 5-year contract to the Public Service Corporation Company to furnish arc lights at $109 per year per lamp. There are 524 lamps. The total cost per year will be $57,378.

ROSWELL, N. M.—The Roswell Electric Light & Power Company is extending its system, for which work material has already been ordered.

ADDISON, N. Y.—It is proposed to rebuild the electric light plant recently burned. Address F. W. Wheaton.

GOWANDA, N. Y.—It is said to be the intention of the Gowanda Electric Light Company to rebuild the dam across Cattaraugus Creek and operate its dynamos with water power.

LOCKPORT, N. Y.—It is stated that the Niagara, Lockport & Ontario Power Company will build the canal under the present charter and seek an amendment next year, which will authorize it to sell power to all counties of the State instead of only Erie, Niagara and Orleans.

BUFFALO, N. Y.—The Le Roy Hydraulic Electric Company, the Le Roy Gas & Electric Company and the Le Roy Power Milling Company have been consolidated, the new capital being fixed at $100,000. A number of improvements in the plant are to be made and the business considerably extended.

ALBION, N. Y.—The Albion Electric Light, Power & Gas Company, of Albion, which is also owner of the electrical plants at Waterport, Brockport and Middleport, is reported interested in a deal to develop a large water power at the latter village, approximating in the neighborhood of 25,000 horse-power.

ROCHESTER, N. Y.—The merger certificate of the Rochester Gas & Electric Company and the Municipal Gas & Electric Company has been filed with the Secretary of State. The filing of the papers was made necessary at this time on account of the proposed merging of the Rochester Railway and the gas and electric companies into the new Rochester Railway & Light Company.

ALBANY, N. Y.—The Kings County Lighting Company has been incorporated with a capital stock of $2,000,000 to manufacture and supply gas and electricity in Brooklyn and Queens Boroughs, New York City. The directors are Ashley T. Cole, Charles T. Lark, New York City; William J. Bagnall, Bayonne, N. J.; Alex. Keogh, New Rochelle, and W. R. Fuller, Brooklyn.

LAWNDALE, N. C.—The Lily Mill & Power Company, of Lawndale, is authorized to increase its capital stock from $50,000 to $100,000.

GREENVILLE, N. C.—Bids will be received on June 22 by the Board of Internal Improvements (L. J. Hooten, chairman) for the construction of an electric light plant.

LIDGERWOOD, N. D.—The council is considering the construction of an electric light plant.

WIMBLETON, N. D.—Fred Zollner, of Courtenay, N. D., has purchased the electric light plant here, and will install new machinery.

WEST MILTON, OHIO.—The matter of establishing an electric light plant is under consideration.

DOYLESTOWN, OHIO.—The proposition to issue $10,000 municipal lighting bonds will shortly be submitted to a vote of the people.

FREMONT, OHIO.—It is stated that the Fremont Light & Power Company is to utilize the water in Sandusky River here and erect a large power plant.

SUMPTER, ORE.—The Sanger Gold Mines Company proposes to construct a power plant at the mines, to cost about $100,000. J. K. Ronig, Baker City, is superintendent.

CLEVELAND, OHIO.—Bids will be received July 12 by H. H. Bohning, village clerk, of Newburgh Heights, for furnishing material and lighting the streets in that village.

NEWTON FALLS, OHIO.—The Village Council has awarded a 10-year contract for lighting the village with electricity to E. E. Mandeville, of Philadelphia, Pa. He is to build and equip the plant, and furnish 16 arc lights at $70 per lamp. A twenty-year franchise for commercial lighting and furnishing power also went with the contract.

MECHANICSBURG, PA.—Bids are wanted July 1 for electric lighting the city. Murray H. Spahr is chairman of the Light Committee.

BLOOMSBURG, PA.—The newly incorporated Irondale Electric Light, Heat & Power Company, of Bloomsburg, proposes to supply Bloomsburg, Catawissa, Rupert and Danville with electricity.

PHILADELPHIA, PA.—The Philadelphia Electric Company is said to be about to award contract for two more 7000-hp generator units for the Gray's Ferry plant similar to the General Electric unit now installed.

HANOVER, PA.—A charter has been granted to the Hanover Electric Power & Heating Company of Hanover, with a capital of $50,000, represented by Geo. Gitt, Chas. Delone, Thos. O'Neil and others, to construct a heating system.

MT. PLEASANT, PA.—The Hartigan Electric Light, Heat & Power Company, with John F. Hartigan, J. L. Kalp and others, of Mt. Pleasant, as directors, are about to apply for a charter to supply light, heat and power by electricity in Mt. Pleasant.

PITTSBURG, PA.—The United Electric Company of Wilmerding, which was formed recently, has placed an order with the Westinghouse Machine Company for two 200-hp engines and has contracted with the Westinghouse Electric & Mfg. Company for two 150-kw generators. This equipment is to be installed in its new plant, work upon which is now going forward.

PITTSBURG, PA.—An application has been made for a charter for the Great Tunnel Company, the object of which is to construct tunnels under the cities of Pittsburg and Allegheny for the transportation of freight. The motive power is to be electricity and the system is to be modeled after the one now in use in Chicago. Among those interested in the enterprise are Ralph E. Flinn and J. S. Weller.

YORK, PA.—The York Haven Water & Power Company has filed a mortgage for $1,000,000 in favor of the Land Title & Trust Company of Philadelphia to secure a second mortgage bond issued for that amount. The proceeds will be used for equipment, extensions, etc., as the business of the company demands. The rebuilding of that portion of the plant of the York Haven Power Company which was destroyed by the high water and ice several months ago is nearly completed. The plant will hereafter be better protected from like damage.

BATESBURG, S. C.—It was voted May 24 to issue $20,000 bonds for constructing water works and an electric light plant. J. C. Glover is City Clerk.

BATESBURG, S. C.—The town of Batesburg has voted a sum not to exceed $20,000 for water and light plants and other public improvements. W. H. Timmerman is on the committee having in hand the issuing of the new bonds.

BROWNSVILLE, TEX.—The City Council has granted Judge Jas. B. Wells, of Brownsville, a franchise for water works and an electric light plant. He will also establish an electric light plant at Matamoras, Mex.

SALT LAKE CITY, UTAH.—An expert appointed by the city council to investigate the alleged poor and irregular light service of the Utah Light & Railway Company has submitted a report, stating that the city is receiving all the electrical energy called for in the contract. There has been much criticism of the company's service, and the establishment of a rival power plant is being seriously considered.

BURLINGTON, VT.—It is proposed to construct an electric light plant here to cost $50,000.

WEST POINT, VA.—Bids will be received by the Town Council on June 10 for sale of a franchise to light the town by electricity.

PETERSBURG, VA.—The Finance Committee of the Council is considering the construction of an electric light plant.

HARRISONBURG, VA.—The Council is stated to have decided to install a municipal electric light plant costing about $70,000. The power will be secured from the Shenandoah River.

MOUNDSVILLE, W. VA.—The council has granted a franchise to the Moundsville Electric Company. A 50-year extension was granted, and the company now has the plans for a $25,000 plant ready.

CHARLESTOWN, W. VA.—The authorities of Charlestown have taken steps to annul the franchise of the Kanawha Water & Light Company, on the alleged ground that the company has failed to comply with the terms of its franchise.

WITTENBURG, WIS.—The Central Construction Company, of Oshkosh, Wis., has secured the contract for an electric light plant. The probable cost is $10,000.

BERLIN, WIS.—Bids are wanted July 1 for furnishing and providing, on moonlight schedule, 46 electric arc street lamps for the terms of 5 and 10 years from June 1, 1905, and such additional lamps as the city may require from time to time. Henry Morman is City Clerk.

MILWAUKEE, WIS.—The finance committee of the common council here has voted unanimously to recommend a bond issue of $150,000 for the purpose of establishing a municipal electric lighting plant. This matter has been agitated in Milwaukee for a long time and has been endorsed by all the political parties. Plans and estimates have been made by the city engineer and Jones Island is favorably considered for the location of the plant.

LARAMIE, WYO.—David McCullagh, City Clerk, writes that the city would like to correspond in regard to the construction of an electric light plant. The council is talking of installing a municipal plant.

RAT PORTAGE, ONT.—The town of Rat Portage contemplates building a new power station.

BRANDON, MAN.—A charter has been granted to the Western Light & Power Company, of Brandon, with a capital of $300,000, to install an electric plant on Assiniboine River. J. M. Robinson and John Russell, of Brandon, are among the incorporators.

THE ELECTRIC RAILWAY.

BESSEMER, ALA.—Estimates of the engineers place the cost of constructing the 16 miles of line between Bessemer and Brookwood at $200,000. S. E. Jones, of this place, is interested.

OPELIKA, ALA.—The Opelika Railway, Light & Power Company has been incorporated and will build an electric road from Opelika to Auburn, a distance of ten miles. J. B. Greene, E. L. Andrews and others are the incorporators.

SAN JOSE, CAL.—The directors of the San Jose, Los Gatos & Interurban Railway Company have under consideration the proposal to establish and install a power plant in the vicinity of the present car houses. The plant will cost between $75,000 and $100,000.

VALLEJO, CAL.—The Vallejo, Benicia & Napa Valley Railroad Company has secured all the rights of way for its line from Napa to Vallejo, a distance of 16 miles. The rails have been purchased, as have also the electrical equipment, trolley poles and ties. The road is expected to be in operation about Aug. 1. The officers of the company are John Cross, president; J. W. Hartzell, second vice-president; J. E. Loomis, secretary. The main office of the company is in Los Angeles.

GREENWICH, CONN.—President Charles Singer, of the New York and Stamford Railway has inaugurated a parlor trolley service, charging double fare for seats in the parlor car and running it between Port Chester and Rye Beach.

GAINESVILLE, GA.—The Gainesville & Dahlonega Electric Railway Company, which has under way the preliminaries for the construction of an electric railway between Gainesville and Dahlonega, has organized as follows: A. J. Warner, president; W. A. Charters, vice-president; W. A. Carlisle, secretary, and J. F. Moore, of Dahlonega, treasurer.

CHICAGO, ILL.—Attorney Charles Aldrich has filed application at Washington for a writ of certoriari from the United States Supreme Court in the case attacking the validity of the Union Traction leases.

ALTON, ILL.—Representatives of J. G. White & Co., of New York, have arrived in Alton to begin preliminary work on the new interurban electric railway between Alton and St. Louis. W. T. Davis will be the superintendent of construction. Work will be commenced at once. The line will connect the Alton system with the extension of the Granite City line, which has been completed as far as Nameoki.

BELLEVILLE, ILL.—It is said that the Southern Illinois Electric Railway Company has abandoned its project for building an electric railway from Okawville through Venedy, New Memphis and Mascoutah, and thence to Belleville to connect with the East St. Louis & Suburban Railway. Donahue Brothers, of St. Louis, who had the contract for grading the line, have pulled stakes and deserted the field.

KANKAKEE, ILL.—The Kankakee Interurban Riverview Railway Company will begin within thirty days the construction of its proposed line from Kankakee to Waldron and Momence, Ill., and thence from Waldron to St. Anne. There will be 30 miles of road in all. The officers of the company are H. T. Bonfield, president and purchasing agent; J. D. Dixon, treasurer; E. W. Bonfield, secretary. The main office of the company is at Kankakee.

MARION, IND.—The Indiana Union Traction Company has acquired the Kokomo, Marion & Western Traction Company and will push the completion of the line into Marion.

CRAWFORDSVILLE, IND.—The Northwestern Traction Company is constructing a modern telephone system between this city and Lebanon, and will soon be ready for the transmission of messages by the conductors regarding the movement of trains and the other business of the company.

EVANSVILLE, IND.—The County Commissioners have granted a franchise to the Evansville & Eastern Electric Railway Company for the right of way through Knight Township. This is the proposed new line between Evansville and Rockport. The company is given the right to furnish light, heat and power in Vanderburg County.

LOUISVILLE, IND.—The Louisville & Southern Indiana Traction Company has secured possession of the Highland Electric Railway Company. The Highland Company has not been in operation for several months. It was built about fourteen years ago, and at first was a paying investment, but of late years the company lost money, and last fall the company stopped operating its cars. The purchaser will rebuild the line and make it part of its system.

EVANSVILLE, IND.—The three electric traction projects planned to run from Evansville to Rockport are pushing their respective arrangements. The survey of the Evansville & Eastern has been completed and the right of way nearly all secured. The Evansville, Booneville & Rockport has obtained a right of way and reports that the road is financed. The Evansville, Newburg & Rockport, a steam line, is to be converted into an electric road at once.

GOSHEN, IND.—Promoters of the Kalamazoo & Lake Shore Traction Company have commenced work on the line that is to connect Benton Harbor, Niles and Kalamazoo. A mortgage for $600,000 has been filed in the register of deeds office in St. Joseph by the company. The American Trust & Savings Company holds the paper and is therefore to provide the money for the construction of the road to Kalamazoo along the lake shore. Work is in progress on the line between Benton Harbor and Paw Paw Lake.

CLINTON, IA.—The Iowa & Illinois Interurban Railway Company's shops, car houses, power houses and office building will be located in this city. The company is building an interurban road between Clinton and Davenport, a distance of 42 miles. About half the grading has been completed and several miles of track have been laid.

ARKANSAS CITY, KAN.—The Kansas-Oklahoma Interurban Railway Company, which was chartered May 10, with general offices at Arkansas City, Kan., organized on May 21 as follows: W. C. Robinson, of Winfield, Kan., president; S. H. P. Northrup, of Arkansas City, Kan., vice-president and general manager; W. D. Sanders, of Arkansas City, Kan., secretary and treasurer; C. L. Brown, of Arkansas City, Kan., general attorney; T. V. Holl, of South McAlester, I. T., chief engineer.

NEW ORLEANS, LA.—A large contract has been closed by Knox, George & Co. It comprises the construction of an interurban railway line at Birmingham which will cost, when completed, about $800,000. The new road, which will be known as the Birmingham & Steel Cities Railway & Power Company, will construct 40 miles of road, which, while operated in the same general district as that covered by the older company, will open up entirely new territory. The line will run from Birmingham to such outlying cities as Ensley, Pratt City, Bessemer and surrounding towns and factory districts.

PRINCESS ANNE, MD.—The Somerset & Wicomico Power, Light & Railway Company has organized as follows: Fillmore Lankford, of Princess Anne, president; Lloyd Riggin, of Crisfield, secretary, and S. Frank Dashiell, of Dames Quarter, treasurer. A committee has been appointed to select a route between Salisbury and Crisfield.

GRAND RAPIDS, MICH.—The contract for building the Grand Rapids & Ionia Electric Railway has been let to the Farnham Construction Company, of Chicago, work to commence before July 1 and to be completed not later than March 1, 1905. The power house will be located at Saranac, from which place construction will be pushed in both directions.

MINNEAPOLIS, MINN.—The Pioneer Electric Railway Company, of Minneapolis, has been incorporated with a capital stock of $100,000, to construct an electric railway from White Rock to Minneapolis and St. Paul. The incorporators are P. W. McAllester, Herman F. Johnson, Fremont D. Woodbury and B. F. Cooper, of Minneapolis, and Anton W. Holmes, of St. Paul.

KANSAS CITY, MO.—A sub-station is being built by the Metropolitan Street Railway Company at Twelfth Street and Cleveland Avenue. It will supply several of the East Side car lines with power. When this work is completed the Blue River power plant will be overhauled and improved.

ST. LOUIS, MO.—The United States Railways Company's electric rolling stock in St. Louis County has been assessed at $40,000; 2.43 miles of double track on public highways at $12,000 a mile; 6.54 miles of single track on public streets at $6000 a mile; 14.33 miles of double and 3.88 miles of single track private right of way at $12,000 and $6000 a mile, respectively. St. Louis and Suburban, 11.766 miles of single track at $6000 a mile, and improvements, $58,000. St. Louis and Kirkwood, 12.477 miles at $8000 a mile, and improvements, $37,150. St. Louis and Meramec River Railway Company 13,422 miles at $12,000 a mile, and improvements, $33,000. Brentwood, Clayton and St. Louis, 12.489 miles at $10,000 a mile, rolling stock, $12,000. St. Louis, St. Charles and Western, 15.567 miles of single track at $6000 a mile.

OMAHA, NEB.—The Omaha, Lincoln & Beatrice Railway, which plans to build an electric railway to connect Omaha, Lincoln and Beatrice, has filed with the Secretary of State articles increasing its capital stock from $200,000 to $2,250,000. Henry Robinson, of Akron, Ohio, is president. Contracts for equipment, it is stated, have been closed.

NEW YORK, N. Y.—The board of estimate and apportionment has voted unanimously in favor of accepting the report made by Comptroller Grout giving the New York, Westchester & Boston Railway Company the right of an entrance over the streets of the city, and compensation to be paid for the same.

NIAGARA FALLS, N. Y.—The Thorold & Lake Erie Railway Company has a bill before the Canadian Parliament to permit it to construct an electric railway from Thorold to Welland and thence to Port Colborne and Buffalo; also a line to Brantford. The idea is to operate the electric railway so that passengers passing through the Welland Canal on any of the Wolvin Company's boats, may make a side trip to the falls by electric railway and meet the boat farther down the canal. The bill is meeting with a great deal of encouragement.

CLEVELAND, OHIO.—A franchise has been granted by the City Council to a proposed street railway company, which is to charge a 3-cent fare. It is the first franchise of its kind in the city. Mayor Johnson is said to be interested in the new line, which, according to the conditions of grant, must be in operation by April 1, 1905.

BAKER CITY, ORE.—Of the proposed issue of $5,000,000 bonds of the Baker City & Oregon Wonder Electric Railway and Improvement Company, $500,000 was recently negotiated by Major Bonta, the promoter, the bonds having been taken by the North American Trust Company of New York. The railway company plans the construction of a system which will extend from this city throughout the southern portion of the state and finally connect with a transcontinental system in Nevada or California. The first line to be built will be to Prairie City, a distance of eight miles, and it is estimated that in this undertaking $750,000 will be expended on construction work and equipment. This does not include the power plants which are planned by the company, although not for the immediate future. Branch lines will be run from the main line to numerous small towns in Southern Oregon.

GREENVILLE, PA.—The Greenville Street Railway Company has been incorporated. William C. Wibert and Samuel G. Bailey, of Pittsburg, are interested.

CONNELLSVILLE, PA.—It is reported that the Pittsburg, McKeesport & Connellsville Street Railway has decided to build a line from Leckrone to Masontown.

JOHNSTOWN, PA.—A charter has been issued at Harrisburg for the Pennsylvania Street Railway Company to build an electric railway from Spangler to Moss Creek, a distance of three miles. The company has a capital of $18,000. F. Marstaller is president. The Pennsylvania Coal Company is understood to be interested in the project.

LANCASTER, PA.—The stockholders of the Lancaster & Mount Joy and Lancaster & Rohrerstown electric railways have decided to merge the two companies into one under the name of the Lancaster, Rohrerstown & Mount Joy Railway Company. The officers elected are Charles B. Keller, president; John S. Graybill, Jr., secretary and treasurer.

DANVILLE, PA.—The Danville & Bloomsburg Electric Railway Company has commenced the construction of its proposed road to extend from Danville to Bloomsburg, a distance of 10 miles. As soon as the bridge over the Susquehanna River is rebuilt the line will extend to South Danville and thence to Snydertown, where it will connect with the proposed Shamokin & Sunbury line.

CLEARFIELD, PA.—An ordinance has been introduced in the Town Councils of Clearfield and Curwensville, granting a franchise to the new Clearfield & Curwensville Street Railway Company. The proposed line will be 12 miles in length. The officers are E. A. Irvin, of Curwensville, president; W. H. Denlinger, R. D. Swope, C. E. Patton, A. W. Lee, F. G. Harris, W. I. Betts, E. W. Hess, F. G. Betts and T. L. Snyder, directors.

CHAMBERSBURG, PA.—The engineering corps of the proposed Catoctin & Myersville Electric Railroad has completed the survey to Pen Mar, where connection is made with the Chambersburg, Gettysburg & Waynesboro Electric Railway. The line as surveyed for the Catoctin & Myersville road runs from the Frederick-Middletown line at Myersville to Pen Mar station, on the Western Maryland Railroad, a distance of 22 miles. The corporation of the new road has elected the following officers: J. H. Maugans, president; A. L. Hauver, vice-president; H. H. Warrenfeltz, secretary; Charles U. Grossnickle, treasurer.

NASHVILLE, TENN.—A meeting of the promoters of the Nashville & Columbia and the Nashville & Gallatin interurban lines was held a few days ago, at which officers and directors were selected. The capital stock of the former road was increased from $50,000 to $2,000,000, and of the latter from $50,000 to $2,000,000. The following officers were elected; Nashville & Columbia, H. M. Gross, of Pittsburg, president; Thos. E. Perry, Jr., of Pittsburg, vice-president Nashville & Gallatin, H. M. Gross, of Pittsburg, president; Thos. E. Perry, Jr., of Pittsburg, vice-president; J. H. Connor, general manager. John H. Connor has accepted the contract for building the road from Nashville to Franklin, and the building of the power house at this point and two substations along the way.

DALLAS, TEX.—A movement is on foot to build an interurban electric railway from this city to Grand Saline, Tex., a distance of about 65 miles. A number of Dallas capitalists are interested in the project.

HOUSTON, TEX.—The charter of the Houston-Galveston Interurban Railway Company has been filed. The company is formed for the purpose of building an electric railway between Houston and Galveston, a distance of 51 miles. It has a capital stock of $250,000. The directors are James R. Patton, of Kansas City; Charles D. Graham, of Fairview, Kan.; T. W. Allen, of Greenup, Ill.; Walter Gresham, of Galveston; O. M. Whitcomb, of Webster, Tex.; W. E. Scott, W. B. Slosson, N. C. Abbott and J. Edgar Lafferty, all of Houston. The principal office is in Houston.

NORFOLK, VA.—Stockholders of the Chesapeake Transit Company have authorized an increase of capital stock from $1,000,000 to $1,500,000. This money will be used in carrying out improvements.

RICHMOND, VA.—The Citizens Rapid Transit Company has completed all details for building a new trolley line in Richmond from Brook Avenue to Fulton and the contracts have been let for the material and work. The new road complete will represent an outlay, it is said, of over $500,000. The new company has been quietly organized by Richmond and Northern capitalists, and is most substantially backed.

ST. ALBANS, VT.—At the annual meeting of the stockholders of the Mount Mansfield Electric Railway Company, the following officers were elected: A. H. Soden, president; C. D. Pike, vice-president; L. C. Moody, of Waterbury, secretary; W. B. McCutcheon, treasurer; F. L. Shepard, general manager.

PARKERSBURG, W. VA.—The Parkersburg, Marietta & Interurban Railway Company is extending its present power station at Parkersburg, W. Va., and installing Westinghouse-Parsons steam turbines. A 400-kw unit will be installed for the present which will operate on 150 lbs. steam and 28 inch vacuum. Steam will be furnished by water tube boilers without superheater. The generator will furnish 2-phase, 60-cycle current at 2200 volts to a single-phase distribution system supplying current for local lighting. The turbine unit will operate in parallel with the present equipment of the plant, which consists of Westinghouse compound engine generating outfits of the belted type.

New Industrial Companies.

THE GEMMILL TELEPHONE COMPANY has been formed at Barberton, Ohio, and will commence the erection of a factory building to manufacture telephones.

THE CENTRAL CALIFORNIA ELECTRIC COMPANY has been incorporated at Tuolumne with a capital stock of $500,000, and the incorporators are J. L. Gibbs, G. G. Grant and J. E. Conde.

THE TRITT ELECTRICAL MANUFACTURING COMPANY, of South Bend, Ind., has filed articles of incorporation with the Secretary of State. The capital stock is $15,000. The directors are B. S. Tritt, A. H. Calvert and C. H. Kreighbaum.

THE ELECTRICAL & CHEMICAL GAS COMPANY, of Harrison, N. J., has been incorporated with a capital stock of $50,000. The incorporators are John A. Yunck, Harry H. Yunck, Millard F. Wellford, Edward G. Nessley and Joseph R. Welfong.

THE IMPERIAL CONSTRUCTION COMPANY, of Charleston, W. Va., has been incorporated to build and operate telephone, telegraph and electric light plants. The capital stock is $50,000, and the incorporators are Homer P. Dixon, E. P. Lowler, James E. Furguson, Harlan W. Gillis, all of Charleston.

Obituary.

JAMES A. MYERS.

MR. JAMES A. MYERS, president and treasurer of the Robbins & Myers Company, of Springfield, Ohio, died at his home in that city on May 27. He had returned on April 22 from an extended business trip and seemed at that time in the best of health. He became ill on May 7, however, and soon developed symptoms of typhoid fever which terminated fatally as noted. Mr. Myers was born at Jamestown, Ohio, in 1851, and was educated at Bowersville Academy. He went to Springfield in 1876 and engaged in business. In 1878 he became interested with Mr. Robbins in the iron foundry business, in 1889 forming the present Robbins & Myers Co., and becoming its president on the retirement of Mr. Robbins in 1900, an office he occupied at the time of his death. Mr. Myers became actively interested in electrical affairs in 1896, about which time his company entered the electrical manufacturing field. From this time his acquaintance among members of the electrical fraternity increased rapidly, until at the time of his death he numbered among them many friends in all sections of the country. Mr. Myers was quite successful in affairs and to his energetic and careful management the prominent position of his company is largely due. He leaves a wife and two sons.

Educational.

LECTURE ON MACHINE SHOPS.—An interesting and instructive lecture was delivered on "The Modern Machine Shop," before a large and representative audience at the Carnegie Music Hall, Pittsburg, Pa., Monday evening, May 16th, by Mr. Charles Day, of the firm of Dodge & Day, Philadelphia, Pa., under the auspices of the Carnegie Technical Schools, not the least interesting part of which was that dealing with the early history of the machine shop. The work done by such pioneers as Watt, Maudslay, Nesmyth and Whitworth was briefly reviewed and some of the original machines designed by them illustrated. The evolution up to the present day was traced through its various stages and graphically illustrated by lantern slides. Mr. Day was introduced by Mr. Frank H. Taylor, vice-president of the Westinghouse Electric & Manufacturing Company.

Legal.

SELF-RESTORING SWITCHBOARD DROPS.—In a communication received from Mr. James A. Keelyn, attention is called to the recent decision of the United States Circuit Court of Appeals in sustaining the patents of the Western Telephone Manufacturing Company covering self-restoring switchboard drops; the effect of which decision, it is stated, is being minimized by some patent attorneys, patent experts and manufacturers of self-restoring drop switchboards. The communication states that these patent attorneys, experts and manufacturers previously claimed that the patent would not win and that their present action is to further mislead the public.

Personal.

MR. C. O. MAILLOUX, consulting engineer, Bishop Building, William Street, New York, is on a trip to Europe. He is expected to return in about a month.

MR. GEORGE WOOD BACON, of Ford, Bacon & Davis, consulting engineers, was married June 1 to Miss Caroline Tilden Mitchell at St. Cloud, Minn., the residence of the bride.

PROF. GEO. D. SHEPARDSON is represented in the current issue of the *Year Book* of the Society of Engineers, University of Minnesota, by a paper entitled "The Electrostatic Capacity of Wires."

MR. RALPH BEACH, well known in the General Electric Company, has returned to New York from a trip to Mexico, where he is very largely interested in the Tula Iron Works, whose equipment is being modernized on American lines.

MR. GORDON M. ARNOLD, brother of Mr. B. J. Arnold, president of the American Institute of Electrical Engineers, has received an appointment to West Point and successfully passed the physical and mental examinations for admission.

MESSRS. LINCH & SPROEHNLE, Pennsylvania Building, Philadelphia, have been retained as consulting and contracting engineers for the new electric railway to be constructed between Palmyra, Valley Glen and Grantville, Pa. Work will be commenced at once.

DR. LEE DE FOREST, of wireless telegraph fame, whose system is now being used so successfully by the *London Times* and *New York Times* off Port Arthur, is the subject of an appreciative sketch in the London *Daily Mail* of recent date, his portrait and apparatus being shown.

MR. F. S. PEARSON, vice-president and consulting engineer of the Mexican Light & Power Company, the Canadian syndicate which is building the huge Necaxa, Mexico City, El Oro power transmission system, is back in New York from a trip to the Southern Republic, to inspect the progress made on the work.

NOYES BROTHERS, of Perth, Australia, have been appointed engineers to the Freemantle and East Freemantle Municipal Councils to design and construct a complete system of municipal electric tramways and lighting. The estimated cost of these works is $420,000, and the system is to be ready for operation in about eighteen months.

MR. A. E. MITCHELL, formerly associated with high tension work in Denver, Col., has been appointed superintendent of motive power of the Lehigh Valley Railroad Company with headquarters at Bethlehem, Pa. He has charge of the entire specifications for the equipment of new shops at Sayre, Pa., which call for a large quantity of electrical equipment.

MR. SALVADOR UGARTE, of the Mexican electrical engineering and contracting firm of Ugarte & Garcia, of Guadalajara, State of Jalisco, which has contracts in hand for the construction and equipment of electric plants in the western part of the Southern Republic entailing an expenditure of fully $500,000 for machinery, sailed this week for Europe, but expects to be back in about three weeks, when he proposes to close contracts here for the equipment.

MR. EDWARD B. ELLICOTT, city electrician of Chicago, who has acted as constructing, electrical and mechanical engineer at the Louisiana Purchase Exposition since last December, has returned to Chicago, having practically completed his work at the Exposition, where he made a record in installing an immense amount of electrical apparatus in a very short time. The Exposition Company's electrical service construction has been well in advance of the other work.

MR. L. E. BENNETT has been appointed superintendent of construction on the extensive harbor improvements at Iloilo and Cebu, Philippine Islands, the contracts for which were recently awarded by the Government to J. G. White & Company. Mr. Bennett some time acted for the Siamese Government on the construction of the electric lighting system in Bangkok, the capital city of Siam. He also installed Yankee lighting equipment in the King's palace. He left the Government engineering bureau in Manila in order to take up his new position.

MR. MASON D. PRATT has opened an office at 18 North Third Street, Harrisburg, Pa., to do a general engineering business, including surveys, plans, etc., and construction for electric railways, power plants, etc. Mr. Pratt is a graduate of Lehigh University, and was with the Phœnix Bridge and Johnson companies. For some 13 years he was with the Pennsylvania Steel Company as street railway engineer, etc., and was in charge of the construction of a power plant for them of 1000-hp, electric sub-stations, etc.

MR. E. N. FOBES, of the Fobes Supply Company, Seattle, Wash., will be in New York next week for the purpose of placing orders for shipment July 1, 1904, March 1, 1905, for 100,000 incandescent lamps, 7000 iron-box bells, 27,000 Edison key sockets, 10,000 dry batteries, 10,000 insulator joints, 50,000 enclosed arc lamp carbons, a substantial lot of flexible and iron armored conduits and a general line of electrical supplies. While in New York he will make his headquarters in the offices at 136 Liberty Street of Mr. T. D. Watson, local representative of the Trumbull Electric Company.

MR. RUDOLPH MIEHLING, formerly New York manager of the Walker Electric Company, has connected himself with the Frank Adam Electric Company, of St. Louis, as sales manager.

MR. J. H. HALLBERG has opened offices at 45 Broadway, New York City, as a consulting electrical engineer and lighting expert. The telephone call is 4578 Broad. Mr. Hallberg has done a large amount of excellent work in late years in the lighting field.

MR. ARTHUR WARREN has an able and very interesting article in the June *American Review of Reviews* on "The Turbine: A New Era in Steam." It is written with his wonted literary skill and is well illustrated. The subject is summed up and discussed in a way that makes it thoroughly intelligible to the general public.

PROF. E. F. NICHOLS.—Professor Ernest Fox Nichols, of Columbia University, has received the Rumford gold and silver medal for marked scientific research. The honor was awarded Professor Nichols not only by the American Academy of Arts and Sciences, but also by the British Society, thus making the distinction a double one. Professor Nichols's research was directed along the lines of radiation, especially in the field of the pressure due to radiation, the heat of the stars and the infra-red spectrum. The medal will be struck off this summer, and will be presented to Professor Nichols at a special meeting of the American Academy of Arts and Sciences.

MR. MAX LOEWENTHAL, secretary and electrical engineer of the Prometheus Electric Company, has returned east from a four-months' trip in the interests of this company, having during that time visited almost every large city in the United States as far west as Denver, Col., establishing agencies for the sale of Prometheus electric heating and cooking apparatus. In the opinion of Mr. Lowenthal, after having thoroughly canvassed the situation, the immediate prospects of the electric heating business are very encouraging. In addition to an active business trip, Mr. Loewenthal enjoyed an excursion through the mining camps of Colorado and a trip to the St. Louis Exposition.

MR. PAUL M. MOWREY, who for the last three years has been connected with the Merchants' Trust Company as adviser on industrial investments, has assumed the office of vice-president of the Engineering Company of America, 74 Broadway. He has been prominently identified with the engineering and contracting business since 1888, when he became connected with the Edison Illuminating Company. Among his numerous successful enterprises was the purchase and consolidation of the street railway and power companies of Richmond, Va., which were later turned over to Mr. Frank Jay Gould.

MR. C. C. TYLER has resigned his position as superintendent of the works of the Westinghouse Electric and Manufacturing Company, at East Pittsburg, Pa., and has been appointed general superintendent of all the works of the Allis-Chalmers-Bullock interests in the United States. Mr. Tyler, who will enter upon his new duties on June 15, will make his headquarters at Milwaukee. His record in the practical management of great machine-shops is well known. Before Mr. Tyler went to Pennsylvania he made an excellent reputation, and at Pittsburg, where he has been for half dozen years, he enhanced this by the results he achieved in his work there. In the equipment of manufactories, in the design and construction of machine tools, in the handling of machinery and material in processes of manufacture, and in fact in all that pertains to the economy of machine-shop administration, Mr. Tyler is recognized as an expert who has no superior in this country. In entering upon his new field of duty, he is sure to carry with him the congratulations of the engineering profession. His appointment is another evidence of the care and strength by which the Allis-Chalmers Company organization (which, it will be remembered, now also controls the Bullock Electric Manufacturing Company) is being wrought together.

PROFESSOR A. MARSTON, who has been in charge of the civil engineering department for the last twelve years, was recently elected Dean of the Engineering Division at the Iowa State College. Professor G. W. Bissell has charge of the Department of Mechanical Engineering, Professor L. B. Spinney of the Electrical Engineering, and Professor S. W. Bayer of the Mining Engineering. The idea is to unify the work of the departments. During the last few years they have been experiencing a remarkable growth and the enrollment the present year is six hundred and seventy (670) students. This is an increase of about five hundred per cent. in seven years, and, taken in connection with the completion and occupation of the new $220,000 Engineering Hall, has brought the Division of Engineering to such a point that it seemed wise to have a more centralized organization. The engineering departments secured from the legislature a small appropriation for the establishment of an engineering experiment station to conduct experimental researches and publish bulletins helpful to the industrial interests of the State. The college also secured an appropriation of $7000 for good roads' experimentation and a law was passed by the legislature making the college a state highway commission. This work also will fall largely to the Division of Engineering, although the Agricultural Division will work in co-operation. It is the intention, among other things, to establish a summer good roads school for the benefit of road officials of the State. Professor Marston is a graduate of Cornell University, class '89.

DR. F. W. ATKINSON, the new head of the Brooklyn, N. Y., Polytechnic Institute, is a man of fine and engaging personality and already well known as an instructor. He was born on May 23, 1865, at Reading, a suburb of Boston. He graduated from the Reading High School and for four years from 1882 studied at the State Normal School, Bridgewater, Mass. Upon graduation from that institution he became principal of the Upton, Mass., High School, in which position he remained a year. Further studies were pursued at Harvard during the next three years, and in 1890 he received the degree of A. B. The following year he was in charge of the Westfield, Mass., High School. Then he went abroad to get advantage of foreign teaching, methods and experience. He studied at the Universities of Berlin, Halle and Leipsic for two years, taking the degree of Ph. D. at Leipsic. The next year he studied at Jena University and at the Sorbonne, Paris. During this stay in Europe Dr. Atkinson visited schools of all sorts in Germany, Austria and France. In 1894 he became principal of the Springfield, Mass., High School, holding the position until May, 1900. In that month, on the recommendation of President Eliot, the Hon. W. T. Harris and the Hon. C. D. Wright, he was appointed by the U. S. Philippine Commission as General Superintendent of Public Instruction in the Philippine Islands. It was wh[illegible] that Dr. Atkinson came most prominently before the public. His service there was purely pioneer and constructive, and the educational policy adopted by the United States in the archipelago was almost entirely his in both conception and execution. In June of last year, on his return from the islands, Dr. Atkinson was immediately appointed Superintendent of Schools at Newton, Mass., which position he now holds.

Trade Notes.

THE C. J. TOERRING COMPANY has removed its offices and factory to 2318 Noble Street, Philadelphia.

THE MORRIS ELECTRIC COMPANY, of Wilmington, Del., is issuing a catalogue which runs for one year from April to March. The 1904 production contains a pretty figure, and a simple announcement of fibre specialties and fibre wiring cleats.

SMITH ELECTRIC STORAGE BATTERY.—The Smith Storage Battery Company, Binghamton, N. Y., in a circular, illustrates and describes the Smith storage battery. Several large installations of the battery, which is of the superposed tray type, are illustrated.

TELEPHONE PAY STATIONS.—With the title "A Bargain in Pay Stations," the Kellogg Switchboard & Supply Company, Chicago, is sending out an announcement of reduced prices for pay stations in order to close out the stock in hand, the manufacture of this class of apparatus having been discontinued.

THE CANADIAN WESTINGHOUSE COMPANY has issued a tasteful circular in English and French editions as to the large works it is putting up at Hamilton, Ont., to build all kinds of Westinghouse apparatus, employing, however, only Canadian labor and material. Over a thousand men will be employed.

THE RITTENHOUSE-MILLER COMPANY has removed its factory from Philadelphia to Trenton, N. J., thus increasing its facilities for the manufacture of Eureka flexible conduit, the steadily increasing demand for Eureka conduit having necessitated this change. The address of the company will henceforth be Trenton, N. J.

ELECTRIC STORAGE BATTERY LOCOMOTIVES.—The C. W. Hunt Company is sending to its friends and patrons a neatly printed invitation to make a visit when at St. Louis to its exhibit of electric storage battery locomotive and cars running on narrow gauge "Industrial" tracks with curves and switches of 12 feet radius.

MACHINERY HALL, unlike the other buildings at the St. Louis World's Fair, is not closed in the evening. It is open until 11 p. m., and visitors in the evening find at work there, among other objects of interest, the big 5000-hp Allis-Chalmers-Bullock engine and generator producing the electric current to keep aglow the 120,000 or more decorative lights which glitter all over the buildings and grounds.

THE DIALECTRIC MFG. COMPANY, of St. Louis, has issued a four-page folder on its W. D. paint, which it says is proof against rust, dampness and electrolytic action. This is a quick-drying black paint affording a permanent insulation protection to wood or metal. Another pamphlet which it has issued speaks of "dielac" which is sticking varnish; "dilectrol," which is for copper coils, and dielectric varnish, which is a baking varnish.

THE WILLIAM B. POLLOCK COMPANY, Youngstown, Ohio, builders of all kinds of steel plate construction, has installed a modern hydraulic flanging plant of the largest size built. This additional equipment enables the company to bend and form the heaviest sections of structural material as well as flange and bend plates up to 2½ inches thick. With this latest acquisition, the William B. Pollock Company's plant is all the more equipped for the erection of heavy steel plate construction for all purposes.

VOUGHT-BERGER FIRE.—On Saturday night, June 4, the factory of the Vought-Berger Company, La Crosse, Wis., was practically destroyed by fire. The fire was first discovered in the assembly rooms on the second floor of the main factory building and ruined a large portion of the work in progress in the telephone and switchboard departments. Fortunately, however, the machine shops, wood-working plant and the plating and the buffing departments were uninjured. All the buildings remained intact and the machinery, tools, dies and jigs and also raw materials and reserve stock were in no way damaged. The loss is placed in the neighborhood of $7000 or $8000. The company was, fortunately, on the verge of making many improvements and enlargements to handle the unprecedented amount of new business, and these plans will be carried out at once. The company states that the delay in shipments will be not more than a week, and that absolutely no damaged material will be delivered to any of its customers.

DRY BATTERY FANS.—Electric fans have ceased to be a luxury and have become a necessity, but every house is not provided with electric current with which to run a fan. This deficiency has been met by the Jones Fan & Motor Company, 62 Vesey Street, New York, in its dry battery fan outfits. The battery and fan are made for each other, so that the best results are obtained from each. The "dry" feature of the battery commends the use of the outfit in the home, as there is no danger from spilling of chemicals, etc. The company guarantees a power-life of the battery of 250 hours with ordinary use of the fan. The battery box contains 20 cells of dry battery, and the fan, being especially designed for this combination, gives a powerful breeze. All those desiring to enjoy the comforts of a cooling breeze, but who have no electric power available to operate a fan, would do well to investigate the merits of this outfit.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 31, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

761,066. LIGHT ACCUMULATOR FOR CONTINUOUS AND ALTERNATING ELECTRIC CURRENTS, August Engelsmann, Stuttgart, Germany. App. filed Aug. 1, 1902. Details of an apparatus for focusing the light of an electric lamp upon a parabolic mirror.

761,090. HIGH TENSION ELECTRIC CONDENSER; Ignacy Moscicki, Fribourg, Switzerland. App. filed Feb. 17, 1904. The improvement consists in the parts of the dielectric which support the edges of the coatings being considerably thicker than the remaining parts covered by the coatings.

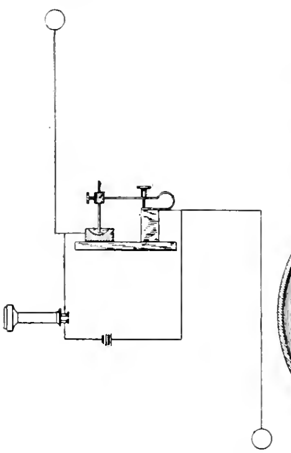
761,094. FUSE; Wm. McElroy, Brooklyn, N. Y. App. filed April 2, 1900. Means controlled by the opening of a main switch for automatically introducing one of the cut-outs into the circuit when a preceding cut-out has operated to break the circuit.

761,102. INSULATOR; Leonard M. Randolph, Newark, N. J. App. filed March 12, 1903. A base and a cap forming between them a channel for the cable and having projections in the line of the channel around which clamps are placed to hold the parts of the insulator together.

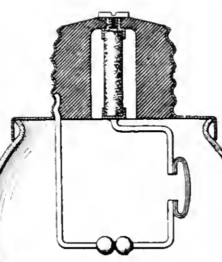
761,111. PRODUCTION OF TUBES FROM REFRACTORY MATERIAL; Elihu Thomson, Swampscott, Mass. App. filed Aug. 28, 1902. A pair of electrodes are surrounded by the refractory material in a divided state and by drawing a gradually lengthening arc the material is fused and forms a tube.

761,117. ELECTRICAL REGULATING MECHANISM; Allyn B. Walton, Lorain, Ohio. App. filed June 25, 1902. The mechanism embodies an electromagnet having two sets of poles forming two magnetic fields, one of such fields being of greater impedance than the other, in connection with a movable coil in series with the magnet coil.

761,133. ELECTRIC SWITCH; Henry P. Ball, New York, N. Y. App. filed Sept. 30, 1902. Relates to the mounting of the oil tank at the back of the switchboard and the construction of the operating mechanism connected therewith.



761,450.—System of Telegraphy.



761,380.—Electric Arc Lighting.

761,134. AUTOMATIC SHORT CIRCUIT ALARM FOR ELECTRICAL GAS LIGHTING OR OTHER SYSTEMS; Ferdinand M. Barrell, Brooklyn, N. Y. App. filed June 15, 1903. Details.

761,150. TELEPHONE ATTACHMENT; George A. Cowgill, Euphemia, Ohio. App. filed July 16, 1903. (See page 1125.)

761,182. ELECTRIC ARC LAMP; Joseph A. Rignon, Berlin, Germany. App. filed Aug. 21, 1902. Details.

761,198. HEAT ACTUATED ALARM SYSTEM; Charles E. Buell, Camden, N. J. App. filed May 28, 1903. Details.

761,199. APPARATUS FOR PRODUCING AN ALTERNATING MAGNETIC FIELD FOR THERAPEUTIC PURPOSES; Ernst Buhtz, Berlin, Germany. App. filed Jan. 30, 1904. Two or more magnets arranged about a common shaft, the lines of force passing between their poles producing on rotation of the apparatus a vortex of lines of force which is said to improve the therapeutic properties of the magnetic field.

761,204. METHOD OF MAKING ELECTRICAL HEATING APPARATUS; Charles E. Carpenter, New York, N. Y. App. filed Nov. 20, 1902. The insulating material while in a molten state is compressed between two metal plates, the heating conductor being at the same time embedded in the material.

761,205. ELECTRICAL HEATING APPARATUS; Charles E. Carpenter, New York, N. Y. App. filed Jan. 27, 1904. The apparatus patent conforming to the method described in the preceding patent.

761,208. RAILWAY SIGNAL; John P. Coleman, Edgewood, Pa. App. filed Sept. 4, 1903. The signal is operated pneumatically from a distance by electro-magnetic apparatus.

761,230. WEATHERPROOF POLE SWITCH; Chester H. Jackson, Portland, Me. App. filed May 29, 1903. Details.

761,250. ELECTRIC HEATER; Edwin F. Porter, Boston, Mass. App. filed Oct. 17, 1898. A heating conductor is wrapped around the blades of an electric fan.

761,256. WIRELESS TELEGRAPHY, Charles K. Salisbury, Lincoln Township, Blackhawk County, Ia. App. filed Oct. 30, 1902. Means for sending two or more messages simultaneously to an equal number of stations and means for utilizing relays for sending messages to stations outside of the electrical influence of the transmitting station.

761,258. WAVE RECEIVER; Richard W. Shoemaker and Lawsen H. Giddings, Pasadena, Cal. App. filed May 2, 1902. The receiver is susceptible to the electrical waves continuously, the susceptibility not being destroyed after each wave is received; the receiver consists of a conducting medium comprising particles of conducting material mixed with particles of non-conducting material.

761,267. MAGNETO; Walter F. Taylor, Brookline, Mass. App. filed Feb. 19, 1904. A polished finishing plate is placed over a coating of protecting material applied to the outer surface of the magnet.

761,280. POTENTIAL INDICATOR FOR HIGH VOLTAGE CIRCUITS; Jonathan E. Woodbridge, Albany, N. Y. App. filed Oct. 30, 1902. By inserting condensers in the leads between the main lines and the instruments, it is rendered safe to operatives to mount the instruments upon the switchboards.

761,284. REDUCTION OF NITRO COMPOUNDS; Max Buchner, Mannheim, Germany. App. filed Dec. 13, 1902. (See page 1125.)

761,308. TROLLEY WHEEL GUARD; Curtis W. Leslie, Pittsburg, Pa. App. filed Nov. 5, 1903. Details.

761,310. PREPARATION OF AZO DYES; Walther Loeb, Bonn, Germany. App. filed March 16, 1903. (See page 1125.)

761,345. STORAGE BATTERY; Theodore A. Willard, Cleveland, Ohio. App. filed Sept. 11, 1903. (See page 1125.)

761,360. ELECTROPNEUMATIC BRAKE; John W. Cloud, London, Eng. App. filed Sept. 30, 1901. An ordinary automatic air brake system with means whereby it can be actuated when necessary by electrically controlled valves.

761,372. PORTABLE ELECTRIC GAS LIGHTER; Edwin R. Gill, New York, N. Y. App. filed Jan. 4, 1902. Details.

761,379. ELECTRIC ARC LAMP; John A. Heany, York, Pa. App. filed Dec. 4, 1903. An arc lamp operating on the principle of the Nernst lamp, the electrodes being non-conducting when cold and an initial current serving to heat them up and at the same time separate them to strike the arc.

761,380. ELECTRIC ARC LIGHTING; John A. Heany, York, Pa. App. filed Feb. 4, 1904. The method corresponding to the previous patent.

761,417. SAFETY APPARATUS FOR USE ON RAILWAY CARS; Sidney H. Short, London, England. App. filed Feb. 11, 1902. In case the insulation of the trolley pole and base breaks down, an alarm is automatically sounded so that passengers on the roof of the car may be removed before any one comes in contact with the trolley pole.

761,432. COLLECTOR FOR THIRD RAIL SYSTEMS; Aldred K. Warren, New York, N. Y. App. filed Feb. 25, 1903. The shoe being at the end of a pivoted arm, is electrically connected with the car circuit by a flexible conductor wound around the axis of the arm.

761,450. SYSTEM OF TELEGRAPHY; John L. Creveling, New York, N. Y. App. filed April 11, 1903. The receiving device is a conducting bath, which is normally of high resistance, but which by electrolysis becomes of lower resistance on the passage of the received wave, and thus affects the local circuit, including the receiving device.

761,454. MANUAL AND AUTOMATIC CIRCUIT CONTROLLER; Wm. L. Denio, Rochester, N. Y. App. filed Jan. 20, 1904. Details.

761,459. SYSTEM FOR OPERATION OF MAGNETIC CLUTCHES; Arthur C. Eastwood, Cleveland, Ohio. App. filed Jan. 14, 1904. Means whereby the clutch magnets are strongest at the time of completing the circuit through them and while the load is being accelerated, the current being afterwards economized and preventing over-heating of the clutch.

761,466. ELECTRIC CUT OUT; Philip H. Fielding, New York, N. Y. App. filed Oct. 10, 1903. A double-pole cut-out in which the switch members are located in deep grooves or cavities in the face of an insulating block, the circuit closing member itself being an inclosed fuse of ordinary type which is readily removed when destroyed and substituted by another.

761,490. SAFETY DEVICE FOR ELECTRIC INTERLOCKING OR BLOCK SIGNALING APPARATUS; Frederick T. Hollins, Leytonstone, Eng. App. filed Feb. 18, 1901. A current-arrester is placed upon the circuits to prevent stray high-tension currents from getting on to the signal circuits.

761,526. INSULATED RAIL JOINT; James C. Mock, Detroit, Mich. App. filed Oct. 26, 1903. A heavy section of rail is fixed to the side of a main rail so that its upper surface will be flush therewith and afford a contact surface for the car wheel for signaling purposes.

761,533. SPRING CLIP; John S. McKee, Pittsburg, Pa. App. filed Oct. 17, 1903. In a switch where two blades connect with the clips at each pole, the intermediate clips are made shorter than the other clips to prevent an arc from forming and melting the inner surfaces of the blades, producing thereon a blister which would prevent the blade from entering the clip.

761,536. AUTOMATIC CAR SWITCH; Morris Nuss, Philadelphia, Pa. App. filed Sept. 25, 1903. Details.

761,549. ELECTRIC RAILWAY CROSSING; Abraham A. Shobe and William Embley, Jerseyville, Ill. App. filed Sept. 26, 1903. A cast box containing insulating material in which the crossing conductors are embedded and from which the latter project to engage with the conductors approaching the crossing.

761,553. THIRD RAIL SUPPORT; Louis Steinberger, New York, N. Y. App. filed Dec. 7, 1903. The insulator upon which the third rail rests contains a conical cavity into which a supporting pin projects, affording certain lateral free movement of the insulator on its support.

761,563. SWITCH FOR ELECTRIC LAMPS; Charles Wager, New York, N. Y. App. filed Aug. 22, 1903. Details.

761,565. TROLLEY MECHANISM; John H. Walker, Lexington, Ky. App. filed July 29, 1903. Details of construction whereby a flexible conductor is connected between the trolley base and pole.

761,566. TROLLEY; John H. Walker, Lexington, Ky. App. filed July 29, 1903. Details.

761,567. TROLLEY; John H. Walker, Lexington, Ky. App. filed Dec. 24, 1903. In addition to the wheel a sliding shoe is provided and mounted to the rear of the wheel in a pivoted yoke.

761,572. ELECTRIC FIRE AND BURGLAR ALARM; Wm. C. Barger, Mammoth, W. Va. App. filed March 31, 1904. Details.

761,574. TROLLEY PROTECTOR; John H. Best, Jr., Sandusky, Ohio. App. filed Jan. 8, 1904. Details.

761,611. TROLLEY POLE; Charles F. Ritchel, Bridgeport, Conn. App. filed Sept. 17, 1903. The wheel is mounted in an extension to the pole which is connected therewith by a vertical axis permitting lateral play of the wheel with respect to the pole.

761,616. SELECTIVE PARTY-LINE TELEPHONE SYSTEM; Albert J. Springborn, Cleveland, Ohio. App. filed June 27, 1902. (See page 1125.)

761,636. AUXILIARY FIRE ALARM SYSTEM; Wm. L. Denio, Rochester, N. Y. App. filed Jan. 20, 1904. Details.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

Vol. XLIII. NEW YORK, SATURDAY, JUNE 18, 1904. No. 25.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

Telephone Call: 7605 Cortlandt. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office - - - - - - 1139 Monadnock Block.
Philadelphia Office - - - - - 929 Chestnut Street.
European Office, Hastings House, Norfolk St., Strand, London, Eng.

NEW YORK, SATURDAY, JUNE 18, 1904.

CONTENTS.

Electrified Passenger Traffic.

The effect of electricity upon the development of street railway traffic has often been referred to, but is again emphasized in the figures brought out by the 1904 edition of "American Street Railway Investments," which is reviewed in our columns this week. This excellent compendium gives among other things a summary of the earnings of 310 street railway companies in the United States; and very interesting data are included. The number of those reporting receipts of over $1,000,000 annually has increased from 38 to 42, and all of these companies show an increase in gross receipts with one special exception. The average rate of increase in the receipts in 1903 over 1902 was in this group 7.1 per cent.; in the second group, including companies over $500,000, it was 10.7 per cent.; in companies over $100,000 it was 16.5 per cent.; in companies over $50,000 the increase was 9.5 per cent., and in the fifth group of companies, over $25,000, it was 14.4 per cent. The general average increase for 1903 over 1902 was 8.5 per cent. This is certainly a healthy rate of increase and is, we think, somewhat contrary to the general supposition that there had not been much gain during the last year. The figures of the United States Census Office showed that the gross receipts of all the street railway companies for 1902 were nearly $248,000,000. If we apply the rate of 8½ per cent. increase to this, the gross earnings for 1903 for the street railways of America would reach the splendid sum of not far short of $270,000,000.

Such figures as the above are certainly encouraging. There seems to be no limit, in fact, to the expansibility of the street railway industry under the régime of electricity; and as the years go by it will be very interesting to trace the effect of electricity in increasing the traffic of the steam railroads to which it is applied. It would appear, from time to time, that other modes of traction, like the automobile, for instance, or the bicycle, might have some effect on street railway traffic; and we are not yet very far away from the time when some street railway managers thought they were going to lose all their income because so many people had taken to riding bicycles to and from business. The figures of street railway traffic, in fact, certainly keep pace with the growth in population quite steadily, and appear to have a further rate of development of their own, depending very largely upon the increase of facilities. The figures in New York City bring out such an idea and confirm it, especially as soon as the benefits of electricity are thrown into the scale. In 1884 the street car passenger traffic of New York City was barely 185,000,000 passengers, and in 1894 it was only a little over 245,000,000; but it had jumped at the beginning of this year to 612,000,000. There can be no question of the fact that the extension of electrical facilities had a great deal to do with the last enormous stride. Just at present the rate seems to have fallen off a little bit, but this is due again to the fact that the elevated railroads by the adoption of electricity have once more come up to the proper standard of efficiency and competition, so that their figures of traffic which in 1889 showed only 174,000,000 passengers, or almost exactly what they were eleven years before in 1888, had jumped in 1903, after the adoption of electricity, to 246,000,000. Thus, whereas on the elevated roads in the period from 1893 up to 1899 there was actually a steady decrease in traffic, since 1900 and with the employment of electric traction there has been a tremendous rebound, so that the increase on the system in 1904 was 14.51 per cent.

The inference from all these figures is that the opening up of the New York electric underground system this year, while it may again check temporarily the rate of increase of the existing systems, will be found very quickly to develop its own traffic and to yield a good return upon the investment. This will in turn foreshadow the possibilities bound up in the adoption of electricity for the suburban traffic of the New York Central Railroad, where we believe agreeable surprises await the Vanderbilt management in the unsuspected rapidity of development of the suburban region beyond the Harlem River.

Central Station Management.

Elsewhere we print in full the excellent paper read at the recent Boston National Electric Light Convention by Mr. Frank W. Freuauff on the subject of central station accounting. One matter which the paper brings forward is, however, much broader than the subject of mere routine office accounting, namely, that of analyses of cost, whereby for each class of service the fixed and several variable costs are segregated. The central station industry has now reached the stage when it calls for the same refinements in details as to costs as prevail in the great manufacturing industries, and the sooner the situation is realized by managements the better will it be for their personal welfare and for the interests of their plants. In workshops the system of accounting for each item in the cost of a product from the crude material to the finished ware delivered to the distributor dates back a quarter of a century, and has revolutionized manufacturing organization. In the early stages the system was viewed with suspicion by the owner or manager who had been accustomed to the old methods, and was content to rely on general results without endeavoring to isolate and take account of all the factors making toward success or failure. Such as these have all had either eventually to surrender their prejudices or step aside to make place for the more progressive.

A similar situation is rapidly confronting all central station men, and those who do not get into line will find themselves dispossessed by others who realize the oportunity that awaits men who can apply to the central station business the principles that now guide the conduct of other branches of production. From one standpoint, the fact that central stations operate under franchises that exclude competition has not been altogether without its disadvantage, in that there has been no incentive to watch competitors and emulate their successful measures and guard against falling into their errors. Doubtless to this situation is largely due the fact that but a small percentage of the electric lighting stations of this country are on a good dividend-paying basis. In the succeeding issue we shall reprint another Electric Light Convention paper dealing with a correlated question—that of segregating distribution losses, in order that the matter of their reduction may be intelligently dealt with. We venture to say that there is scarcely a central station in the United States now on a non-paying basis that could not round the corner by following intelligently the indications of these two papers, united with systematic solicitation of new business; and as the two investigations would probably point to the possibility of considerable and even large reductions in rates for each successive profitable increase in business, there would be heart in the work.

The Second German-American Cable.

The completion, last week, of the second German cable, connecting Germany with America, is in line with the recent German activities in colonial and ex-territorial development, to which we referred last week, in noticing the proposed German cables in the East. Modern national competition is for trade supremacy. In the seventeenth century, colonies were sought by monarchies for dominion. In the twentieth century colonies are valued only as trade supporters. A colonist is not only likely to make a consumer of home manufactures, but he is also likely to spread about and advertise home manufactures to his neighbors. The nations competed for land in past days. They now compete for business. The establishment of colonies for business is a business in itself. It calls for coaling stations, docks and a huge accessory government mechanism. Moreover, the establishment of colonies gives hostage both to peace and to war. To peace, because order must be kept in the colonies, and the national honor is involved in the colonial government. To war, because in case of hostilities, colonial possessions become most vulnerable. In practice, the maintenance of communication with colonies is vital to their preservation in event of war. At present, the only safe way of preserving communication abroad is by means of a continuous network of submarine cables. Until quite recently, the cable system of the world was almost wholly British. This supremacy beneath the seas has been a strong military weapon. In peace, cables belong to all nations alike. There is no preferential tariff in cable rates. In war, cables belong to the governments where they land, unless captured or removed. America has established her own cables with her Pacific islands. France has her own cables to African possessions, as well as to the American continent. Germany has established her own cables to America, and now seeks to extend them elsewhere. It is probably only a question of time when she will lay cables to her African possessions, her eastern Asian possessions, and to South America. In one sense these cable expansions make for peace, since the investment associated with them is hazarded in war, and makes the advent of war more ominous and less easy.

Power Transmission and Irrigation.

The Institute meeting at Chicago next week, to discuss power transmission, promises to be quite interesting. It has been organized by the Transmission Committee and a number of important topics are to be taken up, details of which were given in these pages. Incidentally, as the Republican National Convention will be in session at the same time, rates of fare are made easy and the engineers can learn a good deal from the politicians about the smooth-running of machinery.

The great art and industry of transmission by electricity that has sprung up and developed in recent years is worthy of this special attention and will certainly take on greater importance from year to year. We are very far from having yet exhausted in this country the possibilities of the great and small water powers upon which primarily the new art is based, and the diligent prospecting of the last five years should soon bear fruit. It is true that in many of our large central station systems and minor aggregates of circuit the transmission part of the problem is by no means the smallest, but the subject essentially is thought of from the standpoint of reclaiming waste hydraulic power.

In this connection we believe that in various sections of the country power transmission and irrigation are destined to become very closely related, so that we may see many companies playing the dual part just as in the lighting field so many supply both electricity and gas. We note, by the way, some striking figures with regard to irrigation just issued by the United States Bureau of the Census. It appears that in 1902 there were no fewer than 134,036 irrigated farms in the United States, having a total acreage of 9,487,077. Every acre thus irrigated is an increase of the wealth of the country. It takes about twenty inches of rainfall for the production of the crops, and irrigation is necessary in all sections where this amount of rainfall cannot be depended upon. The area increased from 1899 to 1902 nearly 22 per cent. The cost of constructing irrigating systems has amounted to $93,320,452, an average of $9.84 per acre, and the length of main ditches of irrigating trenches is 59,242 miles. The greatest irrigating States are California, Colorado and Montana. California has 1,708,720 acres under irrigation; Colorado, 1,754,761 acres, and Montana 1,140,644 acres. These are figures applying to the arid regions alone. The Mississippi tributaries are drawn upon more heavily for this purpose than any other streams in the country. The systems receiving water from these tributaries have a length of 20,064 miles. It stands to reason that a great deal of the old and new irrigation work must depend upon water received from much higher levels; and in almost every instance there should be a distinct opportunity for utilizing the head in apparatus for light and power, especially with proper systems of water storage.

THE BEAR RIVER POWER PLANT.

Transmission plants are now such commonplaces of engineering that the addition of another to the rapidly lengthening list is seldom an item of essential interest. The plant we describe in this issue, however, is, we believe, unique in that it was installed with the deliberate intention of utilizing the surplus water of an irrigation system during the season of high water. There are various power plants which utilize the artificial falls of a ditch system, put in merely to distribute the water to advantage, but so far as we recollect this is the only instance in which a plant uses unstored surplus and shuts down during a short dry season. Of course such a plan would ordinarily be infeasible, or would be worked only under conditions which permitted extensive use of an auxiliary steam plant. Here, however, the Bear River plant is itself an auxiliary to five other hydraulic plants, together amply capable of delivering all the power needed during the low-load season. It is a water power auxiliary to help out during the long annual peak. There are three steam auxiliaries on the Salt Lake City system, but water being cheaper than steam can be used to great advantage while it is available. The starting of the Bear River plant makes the sixth water power plant of the system.

Salt Lake City is situated in an ancient basin with no near hydraulic powers of any considerable size, and in fact no large powers within a very long radius. Nevertheless, by persistent enterprise enough power has been developed in scattered plants of moderate size to meet most of the local requirements. The six hydraulic and three steam plants are operated in parallel on the low-tension side, and from all accounts pull together with the utmost harmony, thanks to the somewhat flexible connections supplied by the long lines. The whole system is a fine example of utilization of the facilities afforded by Nature in a somewhat ungenerous mood. Hydraulically the novel feature of the plant is the supply of water for the turbines from a huge inverted syphon connecting two main irrigating canals separated by the Bear River bed. This syphon is in part of redwood stave pipe, to which the steel pressure pipes are connected, and by its use water for the plant can be drawn from either canal, or during the irrigation season water can be transferred from one canal to the other. The transmission line is worked at 40,000 volts and is 82 miles long, delivering the output of a pair of 750-kw, three-phase generators. A word may be said here as to the insulators. For these high pressures there is little uniformity of practice, but in this instance massive brown porcelain insulators were chosen and these were individually tested at 120,000 volts before being accepted. A factor of safety was thus secured which should prove sufficient for all ordinary and most extraordinary contingencies. The whole question of high-tension insulators needs overhauling, and until the art is much further advanced than at present, this plan of individual testing, laborious as it is, has much to commend it.

INFLUENCE OF THE LINE ON THE PARALLEL OPERATION OF SYNCHRONOUS MOTORS.

A single synchronous generator on an alternating-current system takes electrical charge of the system in its own way. The moment that another one is added, however, either as a generator or as a motor, there is always a chance for their quarreling and getting out of step. In a perfectly steady régime two synchronous generators running in parallel do not exchange power, and run at the definite uniform phase difference which corresponds to this condition. The moment that a disturbance occurs, either by the pulsation of the prime-mover of one or by some sudden change in load acting dissymmetrically on the two, a change in relative phase is set up whereby a local current is produced between the two generators. The power components of the current will produce torques in the machines, drawing the machines together. By mechanical inertia the two machines will tend not merely to come back to equivalent cophase, but also to swing beyond. If no damping forces were at work, the mutual oscillations about the cophase position would continue indefinitely. Resistance in their local circuit and conductance in magnetically associated circuits, tend to absorb the swing energy from the system and bring the machines into steady cophase (or equivalent cophase for difference of generated e.m.f.).

If then oscillations persist, there must be a persisting periodic source of swing. This source may be either mechanical or electromagnetic. If mechanical, the prime-movers or engines driving the machines pulsate rhythmically, either by the hunting of their governors, or by the periodic fluctuations of driving torque. If the source of disturbance is not mechanical it may be due to hysteresis in the magnetic circuits of the machines. A lag in the magnetic flux behind the m.m.f. of the armatures' magnetic circuits may give rise, under favorable circumstances, to swinging forces, or negative damping, so that the machines will not come into cophase, but will swing apart until the magnitude of the damping actions evoked by the swing balances the disturbing forces; or even, in the worst cases, until the machines swing themselves out of step. The frequency of such free electromagnetic oscillations is independent of the governors of the driving engines, and depends only upon the moments of inertia of the rotors and upon the constants of the local electrical circuit. On the other hand, when the oscillations are of mechanical origin, the period is set by the mechanics of the governing systems and is only affected in subsidiary degree by the electric circuit.

When the swinging is of electromagnetic origin, the magnitude of the restoring forces depends both upon the magnitude and upon the angle of the impedance in the circuit connecting the two armatures. If the impedance is large, either by reason of large resistance or of large reactance, the restoring forces will be small. If the impedance in the circuit is small, the restoring current will be relatively powerful, but the effective component will be the e.m.f. component. Cases may occur in which the resistance of the circuit, as affected by the transmission line, may materially influence the pendulum action, so that the same pair of alternators which would only swing through an electric amplitude of, say, 20 amperes, when operating in parallel side by side, might swing through an electric amplitude of 200 amperes when operating in parallel with the impedance of a transmission line between them. The interesting papers printed in the *Transactions* of the Italian Association of Electrical Engineers, as referred to on page 1155 of this issue, bear upon this interesting condition. The elimination of the danger of excessive electromagnetic pendulum action lies in the design of alternators of insufficient armature reaction and hysteretic lag to overcome the damping forces under any conditions of excitation and line impedance.

International Electrical Congress.

Acceptances of membership in the International Electrical Congress, to be held September 12-17 in St. Louis, now number over 1,700, and more than 160 specially invited papers are promised. One thousand certificates of membership have been issued to those who have become members by sending in their subscriptions and about 100 more certificates are about to be issued.

Efforts are being made to secure the MSS. of as many of the 160 papers as possible by the first of July, in order to have them printed in advance for distribution among the Congress members at St. Louis.

The programmes scheduled for Sections D and E are given below. The similar programmes of Sections A, B and C have appeared in preceding issues.

All communications concerning the Congress should be addressed to the general secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass.

SECTION D—ELECTRIC POWER TRANSMISSION.

Chairman, Mr. Charles F. Scott; secretary, Dr. Louis Bell.

Name of Author.	*Title of Paper.*
Sig. E. Bignami,	Electrical Transmission Plants in Switzerland.
H. M. Hobart,	Conditions Conducive to Economy in Motor Design.
Mons. Maurice Leblanc,	Transmission of Alternating Currents over Lines Possessing Capacity.
Prof. G. Mengarini,	Utilization of Hydraulic Powers in Italy.
F. G. Baum,	High-Potential, Long-Distance Transmission and Control.
F. O. Blackwell,	The Tower System of Line Construction.
H. W. Buck,	The Use of Aluminum as an Electrical Conductor.
V. G. Converse,	High-Tension Insulators.
M. H. Gerry, Jr.,	Line Construction and Insulation for High Tensions.
L. M. Hancock,	Bay Counties Transmission System.
R. L. Hayward,	Some Practical Experiences in the Operation of Many Power Houses in Parallel.
J. F. Kelly and A. C. Bunker,	Long-Distance Power Transmission.
P. M. Lincoln,	Transmission and Distribution Problems Peculiar to the Single-Phase Railway System.
R. D. Mershon,	The Maximum Distance to which Power Can be Economically Transmitted.
P. N. Nunn,	Pioneer Work of the Telluride Power Co.
J. S. Peck,	The High-Tension Transformer in Long-Distance Power Transmission.
Dr. F. A. C. Perrine (representing Nat'l Elec. Lt. Assoc.),	American Practice in High Tension.
Dr. C. P. Steinmetz (representing American Inst. Elec. Engs.),	Theory of Single-Phase Motors.

SECTION E—ELECTRIC LIGHT AND DISTRIBUTION.

Chairman, J. W. Lieb, Jr.; secretary, Gano S. Dunn.

Prof. André Blondel,	Impregnated Arc Light Carbons.
Herr Max Déri,	Single-Phase Motors.
Herr E. de Fodor,	Rates for Electricity Supply.
Sig. Ing. E. Jona,	Insulating Materials in High-Tension Cables.
Prof. W. Kübler,	Upon a Means for Compensating the Series Connection of Induction Motors.
Herr Karl Roderbourg,	Storage Batteries.
Sig. Ing. Guido Semenza,	Commercial Limits of Electric Transmission with Special Reference to Lighting Service.
Dr. G. Stern,	The Superiority of the Alternating Current for Distribution in Large Cities.
Dr. W. Wedding,	Measurements of the Energy of Light and Heat Radiation from Electric Light Sources.
Arthur Wright,	Recent Improvements in Electrolytic Meters.
Prof. S. P. Thompson,	(Subject to be announced later.)
B. A. Behrend,	The Testing of Alternating-Current Generators.
George Eastman (representing Nat. Elec. Liht Assoc.),	Protection and Control of Large Light-Tension Distribution Systems.
W. C. L. Eglin (representing Assoc. Edison Illum. Cos.),	Rotary Converters and Motor Generators in Connection with the Transformation of High-Tension Alternating to Low-Tension Street Current.
W. L. R. Emmet,	The Effect of Steam Turbines on Central Station Practice.
Louis A. Ferguson (representing Assoc. Edison Illum. Cos.),	Underground Electrical Construction.
Gerhard Goettling (representing Assoc. Edison Illum. Cos.),	Storage Batteries as an Adjunct to Central Station Equipment.
G. Ross Green (representing Nat. Elec. Lt. Assoc.),	American Meter Practice.
Caryl D. Haskins,	Metering Efficiency on Customers' Premises.
Francis Hodgkinson,	Steam Turbines.
John W. Howell,	Incandescent Lamps.
Philip Torchio,	Distributing Systems from the Standpoint of Theory and Practice.
W. F. White,	The Selection of a Distributing System for a Large City.

India Rubber in the United States.

It is stated that imports of india rubber into the United States in the fiscal year about to end will exceed by far those of any earlier year, and will amount to over $40,000,000 in value. The demand for this article of exclusively foreign production for use in manufacturing has increased very rapidly in recent years, and the imports in the present fiscal year, as shown by the Department of Commerce and Labor through its Bureau of Statistics, will amount to about 60,000,000 pounds, valued, as already indicated, at fully $40,000,000. This rapid increase is apparently due, in a large degree, to the increasing use of this material for insulation as well as for tires of electric vehicles and automobiles of various classes, though in other lines of manufacture the demand is also very great.

The rapid growth in the use of this article of manufacture in the United States is illustrated in the fact that the total value of india rubber and gutta-percha imported in 1870 was less than $3,500,000; in 1880, $9,500,000; in 1890, $15,000,000; in 1900, $31,000,000, and in 1904 will be fully $40,000,000. The increase in quantity has not been so rapid as the increase in value, owing to the fact that prices have advanced materially by reason of the greatly increased demand of the various manufacturing sections of the world, especially the United States.

In 1880 the quantity of rubber imported into the United States amounted to 17,000,000 pounds, valued at $9,500,000, making the average price about 55 cents per pound. In 1890 the quantity imported was 34,000,000 pounds valued at $15,000,000, or slightly less than 50 cents per pound. In 1900 the quantity imported was 49,000,000 pounds valued at $31,000,000, or about 63 cents per pound; while in 1904 the record of the ten months for which figures are now available shows an average value for rubber imported of 68 cents per pound. In addition to this, however, large quantities of material utilized in conjunction with india rubber are now imported.

Importations of "gutta-joolatong," a product of India, which is used in certain industries as a substitute for india rubber, now average more than a million pounds a month, while importations of old and scrap india rubber to be remanufactured amounted to over fifteen million pounds in the ten months of the fiscal year for which a record is now at hand. These importations of old and scrap rubber for remanufacture and of gutta-joolatong as a substitute in certain lines of work are comparatively new and have only been reported by the Bureau of Statistics as a separate item during a very recent period.

Bear River Power Plant and Utah Transmission Systems—I.

THROUGHOUT all sections of the West the development of electric power from mountain streams goes hand in hand with great irrigation enterprises; and in many cases, especially in Colorado, Utah and California, the tail race of a hydroelectric plant is the headworks of an irrigation system supplying thousands of acres of rich soil with water through extensive canals. Perhaps none of these combinations of power generation and irrigation is more interesting than that recently put in operation by the Utah Sugar Company on the Bear River in Northern Utah, and a noteworthy fact in connection with it is that the usual conditions are reversed, inasmuch as the irrigation interests in this instance have the prior right to the water and electric power is developed only when there is a surplus of water over the needs of the lands below. In other words, electricity is produced as a by-product. The conditions are as follows:

Some 20 years ago the present hydraulic development of the Bear River was made. It consisted in building a diverting dam at the upper end of the Bear River Canyon. This dam diverts water at each side of the river into separate canal systems. The two canals, one on the west bank and one on the east bank of the river, carry the water for a distance of two miles down the canyon through a series of tunnels, flumes and masonry-supported ditches. They emerge at the lower end of the canyon at a height of 115 ft. above the river and about 1,000 ft. apart. From that point the canals diverge, each dividing a little farther on into branches and laterals, thus irrigating several thousand acres of land. These canals are now controlled by the Utah Sugar Company, which operates a beet sugar factory supplied from the large sugar beet farms of the locality.

Although for some time aware of the possibilities on this river, the company had not taken steps to develop power because it had no market. With the rapid growth of Salt Lake City, however, in recent years, there has come a greater demand on the plants of the Utah Light & Railway Company, so the latter was glad to enter into a contract for the entire output of the new station. The development of the power does not lessen the quantity of water available for irrigation, because only the surplus water is used at the station. The canals below the canyon can carry the entire flow of the river only during the period of extreme low water, which lasts but a few weeks in August and September. During the remainder of the year there is more water than is needed for irrigation purposes, and it is this surplus water which is used to generate electric power. The shutting down of the plant during the few weeks in summer comes at a time when the power can best be spared in Salt Lake City, as the lighting and power loads are the lightest at that season, and can easily be carried by the other plants of the system.

The power house is situated on the east bank of the river just at the lower mouth of the Bear River Canyon, and at a point about four miles north of Collinston, Utah. Here a unique plan has been adopted to utilize the water from either canal, which consists in connecting the canals by an inverted syphon and taking out the water for the turbines at the lowest point. The general arrangement of the syphon and power house is shown in the plan and elevation in Fig. 4, and it may also be observed in the illustrations, Figs. 1 and 2.

FIG. 1.—VIEW OF POWER HOUSE AND SIPHON SHOWING EAST INTAKE TO SIPHON PIPE.

The syphon has an inside diameter of 8 ft. and is built of California redwood, the Excelsior Wooden Pipe Company, of San Francisco, having the contract for the work. Each pipe is connected with its respective canal by means of a concrete turnout, which has been carefully designed to prevent loss of head from water eddies, and before entering the pipe the water passes through an iron screen and large wooden gate, which is raised and lowered by means of hand wheel screens from a platform above, as shown in Fig. 3. Fig. 5 is a view of the west canal and inlet.

The pressure pipe on the east bank is 322 ft. long and is laid at an angle of 17° to the horizontal, while the west pipe is 195 ft. long and is laid at an angle of 29°. At the lower ends of the pipes and connecting with the horizontal part of the syphon are specially-constructed, steel-riveted elbows, securely anchored on converter peers. That on the west bank is shown in Fig. 6. Between these elbows is 418 ft. of straight pipe, the west portion crossing the river on a 225-ft. steel three-span bridge (Fig. 2) resting on concrete and stone piers. Opposite the power house, placed 70 ft. apart, are two steel sections, 15 ft. long, from which steel penstocks, 66 in. in diameter, lead to the turbines in the power house. Figs. 5, 6 and

FIG. 2.—POWER HOUSE AND SIPHON.

7 illustrate details of the wooden pipe and also the method of building it. Since these photographs were taken the pressure pipes have been covered with earth and the horizontal portions are protected from the weather by a wooden sheathing.

By means of this arrangement of pipes water for the turbines may be drawn from either canal, or during the irrigation season, if either canal should break through a retaining wall in the canyon, as sometimes happens, the portion of the canal below the canyon can be supplied from the other canal through the 8-ft. syphon, and thus preserve the crops in the valley until the damaged canal is repaired. The bottoms of the two canals are on the same level, but it is estimated that a difference of head of one foot will produce a flow through the pipe of about 320 cu. ft. per second. Thus, if the west canal be filled to a depth of six ft., and the water in the east canal

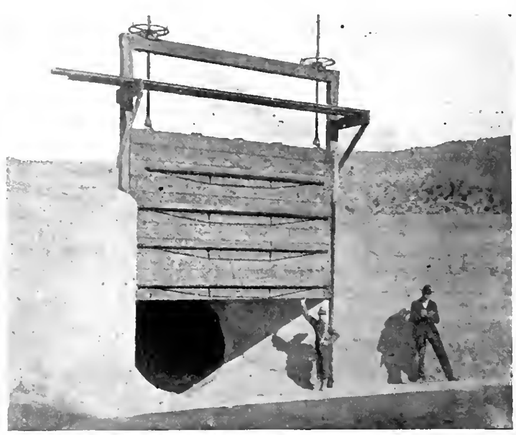


FIG. 3.—ENTRANCE TO EAST INTAKE AND GATE.

stands at a depth of 5 ft., there should be just enough water passed through the syphon to supply all the water which the east canal will carry at 5 ft. depth.

POWER HOUSE.

The power house is substantially built of brick on concrete foundations carried down to bed rock. The roof is supported by timber trusses and consists of standing-seam tin roofing laid on 2-x-6-in. roof boards, which are nailed to 4-x-12-in. purlins. The building is 100 ft. long and 60 ft. wide; 40 ft. from the north wall is a row

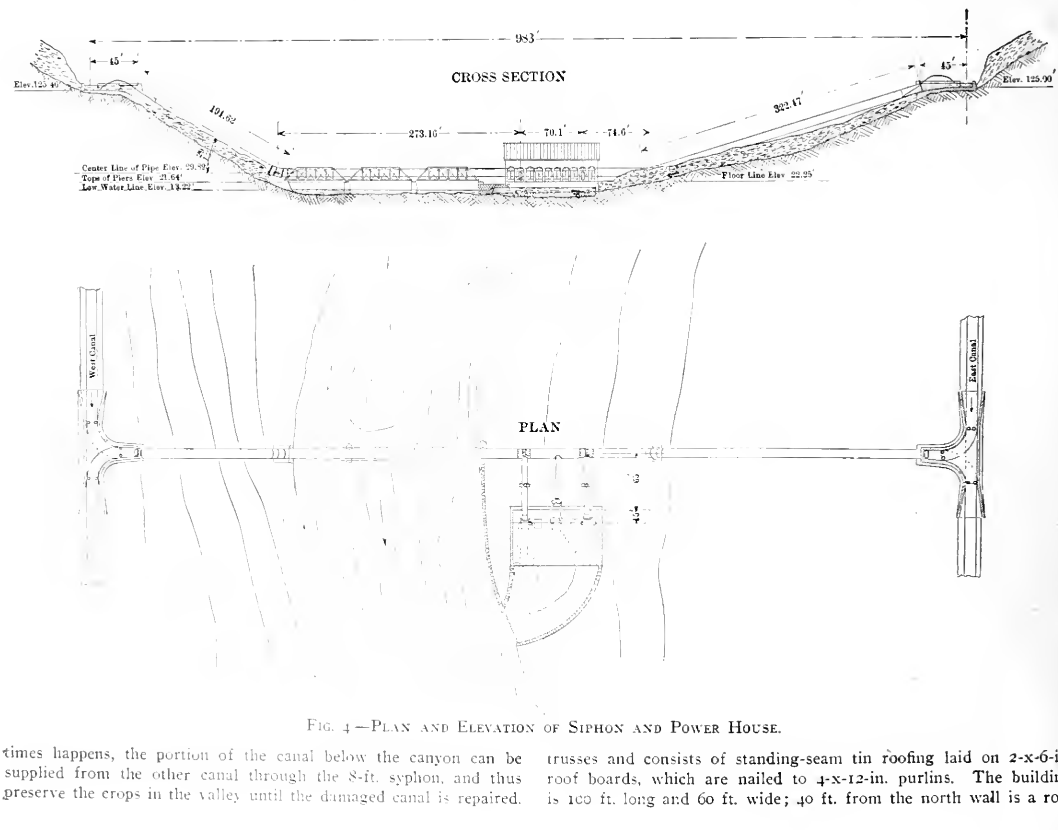


FIG. 4.—PLAN AND ELEVATION OF SIPHON AND POWER HOUSE.

FIG. 5.—WOODEN STAVE PIPE ON WEST BRANCH AND END OF BRIDGE.

FIG. 6.—WOODEN STAVE PIPE AND BRIDGE.

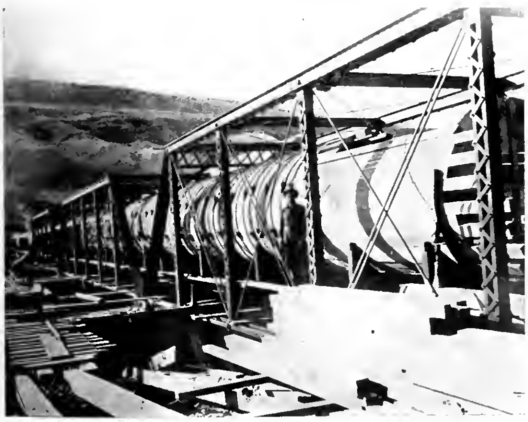


FIG. 7.—BRIDGE AND PIPE.

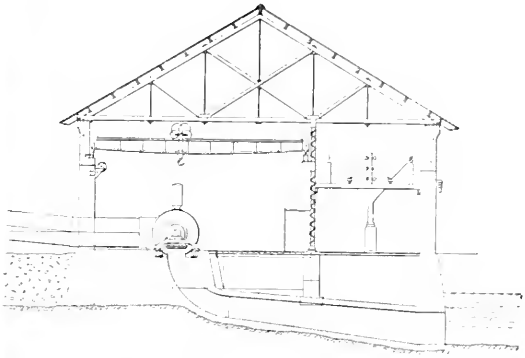


FIG. 8.—CROSS-SECTION OF POWER HOUSE.

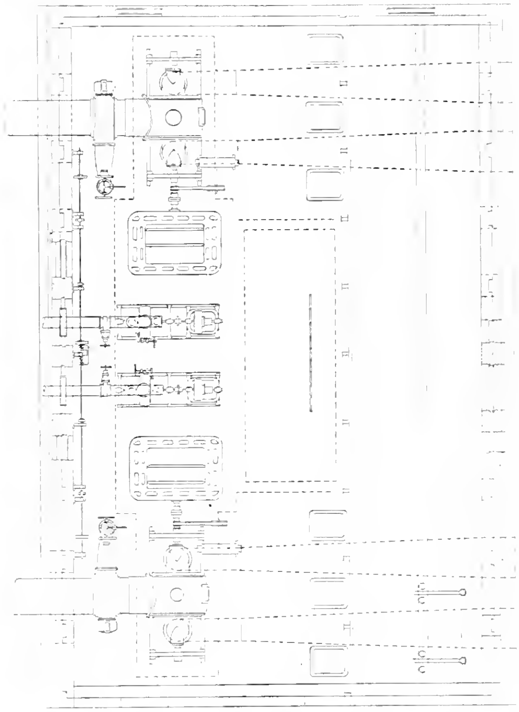


FIG. 9.—PLAN OF POWER HOUSE.

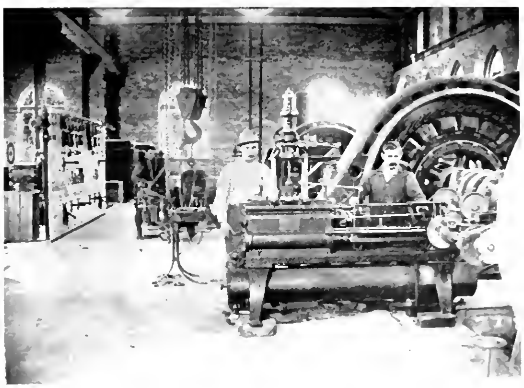


FIG. 10.—VIEW OF INTERIOR OF BEAR RIVER POWER PLANT.

BEAR RIVER POWER PLANT AND TRANSMISSION SYSTEMS.

of steel columns dividing the building into two portions. In the larger portion, which is served by a 20-ton Whiting crane, are located the turbine, generators and switchboard, while the other space is given up to transformers and high-tension switching apparatus. Figs. 8 and 9 show respectively the cross-section and plan of the power station. The building has no basement except under the switchboard. All low-tension wires and cables are carried under the concrete floor in clay conduits.

The hydraulic equipment consists of two 1,400-hp, double-discharge Leffel turbines, each mounted at the end of a 66-in. steel inlet pipe. Each turbine is connected by means of a rigid shaft to a 750-kw Westinghouse revolving-field, 2,300-volt, three-phase alternator. Governing is accomplished by Lombard governors, and levers are also provided for hand regulation. Each of the inlet pipes is provided with a Rensselaer gate valve located just inside the power house so as to be in reach of the 20-ton crane. These valves are among the largest ever made, weighing 17 tons each. They are operated by belting from a 2-in. shaft mounted on the north wall and driven by an electric motor.

Exciting current for the alternators is supplied by generators separately driven by small Leffel turbines, for which water is brought through a 24-in. pipe directly from the large syphon pipe. This pipe branches outside the building into two 18-in. pipes, which supply the turbines. The exciters are thus driven independently of the large generators, and better regulation and greater reliabiility are, therefore, afforded. Figs. 10 and 11 are views of the interior of the power house, showing the large units and switchboard.

The discharge water from the turbines is carried by means of four draft tubes, each leading down with a long 90-degree vertical bend, to a flaring concrete tunnel under the power house floor. These tunnels all terminate in a common tail race and are so proportioned that the water is brought almost to rest before being discharged, so that as much as possible of its energy is utilized. The draft tubes of the exciter turbines discharge into the two inside tunnels.

The nine-panel marble switchboard which receives the 2,300-volt current from the generators has mounted upon it the necessary oil switches and indicating and recording instruments. Three oil-insulated transformers raise the voltage from 2,300 to 40,000 volts. These transformers are set 10 ft. apart and each is exactly opposite one of the 10 windows in the south side of the power house. After leaving the high-tension side of its transformers, each wire of the three-phase circuit passes, without lateral deviation, successively to a static interrupter, a high-tension switch of special design, a low-equivalent lighting arrester, and finally out of the window through a long glass bushing. This window consists of two sheets of heavy plate glass six inches apart, with holes in the centers for support of the bushing. All electrical apparatus in the power house is of Westinghouse manufacture. The transmission features of the plant will be considered in a concluding article.

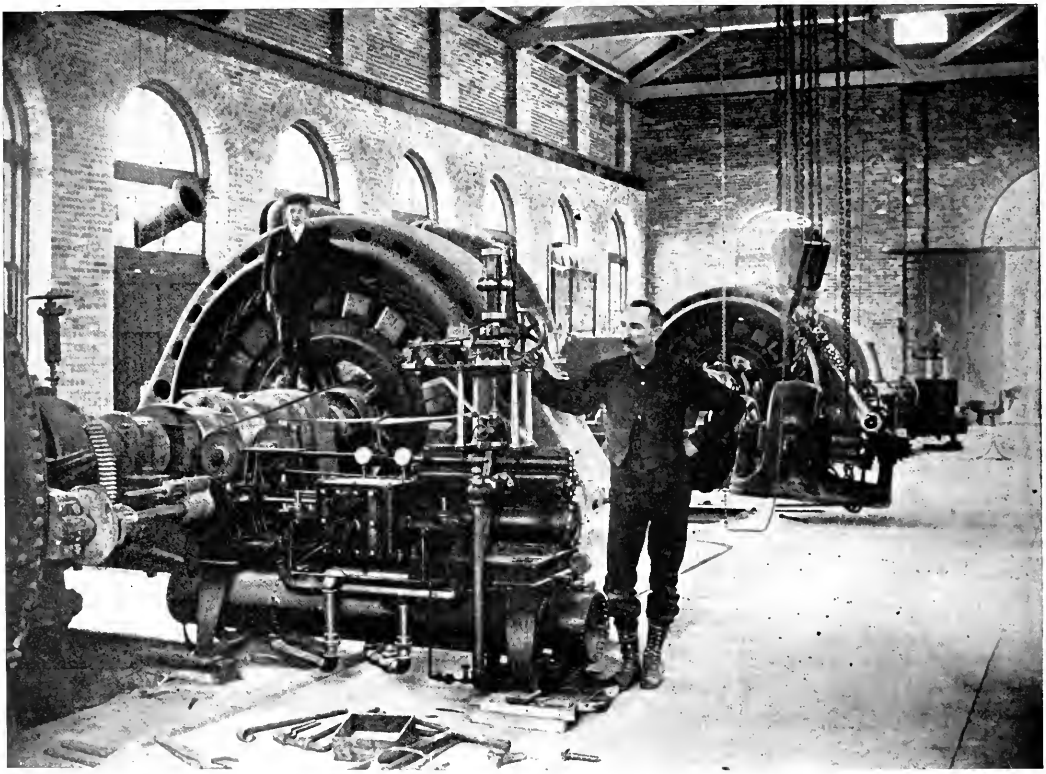


Fig. 11.—View of Interior of Bear River Power House.

Wireless Telegraphy on Russian Ships.

A St. Petersburg dispatch states that the admiralty has installed Siemens & Halske wireless telegraph apparatus on five battleships and the cruisers *Aurora* and *Dmitri Donskoi*. All of the ships that are being fitted out on the Baltic Sea are, it is stated, also being equipped in a similar manner. The Russians appear to have changed their attitude toward wireless telegraphy, since it is but a few weeks ago that a ukase was promulgated against the use of it by neutrals within the zone of hostilities. The operation of wireless systems by the contending forces, and by newspaper correspondents, will no doubt make things interesting, and there will be a clash of forces in the air as well as at sea and on land.

Geysers by Searchlight.

A powerful battleship searchlight has been put in operation in Upper Geyser Basin, at the Yellowstone National Park, to show the working of the geyser at night. The effect, it is said, is marvelously beautiful and hereafter the searchlight illuminations of the active geysers will be a feature in the National Park.

Influence of the Line on the Parallel Operation of. Synchronous Motors.

The Italian Association of Electrical Engineers has printed in its *Transactions* two interesting papers on the influence of the line on the parallel operation of synchronous motors, one by Signor Rebora and the second by Signor Guido Semenza. We give below abstracts of these papers.

Signor Rebora, in introducing his paper, says that it is generally believed that the distance between power houses is not a factor in the satisfactory operation in parallel of alternators, and the object of his paper is to give the result of experiments which will warn electrical engineers to be at least cautious in this matter.

Referring to Fig. 1, *A* is a new power house, built to be operated in parallel with a power house, *B*, 11 miles distant. *A* has three

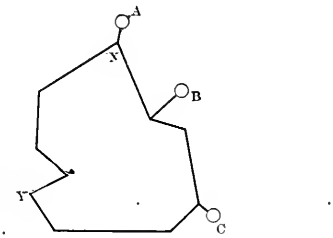


FIG. 1.

three-phase units, of 500 hp each, 360 r.p.m., 6,000 volts, 48 cycles, driven by Pelton wheels. The excitation is supplied by two special groups of turbine dynamos. *B* has three three-phase units of 250 hp each, 480 r.p.m., 6,000 volts, 48 cycles, driven by Pelton wheels. An exciter is belted to each generator.

The line has a total developed length of 50 miles and feeds lamps, induction motors and two 100-hp synchronous motors at *C*. All the generators, as well as the synchronous motors, are of the same type (revolving field, laminated poles, open slots), and their characteristics (saturation curve and short-circuit current) were found to be quite similar. When the new power house, *A*, was ready for operation it was attempted to run the generators of *A* in parallel with the generators of *B*, but in vain. *B* was then cut out, and current was sent from *A* to *C*, but it was impossible to operate the synchronous motors there, though they had been working satisfactorily when commanded by the generators of *B*. Lamps and asynchronous motors were not affected at all by the change of the power house. Signor Rebora then started a series of experiments to find out the cause of the trouble.

While the power house of *B* was working on a certain load of lamps and induction motors, he tried to connect to the line one of the generators of *A*, but as soon as the connection was made the main ammeter, the voltmeter and the exciter ammeter (both at *A* and *B*) started to oscillate violently, with a periodicity of 100 throws per minute, as did also at the same frequency the turbine, the governors and the water in the conduits.

He noticed at once that the oscillations originated in the electrical part of the system. He repeated the experiment several times, changing all conditions which could affect the operation, but the result always remained the same, and did not vary when he tried to couple one of the generators of *B* (250-hp) to one of the generators of *A* (500-hp), the latter being started first. Then he connected the machines of *A* and *B* to the line *A, X, B*, alone—at no load—and under these conditions the generators kept in step. Subsequently he tried to run one of the motors of *A* as a synchronous motor; after coupling it (at no load) as a generator, he shut off the water from the turbine and the machine kept on running as a synchronous motor operated by *B*. However, he was not able to reverse the test, viz.: to run a machine of *B* as a synchronous motor operated by *A*. The coupling of *B* in parallel with *A* as a generator at no load was easily done, but it was sufficient to touch the hand wheel of the turbine driving *B* to start at once the oscillating motion.

Signor Rebora gives an account of a series of schemes that he used in order to run *A* and *B* in parallel, but every one of them failed. After systematically studying and eliminating every reasonable cause of the phenomenon, attention was directed to the influence of the line.

The three conductors which constitute the simple three-phase line in question are supported on wooden poles at the vertices of an equilateral triangle, having a side of 10 in. The following tables give the lengths, resistance and reactance of the different stretches of the line. The capacity is negligible:

	Kms.	Resistance per Wire in Ohms.	Reactance per Wire in Ohms.
A X Y C.	45.00	25.55	13.58
A X B.	18.100	15.45	5.67
A X B C.	31.500	22.75	9.75
B C.	13.400	7.3	4.10
B X Y C.	50.820	37.70	15.75

The configuration of the line suggested an interesting test. First, the motors in *C* were connected directly to *B* through the line *B C* only, and their operation was satisfactory and stable. Then the stretch *B C* was interrupted and current to *C* passed through the line *B X Y C;* the operation became impossible and the pendulum motion appeared. The latter test differed from the former in the length of line only. In the first case the resistance per wire was 7.3 ohms and the reactance 4.10 ohms; in the second the resistance was 37.7 ohms and the reactance 15.75 ohms. This made plain that the regular operation of generator and motor depended on the length of the line between them. A remarkable feature was that even during the pendular vibrations the machines did not fall out of phase.

Signor Rebora repeated his experiments in another plant with very large machines. A sketch of the line is given in Fig. 2. It was

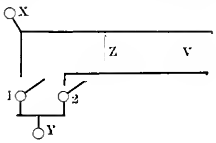


FIG. 2.

possible to use three lengths of line between the generator *X* and the synchronous motor *Y*, viz.: *X Y, X Z Y, X V Y*. The resistances per wire were as follows:

	Kms.	Resistance per Wire in Ohms.
X Y.	12	8
X Z Y.	48	58
X V Y.	84	108

The following experiments were made: (1) Switch 1 was closed (12 km. of line and 8 ohms) and the running in parallel was satisfactory. (2) The current was taken through *X V Y* (108 ohms and 84 km.) and the characteristic pendular motion made its appearance. With the switches 1 and 2 the "hunting" would be started and stopped at pleasure.

When the machine *Y* was operated through the line *X V Y*, the closing of switch 1 was sufficient to damp and eliminate the oscillations, while by closing 2 and opening 1 the vibrations increased up to their full amplitude. In this test, however, it was found that hunting could be stopped by a certain value of excitation: but a further lengthening of the line would probably reproduce the phenomenon, steadily, at any excitation.

Naturally this question presented itself: What influence had respectively the self-induction and the resistance of the line? In order to easier carry out experiments, Signor Rebora made his test on two alternators in the same power house connected through an artificial resistance, inductive and non-inductive, and gives the following results of his observations: Alternators and synchronous motors assume at no load or full load a pendular motion when the resistance of the line between them reaches a certain value. Experimentally, it is difficult to find this exact value, but some limits are obtainable between which the operation becomes unsteady. The self-induction of the line has no important effect on the machines. The phenomenon is affected by the magnetic and mechanical elements of the machines, such as the construction of poles (laminated or solid) the degree of saturation, the resistance and reactance of the windings and the inertia of the rotating part.

The experiments started by Signor Rebora have been continued by Signor Semenza, who gave an account of his work in a paper presented in December, 1903, before the Associazione Elettrotecnica Italiana.

Signor Semenza has carried out two series of experiments. In the first he used two alternators of 300 kw, 42 cycles, 420 r.p.m., 3,550 volts in the same power house, driven by direct-current motors fed by a storage battery. This was an almost ideal condition of operation and the results of the test correspond exactly to Signor Rebora's observations, as follows:

(1) The resistance of the circuit connecting the two alternators has the effect of producing under some conditions a pendular motion. (2) The amplitude and the period of the vibrations increase with the resistance of the circuit. (3) After a certain limit of the resistance the machines fall out of step. (4) The pendular oscillations have no apparent cause, but appear almost automatically and increase gradually. (5) The phenomenon differs in the case of both machines running as generators from the case of one machine running as generator and the other one as motor.

The second series of tests was carried out on a synchronous motor of 165 kw, 42 cycles, 3,600 volts, 315 r.p.m., connected to the main bus-bars of the plant of Milan, the power of the motor being negligible in comparison with the power of the generators. The results of the experiments were as follows: (1) The amplitude of the oscillations is the greater the farther from the position of $cos\ \phi = 1$ the machine is operated. (2) With the excitation corresponding to $cos\ \phi = 1$ there is no tendency to the pendular motion even with high resistances of the circuit. (3) The reactance of the circuit has decidedly the effect of decreasing the amplitude of the vibrations. (4) In the condition of $cos\ \phi = 1$ the oscillations stop rapidly. (5) The frequency of the oscillations do not seem to have any connection with the stability of the operation.

Mr. Semenza gives the following explanation of the phenomenon: Let us recall the vector diagram of the e.m.f's of two alternators, running in parallel, at no load. If their e.m.f's are the same and the speed of their prime-movers is identical and the regulation is perfect, the diagram is reduced to one straight line. But these ideal conditions are never reached in practical operation, and the diagram is as in Fig. 3.

The two e.m.f's, $O\,E_1$, $O\,E_2$, form an angle, α, and a difference of potential, E_1, E_2, exists at the terminals of the circuit formed by

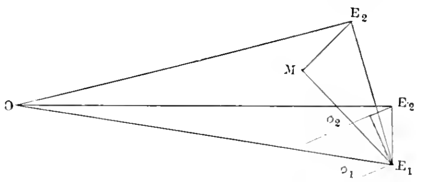


FIG. 3.

the two armatures of the alternators and the line connecting them. A current will flow, determined by the impedance of that circuit. If $E_2M = i\,r$ and $M_1E_1 = 2\,\pi\,n\,Li$ (r and L being the resistance and the reactance of the circuit) the current, i, will have the direction E_2M, and the angles ϕ_1 and ϕ_2 will represent the difference of phase between this current, i, and the e.m.f's of the generators. Now, as far as the resistance and the reactance will not change, the triangle, E_1, E_2, M, will remain similar to itself.

If instead of two generators we consider the case of a synchronous motor connected to bus-bars and the power of the motor is negligible in comparison with the power of the generators, the diagram does not change, but $O\,E_1$ represents the voltage at the bars and $O\,E_2$ the e.m.f. of the motor, and r and L include the resistance and reactance of the motor and of the line connecting it to the bars.

The diagram refers either to single-phase or three-phase machines, if in this latter case we assume that $O\,E_1$ and $O\,E_2$ represent the voltages between the terminal of each phase and the center of the star.

It must be remembered that the current given out by generators running in parallel or taken in by synchronous motors varies with the intensity of the current of excitation, as it is shown by the well-known V curves.

In our vectorial diagram the variation of the value of the exciting current is represented by a shortening or lengthening of $O\,E_1$. When $O\,E_1 = O\,E_2$ and the machines run free, the angle between the two e.m.f's is very small and the direction of the current E_2M is very close to the direction of the e.m.f: the resultant e.m.f., E_1, E_2, reaches a value sufficient to generate the necessary current to supply the power for driving the motor, and since $cos\ \phi_2$ is nearly unity, this current is very small.

But when $O\,E_2$ is different from $O\,E_1$ the angle ϕ increases and consequently the armature current also increases, owing to the fact that the triangle, E_1, M, E_2, must remain similar to itself. This current may lag or lead, depending on the excitation. To be more rigorous, it would be necessary to distinguish the position of $cos\ \phi_1 = 1$ from the position of $cos\ \phi_2 = 1$, but practically these positions are so close together that they can be assumed as coinciding. If the impedance of the circuit remains constant, but the ratio between resistance and reactance changes, the triangle will assume a different form.

By increasing the resistance, the angle E_1, E_2, M will decrease and consequently ϕ_2 will increase, while by increasing L ϕ_2 will decrease. This shows that the resistance and the reactance have an opposite action on the internal displacement of phase of the motor, and it may be easily seen that the resistance calls for a more peaked V curve (this curve is plotted with the amperes of excitation as abscissæ and the amperes of the armature as ordinatæ), while the reactance tends to smooth it. By considering the V curve it can be noticed that in the region of low excitation a point can be reached where the curve becomes vertical or bends backward, and this represents a limit of excitation, at which the motor can no longer keep in step, and the corresponding current will be the smaller, the higher the reactance of the circuit and the lower its resistance.

These deductions will be explained much better by looking into the physical side of the phenomenon. Let us consider a three-phase synchronous motor. The current flowing in the stationary armature sets up a traveling field which drags the inductor. If the excitation corresponds to the minimum input of current, the axes of the poles of the inductor coincide with the axes of the armature field. But if we change the amount of the excitation or we accelerate the rotor, the axes of the poles are shifted, a heavier current is allowed to rush in the armature, the armature field is intensified, and a torque is produced tending to bring back the poles to their former position. This is the principle of the running in parallel of alternators. Furthermore, since the intensity of the armature field may be assumed as proportional to the current, and the e.m.f. of the motor is generated by the flux of the rotor, this synchronizing action is $E_2\ i\ cos\ \phi$. This expression actually represents the power required to compensate the losses of the motor, which is explained by the fact that the action of bringing back the rotor to its normal position corresponds to a variation of kinetic energy—that is, corresponding to a positive or negative work done by the motor. The same thing happens in the case of two alternators running in parallel, every relative displacement between them tending to retard the machine which has been accelerating and to accelerate the machine which has been retarding. Of course, there is a limit; there is a certain angle of displacement, after which the synchronizing action decreases. This angle is $E_1\ E_2\ M$, and its tangent is $\frac{2\,\pi\,n\,L}{r}$, which shows again the opposite influence of the resistance and the reactance.

These graphic representations which make so simple the study of the alternating-current phenomena, have generally the fault of neglecting many of the essential elements. In fact, we have assumed the currents as sinusoidal and they are not; we assumed the reactance of the circuit as constant, while it changes with the position of the poles, the amount of the excitation and the value of the armature current; finally, an important element has been neglected, namely, the reaction of the armature.

As to the pendular oscillation on a three-phase synchronous motor, let us assume that the e.m.f. of the motor forms an angle α with the e.m.f. of the bus-bars, and that an external impulse has the effect of increasing the angle α; as we have seen, a torque will be produced tending to retard the rotor. But while the acting torque varies instantaneously with the reciprocal position of rotor and stator, the variation of the speed follows this torque, lagging behind it on account of the inertia of the mass. We have then the sufficient conditions to produce a pendular motion. In the same way the pendulum keeps up its motion, for when the mass has reached the lowest point and the horizontal component of the gravity is reduced to zero the mass maintains the speed acquired in falling.

Then the rotor after receiving an impulse goes back to its normal position and exceeds it, assuming a pendular motion. This motion would be kept up indefinitely if there were no damping actions. Regarding the frequency of oscillations, Blondel gives for it the following formula:

$$F = \frac{p}{2\pi}\sqrt{\frac{2\,E_1\,E_2\,sin\left(a\,r\,cot\,\frac{2\,\pi\,L}{r}\right)cos\,\theta}{2\,\pi\,n\,R\,\sqrt{2\,\pi\,n\,L^2 + r^2}}}$$

Where $2p$ is the number of poles, n the frequency of the current, K the momentum of the rotating part. A similar formula is given by Steinmetz.

The influence which the formula attributes to the resistance and reactance are stated to correspond exactly to the results of the tests made by Mr. Semenza.

Owing to friction, a pendulum does not maintain its motion indefinitely; analogously, the currents produced by the pendular motion of the alternator in all the metallic parts of the machine and the mechanical friction absorb the energy of the oscillations. Therefore, it must be borne in mind that the pendular motion cannot be kept up by simple inertia on account of the strong damping forces, but there is necessary the intervention of another cause to continue the vibrations.

In the experiments related above it was noticed that the pendular motion started with no apparent external reason, and that the vibrations increased in amplitude gradually up to a certain limit. The test of the first series shows that the cause of the phenomenon is to be found in the motor itself. This cause, which has been pointed out recently by Steinmetz, is the reaction of the armature. When the current of the armature is in phase with the e.m.f. of the alternator, it sets up a flux of reaction, the effect of which is comparatively small, due to the fact that when the polar shoes are exactly in front of the coils of the armature the current in these coils is zero. It is known how the reaction increases when the current is lagging or leading. Now, when the motor or the alternator is oscillating, the reaction of the armature will pulsate with the same frequency, the displacement of phase of the currents being variable during the oscillation. But since the flux in the iron is not in step with the m.m.f., but is lagging behind it on account of the molecular friction of the iron, the reaction of the armature will attain its maximum value while the poles are coming back after having made their maximum swing.

If we suppose that the swinging has originated a leading current, the reaction will help the flux of the inductor; and when the poles start backward from the farthest point of the oscillation, the inducing flux will keep on increasing for a little while, thus giving to the rotor an impulse in the same direction in which it is itself changing its speed. A similar result would occur in the case of a pendulum if the soliciting force were increased in the descending period and decreased in the ascending period, in which case the amplitude of the oscillations would tend to increase.

We have then two forces which act oppositely—the impulses due to the reaction of the armature tending to amplify the oscillations, and the damping forces tending to stop them. The phenomenon will naturally assume different forms, depending on the value of the above actions.

When the alternator running in parallel or the synchronous motor is in the condition of minimum current, the difference of phase is very small and the reaction consequently weak; the damping forces overrule and there is no pendular motion.

On the other hand, when the machines are working in the higher part of the V curve, the currents are heavy and considerably out of phase; consequently the intense reaction varies very much in accordance with the pendular displacement, and there will be a tendency to originate a permanent oscillatory motion of such amplitude that the energy of the soliciting impulses is equal to the energy absorbed by the damping forces. If the special conditions of the circuit call for amplitudes exceeding the limit angle of stable running, the machine will fall out of step; under other conditions we will have stable operation or the permanent pendular motion.

Signor Semenza shows how the results of the tests mentioned in the first part of his paper and the other experiments related by Signor Rebora may be easily explained by the above theory on the running in parallel of alternators. He finally puts forward the following general ideas on the phenomenon.

In every case of running in parallel any perturbation in the speed has a tendency to produce the pendular motion. The oscillations are favored and supplied by the pulsations of the reaction of the armature, which pulsations on account of the magnetic hysteresis of the iron act to encourage, while the damping forces which absorb the energy of the oscillations tend to stop forced pulsations.

Every action increasing the reaction of the armature helps to produce the oscillations. The resistance and the reactance of the circuit have a very important effect, and the resistance may cause some serious troubles when the two synchronous machines are connected through a long line. In fact, the resistance of the alternator is generally very low in comparison with its reactance; by introducing in circuit a line with a resistance of the same order of magnitude or even much higher than the reactance, the ratio between these two quantities may fall beyond the limit of regular operation.

These limits depend on the construction of the alternator, and generally in the case of a long line of transmission they are easily reached.

The operation in parallel of power houses situated far apart can no longer be considered as a problem of easy solution, and manufacturers will be required to design special machines to fit particular cases.

Signor Semenza, in conclusion, expressed the hope that a complete theory of the phenomena considered may soon be contributed by an authority in the branch of alternating currents.

Variation of Motor Speed With Variable Line Voltage.

BY J. L. DICKSON.

THE question of variation of motor speed with line voltage is an important one, and it is the purpose of this article to outline in as simple a manner as possible two different methods of investigation.

In Fig. 1 let M represent the armature of a shunt motor, F its field, R the field resistance, S a switch for breaking the circuit, T the mains, and L a lamp bank. The apparatus is to be connected

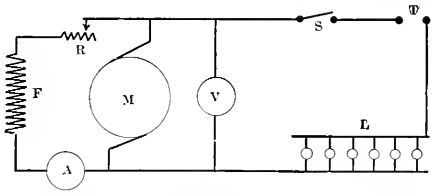


FIG. 1.—CONNECTIONS FOR VARYING CURRENT IN FIELD, VOLTAGE AND SPEED.

up as shown in the diagram, the voltmeter, V, being across the brushes of the machine and the ammeter, A, in the field circuit. The object of the above connections is to vary the current in the field, the voltage across the brushes and the speed of the armature. This is accomplished by means of the lamp bank, L, which regulates the amount of current passing through the entire circuit.

A definite amount of current is allowed to pass through the lamp bank, then the armature is brought up to normal speed by regulating the field resistance, R; the current through the lamp bank is then gradually decreased, step by step, until a sufficiently low reading is obtained, the speed and voltage in each case being noted.

Let us assume that during a certain test readings in Table I were taken:

TABLE I.

Volts Across Brushes.	Armature Speed r.p.m.	Field Amperes.
114	780	1.71
101	720	1.53
96	695	1.45
89	667	1.33
82	640	1.22
66	600	.98
62	585	.92
58	578	.87
55	570	.83
54	566	.80
52	564	.77
49	560	.72
46	558	.68
43	546	.64
36	533	.54
32	520	.47

From these data let us plot the volt-ampere curve (Fig. 2), using volts across brushes as abscissæ and field amperes as ordinates. This curve is found to be a straight line and shows that the voltage across the brushes varies directly with the field amperes.

The above curve can also be obtained as follows: It is seen from Table I that the drop in voltage is 114-32 or 82 volts, and the resistance for the first reading is $R = \dfrac{E}{I} = \dfrac{114}{1.71} = 66$ ohms, while

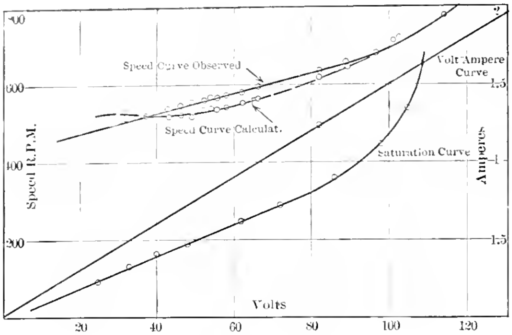


FIG. 2.—VARIATION CURVES.

for the second reading it is $R = \dfrac{101}{1.53} = 66$ ohms. In this manner it is found that the average resistance is 66 ohms; therefore, the current is $I = \dfrac{E}{R} = \dfrac{82}{66} = 1.24$ amp. We then plot 1.24 amp. and 82 volts and connect this point with the origin by a straight line.

Also, from the above readings a speed curve is plotted, using volts across brushes as abscissæ and armature speed as ordinates. This curve shows that these two quantities bear a certain relation to each other, and that as the voltage increases so does the speed, but more gradually and not in a like proportion.

The motor is then to be used as a generator and connected up for a saturation test as shown in Fig. 3, where G represents the armature, F the field, R the field resistance, S a switch for breaking the circuit, L a lamp bank and T the terminals of the generator, G. The

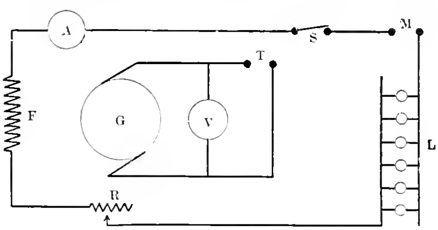


FIG. 3.—CONNECTIONS FOR SATURATION TEST.

field, F, is separately excited from the mains, M, and an ammeter, A, is placed in the circuit as shown. The machine is brought up to speed and the field, F, excited from the mains, M; then the current in the field as read by the ammeter, A, and the voltage across the brushes, taken from the voltmeter, V, are to be noted; the current in the field is then decreased by adjusting the lamp bank and the voltage and amperes again noted. The current is thus decreased until the desired amount is obtained, readings being taken in each case. Suppose for this test the following readings in Table II were noted:

TABLE 2.

Volts Across Brushes.	Armature Speed r.p.m.	Field Amperes.
105	780	1.36
98	780	1.13
86	780	.89
72	780	.72
62	780	.62
48	780	.46
40	780	.36
33	780	.31
25	780	.23

From these readings a saturation curve is plotted (Fig. 2) using volts across brushes as abscissæ and current in field as ordinates. This curve shows that the voltage increases with the current, but not in the same ratio.

If it is desired to obtain the speed curve by calculation, from Table I it is seen that the speed varies with the voltage in the armature, or $S = V_A$ (1) where S = speed in r.p.m. and V_A = volts across armature. Also, the speed varies inversely with the magnetic field, or letting the field be represented in volts generated at speeds 780, 720, etc. (Table I) we have

$$S = \frac{1}{Fv} \qquad (2)$$

where Fv = strength of magnetic field in volts.

Equation (1) is then combined with equation (2) and there results:

$$S = \frac{V_A}{Fv} \qquad (3)$$

The speed for each reading equals $\dfrac{V_A}{Fv}$ multiplied by some constant, K, or

$$S = K \times \frac{V_A}{Fv} \qquad (4)$$

Substituting the first values from Table I we have $780 = K \times \dfrac{114}{114}$, or solving the above equation, $K = 780$. Therefore, the constant is found to be 780. (Fv is taken as 114, because for this reading the strength of magnetic field represented in volts is 114.)

The second values, Table I, are then substituted in formula (4), or

$$S = 780 \times \frac{101}{108} \quad \text{or}$$

$$S = 729 \ r.p.m.$$

The magnetic field, $Fv = 108$, is found from the volt-ampere and saturation curves (Fig. 2). We find 101 volts on the volt-ampere curve, and from this point we go horizontally across to the saturation curve and from this last point we come vertically downward until the abscissæ axis is reached; here the voltage is read and for this case it is found to be 108 volts.

The above method is pursued for finding the magnetic field, Fv, for each case, and substituting in the speed formula we have the values given in Table III:

TABLE 3.

Volts Across Brushes.	Armature Speed r.p.m.
114	780
101	729
96	699
89	664
82	627
66	562
62	550
58	538
55	530
54	533
52	534
49	531
46	533
43	524
36	530
32	531

From these readings another speed curve is plotted as before, which is shown in broken line in Fig. 2, and resembles very closely the previously plotted speed curve. If counter e.m.f. and slight inaccuracy in plotting and reading curves are considered, it is very probable that this latter curve would correspond nearly exactly with the observed one.

The Telescriptograph.

The following rather curious item comes to a New York daily newspaper in a cable dispatch from Brussels of June 11: "M. Malcotti, an Italian engineer resident of this city, has invented an instrument which he calls a telescriptograph, and which will reproduce in print all conversations held over the telephone. He has already secured patents in several European countries and in the United States, where he intends to install his service with the aid of some telephone company. Experiments given in public have demonstrated the wonderful achievements of the young inventor, who claims that his instruments will work without extra wires and apparatus over any ordinary telephone line."

Storage Battery Plate Construction.

By S. H. RABENALT.

WITH reference to the article written in the ELECTRICAL WORLD AND ENGINEER under date of May 21st, by Mr. W. W. Donaldson, on "Storage Battery Plate Construction, with Special Reference to Discharge Characteristics," I take the liberty to take exception to a few statements made.

1. " * * * Provide for good electrical conditions, and the mechanical will take care of themselves." This is hardly a right fundamental principle for the construction of a Planté plate. Is it not just as important that a battery plate retain its original shape, its mechanical structure, during its working period, as it should fill the other requirements of capacity, low-potential drop on high rate discharges, low internal resistance, etc.? Not only should this point not be neglected, but it should be one of the fundamental points to be considered in the construction of Planté, or, in fact, any plates.

One of the chief requirements in station batteries is that the possibilities of short-circuits be eliminated as far as possible. Of necessity, therefore, the plates proper must be rigid; that is, their shape and mechanical structure should not change during the entire life of the battery, no matter what changes in form the active material portions are undergoing.

Most of the Planté designs of the present days comprise ribs and grooves, varying in shape and size, the grooves being designed to hold the active material—electrochemically formed from a part of the ribs. Now, if the plate is to maintain its capacity, the active mass must be retained in the grooves. Experience has taught that the best method of accomplishing this most efficiently is to fill the grooves in the forming process rather tightly, thus not allowing the active mass to become separated from the contact surface by violent gasing resulting from excessive overcharges, which Planté plates are expected to withstand; but where a space is left in the grooves between the layers of active mass on each side, this does occur, and the result is evident.

It is a common thing for Planté positive to "grow" and "buckle," both being most frequently caused by excessive overdischarging and not sufficient charging; this causes an additional formation and volume increase of the active material, this being called "Planté action." The grooves—assumed filled—are unable to accommodate this addition of mass, and the whole active portion (the portion of the grid which contains ribs and grooves) expands. If the expansion on both sides of the plate is balanced, the plate "grows" (expanding force acting in a linear direction); if unbalanced, the plate "buckles" (expanding force changing its direction continually). It is the "buckling" that causes the numerous short-circuits in some types of batteries.

On the other hand, if the grooves are not quite filled with active mass, thus providing space for the "Planté action," the possibilities of growing and buckling are very much decreased, but how about the capacity question? Before benefit is derived from this provision of space, the amount of the active mass may have been reduced considerably, as mentioned above, and the provision prove useless.

It would, therefore, seem advisable to construct a Planté positive of a large number of small "units," comprising the "active portion" of the plate, and to weld these into a solid and rigid frame of antimonial lead. (I do not belong to the class of "cranks" who believe in "always complicating and retarding the proper chemical actions. * * * ") Each section or unit should be joined to the frame at its upper edge only, and be allowed to follow its tendencies, to expand or grow, in three directions, and there should be sufficient space provided that these changes in the individual units may take place without destroying or changing the form or dimensions of the plate as a whole, which fact allows the individual units to be constructed so as to retain the active material.

The writer, who is fortunate in having had an appreciable amount of practical battery experience, considers this type of a Planté positive more nearly the ideal station plate than that described by Mr. Donaldson, in spite of the fact that he condemns the class of "built-up" plates most decidedly. The fact that there are Planté positives in service, whose vertical edges follow a zig-zag line after several months' use, and the shape of the active portions reminds one of a bowl, shows conclusively that there are constructors who "let the mechanical conditions take care of themselves!"

2. "The fundamental requirements for both plates is that their active material must be formed by an electrochemical action. No paste or applied active material should enter into the construction of either plate for stationary high-discharge work." Why? The necessity for a Planté positive, of course, is evident, and the subject has been so thoroughly and on numerous occasions, dealt with, that I consider it superfluous to go into details. But how about the negative?

As far as the writer is aware, there is but one storage battery company in the world that installs batteries having negative plates of the Planté type, and as the number of installations of this kind probably amounts to no more than 1/100 of one per cent. of the total battery installations, it is unreasonable to assume that the use of a Planté negative plate is ideal or even desirable.

The assertion above noted is too general for a detailed discussion. It might be mentioned, however, that batteries installed with Planté negatives, result in exceptionally high c.e.m.f. on charge, and are very susceptible to "treeing."

3. " * * * The plate must not be built up of separate parts." This is another statement to which I take exception. Mr. Donaldson goes on to say that the active material should not be relied on as a conductor of current. Here it seems to me that the author has in mind a certain type of an earlier origin than "the well-known type" whose positive plate is mainly characterized by the peculiarly shaped active units which suggest a series of buttons. In that type it is true the entire current, developed in a unit or button has to travel through a portion of the active material (the periphery of this spiral), the active material being compelled to take the part of a conductor. I admit that in this respect the mentioned type does not comprise the "ideal" Planté plate, but undoubtedly the type in question results in a rigidity which cannot even be dreamed of in connection with the "well-known type."

It is not necessary that the active material of a small unit should play the part of conductor, as it does not in the type described by the writer. Therefore, it is not fair, from a neutral, technical point of view (which I suppose the author has taken), to condemn a class of plate generally because he finds a bad defect in one particular type of this class.

4. It is stated that no other metal save pure lead should be used. There is certainly constant local action between the PbO_2 and Pb of the grid, this being an increased function of the contact area, but in my opinion the increase in local action caused by a moderate percentage of antimony in the grid (the only metal alloyed with lead for battery use) is, if other conditions are kept the same, inappreciable.

5. I will, of course, not deny the fact that rolled lead is denser than cast lead, and I also admit that the former offers somewhat more resistance to the oxidizing actions of the current, i. e., Planté action. But to generalize the claim of superiority of one kind of lead over another on that score is not justifiable. And contrary to this assertion, I wish to say that in some respects it may not be best to employ rolled lead in battery constructions, for the plates will very frequently be subjected to excessive overcharges, more seldom overdischarges. This condition will develop a very pronounced tendency, caused by violent gasing, to expel the active mass, emptying the grid and decreasing the capacity in proportion. If very dense rolled lead has been employed in the construction, the contact surface will be very smooth; and owing to the greater resisting qualities toward Planté action, will remain smooth, with an extremely thin layer of peroxide and a proportional capacity. Cast lead being more susceptible to Planté actions, will be peroxidized by the repeated charges and discharges to a far greater extent, giving to the positive plates the ability to take and hold a charge, while plates of rolled, dense lead will be less attacked and will have proportionately less capacity.

In cases where batteries are subjected to very extensive discharges, especially at low rates, and also charged at quite low rates, it would be best to use a very dense lead. The density of cast lead may be greatly varied by varying the pressure under which the casting is done, or by compressing the casting as it solidifies.

6. Some interesting figures are given for percentages of weight of supporting frame to weight of plate proper. As to 15 per cent. for frame construction, it is obvious that "the mechanical conditions take care of themselves." If a plate is to remain in its original shape and not adopt curves similar to an ocean wave, it might be well, perhaps, to increase the above percentage.

It is impossible to give an absolute figure for the amount of lead to be used in the frame construction, as it depends entirely upon the design of the grid. While in some well-constructed types 25 per cent. to 30 per cent. may result in a rigid plate, 40 per cent. to 50 per cent. may prove insufficient in some others, and the "well-known type" has proven conclusively that 15 per cent. is altogether insufficient.

The contact area and thickness of the support (ribs) are, in my estimation, well considered.

7. It is stated that the plate, as a whole, should be as thin as consistent, and should not exceed one-half an inch from face to face. The object of this is not clear to me. It would be very interesting to hear on what basis this assertion is made.

For each individual type such limit can be determined, beyond which the characteristics are commenced to be unfavorably influenced, but hardly for *all* types. I wish to mention the fact that some leading European types exceed a half inch by a good deal. Were those constructors all wrong in their viewpoints?

8. The argument is advanced that the grooves should be tightly filled in order to maintain contact between the grid and the active mass. This argument I condemn most decidedly. The fact that a groove is tightly filled will not prevent the formation of additional peroxide if conditions favor a tendency for it.

If the grooves are so tightly filled that they are unable to accommodate additional mass, the mass will make itself the necessary space. If the frame construction (which encloses the active portions *tight*, not providing for expansion space) is made out of soft lead, the plate will grow and buckle. If the frame construction is made out of antimonial lead (with a comparatively high percentage of antimony) the plate will very often crack and break.

It is further stated that the negative plate should be integral and of pure lead, alloys to be avoided on account of local action. If local discharges take place in negatives, it is not so much due to the action of alloys, as due to a primary sulphation of the spongy lead. Metallic lead undergoes a slight sulphation in diluted sulphuric acid. Since from a chemical point of view spongy lead and solid lead are one and the same (the difference between the two is solely of physical nature) the spongy lead will, therefore, also undergo a sulphation, only to a much greater extent, for the spongy lead offers the acid more attacking area, being so finely divided. And sulphation of an active mass means discharge.

It is claimed that "local actions due to alloys are the chief cause of capacity loss in many forms of negatives." There is, of course, local action between an alloy of lead and pure lead. But is the local action in a positive not far greater? First, the contact area in a positive is from 10 to 20 times as large as the area in a negative, and the local action takes place in a ratio to the contact area. Second, the intensity of the current being active in the local discharge is far greater between peroxide of lead and lead as between a lead alloy and pure lead, because the former combination gives a much higher e.m.f. than the latter.

The maximum local discharges in a negative (the primary sulphation plus the electrolytic sulphation caused by the alloy) are only a very small portion of the local discharges which take place in the positive plate; therefore, this point can be neglected with good conscience.

Central Station Office Methods and Accounting.

In introducing his paper on the above subject read before the recent Boston Convention of the National Electric Light Association, Mr. Frank W. Frueauff said that the lighting companies throughout the country are all making an effort to increase their sales of current either to present users or new consumers, or by taking on business that was formerly done by isolated plants or other forms of power. These conditions have necessitated a much closer study of costs and receipts and have resulted in a much finer separation of the items entering into the cost of production for any particular class of current or for consumers using service in an unusual way. The usual method of grouping all expenses under the three arbitrary heads of manufacturing, distribution and general expenses and making separation under them for different sub-divisions desired, has only given costs and must therefore be misleading for purposes of figuring for new business to be secured or for analyzing present results in order to know the profitable from the unprofitable business. The plan of apportioning the costs of operation to the class of current made and of separating fixed and variable costs has therefore come to be a necessary part of a company's report of operations, and is now in operation among a number of companies with marked success.

The expenses occasioned in manufacturing and distribution for any one class of current are kept distinct from those incurred in another, so that the actual cost of manufacturing and delivering arc, power or alternating current is known separately. These costs for any one class are also separated to show the costs that are fixed as distinct from those that are variable. For example, station foreman, meter department, shop expenses, etc., are practically a fixed expense; that is, they are an expense resulting from the size and running of an electric business and do not noticeably vary as the business may increase or decrease. Some expenses depend upon the amount of current made and sold; that is, they vary with the output. For example, boiler fuel, firemen, lamp renewals, carbons, and so on. A third class of expenses is made up of those that vary with the number of consumers supplied or number of meters in use. Under this head may be included meter repairs, arc-lamp repairs, service repairs, meter-reading expense, collection and office salaries.

With the cost of current for any class of current separated into these three divisions, it is possible to know just what results are being obtained. One may then know whether or not the output expenses are increasing at a greater rate than the output, and if the expenses proportioned to consumer are increasing faster than the number of consumers. In figuring rates to be made to secure new business this plan of separating costs is particularly valuable. For example, in figuring to take on a long-hour burning consumer you know from the figures of costs that the fixed costs will not be materially increased, nor will the consumer expenses, and that only the output cost will be increased. You may therefore assume that this business can be secured at a very low figure and still show a much larger margin of profit than business that will add to your expenses of capacity or consumers while only showing a small amount of current used.

COMPLAINTS.

The electric companies are now realizing as never before that a satisfied consumer is one of their best assets. To make or hold these satisfied consumers requires constant and careful watching. A department of the business is established where these complaints are received and adjusted. They must be systematically followed up or great dissatisfaction will result. One plan in use is to record all complaints as received, showing the date, name, address, time complaint was received and nature of complaint. From this record typewritten orders in duplicate are made on a 3 x 5 slip, the original being sent to the inspection department immediately and the duplicate being held to insure the return of the original. The order is given to an inspector, who attends to the complaint as carefully as possible. He notes on the order the result of his investigation and signs it, when it is returned to the order or complaint department. The date of execution and name of man are entered on the record and the duplicate taken from the pack of outstanding orders. A reply postal card is then made out from the order, stating that complaint had been made of certain trouble and asking if our inspector had attended to it satisfactorily, these cards being sent in answer to all complaints. The reply cards do not all come back, but we are sure that if the investigation or work has not been satisfactory consumer will be sure to reply. If an unfavorable reply is received, an order is sent to inspection department calling attention to unfavorable report, and when work is again completed another reply card is sent. The original order is then sent to the filing room, where all orders of every class are filed by dates under the street number, this file being used for reference from time to time and giving a complete history of all work done by the company at any house connected to our system.

A daily report is made from the order record, showing the number of complaints received, separated by classes, and showing the number of each class for same days of previous year and the accumulative number received during the past month. This report is sent to the general manager each day and enables him to keep in touch with the troubles coming up. At the close of each month a statement is prepared showing the number of complaints handled by each inspector and the number from which "unsatisfactory" reports were received on the reply cards, also showing the per cent. of satisfactory work done. This report, after being inspected and signed by the general manager, is posted in the inspection department where all men can see it. This plan of compiling the efficiency of the men has a splendid effect in stimulating them to careful and thorough work on all orders, and means a saving of time and money to the company and better feeling on the part of the public.

BUREAU OF INFORMATION.

A new departure in the office is the establishment of a "bureau of information." This bureau is located in the most conspicuous point in the office and is in charge of a clerk thoroughly posted on all general matters of the company. His duties are to direct any and all inquirers to their desired point, such as application window, teller's window, manager's office, appliance department, etc. He has charge of the list of desirable vacant houses in the city, and upon request directs the inquirer to the real estate agent who has the property in charge. This list of houses includes only those along the company's lines or mains and only those that are equipped to use the company's service. By this plan we are able to get newcomers to the city, or those intending to move, to occupy houses where we can supply them without further investment. The list is revised each day by reports made from the soliciting and application departments of houses connected and disconnected. In connection with the bureau of information, bulletin boards have been placed at each plant, shop and department of the company. Upon these boards any announcements of changes of regulations, special inducements, information of particular importance to employees and copies of all new advertising matter being sent out are posted, in order that the employees in every branch of the business may be kept in touch with what is going on, and may be in position to talk intelligently if questioned when attending to their duties, or after hours.

METER READING.

One of the most important requirements for satisfactory relations with consumers is the necessity for accurate meter reading and billing. The coupon system of meter reading cards, originated by Mr. S. J. Glass (see Fig. 1, in which only the coupons for two months

Form 13-5.

DIVISION	FOLIO	ROUTE NO
APPLICATION NO.	**DATE SET**	**DATE OUT**
MAKE AND SIZE	**MAKER'S NO.**	**COMPANY'S NO.** Constant

NAME AND LOCATION:

MAY APRIL

FIG. 1.—COUPON SYSTEM OF METER READING CARDS.

are shown), seems to be the best and safest method in use. Under his plan a slip with 12 coupons attached is made for each meter; each coupon bears an identifying number, corresponding with the account on the consumer's ledger. After the meter has been read and bill made the coupon is detached and filed for reference. The meter reader then has only the meter number and house number to direct him when he next takes the reading. By this plan no readings can be averaged or readings put down without actually seeing the meter, and as the man has no previous reading to assist him, he must use unusual care to get the correct figures.

By keeping the same men reading each month and throughout the month and not picking up extra men each month to take statements, a considerable saving can be made, as men familiar with the routes can make much faster time and will not have to go back to get meters skipped or read wrong on the first trip. The plan of posting a list of all mistakes made by the meter readers will also increase the efficiency of this department. At the close of each month a list is posted in the department showing the number of meters read by each man and the number of errors discovered. A bonus is paid to each man who makes no mistakes during the month. One month's records show 13 men read 32,000 meters with a total of but eight errors made by all these men.

OFFICE MISTAKES.

The plan of recording and then posting a list of all errors made by the consumers' bookkeepers is followed. In this list appear any errors or omissions made by them, including errors in extensions and calculations, failure to send bill to proper address, omission of balance owed for previous period, and so forth. This posted list has the same stimulating effect as the lists of errors made by the meter readers and trouble-men.

In the general office a Dey registering time clock is used. All office employees are required to register as they come into and leave the office. From this record the office time is kept. We find it of particular value in impressing promptness upon all employees; and as clerks are on duty from seven a. m. to midnight, it is possible to know the time they arrive and leave without requiring the chief clerk or a time-keeper to note their movements. A list is posted each morning of any who have registered late in arriving or who have overstayed the hour off for lunch. At the close of each month a list is made of those who have been prompt and punctual throughout the month.

CARD RECORDS.

The use of card index records in offices is constantly growing and is satisfactory for most purposes. We are now using a house record (see Fig. 2) index in our application and order department.

STREET *No.*

Order Number	NAME	Nature of Order	Date Issued	Date Executed	Ill. Gas Meter No.	Fuel Gas Meter No.	Electric Meter No.	Index

FIG. 2.—HOUSE RECORD.

A card was made for each house connected, and as orders were taken to connect, disconnect, or change meter, arc lamp, etc., a posting to this effect was made on the house card; after the order had been executed the date of execution was entered on the card, so that we constantly have a record of our standing at each house. This has done away with all duplicate or wrong orders. Under the old plan of listing orders in a book or books we frequently sent men to re-read meters for a new tenant when we had just ordered the meter returned on instructions from the old occupant; but with the house card to refer to before sending order to shop for execution, a wrong order is detected and new one substituted to cover the latest development, or the order previously sent out is ordered recalled.

Visible-writing typewriters with card-holder attachments are used on all orders of every description. We find by their use fewer errors in copying and reading addresses and that names of consumers, being more legible than when written by hand, are correctly carried through the records and to the addressing machine.

The filing cabinet referred to before is also a feature in the card system. A guide card is placed for each street and number, and back of it are filed all completed orders for setting or removing of meters, complaints, connection of appliances, etc. If it is desired to refer to any original order, it is readily located by this plan.

For the record of stock of materials carried, a loose-leaf system is in use. One sheet is arranged for each article, showing amount on hand and received in one column, the amounts sent out in another, and a column to show the running balance of materials on hand.

This record is kept to show both the quantity and value of each article in stock, and is kept up each day from the storekeeper's reports of materials received and sent out.

ACCUMULATED REPORTS.

After the monthly report is complete, the records therein shown are transferred to loose-leaf sheets containing columns for every item on the report; these figures are carried on an accumulative basis and always show the results for the past twelve months, this being done by adding or deducting the difference between the last month and the corresponding month last year, from the previous yearly total. These accumulative figures show much more clearly any real increase or decrease, and are not misleading, as the results for any one month might be. From these accumulative sheets a year's report can be made without any trouble or delay.

OFFICE LABOR-SAVING DEVICES.

In Mr. Anthony's paper, read before the convention last year, he described several of the labor-saving methods in general use. I will therefore refer only to some not mentioned by him.

We use a Boettescher & Knecht machine in the teller's cage for receipting all bills. This machine is driven by an electric motor. The bill is placed in front of the machine by the teller, who then touches a spring; this releases the lock and sets the machine in motion, the bill is drawn under the roller, the coupon cut off and dated and dropped in a drawer below and the receipted bill forced out to the front of the window, where it may be picked up by the consumer.

We are now using an adding machine made by the Universal Adding Machine Company, of St. Louis, which has an electric driving attachment. Instead of pulling down a lever, as with the usual adding machine, a spring is touched which sets the machine in motion and performs the same office as the lever.

Self-adding sheets are a simple arrangement used in tabulating results such as number of meters or consumers gained or lost, and so forth. The sheets are ruled for units and every tenth space is so marked. When all marks are down the number of vertical spaces times the number of horizontal spaces used shows the total desired.

The slide rule frequently used in engineering work can be made to play an important part in modern office methods. Clerks can be easily instructed in its use and calculations requiring multiplication or division worked out in much less time than by the old methods.

The Thatcher calculator made by the Keuffel & Esser Co., New York, we have found the greatest labor saver yet tried. All costs and receipts are worked out on the reports on a basis of current made or sold. With several hundred separations, it will require a couple of days' time to do the division required. By the use of the calculator the results may be set down as fast as one can read the numbers on the machine. This machine is unique in construction and easily understood. Where a constant multiplier or divisor is used the results are shown more quickly than with any of the other calculating machines. This feature therefore makes it particularly valuable in use on monthly reports.

A tube system, such as is used in department stores, has been of great benefit to us. We have connection at all windows in the accounting office direct with the bookkeeping and collection rooms. If a copy of a bill is desired or explanation required, the detail can be secured in much less time than by going to consult the books and leaving the consumer waiting. We are able to do all bookkeeping work on another floor of the building, which is away from all the disturbance of the public office. We find that by this plan our bookkeepers are able to handle more accounts and with fewer interruptions.

We are installing a Hollreith electric tabulating machine. This machine is now in successful operation in a number of railway accounting offices, in some large factories, and was used by the United States Census Bureau in compiling its statistics. The equipment consists of two parts: The punch, into which properly printed cards are set, transfers the information by punching a hole in the proper space. When all information has been transferred to the punched cards they are set in the tabulating machine, which sorts them into several kinds and then compiles the information. It is our intention to use this machine to tabulate our records of all consumers, to show the possibilities of each class of business, and to use it in making up the pay-rolls. Use will also be made of it in our engineering department in keeping track of our current made, sold and lost, of the various types and efficiencies of transformers and meters.

Your reporter received his appointment at such a late date as to prevent his making inquiries among the different members as to their experience with any new office methods or labor-saving devices. I have therefore only mentioned some of the methods now employed in the Denver office. We have endeavored to kep in touch with all the newer plans suggested for accounting and for labor saving, and have adopted any that seemed to have advantages over those previously employed.

STEAM GENERATION.

An analysis of steam generation enables us to determine what proportion of the generating expense should be charged to each class of current sent out from the station. The generating apparatus for the different kinds of service is usually not of the same efficiency. To compensate for this we apply the average efficiency of the apparatus to the output in kw-hours of each class of current. This gives us at the throttle valve of the engine the equivalent of the output from each class of current. From this point the generating expenses proportional to output are common. Having this equivalent steam energy, we can divide the generating expense in the same proportion that this equivalent energy appears. This would give us expense proportional to output, which should be charged to each class of service. The expenses proportional to capacity should be divided in proportion to the capacity of each class of apparatus in the station.

Test of Westinghouse-Parsons 400 KW Steam Turbine.

In December last Messrs. Dean and Main, of Boston, made an elaborate test of a 400 kw steam turbine at the works of the Westinghouse Machine Company, East Pittsburg, Pa. As is well known, these works are provided with all facilities for the most accurate steam consumption tests of engines of the largest size. In making the present tests the condensed water was measured at intervals of ten minutes and the brake horse power was determined by means of a water dynamometer of the Froude type. The duration of the tests was two hours for the full load test with 100° superheat, and one hour for most of the other tests, though a few were made 20 to 30 minutes in length. The accompanying table gives the results of the principal test.

TEST OF 400-KW STEAM TURBINE.

Dry Saturated Steam.	Overload.	Full load.	Med'm load.	Low load.
Revolutions per minute	3,481	3,545	3,583	3,602
Throttle gauge pressure	153	154	156	156
Vacuum	26.87	26.84	26.80	26.90
Ratio of rated load	1.26	1.02	0.77	0.42
Steam per brake hp-hour	13.63	13.91	14.48	16.06
Superheat, 100° F.				
Revolutions per minute	3,457	3,546	3,580	3,588
Throttle gauge pressure	150	156	154	153
Vacuum	27.10	27.06	27.10	27.10
Ratio of rated load	1.31	1.02	0.77	0.41
Steam per brake hp-hour	12.07	12.41	12.86	14.62
Superheat, 180°.				
Revolutions per minute	3,477	3,542	......	......
Throttle gauge pressure	151	154	......	......
Vacuum	27	27.10	......	......
Ratio of rated load	1.32	1.02	......	......
Steam per brake hp-hour	11.17	11.45	......	......

Tests were also made to determine the variation of the speed of the turbine at different loads. This variation in the test with steam superheated to 100° F. was 2.5 per cent. below speed at rated load, for 31 per cent. overload, the figures for 77 per cent. load and 41 per cent. load being .9 and 1.2 per cent. below rated speed, respectively. In the test with dry steam the variations were 1.8 below normal for 20 per cent. overload; 1.60 per cent. above for 42 per cent. load, and 3.4 per cent. above for friction load.

The report contains curves showing the effect on economy from superheat, which indicate that the saving is 1 per cent. for every 10° of superheat between the limits employed in the tests.

The report calculates the thermal efficiency of the turbine tested for the several different conditions of operation. Since the thermal efficiency of a reciprocating steam engine is usually referred to indicated horse power, and as the tests of the turbine were in terms of brake horse power, in order to have a common basis for comparison it was assumed that the friction of a reciprocating engine is 6 per cent. On this basis of internal steam horse power, the thermal efficiency for dry steam is given as 17.22 per cent.: for 100° superheat 18.43 per cent., and for 180° superheat, 19.43 per cent.

Recent Electrochemical Developments.

INDUCTION FURNACE.

In the metallurgy of iron and steel electric furnace methods have been commercially successful up to the present mainly along two lines, the production of ferro-alloys and the manufacture of special high-priced steels. The high temperature easily attainable in the electric furnace is of decisive importance for the production of certain ferro-alloys, on account of the high reduction temperatures of the oxides treated. On the other hand, for the production of special steels (which have to compete with our crucible steels) no specially high temperature is required, since the process is essentially a smelting operation, and in this case the cleanliness and easy control of the electric furnace operation, the impossibility of impurities being introduced into the charge from the fuel or fuel gases (because there are none) and the ease of treating any large quantity of charge in a single operation are of signal importance. The only difficulty to be solved in this case is the prevention of impurities being introduced into the charge from the electrodes, as we generally say, although the term is improper, since no electrolytic action takes place; the "electrodes" are here nothing but terminals by which the electric current is introduced into the charge from the external source of current.

The most radical course of solving this difficulty is to use no electrodes or terminals whatever, but to introduce the electric current into the charge by inductive action in the same way as electrical energy is transported from the primary of a transformer to its secondary. In fact, the induction furnace, as operated by Kjellin, at Gysinge, in Sweden, for the production of special steels, is essentially a transformer; its primary winding, having a large number of turns, is supplied with high-tension alternating current, while the secondary has a single turn and is constituted by the charge to be melted. However, the furnace design of Kjellin seems to be capable of improvement. The efficiency of his furnace is rather low. According to *Electrochemical Industry* (December, 1903, page 578) the

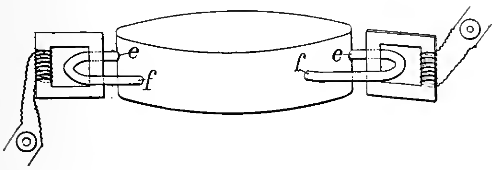


FIG. 1.—SCHNEIDER INDUCTION FURNACE.

electric power supplied to the primary is 165 kw, of which 87.5 kw are lost and only 77.5 kw are utilized in the secondary. The efficiency is, therefore, only 47 per cent.

In a patent, granted on June 7, G. P. E. Schneider, of Le Creusot, France, remarks that if the secondary (i. e., the charge to be treated) is made in form of a single ring of uniform cross-section, the current induced in it will be unnecessarily high and the reaction of this current upon the primary coil will produce an unfavorably large phase difference in the primary circuit. Schneider proposes, therefore, to increase the resistance of the secondary by making it in form of a tube of small cross-section, communicating at its both ends with a crucible of large dimensions containing the greater part of the charge. The latter part of the charge will then be at a considerably lower temperature than the charge in the tube. The one end of the tube is at a higher lever than the other end. Under the influence of the difference in density of the charge in the tube and in the crucible, an active circulation of the charge will result. The general principle of his idea will be seen from Fig. 1, which shows one large crucible in combination with two induction furnaces: one of the ends, *e* and *f*, of the tubes is at a higher level than the other. It is, of course, also feasible to have both ends at the same level, and to provide means for tilting the furnace chamber whereby the line joining the outlet and inlet of the tube may be thrown out of the horizontal plane.

The specification of Schneider's patent also contains some interesting suggestions concerning the application of the electric induction furnace, not as a substitute for, but in combination with, ordinary metallurgical furnaces. This is quite a promising idea and should in no way be confounded with the several schemes of replacing our blast furnaces by electric furnaces for making pig iron. It is easy to concentrate by means of the electric current a high heat at a certain point and at a certain stage of the operation. Thus, in his recent presidential address before the American Electrochemical Society, Dr. J. W. Richards suggested the auxiliary use of electric heating to take off "the peak of the load," so to speak, in our open hearth steel furnaces; that is, to furnish the last few hundred degrees of necessary temperature, while the combustion of gas furnishes the lower range.

Schneider's patent specification contains several suggestions of this kind. We may mention only the combination of the induction furnace with a blast furnace. Fig. 2 shows the vertical and hori-

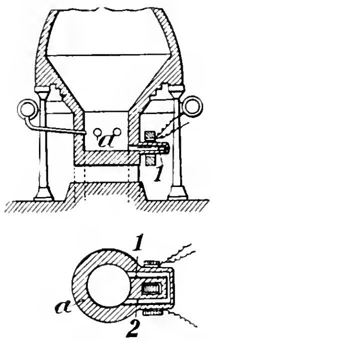


FIG. 2.—SCHNEIDER INDUCTION FURNACE.

zontal cross-section of a blast furnace, the crucible, *a*, of which is provided with the heating tubes, 1 and 2. The crucible, *a*, may thus be supplied at any stage of the operation with additional heat by electrical means. The electrical energy could be easily and cheaply provided by using part of the blast furnace gases for the operation of gas engines coupled to electric generators.

BATTERY INVENTION.

A patent granted to J. von der Poppenburg refers to the construction of a storage battery plate, in which cross pieces adapted for dividing or separating the active material protrude from the frame on both sides and are provided with holes at the part protruding from the frame; through these holes pass elastic bars, which press or bear against the protecting strips that prevent the active material from dropping off. The object is to obtain, in case of an expansion of the active material, only a bending of the elastic bars and to prevent the formation of wide cracks.

Two patents granted to G. F. Atwood refer to the composition in specific proportions of the two solutions used in the two compartments of primary batteries of the Bunsen type.

MISCELLANEOUS.

A patent, granted to H. Blackman, refers to the construction of an anode for use in electrolysis of sodium chloride. It is an iron or steel plate, the surface of which is completely covered with a dense layer of iron oxide. Several methods of producing this cover of oxide are described. This anode is stated to be incorrodible, except at the surface of the electrolyte. At this point it is, therefore, provided with a protecting band of glass of vitreous glaze.

A patent granted to G. Cornara refers to the production of explosive cartridges by producing explosive gas mixtures by electrolysis and igniting the mixture by an electric spark. As electrolyte he uses an aqueous solution of caustic soda or potash; the gas produced is, of course, a mixture of hydrogen and oxygen. Applications to blasting holes formed in rock and for projective torpedoes are described.

The Metric System in Great Britain.

The House of Lords of the British Parliament has passed a bill establishing the metric system as the legal system of Great Britain. It is confidently expected that the bill will be passed by the Commons at the next session, almost a majority of the members having committed themselves as in favor of the system.

Ohio Independent Telephone Association.

About 200 independent telephone men attended the meeting of the Ohio Independent Telephone Association, held at Columbus recently. An address of welcome was made by H. A. Lanman, president of the Columbus Citizens' Telephone Company, which was responded to by G. P. Thorpe, attorney of the Wilmington Home Telephone Company. Mr. J. B. Hoge, of Cleveland, then addressed the convention outlining a plan of organization. Two hours were profitably spent in discussing various subjects that had been placed in a "Question Box." Cyrus J. Huling, of Columbus, made a report on the post-office telephone fight, which was made in Washington last winter, showing how the independents had carried their point.

The committee on permanent organization presented a set of rules and regulations for the government of the association, after which the following-named officers were elected: President, Frank L. Beam, Columbus. Vice-presidents—W. Wilber Thompson, Lebanon; G. P. Thorpe, Wilmington; James B. Hoge, Cleveland; R. E. Hamblin, Toledo; J. C. Reber, Dayton; Dwight E. Sapp, Mt. Vernon; G. A. Mathany, Lima; W. F. Laubach, Akron; J. B. Rhodes, Zanesville; E. E. Knox, Portsmouth, secretary, and Ralph Ramer, Columbus, treasurer and assistant secretary. An executive committee consisting of five members, of which the president is ex-officio chairman, is yet to be appointed.

The plan of organization is to divide the State into nine districts, each vice-president to take charge of a district and organize the same so as to make a complete union of interests. Reports to the convention showed a very satisfactory condition throughout the State.

Mr. Harry Gates, of the Queen City Telephone Company, Cincinnati, made an interesting report stating that work had been commenced on the Cincinnati plant, and that they expected to have their plant in full operation inside of the next two years. He said that franchises would be asked for immediately in all adjoining suburbs.

Municipal Ownership in Canada.

In the return of reproductive undertakings operated by municipalities in Ontario, it is stated, in an official report, that out of 14 cities, 106 towns and 134 villages, to which forms of inquiry were sent, returns had been received by the 18th of November, 1903, from 12 cities, 90 towns and 118 villages. Of these, 11 cities, 57 towns and 21 villages had been carrying on reproductive undertakings and a number of the others reported that they were about to acquire waterworks or electric lighting plants. There are 79 municipalities in Ontario which own their water works, 35 which have their own electric lighting plants, 4 which supply electricity, 2 supply gas, 2 have municipal cemeteries, 1 possesses a dock, and 1 operates its own street railway. There was an average annual loss on the municipal street railway and electric lighting system combined at Port Arthur of $1,370.95, for the period of four years ended December 31, 1902. Profits are shown in 44 cases and losses in 48. In one case there was no profit or loss, and in 23 no reports were made. The municipal gas plant at Brockville, which was established in 1901, realized an annual profit of $4,000 on an invested capital of $85,000, but the natural gas sold by the corporation at Kingsville showed a loss of $243.38 on an invested capital of $27,000. The business of supplying electricity to consumers by municipalities has been begun too recently in most cases to admit of statistics of profit and loss. In Bracebridge there was an average annual profit of $620.28 on electric lighting and electric supply combined, which were first provided by the town in 1895; but at Hespeler, where the system was established in 1900, there was a loss of $3,084.60 on an invested capital of $15,483.48. There does not appear to have been any investigation as to the exact nature and realization of the alleged profits.

Telephony and Electric Light In New York.

A bright and amusing book on the United States, entitled: "Dollars and Democracy," has just been issued by the Appletons, from the pen of the portrait painter, Sir Philip Burne-Jones, Bart., who was over here not long ago. It is light and skittish in touch and makes no effort at serious discussion of American affairs, but makes many shrewd comments on public affairs, manners, society, etc. Sir Philip remarks that when he returned to British soil there were three things he missed above all: the domestic bath arrangements, the telephone service and the electric light. We feel we must quote him fully as to the last two:

"In New York and indeed generally throughout the United States, a telephone has become as necessary a part of the equipment of a well-appointed house as the aforesaid bath itself. The instrument is in constant use, and invitations to dinner and the opera are frequently transmitted by this expeditious means. How pleasant it is, when one feels lonely or depressed, to call up a friend and hear his cheerful voice across the city. In New York it is the exception not to have a telephone."

Sir Philip is even more emphatic about the electric light:

"The third thing I miss is the electric light—that really gives light. The bastard product of science and commercial enterprise known by the same name in London bears little resemblance to its transatlantic namesake. I think Broadway at night, with its myriad brilliant lamps, the names of its theatres and restaurants picked out in blazing points of electric fire, is a sight not readily to be forgotten, and one which impresses itself upon the imagination as much as anything in the great city of which it is the principal thoroughfare. The Waldorf-Astoria at night is also impressive at a respectful distance, but the effect on the spectator of them both is due to the brilliancy and purity of the electric light as manufactured in New York. I can do without 'rapid transit'; I can do without a 'quick lunch' (the very words give an indigestion); but I now know what baths, telephones and electric light can be under the most favorable conditions—and henceforth I shall have a new standard in mind for all three which I fear has not yet been attained in England."

The Telegraph in Presidential Election Years.

When the Western Union Telegraph Company announced $157,000 decrease from last year in its net earnings for the quarter, most people, says the New York *Evening Post*, jumped to the conclusion that this reflected the vanished pool room business. A little reflection showed that, since bills for telegraph contracts are not settled daily, the effect of the discontinuance order of May 19 would hardly be left until near the quarter's end. The company's officers, however, ascribed the decrease to the fact that whenever a Presidential election approaches "business is dull and receipts of the telegraph company grow smaller."

This sounded reasonable. It aroused, however, some interesting queries as to another equally well-known tradition—namely, that the company prospers immensely during the campaign itself, because of the increased use of the telegraph. There is an easy way to ascertain the facts. Following is the increase and decrease in Western Union's net earnings for the last three quarters of each of the six past Presidential years. Comparison is made in each case, of course, with the year before:

	JUNE QUARTER.		
1900	− $51,803	1888	+$250,538
1896	− 182,649	1884	− 5,636
1892	+ 221,440	1880	− 85,536
	SEPTEMBER QUARTER.		
1900	+ $38,189	1888	+$400,468
1896	− 255,116	1884	− 166,832
1892	+ 49,623	1880	− 334,835
	DECEMBER QUARTER.		
1900	+$133,345	1888	+$426,660
1896	− 57,962	1884	− 239,584
1892	+ 105,751	1880	− 502,613

This is a rather perplexing exhibit, and seems to prove nothing very conclusively. It should, however, be remembered that 1896 was a year of great depression; and that in 1880 the two rival telegraph systems were slashing rates in a life and death struggle.

Chicago Lighting.

The Chicago City Council has ordered two bills to be prepared. One will enable the city to regulate the price of gas and the other will authorize it to own and operate gas and electric light plants and to sell gas, electric light and power. Mayor Harrison has taken the initiative in this proposed municipal ownership of public utilities, considering it advisable to strengthen the case of the city in its contentions in the courts, with a specific grant covering these points.

CURRENT NEWS AND NOTES.

NEW YORK STATE TELEPHONY.—The annual meeting of the New York State Independent Telephone Association will be held at the Genesee Hotel, Buffalo, on June 23 and 24. A number of prominent independents will be present and an interesting programme is being prepared, while a good attendance is expected. Mr. T. S. Lane, of Buffalo, is the secretary.

SUBMARINES FOR THE EAST.—It is said that the submarine electric boat *Protector* has been shipped eastward by the Lake Submarine Torpedo Boat Company for Japan, to be succeeded by others. Meantime the United States Navy is making elaborate tests of some of the latest Holland boats, of which it is also whispered shipments to the scene of war have been made. It is all very vague and indefinite, but the inference is that "something is doing."

NEW RÖNTGEN-RAY TUBE.—Dr. J. Mount Bleyer has announced that he has discovered a special class of glass peculiarly adaptable for Röntgen rays. He found on experimenting that this glass fluoresced bluish, and on making a number of crucial tests he discovered, much to his surprise, that a tube gave out bi-ultra-violet rays in combination with Röntgen rays, much richer than he had ever observed before from any tube made from other kinds of glass.

TROLLEY AND STEAM.—The *Wall Street Journal* has the following note: "A banker who has just returned from a Western trip says: "Railroad earnings in the central West are being affected by electric railway competition. In Ohio and Indiana electric traction is developing rapidly and is cutting into steam road passenger earnings. Within the past month sleeping cars have been put on the electric lines between Indianapolis and Columbus, and between Indianapolis and northern Indiana towns. The fare on electric sleeping cars, including berth, is less than the fare on steam roads."

CONTROL OF WIRELESS.—It is stated from Washington that the joint Army and Navy Board has postponed until next fall the consideration of the question of control of wireless telegraph systems operating along the coasts of the United States. The army members of the board informed the naval members that they were not ready to make a report at this time, owing to pressure of other duties. The proposition came up on a request of the navy for the co-operation of the army for the control of wireless systems to be under the direct supervision and management of the navy, while the army officers of the joint board did not submit any reports. Gen. Greely, the Chief Signal Officer, has submitted his views to the General Staff, advising against any interference whatever with commercial line systems of wireless telegraph, maintaining that, in case of war, the government would take control of such systems, as it would of telegraph and cable lines operated in or to and from the United States. Gen. Greely also points out that the signal corps is now introducing and operating a satisfactory system of wireless telegraphy at different points, which it is proposed to use as a part of the signal corps' regular work. The indications are that the army is in no hurry to accede to the proposition of the navy. This whole subject has recently been fully discussed in these pages.

LETTERS TO THE EDITORS.

Electrical Trade With South America.

To the Editors of Electrical World and Engineer:

SIRS:—We are constantly in the market for electrical supplies of all kinds and should like to have catalogues and lowest export prices on such goods. Of course, we are in possession of the addresses of some American factories, but we should like to have others to compare prices. However, we would mention that quotations should in all cases be given f.o.b. vessel, New York. We now have before us a number of catalogues from different concerns in the United States and would probably have sent for some of these goods, but we are unable to compute freight from point of shipment inland to New York. All our European quotations are based f.o.b. Hamburg. We can thus easily figure total cost, which is impossible on, say, a shipment originating in one of your central States, like Ohio or Illinois, on account of not knowing rates from these points to New York. In the case of electrical novelties it would also be advisable to send a sample, so that one can judge if the article is worth importing and at the same time get correct import duty. We do not mean by this, however, that we expect manufacturers to send articles of value, merely as samples.

Now regarding the addresses of correspondents. Invariably letters coming from the United States with few exceptions have simply the name of addressee and Buenos Ayres, S. A. In the case of first-class mail, this is not so bad, but on printed matter such as catalogues, etc., nine cases out of ten they are not delivered. Buenos Ayres has a population of nearly a million, and the postal service is tolerably good here in the capital; but such punctuality or exactitude as in Europe, or as we suppose also in the United States of America, is not practiced here. Therefore, especially all catalogues should in all cases have full street address or post-office box "Casilla Coreo" number.

BUENOS AYRES, S. A. JENS HOLM HANSEN.

A Suggestion for Independent Telephone Companies.

To the Editors of Electrical World and Engineer:

SIRS:—The growth of independent telephony has often been pointed out in your columns, and no one who in any way tries to keep in touch with this interesting movement can fail to realize that as far as local service is concerned, the development has been very gratifying. This does not mean that the writer necessarily is a believer in competition in telephony, but as "we are confronted with a condition and not a theory" in the matter, an impartial observer likes to see the service of both Bell and independent organizations improved in every possible way.

There is no doubt that some of the independent people are making vigorous efforts to extend their long distance connections. It probably will not be long before the Middle West and the Atlantic seaboard will thus be in communication. Such a far-sighted policy is a mark of broad progress, and to one who stands outside the telephone business it is significant of commendable enterprise.

The point which I wish to make is, that many of the smaller independent companies do not as yet realize the full benefit of exchanging business with their neighbors or of offering through toll connections to distant points. The situation is, in many communities, a good deal like that which characterized the electric railway field about ten or fifteen years ago, when interurban lines were few and far between, and service between neighboring cities was of the haphazard variety, if indeed there was much of any service at all. The different independent companies use a great variety of apparatus; overhead line construction is in numerous cases little adapted to long distance conversations, and the traffic arrangements between adjacent organizations offer an attractive field for improvement.

It would seem that much progress toward more extensive business and greater profits might be made by some of the independent companies if they would settle down to a common basis of operating their systems. Certainly the various independent conventions have done much to foster an esprit de corps among competitors of the Bell organization, but in the writer's opinion it is better to adopt other methods than abuse in trying to gain a foothold in any given community. Good service at reasonable rates is the thing which counts and not an indiscriminate hurling of unpleasant epithets at one's rivals.

How can this common basis of operating be secured? There are several means of attaining it, but the writer believes the best course to be one which is comparatively undeveloped at present. We can take a leaf from the centralized control or better management of electric railway, power and lighting systems in finding the answer. It is a well-known fact that small systems of every kind usually have little extra money to pay for expert advice and oversight. As a result, the service is generally much below the standard set up by large and prosperous companies. If, then, several independent telephone companies will pool their issues and unite in securing the advice of some recognized expert in each branch of telephone work, they can secure many of the advantages of expert management at a comparatively small outlay for each individual company. Thus, in matters of engineering, it would certainly be profitable for a consulting telephone expert to advise, say, a dozen small companies at one or two hundred dollars a year apiece, and it would be an immense advantage to the different companies. In a small organization, the engineering problems which require expert knowledge of the highest order in their solution do not come up often enough to make it profitable to employ a permanent engineering staff in daily work, but when these problems do arise, the entire future of the company's business may depend upon a correct and skilled solution. Inasmuch as only a comparatively small part of such a consulting engineer's time is required to attend to the wants of each particular company, the arrangement may be highly profitable to all parties concerned. In the same way the traffic problems may be laid before an expert retained by several different independent companies, who will guarantee to increase the business of each company by at least the amount of his retaining fee, or else charge nothing for his particular service. Legal advice, also, is open to the same possibilities.

All this does not signify that a centralized financial control is essential—only a concentration of expert advice. The principle of sharing something by individual contribution which would in itself be too expensive for individual maintenance in its entirety is an old one in economics, but the writer believes it is not sufficiently realized in the independent telephone field of to-day. As an advocate of increased efficiency in every kind of electrical service the writer feels justified in calling the attention of the independent telephone world to a method of improving its service which is bound to produce results, if care is exercised in choosing the expert who will divide his services among the united companies who employ him.

Chicago, Ill. Chas. L. Roberts.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Voltage Drop in Direct-Current Generators.—Behn-Eschenburg.—An illustrated article in which he first compares the relative merits of two methods devised by him and Rothert, respectively, for determining the voltage drop in an alternating-current generator. The characteristic feature of his own method is that from the short-circuit curve of the generator different values of the internal impedance are calculated for different degrees of saturation of the magnetic system. These values of impedance multiplied with the current are then assumed to give the counter e.m.f. The error of this method is the supposition that the magnetic reluctance of the system for a certain e.m.f. of the magnetic coils excited by a direct current is not influenced by the m.m.f. of the secondary winding carrying alternating current. This supposition is correct as long as the magnetic reluctance is approximately constant, i. e., as long as the curve of the voltage of the generator, as function of the excitation, is approximately a straight line. The supposition is also approximately correct for strongly saturated generators, if the magnetic saturation is essentially produced by stray fields which cut the magnetic coils, but not the secondary coils, or on the other hand if a large amount of the magnetic field of the secondary coils does not cut the primary magnet coil. Rothert's method also uses the short-circuit curve; he therefrom calculates the equivalent of the m.m.f. of the magnet coils, corresponding to a certain counter m.m.f. of the loaded secondary coils. Here the supposition is made that the magnetic reluctance of the total system remains constant if the sum or difference of the m.m.f. of the magnet coils and of the m.m.f. of the secondary coils, as derived from the short-circuit current, remains constant. This supposition is fulfilled as long as the magnetic reluctance of the generator remains approximately constant; it is also fulfilled if the total magnetic fluxes produced by the magnet coils cut the secondary coils without stray fields, and if the total magnetic fluxes of the secondary coils cut the primary coils. Both methods are, therefore, not exact. The author gives a simple mathematical treatment of the subject and shows how by a simple correction the results obtained by both methods may be rendered correct.—*Elek. Zeit.*, May 19.

Power.

REFERENCES.

Charging Gas Retorts.—Guarini.—An illustrated description of electrically-driven machines for charging gas retorts with a uniform layer of coal of suitable size, at a speed which can be regulated, and without scattering or wasting the material.—Lond. *Elec. Rev.*, May 20.

Boilers.—A long report of competitive tests made between two different types of boilers at the plant of the Pacific Light & Power Company, at Los Angeles, Cal.—*Jour. of Elec.*, April.

Steam Turbine.—Falley.—A brief illustrated article on the De Laval steam turbine.—*Rose Technic.*, May.

Traction.

Leicester: an Automatic Reversible Booster.—An illustrated description of the municipal electric tramway system of Leicester recently described in these pages, which gives information in detail relating to the storage battery auxiliary. The battery consists of 240 cells, capable of giving 600 amp. for one hour, or 900 amp. for short periods; it can be charged normally at 270 amp., or at 450 amp. for short periods. An automatic reversible booster set is provided which consists of a shunt-wound motor, fed from the bus-bars, and a differentially-excited booster, directly coupled on one bed plate. The booster is connected in circuit with the battery and is used for raising the bus-bar pressure to the amount required for charging the battery or for raising the pressure of the battery when discharging. It is rated to give a current of 250 amp. at 130 volts on the charge, and 600 amp. at 70 volts on discharge. The machine is capable of dealing with an overload of 25 per cent. at any pressure between 20 and 70 volts, and delivers the above-mentioned currents at any pressure between zero and the maximum pressure indicated. A shunt-wound motor, working at 500 volts and running at a speed of 650 to 700 r.p.m. is employed, and the set is provided with the necessary auxiliaries, switch gear, etc. One of the main features of this system is the use of the Thury automatic pressure regulator for automatically maintaining a constant load on the generators running in parallel with the battery. The booster armatures are drum-wound with a slightly channeled core, and the coils are held in by driving horns, a double-wound armature is employed, and each winding is connected to a commutator, one at each end of the machine. The two armature coils can be connected in series or parallel as required. In the design of the reversible booster special attention has been paid to meeting the rapid changes of load and voltage without sparking. With these armatures the winding on the smooth core is placed as near as possible to the periphery and with the tangentially-arranged field coil the iron in the field magnets is reduced to a minimum. The combined efficiency of the reversible booster set is 81 per cent. After a six-hours' run at full load the temperature rise does not exceed 70° F. Fig. 1 gives a diagram of connections of the Thury auto-

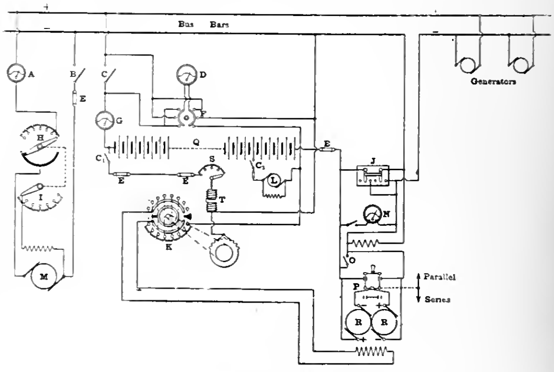


FIG. 1.—DIAGRAM OF REVERSIBLE BOOSTER.

matic reversible booster system. *A* is an ammeter, *B*, *C*, C_1, C_2, *F*, switches; *D* a voltmeter, *E* a fuse, *G* the battery ammeter, *H* the starter, *I* rheostat, *J* the booster reversing switch, *K* automatic regulator, L regulator motor, M motor, N booster voltmeter, O reverse-current cut-out, P a two-way switch, Q the battery, R the booster with two commutators, S a rheostat solenoid, and T a regulator solenoid.—Lond. *Elec.*, May 20.

REFERENCES.

Canton-Akron Railway.—A description of an extensive interurban railway in Northern Ohio. All dispatching is done by telephone. Every car carries a portable box telephone, which may be used at any point on the line on tapping the telephone wire by means of a long bamboo rod carried on the car. In addition to passenger traffic, the company does some express business.—*St. R'y Jour.*, May 28.

Trolley Harp.—An illustrated description of a trolley harp, the principal feature of which is the method by which the wheel is enabled to turn freely in going around curves. The loose mounting of the bearing blocks permits the trolley wheel to twist in the forks of the harp, one of the bearing blocks remaining stationary and the other sliding forward until it abuts against one of the retaining levers. The trolley wheel shaft is held against rotation as it is formed integral with one of the bearing blocks.—*St. R'y Jour.*, June 4.

California Railway.—Some notes on the San Diego & Coronado line in Southern California, which has some novel features, among them the use of a double-deck car. Owing to the distance from large manufacturing plants a number of repair shop tools have been developed. Oil is used as fuel.—*St. R'y Jour.*, June 4.

Electric Power in Metallurgical Plants.—The first part of a profusely-illustrated article on electric aerial suspended tramways for quickly transporting materials from one part of a metallurgical plant to another. The system described is that of Kolben & Co. for special use in iron and steel works.—*Elek. Bahnen.*, May, No. 10.

Electricity for Mine Hoists.—An illustrated article on electrically-operated versus steam-driven mine hoists. Some examples from various plants are described. The losses in steam pipes, operating pumps, ventilators, hoists and other mining machinery by engines of small capacity, as well as the low efficiency of these engines, make the use of electric power preferable.—*Sc. Am.*, June 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Rapidly-Growing Western Central Station.—BARTH.—An illustrated description of the generating plant of the Kansas City Electric Light Company, which had in 1899 a maximum load of 900 kw, while in 1903 it was 3,400 kw. The growth was so rapid that many makeshifts had to be resorted to. The company had a number of stations throughout its territory, with no less than 42 generators of various sizes and makes. The new station was finished in 1902, the equipment consisting of six double-deck water tube boilers rated at 514 hp fitted with traveling link grates, a traveling coal conveyor and ash remover being also installed: two 2,250-hp Allis-Chalmers vertical cross-compound engines drive 1,500-kw, 6,600-volt, 25-cycle alternators. The station supplies all the current for the series arc lights in the western part of the town and in the immediate vicinity. All of the 60-cycle alternating current for incandescent lamps is also furnished from here and the 6,600-volt, 25-cycle current is carried to uptown sub-stations, which are described. As the company has had so many different types of stations under its control, under similar conditions as to wages, price and quality of coal, and efficiency of management, it has determined the relative economy of the different apparatus. Data are given in the article. On May 31 the station was flooded by the rising of the Kaw River, but current was again on the lines eleven days after the flood, and the only loss which could be traced to the flood was some small potential transformers, which did not receive the proper amount of care in the drying-out process.—*Am. Elec.*, June.

ELECTRO-CHEMISTRY AND BATTERIES.

Conductivity and Fluidity.—HOSKING.—In a former investigation the author has found that the specific molecular conductivity and the fluidity of the solutions investigated by him became zero at the same temperature, viz.: 35.5° C., this result being obtained by extrapolation. Another general result obtained by him was that the fluidity-concentration isothermals and the conductivity-concentration isothermals all cut the axis of zero fluidity and conductivity respectively at the same point, representing a concentration of 10.74 normal. The author has now made an extended study of lithium chloride solutions. He finds that both the fluidity and conductivity values can be expressed by equations of the same form, and that they are proportional to the mth power of the temperature measured from a fixed point below zero degree C., which is the same for all solutions. This temperature is 48.10° C., while m varies for the different solutions. He makes some remarks on Kohlrausch's hypothesis that ions in aqueous solutions are surrounded by watery atmospheres carried along with them and the resistance the ions have to overcome is mainly friction between this atmosphere and the solvent water.—*Phil. Mag.*, May.

ELECTRO-CHEMISTRY AND BATTERIES.

Gold Refining.—WOHLWILL.—An illustrated article on his electrolytic process of gold refining, which is now in use in the Philadelphia Mint. Its main features are the addition of hydrochloric acid to the electrolyte of gold chloride and the use of an elevated temperature. If the anode is gold containing platinum, both gold and platinum pass into the solution, but only the gold is deposited upon the cathode. The platinum can be precipitated from the solution afterward in a very simple way. The author points out that all natural silver and gold contain platinum, and that the refiner should endeavor to recover the platinum, which can be easily done by electrolysis. He also speaks of iridium and palladium.—*Electrochem. Ind.*, June.

Extracting Copper from Ores.—JONES.—An illustrated paper on the methods of leaching and precipitating copper, in use at Rio Tinto in Spain. Huge heaps of the mineral are allowed to oxidize under the influence of moisture and air and subsequently the copper sulphate is washed out as soon as it is formed by running water through the heap. The liquor is run into the precipitation tanks over pig iron to precipitate the copper in the form of so-called cement copper. While thus the process does not contain the application of an electric current, some of the reactions are electrochemical in nature, due to the occurrence of galvanic couples in the tanks. The method of working is described in detail.—*Electrochem. Ind.*, June.

Chemical Applications of N-Rays.—COLSON.—In a continuation of his researches in which he observed that N-rays are given off during certain chemical reactions and that they can be utilized as a physical criterion for such actions he has now found that the chemical reactions which give rise to N-rays are invariably accompanied by some physical action such as contraction or cooling. Some very vivid chemical reactions, such as a precipitation of salts are not accompanied by any evolution of N-rays, so that there is evidently no proportionality between the chemical action and the evolution of N-rays. It is just this lack of proportionality which makes the N-rays valuable to the chemist, since he is thus enabled to discover actions which may be masked by the more evident chemical reactions.—*Comptes Rendus*, May 21; Lond. *Elec.*, May 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Multipolar Electrostatic and Electrodynamic Instruments.—MORRIS.—In the discussion of Duddell's paper abstracted in the Digest last week, he said that the working forces in an electrostatic instrument could be increased by limiting the angular range without increasing the amount of inertia of the moving system. For instance, this can be effected in the quadrant electrometer with a wide needle by subdividing the quadrants in a similar manner. The needle would then have the same total moment of inertia as before. If the fixed quadrants are similarly divided into sectors, then the working forces are increased. The force available for use depends upon the angular rate of change of capacity of the needle; and although by the change described, the actual capacity (and therefore the capacity current) have not been increased, yet a very small angular movement is required for the needle to pass from the position of maximum capacity to that of least capacity. The limit to this process of subdivision in the case of zero or small deflection instruments is decided by the practical working clearance, the clearance being determined by the tilting of the needle due to unbalanced electrostatic forces. Small charges on the parts due to contact potential differences render low-voltage electrostatic working very troublesome. Both these troubles are, however, simultaneously avoided by using a separate needle attached to and in the same plane as the other, but insulated from it, and connected electrically with the other set of sectors. On this principle an instrument was constructed of a cylindrical type. In order to measure small alternating-current voltages on an ordinary potentiometer, the needle was brought back to zero by a small direct current, flowing in a little dynamometer coil attached to the mirror. These principles have been adopted in some of Addenbrooke's sensitive electrostatic instruments. Such an instrument might be called a multipolar electrostatic instrument, and he has used the same idea in the construction of a multipolar electrodynamic instrument. Air is, after all, but a poor conductor for magnetic lines, and there is no reason why it is necessary to provide enough coils to send a reasonable flux into spaces such as the center of a dynamometer or wattmeter of any given type where the flux is not wanted. This only causes inductive error. He supposes that the inductive errors depend very nearly upon the volume of the space, which is filled with the alternating flux. The sides of the moving coil of an ordinary dynamometer, or even of a modern high-class wattmeter, occupy but a small part of the space so magnetized. If, however, both the fixed and moving coils are wound multipolar, then, though the angular range is restricted, the sensitiveness might be increased and the inductive error clearly very much reduced.—Lond. *Elec.*, May 20.

Measuring the Effective Resistance and Inductance and the Energy Loss in Alternating-Current Apparatus.—Dolezalek.—An illustrated description of a method based on the principle of the Wheatstone bridge. The apparatus, the effective resistance and inductance of which are to be determined, is placed in series with a non-inductive resistance box in one arm of the bridge. The ordinary galvanometer of the bridge is replaced by a telephone, in order to send first alternating currents through the system. Balance is first obtained by sliding one terminal contact of the branch which contains the telephone along a measuring wire and by adjusting the resistance box. The alternating current is then disconnected and a galvanometer substituted for the telephone and direct current is sent through the system. The current in the galvanometer branch is brought to zero by adjusting the resistance box. This last adjustment gives directly the difference of the effective resistance of the apparatus for alternating current and the ordinary ohmic resistance. This difference is due to the hysteresis and eddy-current losses, etc. If it is multiplied with the square of the current one gets the loss due to hysteresis, eddy currents, etc., in watts per second.—*Elek. Rund.*, May 15.

Telegraphy, Telephony and Signals.

Alarm Bells Tuned to Alternating Current of Given Strength or Given Frequency.—Baumann.—In the continuation of his article, the first part of which was abstracted in the Digest last week, the author first described the use of alarm bells tuned to a certain strength of alternating current. The principle is shown in Fig. 2.

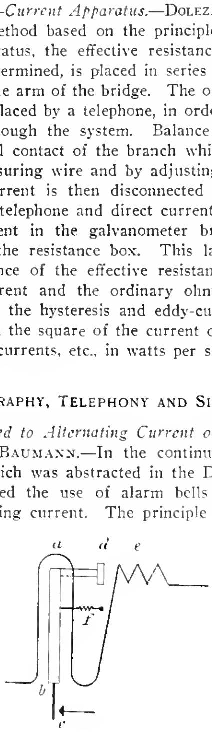
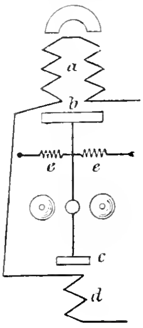
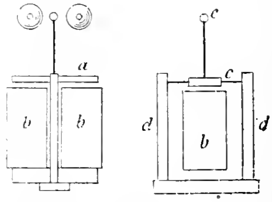


FIG. 2.—ALARM BELLS.

A relay is provided consisting of two coils, *a* and *c*. One of them, *a*, surrounds a permanent magnet, *b*, which can revolve in a horizontal plane. The one terminal of the permanent magnet has a torque which closes the contact, *c*, when it is displaced under the action of the current; at the other end of the permanent magnet a perpendicular piece of soft iron, *d*, is provided which is opposite to the pole to the electromagnet, *e*. If an alternating current passes through both coils, the permanent magnet is subjected to two actions. The coil, *a*, tries to remove the permanent magnet out of the plane of the coil while the action from *e* and *d* tries to hold the magnet. In the same sense spring *f* is acting. The first force is proportional to the current, the second is proportional to the square of the current, while the third is constant. It can be easily shown mathematically that the magnet is deviated only if the current is between two certain limits. A tuned bell, based on the same principle, is shown in Fig. 3; *a* and *d* are electromagnets. The springs, *e*, try to hold the clapper of the bell in its central position. If the current is small, the clapper remains at rest. If it is increased *a* will act on *b* and the bell will ring. If the current is further increased the action of *d* upon the soft iron piece, *c*, will be greater than the action of *a* upon *b* and the clapper will be at rest. Fig. 4 shows an alarm bell tuned to a certain frequency of an alternating current. The armature, *a*, of a polarized electromagnet, *b*, is perforated in its center, a steel wire, *c*, passing through, which is fixed at the two posts, *d*. If the period of the alternating current is equal to the natural period of the





FIGS. 3 AND 4.—ALARM BELLS.

oscillations of the system, *a*, *c*, *e*, it will begin to vibrate and the bell will ring. The natural period of this system can be easily adjusted by regulating the distance of the armature from the magnet poles and the torsion of the wire, *c*.—*Zeit. f. Elek.* (Vienna), May 15.

Transmission of Pictures.—Ennsbruner.—An illustrated article on the electric transmission of photographs, pictures and writings. This has been tried repeatedly with the aid of the well-known property of selenium having a greater electric resistance in the dark than in light. The author describes the system of Korn. The features of this system are essentially the methods of keeping two rolls in synchronous rotation at the transmitting and receiving stations and to correct at certain time intervals any difference in synchronism. In the receiver he uses a vacuum tube, the radiation of which is changed by the currents received from the transmitter. At the transmitter the rays passing through a small part of the picture at any moment fall upon a selenium cell and cause its resistance to change.—*Elek. Neu. Anz.*, May 15.

Railway Signalling.—A description of the system of signalling adopted on the Boston and Worcester electric railway, by which the dispatcher can summon to the telephone any car crew and give orders. The telephone wires extend the entire length of the line, with instruments at all turnouts, and pads on which orders received by the car crew are written down in pencil and copies preserved in the box. Adjoining each telephone is a signal box containing semaphore signal, pendulum and magnet, each pendulum being of different length. The dispatcher in the main office, by means of a 75-mm. cog wheel, can send electrical vibrations through all of the electromagnets, and by timing the vibrations the pendulum whose period is synchronous with a period of the electromagnetic impulses will commence to vibrate, tipping the lock holding the semaphore in a vertical position. When the semaphore falls it closes a lamp switch giving the luminosity signal needed at night. After the motorman has reported to the main office and received his orders, he resets the signal to "clear."—*St. R'y Jour.*, June 4.

REFERENCES.

Telephone Engineering.—Dommerque.—Another of his series of articles on telephone engineering. He treats of three kinds of protective devices used on telephone circuits; that is, lightning arresters, strong current protectors or fuses, and sneak current arresters or heat coils. Lightning arresters are to protect against atmospheric electricity and high-tension currents; strong current protectors or fuses, against currents of electric light, power and all circuits of moderate potential; heat coils, against sneak currents caused by leakage or poor insulation. The author describes the various devices on the market.—*Am. Elec.*, May.

Wireless Telegraphy.—Collins.—A long and well-illustrated description of the modifications and improvements which wireless telegraph apparatus have undergone since 1896. He describes the type of transmitter of 1896, various types of telegraph keys, induction coils, interrupters and spark-gaps, the type of receiver of 1896, various relays, decoherers, electric wave detectors, Marconi's magnetic wave detector, and various inductors.—*Eng'ing. Mag.*, June.

Cable Steamer.—A fully illustrated description of the cable steamer

Pacific, which has been built for the Great Northern Telegraph Company as an addition to its cable repairing fleet. Three cable tanks have been provided which will hold about 450 miles of deep-sea cable—say 1,000 tons.—Lond. *Elec.,* May 20.

MISCELLANEOUS.

Nerve Impulses and N-Rays.—CHARPENTIER.—An account of the investigation in which he has proven the existence of a wave propagation of nerve impulses and determines their wave length by means of N-rays. If, instead of using a single wire for the conduction of N-rays, two wires are used, their combined effect upon the screen is sometimes weaker and at other times stronger than the effect of a single wire. This suggested to him the existence of interference, and since the intensity of N-rays emitted by a nerve, is proportional to the activity of the nerve it was reasonable to suppose that the nerve impulses have a definite frequency and wave length. He therefore examined a nerve at two points by means of two wires of equal length and found that there was no effect upon the screen when the points were 16 mm. apart. This he considers to be half the wave length of the nerve impulses and their frequency is about 800 per second.—*Comptes Rendus,* May 2; Lond. *Elec.,* May 20.

Fire Hazards in Electric Plants.—KNOWLTON.—An article in which the author gives numerous detailed rules on precautions against the occurrence of fire in electric plants and on means of extinguishing the flame when once a blaze has started. He thinks that the greater proportion of fire hazards are preventable, and that careless operation is at the bottom of most of the trouble. Inside an electric plant water is of no value in putting out an electric fire, and for this reason automatic sprinklers are undesirable; extinguishers of the dry powder, chemical or compressed gas types, are far more effective for all around service. Fires caused by electric arcs are best beaten out by asbestos or woolen blankets, overcoats, towels, etc., or else quenched by the liberal use of sand. The entire wiring system ought to conform to the practice of the National Board of Fire Underwriters. To prevent confusion in case of a fire, due to the failure of the lighting current, either oil or candle lanterns should always be provided. An automatic fire alarm which will give warning of any unusual temperature rise beyond safe limits is a necessity in all plants which are divided into several rooms, such as telephone exchanges. A few hundred dollars go a long way toward completely protecting all but the largest plants from all fires except those which are unpreventable. —*Eng. Mag.,* June.

New Books.

THE THEORY OF THE LEAD ACCUMULATOR. By Dr. F. Dolezalek. Translated by Dr. Carl L. von Ende. New York: John Wiley & Sons. 252 pages, 30 illustrations. Price, $2.50.

This is a valuable and interesting little book, written along the lines of the newer electrochemistry and presenting a good summary of modern theory on the subject of the lead storage battery. It may be said in general to limit itself to the theoretical side of the topic, but there are many references to practical tests and results. The book is divided into some sixteen chapters, although some of these deal with tables and measurements. The three opening chapters discuss the subject from the standpoints of the chemical, osmotic and thermodynamical theories of the origin of current, not elaborately, but succinctly; still with sufficient clearness and fullness in proportion to other parts of the treatise. It is notable that German and English authorities are cited frequently; American are conspicuous by their absence. But who could blame the author for that? Other chapters treat of variation of electromotive force with acid concentration, and variation of electrode potential; temperature coefficient; influence of external pressure; behavior during charge and discharge; reversibility; changes in the open cell; internal resistance; capacity; degree of efficiency and working efficiency; changes in the cell during formation. A final chapter deals with methods of measurement, and there is also a table of density and percentage strength of mixtures of sulphuric acid and water. An excellent index is furnished.

AMERICAN STREET RAILWAY INVESTMENTS (The Red Book for 1904). McGraw Publishing Company, New York. 362 pages. Price, $5.

This valuable annual record of street railway investments has again made its welcome appearance, and maintains its growth and improvement in make-up and quality of contents. This year's volume is larger than ever before and contains reports of a considerable number of companies which hitherto have declined to present financial statements. In addition to a large increase of information of this character, the publishers have added a number of other useful features, among them the location of power stations and repair shops, parks and pleasure resorts, and much more complete descriptions of the funded debts of the different properties.

The volume also contains a large number of maps of the principal street railway systems in the country, many of them in two or more colors; also some novel and striking maps showing the interurban railways in New Jersey, Ohio, Indiana and Illinois.

The analysis of the earnings of the different properties as reported this year indicates that they have kept up in spite of the decrease in many of the steam railroads and manufacturing properties, and as a whole the industry can be said to be in a prosperous condition. In a comparison for 1903 and 1902 of the gross receipts of 310 companies, the average increase is 8.5 per cent. These figures vary, of course, in different groups or categories, but all the data go to show that the street railway industry to-day, as ever, demands new capital and material, and yields a fair return thereon. It is worth the while of any political or social economist to sit down for an hour or two with this handsome volume and master its many revelations and suggestions, as well as direct data, as to the course of electric transportation in America.

Cooley Rotary Engine.

An engine proof against the effects that usually follow neglect to properly lubricate, sudden turning on or off of power, reversal when under full speed, sudden flooding of water, unintelligent tightening up of wearing parts and lack of attention to ports liable to work loose, and which at the same time will still do its duty and maintain a fair degree of efficiency under the above conditions is claimed to be that made by the Cooley General Development Company, of Boston, and which we illustrate herewith. The simplicity of the engine is brought out in Fig. 1, showing the engine with the cylinder head removed and exposing the working parts. Fig. 2 shows all that there is of the working parts withdrawn.

When the engine is in motion the four short roller valves, *A*, roll upon the interior of the cylinder, thereby effecting a nearly frictionless condition of what would cause the greatest frictional loss with a block or slide valve when under centrifugal influence, the same influence in this case merely rendering more certain the rolling of the valves. The diameter of these valves is so proportioned to their length that binding at their extremities through canting is stated to be impossible, their end surfaces being sufficiently large to maintain alignment. They are practically the pistons of

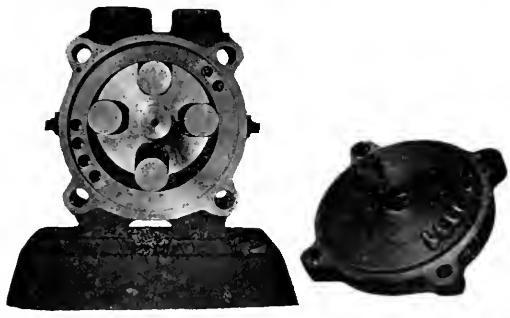


FIG. 1.—ENGINE WITH CYLINDER HEAD REMOVED.

the engine, their distances from the axis of the shaft determining when under steam pressure the leverage and effective piston area of the engine.

In Fig. 1 the upper and lower valves, being the greatest and least effective in causing rotation, may be used as an example. Steam pressing on both of these valves simultaneously from the right will cause a rotation of the engine in the direction of the movement of the hands of a watch because of the greater leverage of the lower valve. The upper valve acts to maintain a joint at the top, and as rotation continues, oppositely located valves consecutively perform these functions. The slotted hub is of cast iron while the valves are of steel insuring fairly good wearing conditions. The cylinder is double, having an annular steam space within the outer wall and completely surrounding the inner wall except at the top and bottom, where partitions are provided to separate the exhaust from the entering steam. A steam jacket is thereby provided by which the inner wall of the cylinder is maintained at a temperature almost exactly equal to the temperature of the slotted hub and valves, thereby practically removing the serious drawback of differential expansion.

The slotted hub and the valves are slightly shorter than the cylinder, the latter being about 2/1000 of an inch shorter and the former 1/1000 of an inch shorter, in a 10-hp engine, which is sufficient to allow their free movement between the cylinder heads. The slight leakage of steam consequent to this condition is less than the amount of loss that would be occasioned by friction if mechanical joints were maintained between the heads and the working parts; the leakage is preferable because it allows cheaper construction, better

FIG. 2.—PARTS OF ENGINE.

economy and less likelihood of cutting and other troubles when oiling is neglected. The entrance and exit of steam are effected through the small holes in the upper right and lower left of counterbore of the cylinder end. They open at both ends of the cylinder, and both cylinder heads are grooved to allow the entrance of steam at both ends of the valves simultaneously and between the slotted hub and the valves as well as into the cylinder.

This method of porting insures a non-broken surface of the interior of the cylinder both while machining it and for the valves to travel over when in actual operation. The exhaust is of large area and free, the mere passing of the valves by the port grooves in the heads effecting a cut-off of steam between consecutive valves and resulting in a useful expansion of the steam which in the engine illustrated corresponds to about one-half cut-off.

Endurance tests have shown, it is claimed, that the engine will stand up and maintain good working conditions under shocks and strains that would instantly wreck a reciprocating engine or other motor of less rugged and enduring qualities. Below are the data of a test made at the shops of the New York Central & Hudson River

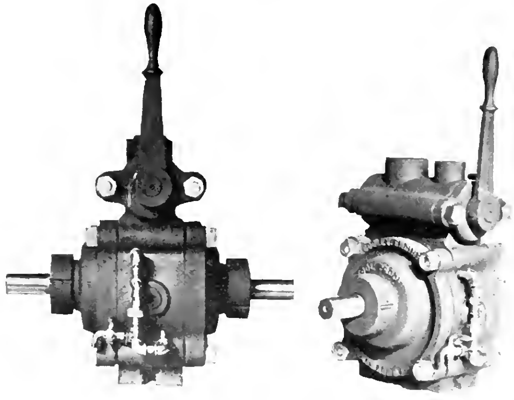


FIG. 3.—TWO VIEWS OF COOLEY ENGINE.

Railroad Company at West Albany: Duration of run, 7½ hours; boiler pressure gauge average, 98.13; average r.p.m., 1,249; total condensed water, 1,358 pounds; developed horse-power, 9.79; length of brake arm, 5¼ ft.; mechanical efficiency, 91 per cent.

The trial consisted of nine separate runs of one-half hour each, readings being taken every five minutes during each run. The exhaust steam was condensed in a surface condenser, the condensing water caught and weighed after each run. A separator was used to dry the steam, with a throttling calorimeter to detect the moisture present. Readings of the thermometer on this were taken every minute throughout the runs. The developed horse-power was measured by a Prony brake. The first run was made with no load to determine friction and thereafter a load increasing by one pound each run was put on.

Willard Storage Battery for Automobiles.

The accompanying illustrations, Figs. 1 and 2, show in detail the improvements lately made in the Willard storage battery. The Willard Co. has fully realized that one of the greatest troubles in vehicle batteries is due, not so much to the character of the plates, as to their tendency to short circuits, and that while the short circuiting from face to face of the plates has been corrected by the use of wood

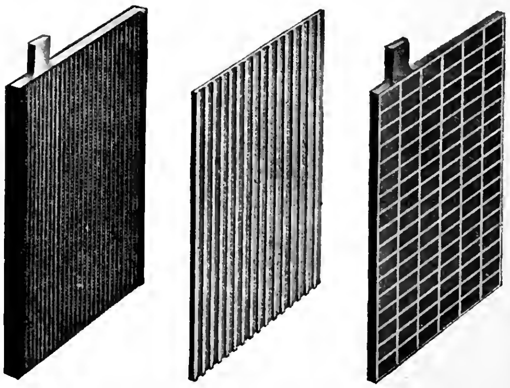


FIG. 1.—STORAGE BATTERY PLATES.

separators, there is still left the probability of the plates short circuiting around the edges and bottoms. This trouble has been corrected in a very simple and effective way by enclosing the positives in an envelope of hard rubber, finely perforated along the faces, but imperforate along the edges and bottoms. With this envelope or

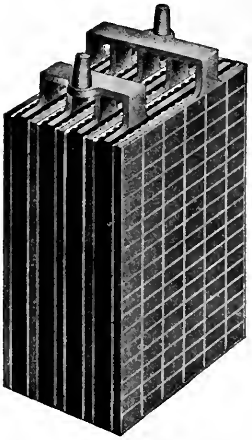


FIG. 2.—ASSEMBLED PLATES.

sheath, there is used a grooved, imperforate sheet of specially treated wood, thus, it is said, entirely doing away with any possibility of short circuit, either across the faces or around the edges of the plate, yet at the same time allowing free electrolytic action and circulation between adjacent plates.

The Willard Co. states that the sheath used with its positive plate is not a new device, as it was successfully used several years ago in connection with its standard batteries, but that its cost at that time precluded any idea of its general use. The company has recently put in new apparatus for producing these sheaths and so reduced the cost as to make their general use practicable.

The company still uses its familiar form of Planté positive, consisting of a sheet of pure rolled lead having fine, vertical grooves, but has changed to a cage type of pasted grid for its negative plates, in this way adopting the particular combination of Planté and Faure plates, which experience has shown to give the highest voltage and longest life.

In the regular type of battery, the straps connecting the plates together are provided with pillar type terminals over which fit covers of molded and reinforced hard rubber. This system is found to do away entirely with the trouble experienced sometimes by the acid slopping and siphoning over the sides of the jars. Ordinarily the cover is sealed in with a compound which makes the jar practically acid-tight, but in some special types the jars are deeper and the covers set in lower down, without sealing. The nine-plate cell shown in the accompanying engraving weighs thirty-two pounds and has a capacity of thirty-six amperes for four hours.

Electrical Exhibits at the St. Louis Exposition.

The office of ELECTRICAL WORLD AND ENGINEER is elegantly and comfortably furnished for the reception of visitors. Complete files of its technical journals and a library of electrical books published by the McGraw Publishing Company are at the service of visiting engineers. A register is kept in which it is intended to have a complete record of all those interested in electrical industries who go to the Exposition. Comfortable and cosy seats and lounges are provided for any who wish to read and facilities are at hand for correspondence. The booth is below the office gallery of the Electrical Department, and its appearance may be noted from the accompanying illustration. It is a great centre and rendezvous for electrical visitors at the Exposition.

FIG. 1.—BOOTH OF "ELECTRICAL WORLD AND ENGINEER."

The Burdette-Rowntree Manufacturing Company has an exhibit of automatic electric dumbwaiters at the northwest entrance of the Electricity Building. The exhibit consists of two complete installations of push control electric dumbwaiters, one running at a speed of 150 feet per minute and the other at nearly 600 feet per minute. Both cars run from the floor to the highest part of the roof of the building. The high speed car is enclosed in glass and contains incandescent lamps that light up automatically when the car is in motion. The most interesting part of this exhibit is the automatic feature that makes the installation what the manufacturers call "fool-proof." The car is operated by means of push buttons, placed both on the enclosure work and on the adjacent desk. In actual practice, they can be located on every floor, so that the car can be operated from any floor, or only from one floor; and by this means one man only has control of its movements. Pressure for an instant on any button causes the car to start, and it automatically stops at the floor corresponding to the button depressed. It is not necessary to keep the finger on the button while the car is in motion. If a button is pressed while any door is open it will not cause the car to start, or while the car is in motion it will have no effect. One cannot open a door, if doorlocks are used, unless the car is at that floor. If doorlocks are not used, and the door is opened while the car is in motion, it immediately stops the car.

The car always automatically slows down before stopping and so comes to rest smoothly and easily. So perfectly is this done that in actual practice a glass brimming full of water can be placed in the car and a round trip made without spilling a drop. The high speed car is operated from the adjacent desk, and has also a signal lamp on the desk which lights up when the car is at rest, and goes out while it is in motion, or when any door is opened. The operator knows therefore the instant the car starts, the instant it has reached the floor to which it was sent, the instant the door is opened by the attendant on that floor, and when the door is again closed and the car is ready for use.

FIG. 2.—BURDETTE-ROWNTREE EXHIBIT.

Just across the aisle is a complete operating exhibit of the Dayton Electrical Manufacturing Company. A Fairbanks-Morse 20 hp gas engine is direct coupled to a 200-light dynamo, which supplies the current for operating the exhibit and lighting the large sign. This engine is ignited by either jump spark, touch spark or the new Apple electric flame at the option of the operator. On the switchboard a new design ignition meter shows the number of charges taken in by the engine and the number of charges ignited by each of the three systems mentioned above, thus showing the comparative merit of each. On a long table there are one dozen flywheels of various sizes operating 24 ignition dynamos fitted with Apple gov-

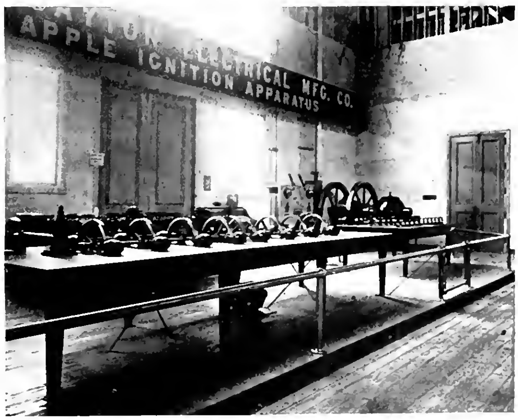


FIG. 3.—DAYTON ELECTRICAL MFG. CO. EXHIBIT.

ernors that maintain the speed of the dynamo constant no matter how fast the gas or gasoline engine may run. In addition are shown storage batteries, jump spark coils, contact coils, plugs, timers and magnetos made by this company. It is a very interesting exhibit.

One of the operating exhibits to which all are attracted is the Hall model electro-plating establishment in the west doorway of the building. The complete operation of gold and silver plating is shown from cleaning the metal surface, depositing the coating, cleaning and polishing. Perhaps the most interesting feature of this exhibit are the electro-plated leaves, fruit and flowers and other non-metallic substances. By a special process there is deposited upon the surface a copper coating, and then the gold or silver plating can be quickly done. The cleaning and polishing is done within glass cases so that the dust and dirt attending such work is entirely absent.

In the Robbins & Myers space a very creditable showing is made of a line of their "Standard" motors and dynamos. These machines are shown in sizes from 1-30 to 15 hp, and these cover the capacities built by the company. One machine is disassembled to show the methods of construction, insulation and the interchangeability of parts. The unique feature of the entire exhibit is an immense revolving fan motor rack. A rack with six arms rests on a ball-bearing upon a center post. From extremities of each arm is suspended a ceiling fan, and above each arm is a desk fan with the plane of the fan nearly parallel with the arm. With the twelve fans going, the desk fans cause the entire rack to revolve, which keeps the air of that entire section in circulation. Another interesting exhibit item is a magnetic separator used for extracting particles of metal from cotton before it reaches the gin.

The generator and motor exhibit of the Triumph Electric Company covers a wide range of application. Power for operating this exhibit is derived from a Warren synchronous motor driving a 35-kw, 220-volt Triumph generator. There is also a Fairbanks-Morse vertical gas engine direct connected to a 7½-kw, 220-volt generator, this set being a good example of the minimum floor space required for a small power station. A motor generator set takes current from the above source and delivers 10 kw at 500 volts. A number of tools are shown in operations illustrating the method of connected Triumph motors to same. A Fay & Egan band saw is driven by a motor and intended for one speed only. The motor-driven Bickford radial drill is regulated by a Cutler-Hammer drum starter and controller. A Lodge & Shipley lathe is similarly equipped and in operation. All

FIG. 4.—EXHIBIT OF ROBBINS & MYERS CO.

FIG. 5.—HALL'S ELECTROPLATING EXHIBIT.

FIG. 6.—TRIUMPH ELECTRIC CO.'S EXHIBIT, AS SEEN ACROSS THE AISLE.

these tool motors are designed for 220 volts. The inoperative machinery consists of a 100-kw multipolar engine type generator and a series of power motors ranging in size from ½ to 25 horse power. A large armature core is partially wound to illustrate the method and details of construction, also other detail parts of the various machines are shown.

More and more attention is given to better hygienic and sanitary

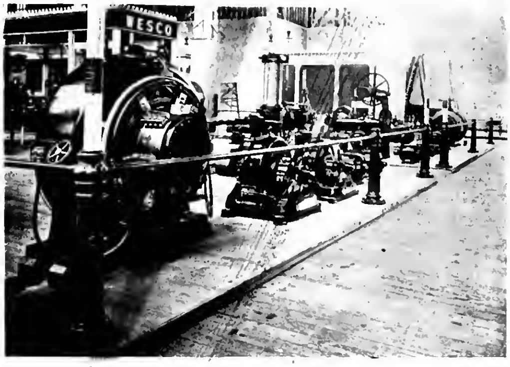


FIG. 7.—TRIUMPH ELECTRIC COMPANY'S EXHIBIT.

conditions wherever large numbers of people are brought in contact. It is claimed that one of the most fertile sources of disease transmission is the telephone transmitter, because it collects the bacteria from the breath of those speaking into the mouthpiece. The Telephone Hygenic Company's exhibit indicates how this can be obviated by stretching an antiseptic paper before the mouthpiece. The paper surface can be changed at any time by the speaker giving the roll a turn. This does not interfere with the transmission of sound, but rather magnifies the vibrations.

The Delany system of rapid telegraphy is demonstrated by a com-

FIG. 8.—HYGIENIC TELEPHONE EXHIBIT.

plete set of operating apparatus. The speed of transmission is as high as 1,000 words a minute and this is accomplished by the following means: A strip of paper passes through a perforator operated by a typewriter keyboard, and the depression of the key instead of printing the letter punches perforations on the tape corresponding to Morse characters. The perforated tape is then passed through the transmitter, and by means of contact through the perforations impulses of equal duration and alternating polarity are sent over the line. At the opposite end of the line, messages are recorded by an automatic receiver on a chemical tape. As the Morse dot and dash record is made, the tape is wound on reels and distributed to typewriters for transcription. Different modifications of parts of this apparatus are also shown in operation.

The exhibit of the Fort Wayne Electric Works is characterized by the life and light displayed. There are sixty arc lamps in and around

FIG. 9.—DELANY RAPID TELEGRAPH EXHIBIT.

the space, which make a most brilliant illumination. A handsome ten-panel switchboard is provided for distribution and regulation. From the building sub-station, two supplies of current are received, one a three-wire, 220-volt, direct-current, and the other 500-volt, direct-current. A series of motor generators convert this current for

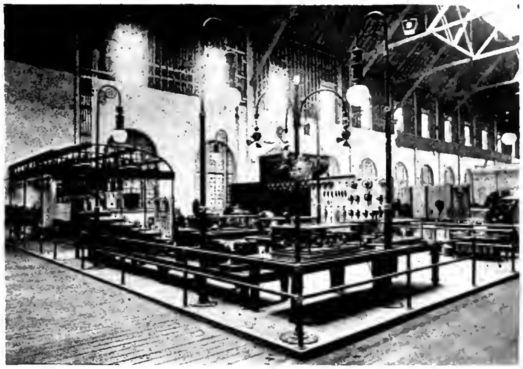


FIG. 10.—EXHIBIT OF FORT WAYNE ELECTRIC WORKS.

the different applications. The first is a 55-hp, 220-volt motor driving a 37½-kw, 1,100-volt alternator, which furnishes current to the series and multiple alternating current arc lamps. The next set consists of a 30-hp, 220-volt motor driving a Wood constant current,

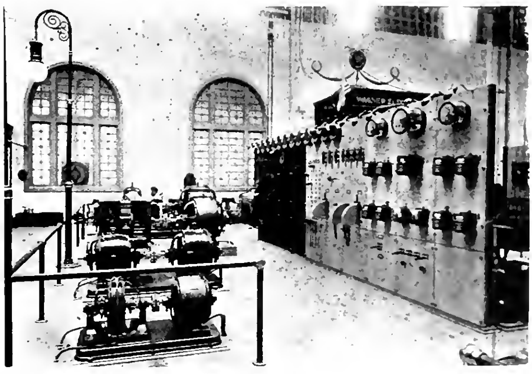


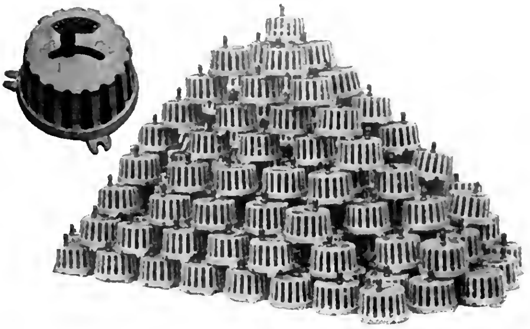
FIG. 11.—ANOTHER VIEW OF FORT WAYNE EXHIBIT.

series arc, 6½-ampere dynamo of 22 light capacity. A 15-hp, 500-volt motor is direct connected to a two-phase 110-volt, 60-cycle generator which supplies current to the 20,000-volt transformer for operating the De Forest wireless telegraph stations already illustrated, one of which occupies a small space in this exhibit. Another supply of alternating current is from a 140-cycle alternator driven at 2,800 r.p.m. by a 4-hp, 500-volt motor. A line of transformers from 1 to 50-kw is displayed, as well as windings and sections showing the thorough methods of insulation. The different types of wattmeters made by this company are displayed under operating conditions on the switchboard panels and in cases are mounted all the separate parts used in the construction of these instruments. The Fort Wayne series alternating arc lighting system, as described in Electrical World and Engineer of June 4, is complete and in operation.

The most popular part of the exhibit is at the corner of the two aisles, where a standard carries a number of Fort Wayne oscillating fan motors which distribute a refreshing breeze to all who stop and watch their gyrations. Perhaps the most interesting item in the space is the arc-light machine constructed by Mr. James J. Wood, in May, 1879. It will furnish power for arc light, and it was so well constructed that after a quarter century of use it is still serviceable.

Ceiling Fan Controller.

As there has been a very considerable demand both at home and abroad for a ceiling fan controller of sufficiently fine appearance to permit of its being mounted in finely furnished hotels, restaurants, clubrooms, private parlors, etc., the Ward Leonard Electric Company, of Bronxville, N. Y., has placed upon the market a small, highly finished rheostat, as shown in the accompanying cut. The company has sent some twelve hundred of these regulators abroad to one house,



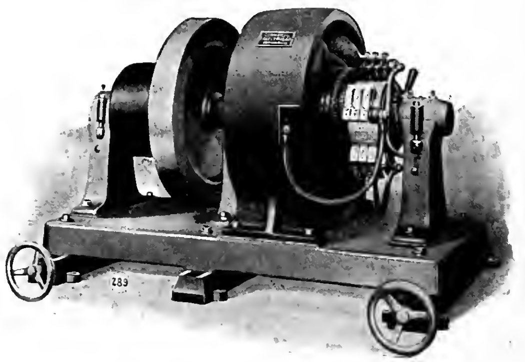
A PILE OF CEILING FAN CONTROLLERS.

Messrs. Geipel & Lange, of England. An interesting pile of them is shown in the illustration.

The resistance of this regulator consists of the well-known entirely enclosed, hermetically sealed resistance units of the company's make. These rheostats are finished in bronze, copper, aluminum or black japan finish, and make a very ornamental as well as useful instrument. The corner view shows a single rheostat of this type.

Generators for Gas Engine Plants.

In the early gas engine electric lighting work it was the habit to place all the blame for irregular running and for flickering light upon the prime motor, but the rapid improvements in this respect, of recent years, have been largely due to the design of special generators. We illustrate herewith a type, or line, of direct-current generators brought out for this work by the Commercial Electric Company, of Indianapolis, Ind. On account of the irregular impulses of the engines, it is necessary to provide a fly-wheel which will overcome the fluctuations of the dynamo speed and produce a steady light, which is impossible where the irregularities of the engine speed are reproduced in the armature of the dynamo. This requirement has sometimes been met by placing a heavy fly-wheel upon an extension of the armature shaft, without providing any additional support for this wheel. As standard dynamo bearings are generally not sufficiently heavy to sustain the extra weight of the fly-wheel, this method has generally given but slight satisfaction. In order to satisfactorily overcome these speed fluctuations without imposing unusual strains upon the dynamo parts, the Commercial company has designed special machines having an extra heavy shaft, which is extended to receive a heavy fly-wheel and which is supported by three bearings, two of which are placed close upon either side of the fly-wheel, where they will support its weight and receive the extra strain caused by the jerking of the



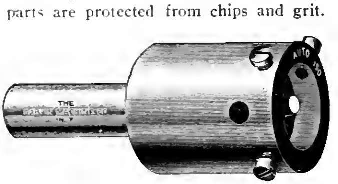
GENERATOR FOR GAS ENGINE.

dynamo belt without injurious effect upon the dynamo. These three pedestals, with the machine frame, are mounted upon a heavy iron base, which is carried upon sliding rails with hand wheels and thrust screws, by means of which the belt tension can be adjusted. By this construction the overloading of the dynamo bearings or the expense of an extra countershaft for carrying the fly-wheel is avoided, and a substantial mechanical machine, capable of producing a steady light, is secured. These machines include all the usual sizes and speeds from ½ to 30 kw.

Automatic Die Holder.

The illustration shows a new automatic hollow shank die holder for screw machines. This die holder is specially designed by the Garvin Machine Company, of Spring and Varick Streets, New York City, for high speed and overcomes many of the defects which develop in these tools, when used under such conditions. It is clutched positively, going forward, but on reverse, when the die is in rapid rotation, and must be stopped, it is held by friction grip, so that it is noiseless in action and reverses without shock and clatter, which conduces greatly to increased durability and efficiency. The friction grip consists of three rollers each resting on a small incline and embraced by a steel shell, all these parts being hardened and of substantial size.

The hollow shank permits long work to pass clear through; but the working parts are protected from chips and grit. To prevent



AUTOMATIC DIE HOLDER.

hammering, when reversing, is more difficult with a hollow shank holder than with the solid shank construction; but in using this new style of holder there is no danger of engaging the reversing clutch too soon, and hammering is done away with.

The die reverses itself instantly and automatically, on throwing the shipper, and begins to run back of itself, and requires no cooperation in starting to move the turret slide backward at the right instant and can, therefore, be operated with less skill and experience on the part of the operator. The die holder is made in three sizes.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—A sharp rally early in the week imparted a little more firmness to the stock market, but there was a lack of speculative interest. United States Steel securities were firm despite unfavorable reports as to the iron trade and the postponement of action on the preferred dividend until the end of July. Little interest was shown in any of the industrials apart from the Steel securities, and the traction group was also neglected. At the close of the week the general market was broader and more active at advances. Brooklyn Rapid Transit, on a fair amount of trading, advanced from 46¾ to 48⅝, closing at 48⅝, this being an advance of 1⅝ points. Metropolitan Street Railway became active and strong, 16,760 shares having been sold at prices ranging from 109⅝ to 114, the closing quotation being 113⅞—a net gain of 3⅞ points. The telegraph and electric stocks, with the exception of Westinghouse, showed increased strength and advances. Allis-Chalmers closed at 8, being 1 point better than the closing figure of the previous week; General Electric rose from 155, the lowest, to 159½, the highest quotation of the week, and closed at 155, thus gaining 3 points net. Westinghouse lost ⅛ of a point, closing at 156. American Telephone & Telegraph fluctuated between 125½ and 128, the latter being the closing price, and an advance of 2¾ points as compared with the last previous quotation. Western Union closed 1⅝ better off, the last quotation being 87½. The curb market was stronger in tone and prices were higher, following the lead of the main market. The feature was the strength of Interborough Rapid Transit, which advanced nearly 3 points in connection with the declaration of the first dividend. Among the specialties a sharp advance in Electric Boat was ascribed to activity in submarine boat building for war purposes. Mackay Companies common made a sharp rise, no particular reason therefore being apparent, and Electric Vehicle seemed to be under manipulation. Following are the Stock Exchange closing quotations of June 14:

NEW YORK.

	June 7	June 14		June 7	June 14
Allis-Chalmers Co.	7½	7½	Electric Vehicle	7¼	8½
Allis-Chalmers Co. pfd	40	41	Electric Vehicle pfd	10¼	11
American Tel. & Cable	88	87	General Electric	155	158⅜
American Tel. & Tel	125	128¾	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	110⅝	114½
Brooklyn Rapid Transit	47	48⅝	N. Y. & N. J. Tel	..	..
Commercial Cable	180	175	Marconi Tel	..	..
Electric Boat	25	30	Western Union Tel	86¼	87
Electric Boat pfd	66	64	Westinghouse com	154	154
Electric Lead Reduction	*⅝	*⅜	Westinghouse pfd	180	180

BOSTON

	June 7	June 14		June 7	June 14
American Tel. & Tel	125	128¾	Western Tel. & Tel. pfd	77	80
Cumberland Telephone	112	112	Mexican Telephone	1¼	1¼
Edison Elec. Illum	*235	234¾	New England Telephone	118	120
General Electric	155	156	Mass. Elec. Ry	18¼	18¼
Western Tel. & Tel	..	7½	Mass. Elec. Ry. pfd	..	70

PHILADELPHIA.

	June 7	June 14		June 7	June 14
American Railways	43	43	Phila. Traction	96	..
Elec. Storage Battery	55	54	Phila. Electric	6⅜	6
Elec. Storage Battery pfd	55	54	Phila. Rapid Trans	12¼	12
Elec. Co. of America	8¼	8½			

CHICAGO

	June 7	June 14		June 7	June 14
Central Union Tel	..	.	National Carbon pfd	101	*102
Chicago Edison	144	.	Metropolitan Elev. com	21	20¼
Chicago City Ry	170	175	Union Traction	*6¾	..
Chicago Tel. Co	118	..	Union Traction pfd	28	*30
National Carbon	26¼	26¼			

*Asked

ALLIS-CHALMERS ANNUAL REPORT.—The Allis-Chalmers Company issues its annual report for the year ended April 30, 1904. The income account compares as follows:

	1904.	1903.	1902.
Net profits	$952,624	$1,653,576	$1,442,259
Preferred Dividends	853,125	1,137,500	1,137,500
Surplus	$99,499	$516,076	$304,759
Previous surplus	820,835	304,759	....
Total surplus	$920,334	$820,835	....

Net profits are given after deducting operating expenses, reserve, depreciation, maintenance and repairs. To the surplus of $920,334 was added the sum of $201,951, which was the excess of par value over book cost of $100,000 preferred stock and $180,000 common stock acquired in settlement of current business contracts, etc. This makes a total of $1,122,286, from which special appropriations amounting to $497,450 have been deducted, leaving a net profit and loss surplus April 30, 1904, of $624,835. The general balance sheet as of April 30, 1904, compares as follows:

Assets:	1904.	1903.	1902.
Real estate, bldgs., plts., good will, etc.	$30,246,084	$29,199,493	$27,352,082
Bills and accounts received	3,437,520	2,475,579	2,778,721
Merchandise, materials, etc.	2,914,878	5,131,800	3,333,665
Cash	1,060,113	1,628,009	4,514,167
Bullock Electric Mfg. Company	463,000	....	....
Total	$38,121,596	$38,434,881	$37,978,635
Liabilities:			
Preferred stock	$16,150,000	$16,250,000	$16,250,000
Common stock	19,820,000	20,000,000	20,000,000
Accounts payable	1,014,396	1,079,671	1,139,500
Mortgage due March, 1905	34,000	....	....
Dividends payable May 1	....	284,375	284,375
Depreciation reserves	478,365	....	....
Surplus	624,835	820,835	304,760
Total	$38,121,596	$38,434,881	$37,978,635

President B. H. Warren says: "The fiscal year will hereafter terminate on the last day of June in each year. In the settlement of several business contracts entered into prior to March 1st, the company became the owner of $100,000 par value of its preferred stock and $180,000 par value of its common stock, which shares have been cancelled, thus reducing the outstanding capital stock to $16,150,000 of preferred stock entitled to cumulative dividends, at the rate of 7 per cent. per annum, from February 1, 1904, and to $19,820,000 of common stock." During the past year the following expenditures have been made in the increase, or for greater economy in the operation, of the productive property of the company:

Additions to plants	$642,232
New plant	77,300
Terminal railroad	49,060
Capital expenditures during the year	$768,592
The cost of manufacture during the past year has included charges for:	
Maintenance and repairs	$752,535
Depreciation	244,478
An operating expense of	$997,013

The report also calls attention to the arrangements with other concerns, and the acquisition of plants, etc., in Canada. It adds: "All the property of the company is owned in fee except the Bullock Electrical Works at Norwood, near Cincinnati, Ohio, the latter being held under a long lease. The entire property is free from mortgage or other lien, with the single exception of that for $34,000 assumed in the purchase of the Norwood Foundry, and which, by its terms, cannot be retired until its maturity, March 22, 1905. No mortgage can be placed upon the property without the assent of 75 per cent. of the amount of preferred stock outstanding."

A UNIVERSITY'S INVESTMENTS.—It were well, says *Leslie's Weekly*, if every college, as a public institution, made a full statement of its financial affairs each year. Harvard College does make such a statement. It is interesting to know some of the forms of the investment of the funds of our oldest university. Railroad stocks and railroad bonds represent a favorite investment. A hundred thousand dollars in the Chicago & Alton 4 per cent. collateral notes; a hundred thousand dollars in the Chicago Northwestern Railroad general mortgage 3½ per cent. of 1987; two hundred thousand dollars of the Louisville & Jeffersonville Bridge Company first mortgage 4s of 1945; a hundred thousand of New York Central & Hudson River Railroad 3½s of 1988, and a hundred thousand dollars of Schenectady Railway first mortgage 4½s of 1941, are entries found in a single column. A score of the great steam railways of the country are represented in the list of securities. Many street railroads, too, as those of New York, Minneapolis and Massachusetts electric companies, are found in the list. The notes also of great manufacturing companies, such as the Manchester Cotton Mills and the Merrimac Manufacturing Company, are a favorite form of investment. Manufacturing and telephone stocks and real estate trust stocks are not absent. The total is about $3,000,000.

DIVIDENDS.—The United Railways Investment Company of San Francisco has declared a semi-annual dividend of 1¾ per cent. on the preferred stock, being an increase of ¼ per cent. payable July 1st. The Interborough Rapid Transit Company of New York has declared a dividend of 2 per cent. United Gas Improvement Company has declared a dividend of 2 per cent. for the quarter. The Seattle Electric Company has declared a semi-annual dividend of 3 per cent. on the preferred, payable October 7th. The directors of Commercial Cable have declared the regular quarterly dividend of 2 per cent., payable July 1st. In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway Company, a semi-annual dividend rental of $2 per share will be paid on West End Street Railway preferred stock July 1st. The Strowger Automatic Telephone Company has declared the regular semi-annual dividend of 50 cents per share, payable July 1st. The directors of the Railway Equipment Company have declared the regular monthly dividend of 1½ per cent. and an extra dividend of 2 per cent., payable June 15th.

WESTERN UNION REPORT.—The Western Union Telegraph Company issued last week its annual statement for the year ending June 30th, together with a statement of the business for the quarter ending on the same date. The statements are partly estimated. The annual statement shows a net surplus of $1,908,914, as against $2,268,722 for last year and $1,431,718 for 1902. The company's total surplus is $14,928,638. The statement for the quarter shows a net surplus of $340,433, as against $504,383 for 1903, $420,697 for the same quarter in 1902, and $306,391 for the quarter in 1901. The detailed figures follow:

	1904. (estimated)	1903. (actual)	1902. (actual)	1901. (actual)
Net revenue	$1,850,000	$2,007,698	$1,892,476	$1,762,436
Bond interest	292,550	286,300	254,770	239,040
Balance	$1,557,450	$1.721,398	$1,637,706	$1,523,396
Dividends	1,217,017	1,217,015	1,217,009	1,217,005
Surplus	$340,433	$504,383	$420,697	$306,391
Previous surplus	14,588,205	12,513,341	10,330,306	9,012,894
Total surplus	$14.928,638	$13,019,724	$10,751,003	$9,319,285
Twelve months:				
Net revenue	$7,934,682	$8,214,472	$7,292,329	$6,685,249
Bond interest	1,157,700	1,077,700	992,580	956,160
Balance	$6,776,982	$7,136,772	$6,299,749	$5,729,089
Dividends	4.868,068	4,868,050	4,868,031	4,868,008
Surplus	$1,908,914	$2,268,722	$1,431,718	$861,081
Previous surplus	13,019,724	10,751,000	9,319,285	8,458,205
Total surplus	$14.928,638	$13,019,725	$10,751,003	$9,319,286

The figures are generally considered an excellent showing in view of trade conditions and the lopping off of poolroom business.

NEW YORK INTERBOROUGH.—The Interborough Rapid Transit Company's directors met last week and declared a dividend of 2 per cent. payable on July 1st. This is the first dividend the company has declared. It has an authorized issue of $35,000,000 stock, all or nearly all of which is outstanding. As the subway is not completed, the dividend must be paid out of the surplus of the Manhattan Elevated. The balance sheet of the Interborough Company of June 30, 1903, showed a surplus of $547,000. The Interborough operates the elevated lines under a lease which provides that the yearly rental shall be 6 per cent. on the stock up to and including January 1, 1906, and 1 per cent. additional if earned. After January 1, 1906, the rental is 7 per cent. The Manhattan's surplus for the six months ended December 31st last, after interest and rentals had been paid, amounted to $2,621,278, as compared with $1,765,760 for the corresponding six months of the previous year.

Commercial Intelligence.

THE WEEK IN TRADE.—The iron trade was reported very dull, and production is being curtailed, but stocks increased during May. The other metals were dull and somewhat weaker, the price of copper being reduced ¼c, which, however, did not increase the number of purchases. The closing prices were 12¾ @ 13c for Lake; 12⅝ @ 12⅞c for electrolytic and 12⅜ @ 12½c for casting. The London market is lower for both spot and futures. The exports so far this month aggregate 2,994 tons. *Bradstreet's* reports 171 business failures during the week ending June 9th, against 194 the week previous and 181 the corresponding week last year. The Lake strike is still exerting a detrimental influence in many lines along the northern border. Railway earnings show the effect of the smaller movement of business in May, the aggregate of which shows a decrease of 3.5 per cent. from a year ago. April net earnings indicate a decrease of 6 per cent. as compared with the same month last year, the anthracite coal roads being conspicuous exceptions. Trade and industry are quiet as a whole, and the money market still reflects speculative depression and a curtailment of demand for money in trade circles. There is an expansion of export trade in iron and steel, leather and lumber as a result of lower prices, but there is no improvement in the foreign demand for cereals. Rains, swollen streams and cool weather in various sections have had an unfavorable effect on crop development and on retail trade in seasonable goods. Prices of nearly all classes of staple products are on the downward turn as a result of the slack demand, but it is believed in many quarters that these lower prices are in themselves a good feature, and will induce buying that higher prices had choked off, people preferring to wait.

RAILROAD TIE PROBLEM.—The railroads and trolley lines will in a few years, according to the *Wall Street Journal,* be seriously confronted with the tie problem. This is known in an indefinite way, but the day has generally been thought to be remotely in the future. The eastern railroads for some time have been able to draw only a small part of their tie supply from their own territory. West Virginia for a long time was a great resource, but the tie-producing area has moved south. The great bulk of the ties now comes from the Carolinas and Georgia, whence they are brought north by coastwise sailing vessels. The growing scarcity is reflected in the figures below, which are the average price per tie paid each year by a large eastern road: 1898, 45 cents; 1899, 49 cents; 1900, 59 cents; 1901, 56 cents; 1902, 55 cents; 1903, 60 cents; 1904, 62 cents. The advanced methods in forestry which are gradually coming into vogue are arresting the reckless forest destruction in some quarters. But the results so far are feeble and not general. The solution of the problem by using a substitute for the wooden tie is often discussed. Metal ties have so far proved a failure in America because of the great weight of the rolling stock to be sustained. Under any conditions the steel tie will always be wanting in the resiliency which is so great a desideratum to both rolling stock and track. Should it be that the electric motor will in time supersede the freight locomotive with its ponderous reciprocating parts, some part of the objection to the steel tie may be removed. It is asserted that at no distant date, the demand for steel ties alone will be a big boom for the United States Steel Corporation. There have been suggestions of ties of fibrous artificial material, of toughened glass and of asphalt. The last named proposes the use of a block of wood under each rail base. Such a tie would have weight bearing surface, structural rigidity and resiliency and would seem to be promising. Some roads have already anticipated the trend of things and have established departments of forestry, and gone into the growing of their own ties. This plan commits the railroad to a large expenditure, but it is a wise one. However, it is believed very much could be done by a forestry bureau on each railroad whose territory offers any possibilities of trees growing, such bureau to cooperate with the farmers along the line stimulating forest culture by the many agencies of education and cooperation which the railroad has at its command. The prospect of tie shortage which is coming before the railroads is due to wanton and reckless waste rather than to inadequacy of resources. With better husbanding of resources great things can be done.

CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company, through its New York City offices, of which F. B. De Gress is manager, reports recent receipts of numerous orders for generators, motors, etc., to be shipped to New York, New Jersey and Connecticut points. The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., has ordered four standard motors ranging in capacity from 15 hp to 25 hp. This is a repeat order. The New Haven (Conn.) Clock Company is to be shipped a 100-kw generator and two 50-hp motors. The J. B. Williams Co., of Glastonbury, Conn., has requisitioned for a 150-kw engine type generator. The Derby (Conn.) Gas Company has ordered two 10-hp and two 5-hp motors. The State Board of Education, Trenton, N. J., has placed an order for a 50-kw engine type generator and a 10-hp motor. The Capewell Horse Nail Company, of Hartford, Conn., is to be shipped additional Crocker-Wheeler equipment consisting of a 40-kw generator and a 25-hp motor; while six motors of various sizes have been ordered for installation in the bakery of Hicks & Schmidt, 587 Greenwich street, New York City. The New Jersey Zinc Company has called for two 25-hp standard motors for its Franklin, N. J., plant, and has also ordered three motors of the same capacity for installation in its Hazard, Pa., plant. The John A. Roebling's Sons Co., of Trenton, N. J., is to be shipped a 90-hp motor. Two 13-hp motors will be forwarded to the De La Mar Copper Works, at Carteret, N. J., while the Pittsburg Reduction Company has ordered 22 small motors to be utilized for driving fans at its Massena, N. Y., plant. Mr. De Gress states that the May orders secured in his territory show an increase of fully 50 per cent. over those taken in April, and represent the largest monthly sales so far this year.

A HUGE COPPER CONSOLIDATION.—The *New York World* says: "Announcement will soon be made of a combination of mining interests of America with John D. Rockefeller at its head. The capital of the merged companies, it is said, will be $2,500,000,000, and the purpose is to control the mineral output of the United States, with the possible exception of the Calument & Hecla copper mine of Michigan. Senator Clark's United Verde and Montana properties and those of F. A. Heinze in Montana are said to be included, as also are the principal mining companies of Colorado, Utah and California."

General News.

THE TELEPHONE.

GILLETT, ARK.—The People's Union Telephone Company has been incorporated with a capital stock of $25,000. William J. Stillwell is president.

JONESBORO, ARK.—The Automatic Home Telephone Company has been incorporated with a capital stock of $25,000. R. L. Collins is president.

SANTA ROSA, CAL.—The Westside Telephone of Healdsburg has been incorporated by J. McClish, M. V. Frost and others.

LOS ANGELES, CAL.—Articles of incorporation have been filed in the county clerk's office by the San Fernand Home Telephone Company, of which Charles F. Guthridge, Charles L. Zahm, Arthur Wright, D. F. Boyce and C. P. Platt, all of Los Angeles, are the first directors. The company is capitalized at $50,000, of which $10,000 has been subscribed.

FISHER, ILL.—The Granger Mutual Telephone Company has reduced its capital from $15,000 to $10,000.

NUNDA, ILL.—The Union Light & Telephone Company has increased its capital stock from $15,000 to $25,000.

INDIANAPOLIS, IND.—The Central Union Telephone Company has issued a new order reducing toll rates in Indiana, Ohio and Illinois. New toll lines have been built and the company is now able to handle more business and give lower rates.

EVANSVILLE, IND.—The members of the common council have decided to postpone action on the telephone question. It is generally believed that the Citizens Telephone Company is desirous of giving way to the Home Telephone Company.

MUNCIE, IND.—The Madison & Delaware County Telephone Company is preparing to make extensive improvements in its exchange and lines in this locality. Manager Bromley announces that he will be in the market for a large amount of material for the contemplated work.

CRAWFORDSVILLE, IND.—The Central Union Telephone Company is making an effort to put in a new telephone system in this city. The business men oppose it and insist that there is not room for two systems here. The Central Union maintains a toll station here.

KELLERTON, IA.—The Kellerton Telephone Company will build a line to Mt. Ayr.

WEBSTER CITY, IA.—The Martin Telephone Company has ordered two additional sections for its switchboard.

CEDAR FALLS, IA.—The Cedar Falls Mutual Telephone Company has been incorporated with a capital stock of $25,000, by N. H. Norris and others.

SPEARVILLE, KAN.—The Spearville Telephone Company has been incorporated with a capital stock of $2000.

BANGOR, ME.—The petition of the Automatic Telephone Company to enter Bangor with its lines was voted down at a special meeting of the Board of Aldermen.

CHIHUAHUA, MEX.—Governor Luis Terrazas, of the State of Chihuahua, has granted a concession for the construction and operation of a telephone line from Las Cuevas to Roncesvalles and from Morris to Socorro and other points in the State.

CITY OF MEXICO, MEX.—The Mexican Government and the city council of the City of Mexico have extended for a further period of six months the concession held by Jose Sitzenstaller for the construction of a telephone system in the City of Mexico. Under the terms of the extension the work of construction must be commenced within six months from May 4 of the present year. It is stated that Mr. Sitzenstaller is making an effort to organize a strong company to finance and carry out the proposed enterprise. It is his intention to install a complete system which will be a strong competitor of the system of the Mexican Telephone Company now in operation here.

PLYMOUTH, MICH.—A new telephone company has been formed here by J. J. Sherer, J. C. Brayton and others.

HANCOCK, MICH.—The Michigan Telephone Company will expend $50,000 in improvements to its system in this section.

ANN ARBOR, MICH.—It looks as if there was a movement on foot to consolidate the independent telephone companies of Michigan, and unite the system with those already developed in other states. The Washtenaw Home Telephone Company has already spent $25,000 or $30,000 in Ann Arbor and vicinity and is about ready to begin business.

BAY CITY, MICH.—The Michigan State Telephone Company will build trunk lines on 1000 miles of the Pere Marquette Railroad's right of way, having closed a deal with the railroad company for that privilege. By the end of the year the company will have about 70,000 subscribers, an increase of over 15,000. Rights have also been secured for trunk lines on the South Shore Road's right of way in the upper peninsula.

ST. PAUL, MINN.—The Shakopee Telephone Company has increased its capital from $3000 to $10,000.

DASSELL, MINN.—The Dassell-Collinwood Telephone Exchange Company has been incorporated with a capital stock of $25,000. The directors are S. N. Gayner, S. Oyster and others.

WATERTOWN, MINN.—The Watertown Telephone Company has been incorporated with a capital stock of $25,000. F. A. Barth is president.

ST. PETER, MINN.—At the annual meeting of the Nicollet County Telephone Company, officers were elected as follows: M. P. Quist, president; Charles Samuelson, vice-president; C. C. Nelson, secretary and manager, and P. A. Retrum, treasurer. The company was organized in 1898. The prime movers were farmers, and to-day they own the bulk of the stock, of which $19,650 is paid up. The lines cover over 150 miles of territory, distributed over Nicollet and Sibley Counties. The system has 322 telephones in operation, of which 182 are in the homes of farmers. The company also owns and operates exchanges at Gaylord, Gibbon, Lafayette and Norseland. Many improvements and extensions are in contemplation. The value of the system is placed at over $25,000.

NATCHEZ, MISS.—A long-distance telephone line will be constructed between Natchez, Miss., and Jonesville, La., by the Cumberland Telephone & Telegraph Company.

ST. LOUIS, MO.—A mortgage securing $5,000,000 in bonds of the Kinloch Long Distance Telephone Company of Missouri has been filed for record at Clayton, the county seat of St. Louis County, and copies will be placed on record in thirty-four other counties where the company owns property. The American Trust and Savings Bank, of Chicago, and Geo. W. Galbreath, of St. Louis, are named co-trustees. The bonds are 5 per cent. twenty-five-year gold and are given to pay off the indebtedness of the company and for improvements.

FORESTVILLE, N. Y.—The Conewango Valley Home Telephone Company has been incorporated with a capital stock of $11,000. The directors are A. H. Libbey, B. C. Wilson and others.

SENECA FALLS, N. Y.—A local telephone company has been organized in Fayette and the following-named gentlemen have been elected officers: President, Dr. McWayne; secretary, Fred Emens; treasurer, Charles O'Connor.

CATSKILL, N. Y.—A telephone war is on. The Hudson River Company in 1884 purchased the wires and poles of the Catskill Telephone Exchange, and for years has enjoyed a monopoly of business. Two years ago the West Shore Telephone Company secured a franchise to erect poles and string wires in the village of Catskill. The Hudson River Company has obstructed the West Shore in several ways, but the work has gone on. Last week the Hudson River Company erected a large pole on Grand View Avenue, but neglected to put on crossarms. During the night the West Shore Company strung wires which obstruct the setting of the crossarms. The manager of the Hudson River Company served notice on the West Shore that it would cut the wires. The latter called on the Sheriff of Greene County to protect the lines. It is said that the Hudson River Company never had a franchise to erect its poles. At last reports the conditions were still strained.

PHILLIPSBURG, OHIO.—The Acme Telephone Company, with a capital stock of $15,000, has been incorporated.

ROCKFORD, OHIO.—The Rockford Toll Line Telephone Company has increased its capital from $10,000 to $20,000.

FINDLAY, OHIO.—The Mt. Cory Farmers' Mutual Telephone Company has been organized with W. A. Williamson as president.

ROCKFORD, OHIO.—The Rockford Toll Line Telephone Company has increased its capital stock from $8000 to $20,000 and will make improvements.

BAINBRIDGE, OHIO.—The Bainbridge Telephone Company has been incorporated with a capital stock of $10,000. The directors are O. E. Post, C. S. Leinhart and others.

CLEVELAND, OHIO.—The Bell Telephone Company is stringing two new long distance lines between Cleveland and Columbus, two between Cleveland and New Castle, Pa., and two between Cleveland and Buffalo. Extensive improvements are being made on the Cleveland long distance switchboard.

YORK, PA.—The York Telephone Company has declared its usual semi-annual dividend of 2 per cent. payable July 1.

DOYLESTOWN, PA.—Application has been made for a charter for an independent telephone line to be operated in the upper end of the county under the name of the Franklin Telegraph & Telephone Company. Those interested are H. S. Funk, H. F. Funk, W. F. Witte, T. M. Moyer, N. S. Rice, J. J. Ott, C. B. Weaver and W. O. Ealer.

MANILA, P. I.—A telephone franchise has been applied for by the Sociedad de los Telefonos de Manila. The company will be under American management.

CHARLESTON, S. C.—The Island Telephone Company's entire outfit was sold at auction at Charleston recently for $8200, by Geo. E. Gibbon, said to be representing stockholders of the company. The system, with its numerous connections, may be operated again shortly. Foreclosure of deed of trust was the cause of the sale.

NASHVILLE, TENN.—The Gass Bridge Telephone Company, of Greene County, Tenn., has been chartered with $300 capital. W. S. Babb is interested.

CHATTANOOGA, TENN.—It is announced that the Southern Bell Telephone Company will build a long distance line from Chattanooga to Gadsden, Ala., at a cost of $50,000.

DENISON, TEX.—The Grayson County Telephone Company will spend $50,000 in improving its lines.

BROWNWOOD, TEX.—The Central Texas Telephone Company has applied to the city council of Brownwood for a franchise.

HONEY GROVE, TEX.—A. L. Hill, formerly manager of the telephone company at Smithville, Tex., will install a telephone system at Honey Grove.

SCHULENBURG, TEX.—The Schulenburg Telephone Company has been organized here with a capital stock of $5000. William E. Pertitz is one of the incorporators.

DEXTER, TEX.—The Dexter & Gainesville Telephone Company will install a telephone system in this section. The company was recently organized with principal office at Dexter. J. F. Morris, of Gainesville, is one of the incorporators.

WESTBY, WIS.—The Westby Telephone Company has increased its capital to $10,000.

LENA, WIS.—The Farmers & Merchants' Telephone Company has been incorporated with a capital stock of $4000.

ELECTRIC LIGHT AND POWER.

PINE BLUFF, ARK.—The Citizens' Light & Transit Company, of Pine Bluff, contemplates the installation of another alternator of 250 or 300-kw capacity.

BRINKLEY, ARK. The Farrell Light, Heat & Water Company of this place contemplates the building of a new plant. Mr. J. J. Farrell is the purchasing agent.

FAYETTEVILLE, ARK.—F. W. Fratt, Oklahoma City, Okla. Ter., states that it is proposed to install a new unit of from 120 to 150-kw, a two-phase alternator and an engine. J. W. McLendon, Fayetteville, superintendent, can give further information.

SPRINGVILLE, CAL.—C. L. Witten, of San Jose, is attorney for the Globe Light & Power Company, which intends to construct a power plant.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company, which made a bid of $400,000 for lighting the streets and public buildings for the year ending June 30, 1905, has signified its willingness to accept the figure of $320,000 allowed by the city budget. As the rival gas companies were absorbed last year, this company had no competitor in bidding for the street lighting. The bid for each electric arc lamp per night was 35 5-7 cents; number of lamps not to exceed 1111. The city is to be lighted every night in the year instead of according to the former moonlight schedule. The bid for lighting at the City Hall, Hall of Justice, etc., was 5 cents per kilowatt-hour, or $1 per thousand feet for gas. It was specified that not more than 4885 gas lamps be used. Last year, under competition, the rates were scaled down to fit an appropriation of $300,000, out of which the San Francisco Gas & Electric Company received $296,000.

SAN FRANCISCO, CAL.—The Shasta Power Company, H. L. Shannon, president, will put in the flumes and ditches and erect its 25-mile transmission line from a point on Bear Creek to Redding this fall. The first 1500-kw, three-phase Bullock generator, ordered through the Wagner-Bullock Electric Company, is expected to arrive next April, enabling the plant to be operated next summer. The power water will be diverted from Hat Creek, near Mt. Lassen, and conducted to Bear Creek, where there is a drop of 1500 in 6000 feet of pipe line. This company was recently incorporated by H. L. Shannon, T. I. O'Brien and F. Kingsbury, all of San Francisco, John W. Potts and Charles Jacobs, of Redding. The capital stock is $1,000,000 and money is available to install a plant costing $100,000. This project was erroneously reported last week as being that of the Mt. Lassen Water Power Company. The latter company proposes to install an electric transmission plant on Battle Creek, 35 miles from Redding. The company has been incorporated with a capital stock of $500,000, by C. H. Hilbert and A. Barnard, of Redding; L. M. Robbins, A. G. Sheath, M. A. Kenney and A. E. Bennett, of San Francisco.

BRISTOL, CONN.—The Wallace Barnes Company, Bristol, Conn., is building a new power house 40x60 feet, to be equipped with a 150-hp Cooper-Corliss engine which will operate a 150-kw General Electric generator. Two 100-hp Dillon boilers will furnish steam power.

WASHINGTON, D. C.—Bids will be received June 28 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of flexible conduit, rubber-covered conductor, electrical supplies, etc. Address H. T. B. Harris, Paymaster General.

BRAIDENTOWN, FLA.—The Manatee Light & Traction Company will install a series alternating arc system in this place.

CARROLLTON, GA.—It was voted June 4 to issue $45,000 bonds for water works, a sewerage system and an electric light plant.

ATHENS, GA.—The City of Athens is contemplating the enlargement of the municipal electric light plant. The present plant does not supply power enough for recent and contemplated extensions.

BARNESVILLE, GA.—G. E. Strickland and J. W. Strickland, of Pike, and associates, are applying for a charter for the Flint River Power Company. The property to be developed by the company is the Flat Shoals on Flint River, from which 5000 hp may be obtained.

ATLANTA, GA.—The development of the immense water power at Bull Sluice Shoals, near Atlanta, has developed to the point where the water has been turned into the new electric power dam. It was thought that nearly a week would be required to fill the dam.

ALBANY, GA. The town of Albany on June 9 voted on the question of a contract with the Albany Power & Manufacturing Company for supplying 300 electric horse-power annually for 17 years at $8000 each year. The company has also bought a water power near Albany which will probably be developed.

BOISE CITY, IDA.—The Highland Power Company's dam, located 20 miles up the river from Boise, was swept away by a recent flood. The power house was also badly damaged.

ROCKFORD, ILL.—It is stated that the Central Heat & Power Company will install a new electric plant this summer.

QUINCY, ILL.—The Independent Light & Power Company will increase the capacity of its plant by adding another unit consisting of a 1200-hp engine and a generator.

ELKHART, IND.—The Elkhart City Electric Company has incorporated with a capital stock of $15,000. C. G. Conn heads the board of directors.

DECATUR, IND.—The Decatur city lighting plant is to be enlarged by the addition of another Corliss engine of about 300 horse-power.

IOWA CITY, IA.—It is stated that the J. F. Hill Electric Company will install an electric light plant.

NEW ORLEANS, LA.—It is stated that the Consumers' Electric Company has purchased a site on Rampart and Bienville Streets for a power plant.

VIDALIA, LA.—The electric light plant which has been operated here by a New Orleans firm has been turned over to the municipality for $15,000, bonds for this amount having been voted last year. The plant cost $10,000.

BANGOR, ME.—The Underwriters' Light, Heat & Power Company, of Bangor, with $3,000,000 capital, has been incorporated under the laws of Maine.

TURNERS FALLS, MASS.—At a recent annual meeting of the Turners Falls Company is was voted to increase the capital from $300,000 to $600,000 and continue the work of improving the power and building an electric plant. C. T. Crocker is president.

MARSHALL, MICH.—The old Brush arc machines in the municipal lighting plant in this place will probably be taken out this summer, and the service changed over to the series alternating system. Mr. P. S. Joy is superintendent.

PENTWATER, MICH.—A contract has been entered into between the village and the Oceana Electric Company by which the company will install equipment to furnish 20 arc lights for the village and current for all private consumers at 50 cents per incandescent 32-cp lamp. Arc lights are to be of 1000-cp, and to cost $75 each per month for the 20 lamps.

WHITE BEAR, MINN.—The White Bear Electric Company has increased its capital stock from $10,000 to $25,000.

ROCHESTER, MINN.—A company may be organized to develop electric power from the water power at Jarrett. F. G. Colburn is owner.

MONTEVIDEO, MINN.—It is stated that the Montevideo Electric Light & Power Company will push the work of developing Minnesota Falls.

LAKE CITY, MINN.—A new engine and dynamo are to be installed in the municipal lighting plant, and the system is to be changed to the alternating.

EDINA, MO.—The Edina Electric Light & Power Company has been sold to P. M. Peterson, of Rock Springs, Wyo., through the agency of the J. S. Maurer Company. Mr. Peterson expects to remodel this plant and will therefore be in the market for general electrical supplies.

DELTA, MISS.—The Delta Electric Light & Power Company announces that it will immediately begin the work of extending its electric railway to take in all parts of the city. The rails, etc., have already arrived.

LINCOLN, NEB.—Electric light bonds to the amount of $65,000 have been sold.

CLINTON, N. Y. A municipal lighting plant may be established here. The matter is being considered.

LOCKPORT, N. Y.—A contract has been entered into with the Lockport Gas & Electric Light Company for lighting the city for three years, beginning June 8, at $75 each for 300 arc lights.

MT. OLIVE, N. C.—Plans and estimates are being prepared for an electric light plant.

WEST MANSFIELD, OHIO.—The village of West Mansfield has sold $11,000 worth of bonds for the purpose of installing an electric light plant in the village. Contracts will be placed in the near future.

WARREN, OHIO.—Stockholders of the Warren Electric Light & Power Company are arranging to consolidate the company with the Warren Water Company. The company will be known as the Warren Water & Light Company.

TARENTUM, PA. The citizens have voted to issue $37,000 bonds for improvements to the lighting plant.

SHENANDOAH, PA.—The Shenandoah & Mahanoy City Light, Heat & Power Company has been incorporated, with a capital of $75,000. David Graham, of Mahanoy City, is president, and W. T. Lee, of Shenandoah, is treasurer.

WILLIAMSPORT, PA.—It is stated that the Citizens Electric Light Company, of this place, of which Mr. Jonas Fischer is the principal owner, contemplates the erection of large buildings on the river-front for manufacturing purposes, and the utilization of water power for the generation of electric power for lighting, etc. Mr. Fischer's idea is to furnish commercial lighting, but he will also bid for the city lighting.

NEWBERRY, S. C.—The question of improving the electric light plant at a cost of $5000 is under consideration by the Town Council.

COLUMBIA, TENN.—The Columbia Water & Light Company will add new equipment for supplying a day service.

TRACY CITY, TENN.—The Tracy City Electric Light & Power Company has been incorporated, with a capital of $5000, by Samuel and Henry Werner.

COLUMBUS, TEX.—An effort is being made towards the establishment of an electric power plant on the Colorado River at this place.

LEONARD, TEX.—The Electric Light & Power Company has been organized at Leonard with a capital stock of $15,000. W. C. Evans is one of the incorporators of the company.

SHERMAN, TEX.—The Sherman Gas & Electric Company has been organized at Sherman with a capital stock of $200,000. The incorporators of the company are J. F. Strickland, W. R. Brents and C. N. Roberts, of Sherman; R. B. Sticher, of Cleburne; Osie Goodwin, M. B. Templeton and J. L. Penn, of Waxahachie, Tex.

RICHMOND, VA.—It is said that the Chesapeake & Ohio Railroad will investigate the matter of establishing an electric plant at Richmond for the purpose of supplying light and power for its buildings in the city.

SNOHOMISH, WASH.—The plant of the Electric Light & Power Company was destroyed by fire May 26. The loss was about $6000.

WHEELING, W. VA.—The Mutual Electric & Machine Company contemplates the erection of a $100,000 factory at Glenova for the manufacture of electrical machinery and apparatus. Mr. H. S. Sands is president.

GUAYAMA, PORTO RICO.—Bids will be received June 18 by Fernando Lugo Vina, Mayor, for $140,000 bonds to be used for an electric light plant, reservoir mains, sewerage system paving, erecting city hall, market-house, and for other public work.

THE ELECTRIC RAILWAY.

BUENA VISTA, CAL.—The city has granted to the American Crude Rubber Company, of which F. R. Marsh is president, a franchise to build an electric railway through the city to the various hot springs and summer resorts, not only for the purpose of carrying passengers, but also for carrying ore.

FORT COLLINS, COL.—The City Council has approved the ordinance granting electric street railway franchises to the Northern Colorado Electric Railway Company.

CHICAGO, ILL.—A special meeting of the stockholders of the South Side Elevated has been called for August 9, to authorize an issue of $8,000,000 4½ per cent bonds.

VEEDERSBURG, IND.—The survey is now being made for the proposed Veedersburg & Rockville Electric Railway.

INDIANAPOLIS, IND.—The Fidelity Construction Company, of Detroit, has commenced work near Noblesville, 25 miles from this city, on the construction of the Fort Wayne & Southeastern Railroad.

NEW CASTLE, IND.—Michael Gleason, of Richmond, reports that New York capitalists have consented to finance the Richmond & Northwestern Traction Company, in which he is interested. The line will run from New Castle to Richmond by way of Hagerstown.

MONTPELIER, IND.—The Portland, Montpelier, Warren & Huntington Electric Railway Company has filed articles of incorporation with the Secretary of State. The initial capital stock is $15,000. The directors are James West, Levi Hoffman and Scott Mills. The principal office will be in Montpelier.

FT. WAYNE, IND.—A syndicate of Eastern capitalists, headed by Thomas Wanamaker, of Philadelphia, has purchased the Fort Wayne Electric Light & Power Company's plant, and also the Fort Wayne traction lines and the bulk of the interurban connections which have recently been merged under the name of the Fort Wayne & Wabash Valley Traction Company.

ANGOLA, IND.—The stockholders of the Jackson & Fort Wayne Interurban Railway Company held a meeting here a few days ago and passed a resolution declaring that the road be built, equipped and operated at the earliest possible date, and authorized the directors to issue bonds to the amount of $4,000,000 for that purpose. John H. Roberts is president, and Joseph McKee, secretary.

OSKALOOSA, IA.—The Mahaska Construction Company has been formed to build an electric railway to Beacon and Buxton.

CRESTON, IA.—A company has been formed to build an electric interurban railway to Des Moines. Richard Brown, of Creston, is secretary.

NEW ORLEANS, LA.—The suit of the State of Louisiana against the New Orleans Railways Company involving the validity of the amalgamation of several street railway lines into one system has been reset for trial Nov. 7, at the request of the attorneys for the railways company.

SAGINAW, MICH.—T. E. Tarsney and T. G. Sullivan have asked for a receiver for the Detroit, Flint & Saginaw Railway, the newly projected interurban road from this city, which got as far as Bridgeport, 7 miles distant.

BELLEVILLE, MICH.—Citizens of this place and vicinity held recently a meeting to consider the project of building an electric railway from Detroit to Adrian, passing through this place. George William Moore, of Detroit, was present and addressed the meeting. An executive committee of seven was appointed. The proposed road is to be built on private right of way.

ROCHESTER, N. Y.—The Rochester & Eastern Rapid Railway Company has filed with the Secretary of State a certificate of increase of capital from $500,000 to $1,500,000.

NEW YORK, N. Y.—The Railroad Commissioners are said to have directed the Interborough Rapid Transit Company to equip all of its cars with fire extinguishers placed so as to be accessible in case of accident.

ROSLYN, N. Y.—Representatives of the Central Long Island Electric Light & Railroad Company are busily engaged in getting consents of property owners along the line of the proposed route of the company, between Huntington and Roslyn. All contracts have been signed for the construction of the line.

CHARLOTTE, N. C.—The new Jim Crow car law of Mississippi went into effect June 1, providing separate compartments in street cars for the races.

CARROLLTON, OHIO.—A. H. Snively is obtaining right of way through this district for a proposed electric railway from Canton to Steubenville.

CONNEAUT, OHIO.—George J. Chapman, chief promoter of the proposed Conneaut & Southern Railway, claims that Eastern capitalists will finance the project and that the prospects are good for the early commencement of construction work.

ZANESVILLE, OHIO.—The Southeastern Ohio Railway, Light & Power Company is advertising for bids for the construction of the roadbed of its line from South Zanesville to Crooksville; bids to be opened July 2. M. W. Hissey is president of the company.

XENIA, OHIO.—It is reported on good authority that the American Railways Company, which owns one of the local lines in Dayton, has secured control of the Dayton & Xenia Traction Company, which operates two distinct lines between Dayton and Xenia and a spur line to Spring Valley. It is stated that the Xenia line will be extended to Washington C. H., and the Spring Valley line to Wilmington.

NORWALK, OHIO.—The Sandusky, Norwalk & Mansfield Electric Railway Company has increased its capital stock to $600,000. Officers have been elected as follows: S. S. Burtsfield, of Toledo, president; Sherman Culp, of Norwalk, vice-president; B. B. Avery, of Cleveland, secretary-treasurer. The company has succeeded in financing its project for a line from Norwalk to Mansfield. C. F. Gilbert, of Cleveland, will be chief engineer in charge of construction work.

ST. CATHARINES, ONT.—The rate payers are to vote on June 22 on a by-law to approve the subscription of $20,000 worth of stock in Niagara, Queenston & St. Catharines Railway Company, which will build an electric railway from St. Catharines to Niagara-on-the-Lake and thence along the banks of the Niagara River to Queenston. W. A. Mittleberger is secretary-treasurer.

PORTLAND, ORE.—The Portland & St. Johns Railway Company has received a franchise to extend its line to St. Johns.

LEBANON, PA.—The Philadelphia, Lancaster & Harrisburg Passenger Railway Company has decided to extend its lines to Lebanon.

WEST BETHLEHEM, PA.—The Town Council has passed the ordinance granting a franchise to the Hanover Central Electric Railway Company.

LEBANON, PA.—Philadelphia capitalists, headed by Chas. S. Lurch, will build the proposed Palmyra, Valley Glen & Grantville Electric Railway this summer. A power house will be built at Valley Glen Park, which will be fitted up as a summer resort.

WEST CHESTER, PA.—The charter for the Oxford, Cochranville & Parkesburg Electric Railway has been filed. The entire distance covered is about 14 miles. Thomas E. O'Connell, of West Chester, is the principal promoter of the enterprise. The capital is given at $84,000.

HOUSTON, TEX.—The street car employes of the Houston Electric Company went on strike June 2.

SAN ANTONIO, TEX.—The shareholders of the Southern Light & Traction Company voted on June 2 to reduce the capital stock from $2,500,000, par of shares $100, to $2,500 par of shares 10 cents. The entire stock is owned by the American Light & Traction Company.

McKINNEY, TEX.—The survey for the proposed interurban electric railway between this place and Bonham by way of Blue Ridge and Denton has been commenced. It is stated that most of the right of way of the proposed line has been secured. R. Woodson, of St. Louis, Mo., is associated with local capitalists in the promotion of the enterprise. Jesse Shain, of McKinney, who is interested, can give information.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL CONSTRUCTION COMPANY, of San Diego, Cal., has been incorporated to manufacture and deal in electric and gas fixtures. The capitalization is $10,000.

THE PENN ELECTRIC EQUIPMENT COMPANY, of Camden, N. J., has been incorporated by B. L. Cater, G. C. Rawson and W. C. Rawson, the capital stock being $20,000.

THE NATIONAL BATTERY COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $500,000, the incorporators being R. L. Coleman, W. H. Miller and W. L. Hodges, of New York.

THE GENERAL RAILWAY SIGNAL COMPANY, of Gates, Monroe County, N. Y., has been incorporated with the Secretary of State, with a capital of $5,000,000, of which $2,000,000 is 6% cumulative preferred stock. The directors include Fredk. Cook, of Rochester, Geo. D. Morgan, of Buffalo, and other western New Yorkers.

LEGAL.

RIGHT TO OCCUPY TURNPIKE.—In an appeal by Brown vs. Radnor Township Electric Light Company, the Supreme Court of Pennsylvania has sustained the lower court as follows: 1. Under Act May 8, 1889 (P. L. 136), providing for the incorporation of electric light companies, and section 2, authorizing such corporations to supply light, heat and power to the public in the borough, town, city, or district where it may be located, such a company is not restricted by the word "district" to a division of a city or borough, but may be incorporated in a township. 2. Under Act May 8, 1889 (P. L. 136), providing that every electric light company shall have power to erect the necessary buildings and apparatus, with a right to enter upon any public street, lane, alley, or highway to inspect, alter, and repair its system of distribution, an electric light company has power to enter upon the bed of a turnpike road and erect its poles and string its wires, notwithstanding the objection of abutting owners owning the fee in the bed of the road.

SALE OF ELECTRICAL APPARATUS.—An appeal before the Court of Appeals of New York, settled in favor of the General Electric Company against the National Contracting Company, is of interest, as to sale of apparatus. The decision is summed up as follows: 1. A written contract of sale may be modified as to time of performance by consent of the parties, notwithstanding the contract provides that no modification thereof shall be binding unless in writing. 2. Where a written contract of sale, providing that no modification thereof should be binding unless in writing, was, by consent of the parties, and for their convenience, modified as to the time of performance, and defendant permitted plaintiff to go on with the work after the time specified in the contract, he is stopped from setting up the defense of non-performance as to time. 3. An exception by defendant to certain testimony admitted in proceedings before a referee before the pleadings were amended is not available on appeal where the amendment obviated all objection to the testimony. 4. The seller of machinery to be delivered and installed at a specified time may, on refusal of the purchaser to accept or pay for the same, sell it at public auction, and recover from the original purchaser the price thereof, after deducting the amount received at the auction sale and the cost of installing the machinery, together with interest on such balance from the time of the purchaser's default. The apparatus referred to was for the Hudson River Water Power Company at Spier Falls.

CONTROVERSY AS TO SUBWAY.—The Court of Appeals of the State of New York has decided in the suit of the Western Union Telegraph Co. vs. Electric Light & Power Co. of Syracuse, as to relative subway rights. The original telegraph subway was 16 in. high and 9 in. wide, a few feet below the street surface, with six wooden ducts. The electric light subway, under a later franchise, was 26 in. wide by 17 in. high in close juxtaposition to the other. The Appeals Court held: 1. Where plaintiff sued to restrain defendant from maintaining a street subway in close proximity to plaintiff's subway, previously constructed, and to compel defendant to remove its lines therefrom, but did not allege in its complaint that defendant was insolvent or that a multiplicity of suits would result, a judgment denying the injunction, but directing that defendant should indemnify plaintiff for any injuries it might suffer through the trespass by the execution of a bond, was erroneous, as an adjudication that an action in equity was unnecessary, as plaintiff had a sufficient remedy at law. 2. Where the common council of a city granted a corporation a right to construct a subway below the surface of the street, and provided that such franchise should not be deemed to give such company any exclusive right to the street for such subway, and reserved to the city all rights not spectfically given, such company cannot object because the city thereafter gave another company a right to locate its subway so close to plaintiff's subway as to cause expense in making repairs, if such subsequent location was not an unreasonable interference with plaintiff's rights.

RIVAL LIGHTING COMPANIES.—The Supreme Court of Kansas had before it recently an appeal on error from a district court in the action of the Keene syndicate against the Wichita Gas, Electric Light & Power Company to recover rent due under a lease. On the 14th day of May, 1897, the Wichita Electric Railway & Light Company, a corporation under the laws of Kansas, with its place of business at the city of Wichita, entered into a contract or lease in writing with the Wichita Gas, Electric Light & Power Company, a corporation under the laws of Kansas, with its place of business at the city of Wichita. By the terms of the contract or lease the former leased to the latter for a period of 10 years, at an annual rental of $3000, payable semi-annually, certain machinery and appliances, in the city of Wichita, adapted to and used by the lessor for the purpose of generating electricity for light, heat and power. On the 20th day of March, 1900, the Keene Syndicate, a corporation, purchased of the lessor, the Wichita Electric Railway & Light Company, the property included in and covered by said lease, and also its interest in said lease, taking a written assignment thereof. The lessee, the Wichita Gas, Electric Light & Power Company, being in default of three years' rent in August, 1900, the Keene Syndicate, as assigree of the Wichita Electric Railway & Light Company, commenced its action in the district court of Sedgwick County to recover the rent, the amount claimed due it from the lessee. The syllabus of its decision against the lease by the Supreme Court is as follows: "A corporation, engaged in the business of generating and furnishing electricity for public and private use, leased to a rival corporation in the city, for a period of 10 years, machinery and appliances used in generating electricity, obligating itself by the provisions of said lease not to engage in the business of furnishing electric light and power to public or private consumers in the city during said period, and not to dispose of any of its property, machinery, or appliances retained by it for producing or generating in said city electric light and power. Held, in an action on said lease to recover rents from the lessee, that the lease is in contravention of public policy, and that no action to recover rents can be maintained thereon by the lessor or its assignee."

TELEPHONE LINE IN HIGHWAY.—The Supreme Court of Kansas in the suit of McCann vs. the Johnson County Telephone Company has decided that the construction and maintenance of a telephone line upon a rural highway is not an additional servitude for which compensation must be made to the owner of the land over which the highway is laid. The complainant was a farmer. In constructing a telephone line the Johnson County Telephone Company planted poles along the highway in front of his farm. The poles were placed near the hedge fence on the land dividing the farm from the highway, and were so located as to interfere with the trimming of the hedge, and also with the cutting of the grass and weeds on the roadside. He brought an action of injunction, alleging that the company had not obtained his consent to plant telephone poles on the highway opposite his farm, that his interest as the owner of the fee had not been conveyed, condemned, nor otherwise appropriated; and that no compensation had been paid to him for the proposed use. A temporary order, restraining the company from placing poles opposite the plaintiff's farm was issued, but on the final hearing it was dissolved, and a perpetual injunction was denied. The question presented in this appeal was, as at the first hearing of the proceeding, whether the telephone company might occupy the highway in front of McCann's farm without obtaining his consent or paying him compensation for the right. Was this a contemplated use when the road was established, or does it constitute an additional servitude? The court quoted with approval the decision in Cater vs. Northwestern Telephone Exchange Co.: "The methods of using public highways expanded with the growth of civilization until to-day our urban highways are developed to a variety of uses not known in former times, and never dreamed of by the owners of the soil when the public easement was acquired. Hence it has become settled law that the easement is not limited to the particular methods of use in vogue when the easement was acquired, but includes all new and improved methods, the utility and general convenience of which may afterward be discovered and developed in aid of the general purpose for which highways are designed; and it is not material that these new and improved methods of use were not contemplated by the owner of the land when the easement was acquired, and are more onerous to him than those then in use." The court held that the construction and maintenance of a telephone line on a country highway did not impose an additional servitude upon it, but was to be regarded more as a newly discovered method of using an old public easement.

OBITUARY.

E. B. CHANDLER, who was the first city electrician of Chicago, and afterwards western agent of the Gamewell Fire Alarm Telegraph Company, died at his home in Chicago, June 7. He was born in Hartford, N. Y., in 1838.

MR. W. A. VAIL.—William A. Vail, assistant general manager of the Northwestern Telephone Company, died of pneumonia at his home in Minneapolis on June 4. Deceased was well known in telephone circles throughout the country, especially in New York, where he was located for several years. Mr. Vail was 45 years of age.

PERSONAL.

MR. CHAS. R. GUERTLER, of the Engineering Company of America, is making an examination of the route for the proposed Roanoke and Mt. Airy electric railroad.

MR. DONALD MURRAY has reprinted in pamphlet form from the *Elektrotechnische Zeitschrift*, the elaborate article recently published on his automatic telegraphic system, written by Herr A. Kraatz. It is an exhaustive description.

DR. CHARLES BASKERVILLE, who attracted considerable attention a few months ago by "splitting" thorium into two elements, which were named carolinium and berzelium, has come to New York as head of the department of chemistry in the College of the City of New York.

MR. SAMUEL INSULL, president of the Chicago Edison Company, who has been taking a holiday with his family in England and on the Continent for some weeks past, has just returned, feeling much better for the change. Part of the stay in England was occupied with automobile tours.

MR. WALLACE C. JOHNSON, consulting engineer of the Niagara Falls Hydraulic Power & Mfg. Company, has been engaged by the Sientere Viva Mining Company, Bluefields, Nicaragua, to draw out plans and specifications, as well as to construct and equip extensive electrical power development and transmission systems in the locality of Bluefields.

MR. G. MARCONI has returned again on the Cunarder *Campania*, the trip being made with the object of starting up a regular newspaper service on the line by wireless. The newspaper proved very successful, plenty of news being received and printed on the trip. The *Cunard Daily Bulletin* is an excellent little sheet, and ought to prove a good journalistic property.

MR. ROBERT McF. DOBLE, of San Francisco, consulting and supervising engineer, making a specialty of hydro-electric power developments and long distance power transmission, announces that he has become identified with the Abner Doble Company, engineers and manufacturers of tangential water wheels with needle regulating nozzles. His offices will be at 417 Rialto Building, San Francisco.

MR. T. DURMAN, representing W. S. Laycock, Ltd., the well-known government and railway stores contractors of Sheffield, England, is on a visit to this country after about ten years' absence. He is very much pleased and surprised at the growth in that period. He is proceeding from New York to St. Louis, where he expects to devote some time to the Transportation Building. He will also visit some of the Western cities.

MR. U. N. BETHELL, vice-president and general manager of the New York Telephone Company, on June 3 gave an interesting talk before the Men's Club of the Methodist Church, Montclair, N. J., taking for his subject the business and social aspects of the telephone. Mr. Bethell's thorough knowledge of his subject and his masterly manner of presenting his facts insured deep and thoughtful attention from his audience.

MR. GEO. A. DAMON and Miss Henrietta B. Diller, daughter of Mr. and Mrs. Henry B. Diller, of Chicago, were married at Chicago, June 8. Mr. Damon is the managing engineer of the Arnold Electric Power Station Company, and has many friends and admirers among the electrical engineering profession in Chicago, where he is very prominent in technical circles. His recent paper on the earnings of electrical engineers attracted universal attention, and embodied a large amount of valuable data.

W. K. VANDERBILT, JR., is busily engaged studying electricity, says the *New York Times*, and getting informed on the technical points of railroad administration. The young millionaire is working in the department of Mr. W. J. Wilgus, fourth vice-president of the New York Central. He gets to his office every morning before 10 o'clock and leaves about 4. P. M. for his yacht, anchored at the foot of East Forty-second Street.

MR. W. C. GOTSHALL.—A few weeks ago Mr. W. C. Gotshall, president of the New York & Port Chester Railroad Company, while driving an automobile through one of the east side sections of New York City, with his wife, was attacked by a gang of roughs, who stoned the vehicle. Mrs. Gotshall was severely wounded on the head and her life was despaired of. We are glad to announce that she is now much better and will be able to be up and about within the next week. Meantime the hoodlums appear to have escaped punishment.

MR. S. S. FOLWELL, manager of the street railway department of G. D. Peters & Company, London, was in New York this week winding up a visit of some two months in this country. Mr. Folwell states that the business outlook on the other side of the Atlantic is good. G. D. Peters & Company have just secured the contracts from the Underground Electric Roads, of London, Ltd., for the car seats and blinds for the 420 new electric cars which will shortly be used in the District Underground Railway. This is the old original London Underground which is now being electrified. The seats are "Hale & Kilburn," similar to the seats used on the Manhattan Elevated Railway.

Trade Notes.

THE TWYFORD MOTOR CAR COMPANY, Brookville, Pa., is erecting a two-story building, 50x200 feet, and has ordered all the machinery for its equipment.

W. M. SHEEHAN & COMPANY, 136 Liberty Street, N. Y. City, have issued catalogue No. 25, a neat little pamphlet devoted to direct and alternating current fan motors of all styles of application. These are all illustrated, and sizes and prices are given.

DIXON'S GRAPHITE CUP GREASES are the subject of a neat little special pamphlet issued by the Joseph Dixon Crucible Company, of Jersey City, N. J., and devoted to a discussion of this interesting subject, as well as giving details about the varieties, etc.

"NOSCRU" PUSH BUTTONS.—The Sarco Company, 906 Sixth Avenue, New York, manufacturer and owner of several electrical appliances operated without screws, particularly the "Noscru" push button, reports that where dealers are running short of midget push buttons they are ordering the "Noscru" in preference to others having screw connections. Some of these devices have been recently described and illustrated in these columns.

THE NERNST LAMP.—A very useful and interesting, as well as attractive little pamphlet has just been issued by the Nernst Lamp Company, of Pittsburg, entitled, "The Value and Utility of the Nernst Lamp to the Central Station." It is not only a brisk discussion of the subject, in cogent terms, but embraces considerable data. Our central station readers ought to secure a copy.

THE CENTRAL ELECTRIC COMPANY, Chicago, announces the fact that it is prepared to furnish D. & W. fuses and blocks, up to 800 amperes in both 250 and 500 volts. The company is also authority for the statement that the demand for D. & W. material is still increasing and says that the most fortunate thing about it is that a customer who tries D. & W.'s is sure to continue using them.

NATIONAL-ACME.—The National-Acme Manufacturing Company, of Cleveland, Ohio, announces the opening of a New York office at 220 Broadway, in charge of Mr. R. A. Scranton, manager, to attend to business in this part of the world in its Acme automatic multiple spindle screw machines, screw slotters, cap screws, set screws, etc. Local orders and inquiries will receive prompt attention from Mr. Scranton.

THE EMERSON ELECTRIC MFG. COMPANY, of St. Louis, reports that prompt shipments can be made of Emerson desk and ceiling fans for any regular voltage or frequency. This company, as usual, is carrying a well-assorted stock in New York City, as well as in St. Louis, and Eastern customers can depend upon receiving prompt service from New York City. Over twenty styles are regularly carried in stock.

ELECTROLYTE FOR STORAGE BATTERIES.—The Franklin H. Kalbfleisch Company, New York, the well-known manufacturing chemist, has just issued a little pamphlet giving some extracts from publications of various concerns, and the published works of authorities as to the importance of using pure chemicals in storage batteries. All of the authors are unanimous on this point. The Kalbfleisch Company guarantees its electrolyte to be made from pure Sicily brimstone sulphuric acid and distilled water.

THE CRESCENT COMPANY, of Chicago, has shown its faith in the time switch as the coming way for handling show window signs and hall lights by taking the exclusive Western agency for the Crescent time switch. To get this agency, it had to contract for an immense number of these machines. The hustling abilities of this company are a guarantee that they will be distributed. This device has met with great favor on account of its low price, simplicity and positive action. Bulletin 205 fully describes it.

EWING-MERKLE ELECTRIC COMPANY, of St. Louis, Mo., has issued an illuminated and indexed map of the World's Fair grounds and the pike, which is remarkable in its completeness and convenience. It is 8x12 inches in size and folds up into a neat envelope, so that it can be easily carried in the vest pocket. It shows the location of every building and every feature on the grounds, and the index enables one to find instantly the location sought. A copy will be given free to anyone who applies for it either personally or by mail.

MESSRS. JORDAN BROS., 58 Fulton Street, New York, have brought out an ingenious exhaust and ventilating device which is easily and readily installed. It consists of a separate window sash which is screwed on the inside of the window case. In the window pane is cut out a circular hole of the same diameter as the fan guard, and an electrically-driven fan is mounted on a bracket so that it can be placed in front of the aperture in the window and moved away from it when it is desired to close the opening, which is done by raising the regular window sash. The fan is then swung back against the wall. This device is recommended for offices, private residences, churches, clubs, yachts, restaurants, etc. It keeps the air pure and clean in winter without draft or lowering the temperature of the room, and in the summer doing an equally valuable service either as an exhaust or suction fan.

NILES-BEMENT-POND COMPANY.—The May bulletin of this company has some very interesting data in its twelve handsome quarto pages. The first page shows a new 10-foot mill for use on high power tool steel, and another fine tool shown, as well as described is the 3 by 36-inch turret lathe, Pratt-Whitney type. A striking tool also is that driven by electric motor, a 108-inch Bement lathe, which swings 109½ inches over the bed and 74 inches over the carriages. A controller handle is provided for each carriage, so that the speed of the lathe can be conveniently controlled by the operator without change of position. There are also shown a 90-inch driving wheel lathe, a No. 11 vertical milling machine, hydraulic angle and bar shear and splitting shear. A very interesting view is that of a horizontal boring, drilling and milling machine on a milling job on the base of a casting too large to go through the planer.

A STERLING INVITATION.—Mr. W. E. Doolittle, president of the Sterling Electric Company, of Lafayette, Ind., has issued the following hearty circular of invitation: "The Indiana State Telephone Convention has been called to meet in Lafayette, June 28 and 29. As this is the home of the Sterling Electric Company we shall use every effort to make this the largest state convention upon record. From assurances already given, we believe we can state that there will be from 200 to 250 representatives of operating companies present. The headquarters will be at the Hotel Lahr. We have provided as entertainment for all; street-car ride, vaudeville show at Tecumseh Trail (a summer garden), inspection of Purdue University, boat ride, banquet at the German National Park, and a general good time. We wish to extend our invitation in addition to the notice of the Association, requesting that you be present. We assure you that you will be accorded every privilege that we have ourselves and will be treated with all fairness. We shall at least endeavor to make the Convention a pleasant one and sincerely hope that you will make it a profitable one. Give the matter your early consideration and arrange to be represented. Would suggest that you make an early reservation, and would be pleased if you would notify us the number of people you will have present so that it will assist us in arranging for the entertainment."

THE ELECTRIC SUPPLY COMPANY, of Savannah, Ga., is now doing business at No. 38-40 Drayton Street, with a branch store at No. 309 Bull Street, devoted almost exclusively to the automobile business. This company is now recognized as a factor in the electrical supply business of the South. Its customers are found all throughout the States of Georgia, Florida, Alabama, South Carolina and Texas. Its prominent Southern location and its fine new stores and sales rooms with increased shipping facilities, enable it to handle its fast increasing business with much better satisfaction to customers. It has quite a line of first-class specialties, such as Circular Loom flexible conduit, Fostoria incandescent lamps, Crocker-Wheeler motors and dynamos, and all standard makes of electric ceiling and desk fans. It also carries a large stock of general supplies and is increasing its line constantly by putting in new specialties as fast as perfected. This company's construction department has secured contracts since June 1 amounting to nearly $50,000. This covers the wiring of government buildings at Fort Dade, Fort De Soto and Fort Barrancas, Fla., and Fort Screven, Ga.; the Jacksonville, Fla., Post Office annex, and the Savannah, Ga., City Hall Building. This company has just finished wiring the Central of Georgia Railway Co.'s office building at Atlanta, Ga., and installing chandeliers in the Germania Bank Building at Savannah, Ga., and is now wiring the County Court House at Washington, Ga., and installing the Sandersville, Ga., electric light plant. The company's new venture—its automobile department—is meeting with great success, the business done the first two months having exceeded its most sanguine expectations.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 7, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

761,465. ELECTRICAL APPLIANCE; Philip H. Fielding, New York, N. Y. App. filed Aug. 26, 1903. A receptacle adapted for stringing lamps outside, it having the shape of a yoke to be saddled over a guy-wire and having means for making weather-proof connection with conductors and with the lamps attached to it.

761,637. TROLLEY GUARD; Linwood B. Aikens, Rockledge, Fla. App. filed March 24, 1904. A roller is mounted eccentrically on each side of the trolley wheel; when the wire leaves the wheel and falls upon a roller, the latter is caused to rotate and lift the wire to a position where it will again fall into the groove of the wheel.

761,641 and 761,642. EXCITING FLUID FOR ELECTRICAL BATTERIES; George F. Atwood, Wakefield, Mass. App. filed Oct. 3, 1903. (See page 1163.)

761,675. ELECTRIC CUT OUT; William J. Hartwig, Detroit, Mich. App. filed Feb. 29, 1904. Details of an inclosed fuse.

761,682. CONTINUOUS CURRENT DYNAMO; Emile J. Javaux and Alfred L. Barbou, Paris, France. App. filed Jan. 28, 1903. Iron rods are moved to a greater or lesser distance into passages in the pole pieces to interpose more or less iron in the magnetic circuit.

761,694. ELECTRIC RAILWAY SYSTEM; Charles H. Murphy, Scranton, Pa. App. filed Sept. 1, 1903. Details of a switching device for energizing sections of a third rail as the train traverses it.

761,743. ELECTRIC SWITCH FOR HIGH POTENTIALS; Gilbert Wright, Pittsfield, Mass. App. filed Sept. 24, 1903. The contracting surfaces are formed with corresponding inclines which come together upon the closing of the circuit, but which are not in contact while the circuit is held closed; the circuit is broken upon the same inclined surfaces, which therefore receive the effect of the arc and shield the main contact surfaces therefrom.

761,744. SWITCH CONTACT; Gilbert Wright, Pittsfield, Mass. App. filed Oct. 14, 1903. A modification of the preceding patent.

761,745. SWITCH FOR ELECTRIC CIRCUITS; Gilbert Wright, Pittsfield, Mass. App. filed Nov. 30, 1903. A further modification of 761,743 involving an oil switch.

761,748. CIRCUIT BREAKER; John R. Anderson, Jr., Pittsfield, Mass. App. filed Sept. 12, 1903. A device for adjusting finely the position of the magnet core with respect to the armature upon which it acts.

761,760. INSULATOR; Cummings C. Chesney, Pittsfield, Mass. App. filed

Aug. 8, 1903. A number of petticoats telescoped into one another with their edges of such shape and size as to be equidistant at all points.

761,776. CIRCUIT BREAKER; William J. Lloyd, Pittsfield, Mass. App. filed Aug. 19, 1903. The retractile spring on the armature is so disposed that its force diminishes as the armature is moved by the attraction of the magnet.

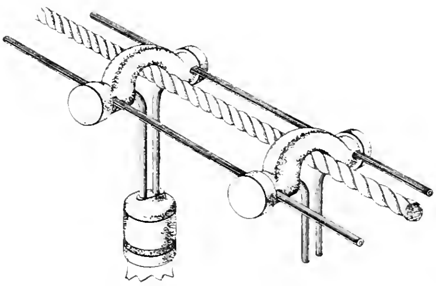
761,814. COMBINED INSULATOR AND FUSE BOX; Aaron Bearse, Syracuse, N. Y. App. filed Aug. 26, 1903. A knob insulator containing a chamber above the end of the pin for a fuse.

761,848. TROLLEY SIGNAL; Charles H. Morse, Cambridge, Mass. App. filed June 27, 1901. Details.

761,853. ELECTRIC RAILWAY SIGNAL; Robert J. Sheehy, New York, N. Y. App. filed Sept. 9, 1902. The current for operating signals in a block system is taken from the third rail power current by the car and transferred to another rail alongside the third rail; the latter is divided into sections and the signals are located in the cab of the car and are operated by arms at the roadside which are thrown into position automatically.

761,875. OVERHEAD ELECTRIC CARRIER; Charles M. Clark, South Orange, N. J. App. filed Nov. 24, 1902. The motor in a telpher system can be reversed and the bucket dumped at any predetermined point.

761,876. MEANS FOR REVERSING ELECTRIC MOTORS; Charles M. Clark, South Orange, N. J. App. filed Dec. 10, 1902. In a system similar to that previously described the breaking of the circuit through the motor throws a reversing switch, and upon a renewal of the current the parts are again put in position to reverse the motor.



761,405.—Electrical Appliance.

761,877. INSULATING BLOCK FOR ELECTRIC CONDUCTORS; Charles M. Clark, South Orange, N. J. App. filed July 7, 1903. Details of an insulating block used in the two systems preceding.

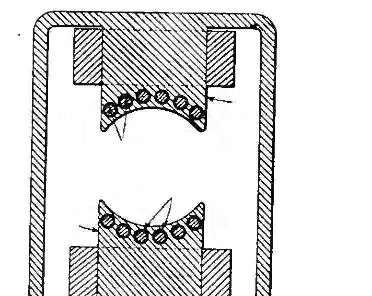
761,884. TELPHER; Henry M. Harding, New York, N. Y. App. filed Dec. 3, 1902. Means for regulating the lowering and hoisting of the bucket and means by which the circuit through the motor will be automatically broken and the telpher returned to its starting place.

761,895. SYSTEM OF ELECTRICAL DISTRIBUTION AND CONTROL; Lamar Lyndon, New York, N. Y. App. filed Dec. 15, 1903. In a system of distribution where current is generated from a car axle, means are provided for bringing the generator wholly to rest under conditions requiring such action.

761,917. TELEGRAPH TRANSMITTER; Willis J. Roussel, New Orleans, La. App. filed Feb. 11, 1903. The movement of a key in a key-board rotates a disk through one turn and brings metallic segments in the surface of the disk, corresponding to Morse characters, successively into contact with a finger trailing thereon.

761,920. ELECTRIC FURNACE; Charles Prosper Eugene Schneider, Le Creusot, France. App. filed Oct. 12, 1903. (See page 1163.)

761,928. MEANS FOR MOVABLY CONTACTING ELECTRICAL CONDUCTORS; Frederick G. Walker, Cleveland, Ohio. App. filed Aug. 12,



761,682.—Continuous Current Dynamo.

1903. Two trolley wheels placed at an angle with their rims together to form a single groove for the wire.

761,971. APPARATUS FOR GENERATING ELECTRICITY; Andrew C. Kloman, Pittsburg, Pa. App. filed Sept. 18, 1903. In a thermal generator means for simultaneously heating and cooling different parts thereof and for reversing the conditions so as to simultaneously cool the heated portion and heat the cool portion.

761,985. ROCKER RING FOR ELECTRICAL MACHINES; Edson R. Norris, Wilkinsburg, Pa. App. filed Sept. 16, 1903. A clamping device for a split ring consisting of a loop carried at one end of the ring and adapted to engage an inclined surface on the other and to be held in position by a set screw.

761,987. RAILWAY TRACK CURRENT CONTROLLER; Alfred Oesterreicher, Vienna, Austria-Hungary. App. filed May 28, 1903. A short length of rail held by a spring against the side of the track rail, to be moved laterally by the flange of the car wheel and thus close a signal circuit.

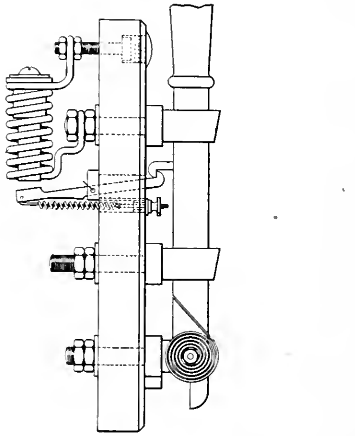
762,009. AUTOMATIC BLOCK SIGNALLING SYSTEM; Herbert B. Taylor, Newark, N. J. App. filed Oct. 14, 1903. Details.

762,030. INCANDESCENT LAMP; Samuel E. Doane, Cleveland, Ohio. App. filed Dec. 12, 1903. Certain kinds of metal have the same coefficient of expansion as glass and which could not heretofore be used for leading-in wires, on account of oxidizing and permitting leakage, are made available by plating them with an inoxidizable metal.

762,034. ELECTRIC SWITCH FOR MOTOR CARRIAGES; Henry Folger, West Somerville, Mass. App. filed Dec. 18, 1903. The handle of an ordinary three-point switch is made readily detachable for the purpose of disabling the switch.

762,074. BRUSH HOLDER; Emil S. Lueth, Baraboo, and Charles D. Knight, Milwaukee, Wis. App. filed March 21, 1904. An eccentric clamp for holding the torsion spring at any degree of tension.

762,105. ELECTRIC SEMAPHORE SIGNALING MECHANISM; Bruno O. Wagner, Amsterdam, N. Y. App. filed May 12, 1903. Details.



761,776.—Circuit Breaker.

762,111. ELECTRICALLY CONDUCTIVE COIL AND METHOD OF CONSTRUCTING SAME; Vincent G. Apple, Dayton, Ohio. App. filed Sept. 21, 1903. The layers between which the higher differences of potential exist are separated by thicker insulation than the other layers.

762,112. ELECTRICALLY CONDUCTIVE COIL AND METHOD OF CONSTRUCTING SAME; Vincent G. Apple, Dayton, Ohio. App. filed Sept. 21, 1903. Ribbon conductors are wound upon the core simultaneously with strips of paper which are so laid as to furnish the necessary insulation between adjacent turns.

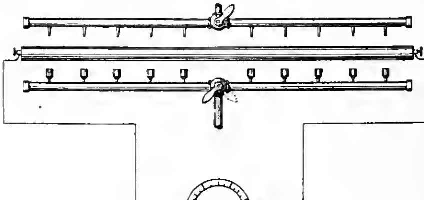
762,114. REGULATING DEVICE FOR ELECTRIC CIRCUITS; Malcolm H. Baker, East Liberty, Pa. App. filed June 25, 1902. The apparatus consists of a reactance device in series with the translating devices, the magnetic pull of the reactance device being opposed by a weight so regulated that the choking effect of the coil will vary automatically to compensate for changes in the resistance of the circuit.

762,125. ELECTRICAL TEMPERATURE ALARM; Joseph P. Bolton, Fresno, Cal. App. filed June 16, 1902. Contacts are adjustable in the path of movement of the needle of a thermometer.

762,141. ELECTRIC MACHINE; Niels A. Christensen, Milwaukee, Wis. App. filed April 8, 1901. A dynamo or motor is provided with a back-gearing device which is made adjustable for the purpose of using the machine on the floor, ceiling or wall.

762,192. SIGN RECEPTACLE; Clarence D. Platt, Bridgeport, Conn. App. filed Jan. 11, 1904. Details.

762,204. CIRCUIT BREAKER; Frank L. Sessions, Columbus, Ohio. App. filed June 16, 1902. Flat faced carbon contacts overlap each other, one of them sliding onto and off the other, the stationary plate being so mounted



761,971.—Apparatus for Generating Electricity.

as to assume a position which will ensure contact throughout the entire abutting surface.

762,215. SEARCHLIGHT; William O. Webber, Boston, Mass. App. filed Jan. 6, 1904. A traversing and make and break device whereby the light is caused to traverse intermittently over any desired arc and automatically reversed at each end of the traverse.

762,227. ANODE AND PROCESS OF MAKING SAME; Henry Blackman, New York, N. Y. App. filed Dec. 8, 1896. (See page 1163.)

762,229. EXPLOSIVE CARTRIDGE; Giovanni Cornara, Mantova, Italy. App. filed Dec. 31, 1897. (See page 1163.)

762,249. SAFETY STOP DEVICE FOR STATIONARY STEAM ENGINES; Charles A. Ott, Lincoln, R. I. App. filed Oct. 31, 1903. An electro magnet when energized operates a trip to move a controlling valve.

762,257. SYSTEM OF DISTRIBUTION; William M. Scott, Philadelphia, Pa. App. filed Aug. 18, 1903. A circuit breaking mechanism.

12,228. STORAGE-BATTERY ELECTRODE; Johannes von der Poppenburg, Charlottenburg, Germany. App. filed Nov. 12, 1903. (See page 1163.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, JUNE 25, 1904. No. 26.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the
McGRAW PUBLISHING CO.
114 LIBERTY STREET, NEW YORK.
TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
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NEW YORK, SATURDAY, JUNE 25, 1904.

CONTENTS.

THE POINT OF VIEW.

This is the season of the year when hundreds of young men, receiving the coveted diploma for which they have worked so long and hard, step out into the world as graduated electrical engineers and mechanical engineers; and are thus set apart and sealed to the professions toward which all their studies have been directed. It is a moment of anxiety as well as of congratulation for them and their relatives, but after all it is something that they cease to be merely part of the assimilative and destructive forces of the world and become portion of the influences and agencies that are to add to its stores and resources. Upon them in the next twenty-five years rests the virtual responsibility also for whatever advances American engineering is to make. Under these circumstances, it is not a little important that their training should have been broad, their culture deep, equal to and justifying alike their courage and their ambitions. How far this may be, no one can yet tell; but we do know how earnest and devoted has been the discharge of the professional functions under the exercise of which these young men have been shaped; and we can, therefore, but hope that the outlook is sunny for these latest exemplars in the noblest of professions.

At the commencement of Stevens last week, Mr. Walter C. Kerr, in a felicitous address to the graduating class, as noted elsewhere in these pages, took occasion to dwell upon the importance of the "point of view" for these young engineers. His sententious wisdom and shrewd epitomizing of an engineer's experience can but be heartily commended to every beginner. "To thine own self be true" is its keynote, and this is peculiarly applicable where the powers and instrumentalities to be dealt with are so tremendous there might easily be a temptation to think that the mechanism was all and everything and the man went for naught. Mr. Kerr, moreover, wants his engineer to be an "all around" engineer. That is sound advice and philosophy, and it may fitly be carried further with the suggestion, that the best object of all higher educational training is to create the "all around," manly man. It is for him that the world and society are looking, whatever be his differentiation as engineer, lawyer or physician.

As these young engineers emerge from the scholastic cloisters, one of the first inquiries is naturally as to the extent of the opportunities awaiting them. The current year may not perhaps be as insatiable in its demands for new blood as were the recent periods of gigantic activity, but there can be no doubt as to the work that awaits every one of them in the physical conquest of this continent or in the extension of American enterprise beyond the seas. In some ways the great consolidations may have restricted possibilities for the younger men, but that is very much open to doubt; and if it is actually so, it will prove but a temporary phase, for the next movement would be centrifugal and toward heterogeneity. Besides, there are many signs of newer days in electricity and mechanics. With radium on one side and the turbine and the gas engine on the other, no one knows yet in any degree what even these factors are cutting out in new work. As to cutting out also the Panama Canal is ahead, and it is not to be forgotten that the opening of the Suez Canal led to the swift, three-fold reconstruction of the mercantile fleets of the world, not to mention the navies. Hence, as we welcome the newly made engineers, we think it is quite safe to bid them let their "point of view" as to the future be a bright and cheerful one and then to bend all their energies toward making this world better and more habitable than they found it. If they do just this all the other things will be added unto them.

FOUCAULT PENDULUM SYSTEMS.

The article by Mr. Ernest K. Adams on page 1120 of this issue describes a variety of Foucault pendulum suspension that might be tried for maintaining the swings of the pendulum indefinitely. So far as we are aware no apparatus more perfect than the original Pantheon pendulum has ever been exhibited on a large scale. That classical experiment, although entirely satisfactory as a demonstration, was necessarily very crude, because no means were provided for maintaining the swing, and the period of time during which the swing could be self-sustained within the required limits was necessarily limited. Nowadays it should be possible to overcome this difficulty without great expense, and a self-supporting free pendulum would be a very pretty thing, worth going far to see. The suggestions for improvement offered by Mr. Adams in the present and in a previous article should, when experimentally sifted, result in an apparatus possessing all of the requirements for permanent public exhibition; and as an object lesson in the fundamental conceptions of motion, a view of such an apparatus would be highly instructive to the public—not only the untutored portion, but even those who have by rote learned the laws of planetary motion.

A. I. E. E. TRANSACTIONS.

The latest bound issue of the *Transactions* of the American Institute of Electrical Engineers is a slender volume which promises to be lost sight of on a shelf when sandwiched between its portly brothers. Another singularity about the volume is that while the title page describes the *Transactions* as covering the period from July 1 to December 31, 1902, the earliest date of transaction recorded is September 26, 1902. This miniature volume also puts an end to the further identity between the volume number and the age of the Institute. If the only reason for this odd volume is that the work of one administration should be separated from that of another, it would appear preferable to carry over matter corresponding to the beginning of an administration and include with it that of the remainder of the administration; or in case the extent of matter calls for two volumes, to divide it nearly equally to form two sections issued as "Parts" and carrying the same volume number. In any event, it does not seem desirable that the *Transactions* should continue to be issued in the form of a portly tome covering part of a year and a tiny complement covering the remainder. The prestige of the Institute rests very largely on its *Transactions*, and the form of these should not by their oddity give rise to adverse comment; and viewing the matter from the financial side, the cost of binding and distributing 3,000 or more copies of this extra volume probably formed no small draft on the slender resources of the Institute.

THE HUMMING TELEPHONE.

Accounts of the recent Conversazione of the Royal Society seem to show that the exhibits possessed more than usual interest. Every year the Royal Society holds a conversazione resembling somewhat the opening of the National Gallery of Art, in that the scientific exhibit of the year is made for the inspection of all beholders. The very successful A. I. E. E. Conversazione of 1901 showed that a similar custom could easily take root in New York, and we hope that the annual Institute dinner may occasionally in the future give way to a function of this kind. Among the exhibits at London was a curious application of the humming telephone. It is well known that if a telephone is placed in the circuit of the ordinary microphone transmitter, and held closely facing the same, the two will set up conversation in the form of a particular hum or musical note, the telephone diaphragm stimulating the transmitter to this note, and the transmitter reacting on the telephone. The apparatus referred to is described as consisting of a vibratory steel bar carrying a microphone. Vibrations started in the rod, generate currents of the same frequency in the microphone circuit. These currents are caused to act upon an electromagnet, which in turn stimulates the rod to yet more vigorous vibration. Induced alternating currents are tapped from the apparatus, considered as a high-frequency generator, for inductance measurements, or tests, in which only a relatively feeble unit-frequency current is desired.

THE ARCHITECTURE OF CENTRAL STATIONS.

As a rule central stations are designed strictly in accordance with the Socratic canon of beauty, and judged by the ideals of date later than B. C. they are generally masterpieces of ugliness. With a few exceptions they follow the graceful design of a shoe box surmounted by several lengths of stove pipe rampant. A paper has recently come into our hands read by Mr. C. S. Peach before the Royal Institute of British Architects, which throws a new light on the possibility of combining sound design with some degree of architectural grace. It is rich in illustrations, derived mainly from Continental practice, of power stations great and small, marked by an attention to artistic effect quite unknown in this country. We should not, of course, expect too much of a building designed for brutally utilitarian purposes, particularly in these days of twenty-story steel boxes, when he is accounted the best architect who can most scamp his design so as to secure the minimum cost per cubic foot of volume and square foot of floor space. And we realize, too, that there should be some degree of appropriateness to the desired ends—that Notre Dame with its towers converted into smokestacks would lack a certain unity of conception. But joking aside, Mr. Peach's admirable paper shows very plainly that it is possible to build great power stations on thoroughly sound engineering principles without sacrificing architectural dignity and beauty. It is a lesson worth studying for its own sake, however small be one's reasonable hopes that it may be generally taken to heart.

To begin with, one may divide power stations into three classes—steam-driven central stations, hydraulic stations and auxiliary or sub-stations in which steam power is either absent or quite inconsequential. The first class is obviously by far the most difficult to treat architecturally on account of the necessity of chimneys, which may be short or tall according as artificial or natural draft is used, but still are chimneys with their purpose fully in evidence. Add to this necessity the considerable space required for boiler and engine rooms, coal storage and other purposes and the difficulties of the situation are self-evident. Yet in spite of all this, Mr. Peach shows that it is possible to unite the severe requirements in buildings that are at once dignified and picturesque. Especially commendable are the power stations of the municipalities of Munich and of Vienna. The latter, with its four huge stacks and great size, was particularly difficult of treatment, yet the final result is most admirable. The Munich station, much smaller, is equally good and the chimney is of particular interest as an innovation upon the usual designs. And the most striking thing about these and some other fine Continental stations is that the excellent architectural result is obtained without any material increase of cost—merely by knowing how to obtain good effects by simple and inexpensive means. In this connection the author very shrewdly points out that a little additional expenditure on the building to the benefit of the surrounding property often brings large returns in good will and freedom from opposition and litigation. It is well to bear in mind that the rights of neighbors are being more and more upheld by the laws as time goes on, laying more and more emphasis on the doctrine that in a complexly organized community there are no absolute rights in property, but only predominant equities. It is this feature of the case that gives so great a value to public good will in enterprises of a permanent character.

Water power stations offer an entirely different set of conditions. Situated often in isolated situations and on sites closely defined by the hydraulic requirements, there is less need for an opportunity for architectural display. Yet now and then when a water power is developed in a city or when the situation is favorable elsewhere, capital effects can be and ought to be achieved. A beautiful example of the possibilities of hydraulic stations is cited by Mr. Peach in the station at Tivoli on the Tiber, which supplies the city of Rome. Here the aqueduct is built of masonry after the ancient Roman model and passes with hardly an architectural break into a stone power house clinging to the cliff above the river. More frequently, however, the necessity, real or supposed, of building very long and narrow stations makes anything by the crudest treatment quite impossible. The easiest case for the architect in electric power stations is found in the sub-stations now so frequently installed in connection with transmission plants and great central stations. These, generally speaking, are inside city limits, but they are not hampered by tall chimneys, and the apparatus brings no extraordinary requirements for space. The main difficulties are met with in securing adequate foundations so that no vibration shall be transmitted to neighboring buildings, and in planning the building so that the noise of the moving part of the machinery, if any, shall be suitably deadened. These are, so to speak, internal requirements on which engineer and architect must join forces; the exterior requirements give the latter for once a free hand. How effectively this opportunity may be grasped is admirably shown in Mr. Peach's own design for the great Mayfair motor-generator station of the Westminster Electric Supply Corporation, where a partially sunken station with graceful entrance porches is crowned by an Italian garden. Even without so radical a departure from ordinary methods there is no reason why a sub-station should not be built with an appropriate and decorative exterior. Mr. Peach has assuredly done a public service in showing how the material accompaniments of a great modern industry may be made harmonious and even artistic. We hope his lesson will not be forgotten in future construction.

THE STRUCTURE OF THE ATOM.

The present trend of scientific speculation and theoretical investigation is toward the interior of an atom of matter, or to examine into the nature of its works. Until the last few decades, chemical and physical theories of matter stopped at the atom. Every substance was supposed to be formed of molecules, and each molecule was an orderly arranged group of a definite number of atoms. Atoms might be spherical masses like very minute shot. All atoms of the same element were identically alike, and atoms of different elements were characteristically and eternally different. Chemistry desired no more than this working hypothesis. Physics needed no more. The kinetic theory of gases was thereby satisfied. But the progress of natural philosophy in general, and the development of spectrum analysis in particular, upset the crude simplicity of the atom, and demonstrated that each atom was probably at least as complicated inside as a solar system. The advantage gained by this intra-atomic complexity was that it enabled all kinds of atoms to be ideally constructed out of one and the same fundamental stuff, for which mother material the name "protyle" has been used. Different dynamic systems of moving particles of protyle thus formed the different kinds of the atoms of chemistry. Different aggregations of atoms formed molecules, and aggregations of molecules, or groups of molecules, formed the matter that our senses reveal to us. The advance in theory thus made promoted the atom from the minimum thinkable mass to a relatively large mass, although of absolutely very minute dimensions. It made the minimum thinkable quantity of mass the particle of protyle. The question then arose as to whether these ultimate particles of protyle were to be regarded as point-spheres, like shot, the shot in different atoms being all alike, but differing in number, grouping or activity. One form of the most recent electron theory regards these particles of protyle as point-charges of electricity. On this view different groupings of electric charges make up the different atoms, and so on. Consequently, on this theory, all matter is ultimately electricity, and electricity may be a special localized disturbance of the all-pervading ether; so that all matter is ultimately energized ether.

As bearing on this hypothesis, a very interesting paper "On the Structure of the Atom," by Prof. J. J. Thomson, appears in the *Philosophical Magazine* for March last. The article contains an analysis of the actions that would occur in an atom consisting of a number of electric point-charges subjected to certain assumed forces. The forces involved are three, namely: a centripetal electric force, toward the center of the atom, varying directly as the distance therefrom; secondly, a repulsion, due to the action of similar electric point-charges in the neighborhood; and, thirdly, centrifugal forces of inertia, due to planetary rotation of the charges about the center. This represents a sort of Newtonian planetary system inside the atom, except that the attraction toward the central sun increases as the planet is farther away, and that the planets push each other apart instead of mutually attracting. The writer tries to determine mathematically from these premises what groupings and velocities of the electrons, or corpuscle point-charges, would form stable atomic systems. The general problem in three dimensions has been too hard even for the well-known mathematical powers of the writer—but a number of solutions are given for two-dimensional distributions, in which the corpuscles are arranged in concentric rings, the rings moving around in the direction of their length, or tangentially to themselves.

It is shown in a masterly way that rings of three, four, five or six corpuscles are stable, at certain planetary velocities. Above six corpuscles, the rings require interior planets to effect stability. In the case of twenty-five or more corpuscles, three concentric rings would be required. With thirty-five or more, there would have to be four concentric rings, one within the other, and with fifty-five or more corpuscles, five concentric rings would be needed. The natural periods of vibration of such atomic systems would be both rotational and perturbational. The rotational period would be the period of a planetary "year," divided by the number of corpuscles in the ring belt. The perturbational periods would depend upon the proximity between neighboring corpuscles. It is shown that if all the possible stable arrangements are produced, the atomic systems may become periodic in their properties, suggesting the periodic series of the chemical elements as discovered by Mendelief. A number of other interesting chemical or electrochemical properties are indicated. While the theory of the article is necessarily tentative, yet it foreshadows the possibility of great progress being effected at no very distant date in theoretical and physical chemistry. It is quite conceivable that some day the student of chemistry will be able to compute mathematically all the possible chemical reactions of substances, without having to carry out the actual process in the laboratory. Howbeit, that end is not yet.

Honors at Stevens to Electrical Engineering.

The Stevens Institute of Technology, Hoboken, N. J., has contributed a large number of useful and influential men to all departments of engineering, and to-day has many worthy representatives in the field of mechanics and electricity. This year in the person of Mr. J. W. Lieb she has seen one of her graduates elected president of the American Institute of Electrical Engineers, a body on whose council she has already had recognition. And now a further bond of relationship is to be found in the fact that last week at the commencement exercises, Mr. Edward Weston was made by Stevens a Doctor of Science, this being the first time in its history that the Institute has conferred that degree. The relation between Mr. Weston and the graduates of Stevens has always been close and intimate, and ever since this distinguished engineer and inventor began his career at Newark, near by, the shops and plants under his management or name have given abundant occupation and opportunity to Stevens men. Not long ago Mr. Weston, an Englishman by birth, was made a Doctor of Laws by McGill University, but it is even more fitting that the specific technical recognition should come from New Jersey and the country of his adoption.

In presenting Mr. Weston for the degree of Doctor of Science on June 16, President Humphreys said: "In addition to conferring degrees for work done in course, Stevens Institute, in common with other higher institutions of learning, exercises the high privilege of conferring honorary degrees upon men who have, by work done outside as well as inside of college walls, proved their right to be acknowledged as men of eminent intellectual attainment. While it is a great privilege to be authorized to so seek out and honor those who have proved themselves worthy, it is a privilege not lightly to be exercised. That Stevens Institute has not misused its privileges in this connection is indicated by the fact that during the past thirty-two years we have graduated 1,089 men; but we have, during the same time, conferred only 15 honorary degrees. This year the faculty and trustees have decided to confer for the first time the honorary degree of Doctor of Science. I present for the honorary degree of Doctor of Science Edward Weston, Doctor of Laws of McGill University, Toronto, original investigator in science, inventor and engineer.

"This is frequently spoken of as the age of electricity, and this because during the past few decades the manifestations of electricity have been studied until it has been possible in many marvelous ways to apply for the use and benefit of mankind the laws of nature so discovered. In so discovering and applying the laws of electrical science, probably no one has done more for mankind than Edward Weston. Many years ago he made radical improvements in the art of depositing the various metals by electricity. He developed the dynamo machine to take the place of batteries in this work. He took the lead in the work of investigating the separate losses in dynamo machines and his inventions served to greatly reduce those losses. He developed dynamo machines for electric lighting and power transmission. He built the first factory in the United States for manufacturing dynamo machines and in this factory the electric current was first used for transmitting power. He invented processes, machines and devices for arc and incandescent lighting, including the copper-coated carbon, carbon filaments from amorphous cellulose, and the hydro-carbon treatment now universally used for flashing incandescent lamp filaments.

"In later years he discovered two alloys having a zero temperature coefficient, now universally used for resistance standards. He invented a standard cell with a practically zero temperature coefficient, and he invented and developed a most complete line of direct indicating electrical measuring instruments which to-day are the standards throughout the civilized world. It is seldom that the ability to carry on work in the line of scientific research is found combined with the ability to practically apply the laws so discovered as is found in the person of Mr. Weston. In acknowledgment of the varied, original, important and great amount of scientific work he has accomplished, the record of which I have barely outlined, I ask you to confer upon Edward Weston the degree of Doctor of Science."

Another interesting part of the exercises was the address to the graduating class by Mr. Walter C. Kerr, a trustee of Cornell University, and president of Westinghouse, Church, Kerr & Co., who with wonted felicity and suggestiveness spoke of the importance of "The Point of View." He called attention to the fact that the so-called liberal education had always been highly academic, while trade school engineering had been strictly non-academic. But the two had joined hands in the engineering institutes, with advantage; but there was a danger of engineering education now becoming too academic, a tendency to be watched. He asserted that the highest refinement of knowledge follows from the highest use of the senses. "It is only within the past century that the human mind has seemed capable of turning from the lesser resistance of intellectual attainment to the greater capacity for physical comprehension and observation. We have but recently come to the era of intense mental operations, dealing with laws and principles which require insight greater than the intellect can grasp unless aided by the senses." He expressed the hope that the spirit of engineering as found in practice would form a more definite part of engineering education, and suggested the idea that professors would eventually come to a system of devoting all their time to teaching while they taught, but would go periodically into the world, a few years at a time, for practice.

Mr. Kerr then speaking more directly to the students, urged on them the importance of the right "point of view" as they began active life and went through it. Adam, William Tell and Sir Isaac Newton each had an affair with an apple, but with different results. They were to neglect no opportunity as too small, and were to remember that knowledge after all had not much to do with effectiveness. It was a good tool, but not the performing vital form. They must cultivate singleness of purpose. The power of concentration, however, is not in the books. From directness of purpose follows diligence in getting what one is after, and in getting it all. The mediocrity of compromise was to be avoided. To be right they must be 100 per cent. right. Much of our engineering is only done once, and it must be done right that once. Real power is ability to perform right the first time that which a man never did before. Hence, by sequence, clearness of thought is also essential, aided by the moderate cultivation of system, without slavery to which each can find his own logical way. Intuitions were thus quick reasonings, but all ideas little or big were only valuable when put into execution. A point of view is involved in the power to rationalize, which is in itself a great check upon error.

Mr. Kerr enlarged quite interestingly also upon the "point of view" in engineering expression—designs, drawings, mathematical determinations, words, work done, of which words were the lamest. Hence, he urged learning the right use of words, for engineering documents were usually full of misstatements due to the careless use of language, so that plain, concise terms could not be overestimated. Facility was to be cultivated in reading the words of others. Per contra, one of the worst attributes, fundamentally born of conceit, was the tendency to fasten error and censure on others. A man needed to stand up in front of himself and ask, "What is the matter with me?" To admit an error or frailty of judgment is a measure of strength rather than weakness. Mr. Kerr then lay special stress on a cheerful disposition, pleasantry and non-contentiousness, because a reasonable optimism—to vote aye and believe that things can be done—is helpful to others and to enterprises.

Some of them probably had a special "point of view" in a preconceived notion of following some line of engineering. He warned them to be careful about their self-analysis. The field of engineering is large and has room for all, whether constructive, inventive or contemplative. Some tended toward professional, others toward trade work. He could not help, for himself, a certain predilection in favor of a young man being just an engineer—not specializing too young, but developing along versatile lines, ready to turn his hand equally well to any task within his general scope. The man who believes he can apply himself in one direction about as well as another, will come nearer doing it than one who thinks he cannot. They would also doubtless try to improve things when they started. It is a legitimate purpose if not overworked. The one improvement that most things needed was in the line of sufficiency. A "point of view" rarely considered had to do with environment and the power to vary. All the way up from protoplasm, environment grew constantly more intricate and resistance retarded evolution. This complexity presses down and holds back. Environment was not a producer, but often against production, so that all the good they did must come out of themselves. It was the inherent capacity to perform with their own brain that would make them whatever they became and not the mere transmission of what they had acquired. Many a man who had received an education has not got any, because it never became part of his personality and slipped away. Many a man had gone through experience without acquiring it.

Bear River Power Plant and Utah Transmission Systems—II.

(Concluded.)

FROM the power house the three-wire transmission line passes up the east bank of the river and skirts the base of the Wasatch Mountains, keeping for the most part above the cultivated farms. It taps into the Utah Light & Railway Company's line at Ogden. The total transmission distance from the power house to Salt Lake City is 82 miles and the route of the line is shown on the map, Fig. 17, to which reference will be made later.

The transmission line consists of three No. 0 soft-drawn copper wires, carried on 40-ft. round cedar poles set 120 ft. apart. The insulators are carried on two cross arms, as shown in Fig. 12. The lower arm, which carries two wires, is 7 ft. long and is bolted to the pole 5 ft. below the top. Additional support to the arm is provided by two 30-in. x 1¼-in. x ⅜-in. iron braces, fastened with lag

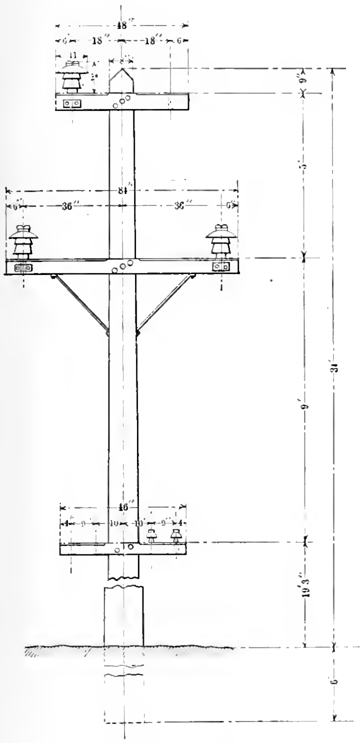


FIG. 12.—ELEVATION OF 40-FT. POLES.

screws. The top insulator, instead of being mounted on the top of the pole, as is frequently done in the West, is carried by a 4-ft. cross arm bolted to the pole 9 in. below the top, thus giving a better mechanical construction. Both cross arms are 3¾ in. x 5¾ in. in cross-section. The top insulator is mounted 18 in. from the center of the pole and on successive poles is reversed from one end of the arm to the other, as may be seen in Fig. 12. This arrangement is an advantageous one in case of a broken insulator, as the wire will fall on the cross arm and against the pole and thus be kept from causing a short-circuit by falling on the wires below. The three wires, of course, are not spaced to form an exact equilateral triangle, but it is an approximate one, with 6-ft. sides.

In the construction of the pole line the insulators have been relied upon entirely for insulation and the rest of the line has been made as strong mechanically as possible. The insulators are of the Locke brown porcelain type, made in three pieces and afterward cemented together. Each insulator was tested at the factory with a 120,000-volt current before being accepted. The insulators are 10 in. high, 11 in. in diameter and weigh sixteen pounds apiece. They are mounted on cast-iron pins, which have a height of 10 in. above the cross arm and are threaded at the top to receive the insulator. The cast-iron

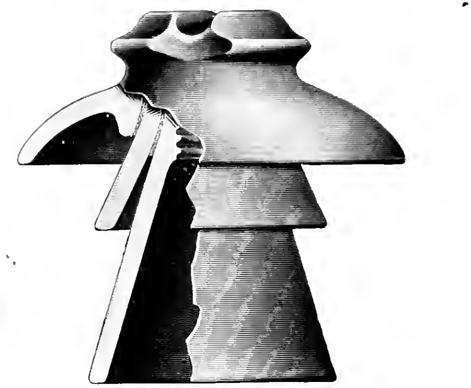


FIG. 13.—PORCELAIN INSULATOR.

shank of the pin is 1¼ in. in diameter and 5 in. long, and has a ⅝-in. round steel core, which projects below and is threaded to receive a nut for bolting the pin securely to the cross arm. Further security is provided by 3 x 4 x ⅛-in. plates bolted to the sides of the cross arms opposite the pins.

Fig. 13 shows the insulator used. The middle and lower shells were cemented together at the factory, and the top shell cemented on in the field. Fig. 14 shows an insulator under test at 75,000 volts with

FIG. 14.—INSULATOR UNDER TEST AT 75,000 VOLTS.

a shower of water corresponding to a precipitation of ¾ in. per minute, the test covering 15 minutes. The standard test under normal conditions is at 100,000 volts.

Nine feet below the large cross arm is a 46-in. cross arm which carries a No. 9 iron-wire telephone circuit. The telephone line is transposed every half mile and is said to give perfectly quiet service, although there is an induced voltage between either side and ground sufficient to light an incandescent lamp. For the use and convenience of the men patrolling the line, telephones are connected at intervals along the route as well as at the power house and receiving station in Ogden. They are placed in booths so insulated as to protect the user from danger of an accidental cross between high-tension and telephone wires in case of a breakdown.

The entire output of the Bear River plant of nearly 3,000 hp is sold by the Utah Sugar Company to the Utah Light & Railway Company, as already mentioned, and the latter company operates the station and transmission system. It has recently been decided to install a third unit at the power house of the same size and style as those now in operation.

The concrete work and power house were built under the direct superintendence of Mr. J. C. Wheelon, superintendent of the Utah Sugar Company's canal system. The entire plant and transmission system was designed and supervised by Hayward & Gray, consulting engineers of Salt Lake City. To Mr. O. H Gray, successor to the firm of Hayward & Gray, appreciation is due for kindly supplying data and illustrations for this article.

NOTES ON UTAH TRANSMISSION LINES AND SALT LAKE STATIONS.

A general idea of the extensive interconnected power transmission

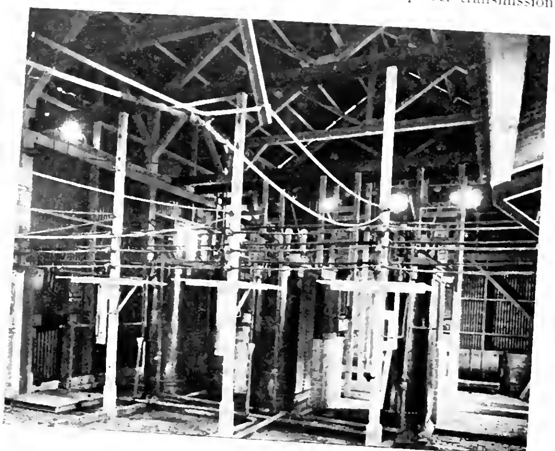


FIG. 15.—INTERIOR OF SUB-STATION, SHOWING HIGH-TENSION BUS-BARS, TRANSFORMERS, ETC.

system in Utah may be obtained from the map, Fig. 17. This map shows the lines of the Utah Light & Railway Company, including the Bear River system, indicated by a heavy, full line, the circuits of the Telluride Power Transmission Company indicated in heavy broken lines and the system of the American Fork Canyon plant in crossed lines.

The Utah Light & Railway Company operates the Bear River, Ogden and two Cottonwood water power plants and three steam stations in Salt Lake City. The Telluride company has a water power

FIG. 16.—INTERIOR OF SUB-STATION, SHOWING LIGHTNING ARRESTERS, ETC.

plant at Logan, 85 miles north of Salt Lake City, and another at Provo, 45 miles south. These two stations are connected by a duplicate pole line and at Salt Lake taps are taken off to a transmission sub-station of the Utah company situated close to a new station of the company in the western part of the city. At this station the power from the Telluride system and the company's northern lines

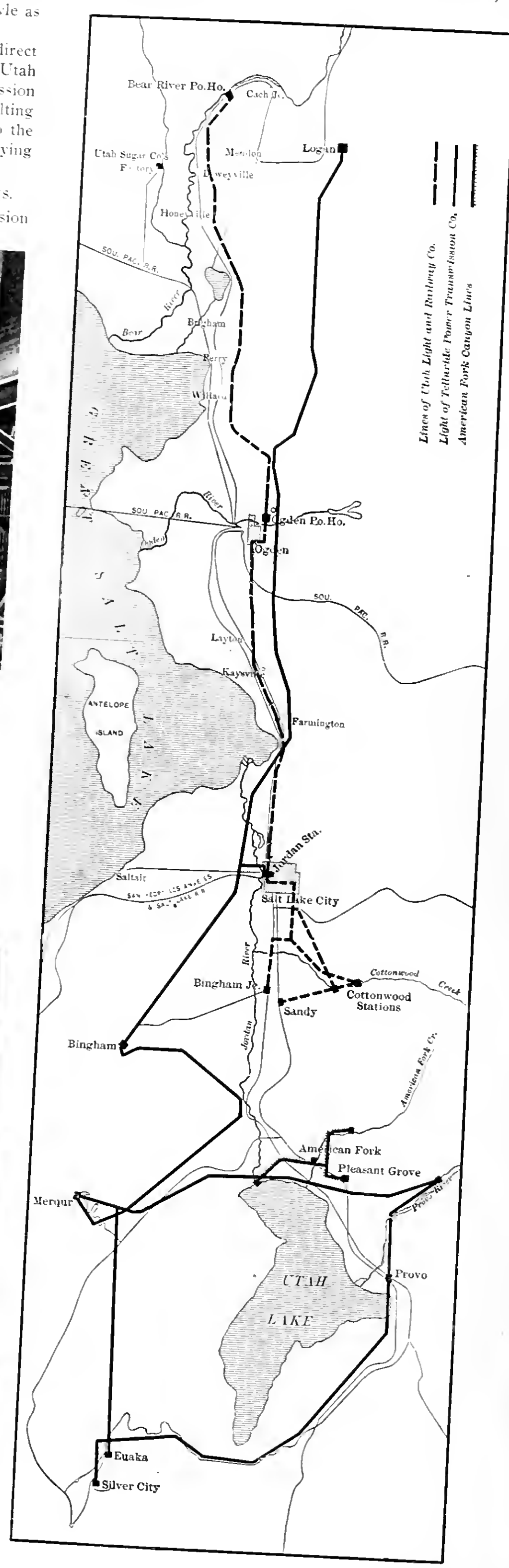


FIG. 17.—MAP OF TRANSMISSION SYSTEMS.

is received and stepped down from 40,000 to 2,300 volts by means of water-cooled, oil-insulated transformers. This sub-station now has a capacity of 2,700 kw, but it is being rebuilt and enlarged and by fall will have a capacity of 6,000 kw and will receive the power from all the transmission lines of the company, including those from the Cottonwood stations, which now come into another sub-station at a lower voltage. The sub-station is equipped with lightning arresters, static interrupters, air-break switches and a complete set of indicating and recording instruments.

The steam station is called the Jordan station, as it is located on the bank of the Jordan River. It was erected as a temporary power house to carry the company through its peak loads until a large steam turbine central station now planned by the company can be erected. The equipment consists of six 250-hp Babcock & Wilcox boilers set in three batteries, and a 1,200-hp Hamilton Corliss engine, which drives by means of a large belt a 750-kw alternator. This plant is used for a few hours each night to help over the peak of the load.

It is interesting to note that these six water power and three steam stations are all operated in parallel through the low-tension side, and although some of the stations are nearly 150 miles apart the generators operate in perfect synchronism.

Fig. 18 is interesting as showing how a high-tension transmission line from the Cottonwood plants is brought through Fourth South

FIG. 18.—HIGH-TENSION LINE, SALT LAKE CITY.

Street, one of the principal streets of Salt Lake City, on 60-ft. poles. These poles are set in the center of the street, as are practically all poles in the city on account of the unusual width of the streets.

An interesting transmission system in Utah is that from American Fork Canyon to Utah Lake and indicated on the map by crossed lines. This system is a striking illustration of the use of water power as an aid to irrigation. The power in this case is transmitted electrically to the head of Utah Lake, where it is used to drive four 100-hp pumps, which raise about 500 cu. ft. of water per second out of the lake into a system of five large canals. These canals irrigate the Salt Lake Valley. Power for the pumps was formerly supplied by the Jordan Narrows plant, but the American Fork plant has recently been enlarged and the transformers at the pumping plant have been rearranged for this purpose. The reconstruction work was done by Mr. Owen H. Gray.

Deep Sea Cable Between Valdez and Nome.

The second consignment of deep sea cable now being laid by the Government between Valdez and Nome has just been shipped in a special train of thirty-one cars over the Lackawanna Railroad. This shipment consists of 800 tons, and is part of an order for thirteen hundred miles of submarine cable being executed by the Safety Insulated Wire & Cable Company.

An Object Lesson to the Public in Metering.

An interesting piece of apparatus for the instruction of the general public in regard to electric light meters is in operation at the main office of the Denver Gas & Electric Company, on Seventeenth Street, Denver, Colo. The device consists of eight incandescent lamps mounted in porcelain sockets on a wooden panel about 25 in. square; an electric meter and eight snap switches. The lamps are wired to the regular 100-volt alternating circuit of the company and are numbered consecutively from one to eight. The first and eighth lamps are 4 cp each, while the candle-power of the intermediate lamps is 8, 10, 16, 25, 32 and 50 in the order named. Each one or any number of these lamps may be switched into circuit at the will of any customer desiring to experiment with the meter. The snap switches are numbered consecutively to correspond with the different lamps and are mounted in a horizontal row at the bottom of the board. A great number of candle-power combinations are thus possible for experimental purposes, and these vary from 4 to 149 cp. Even the effect of one candle-power may be noted by combining the lamps properly.

The meter is a 100-volt, 10-amp. watt-hour instrument mounted in a glass case, and designed for 60-cycle current. It is direct reading and has a dial capacity of 100,000,000 watt-hours. The brake disc is marked at a point on the circumference so that the revolutions may be accurately tuned and counted. In the center of the panel is a notice to the public as follows:

"THIS IS AN ELECTRIC METER"

like those which are in the houses and stores of our customers, except that this one is constructed partly of glass in order that you may see how an electric meter is made and how it operates. This particular meter measures the current that supplies the lamps on the board surrounding it. By turning on one lamp at a time or by turning on lamps of different candle-powers you can see that the motion of the moving parts of the meter varies in proportion.

"An electric meter is an almost perfect measuring instrument. It measures current with great accuracy. We test all our consumers' meters at frequent intervals to see that they are registering correctly, and then abide strictly by their readings in making out our consumers' bills.

"We have no control over the size of our consumers' electric bills. That is a matter which rests entirely with the consumers themselves. We cannot make their bills larger or smaller unless we should go into their houses and turn on or off some of their lamps. If the consumer thinks his bill is too large we are glad to do all we can toward helping him ascertain the facts in the case. If he thinks his meter is incorrect we shall be glad to take his meter out and test it in his presence. If the test shows that the meter has been registering against him we will rebate him accordingly.

"We are especially desirous that our customers should learn to read their own meters so that they may verify the correctness of our bills and keep tab on their consumption of current from time to time during the month. The reading of an electric meter is as easy as telling the time of day by a clock. You simply begin with the left-hand dial and set down in turn the smaller of the two figures between which the "hand" on each of the dials appears and then add two ciphers. This will give you the reading in watt-hours, and, pointing off three places from the right gives it in "kilowatt-hours." Subtracting the previous reading from this one will show how much current has been consumed since the previous reading. Please ask us for a copy of our printed instructions for reading meters.

DENVER GAS AND ELECTRIC COMPANY."

At the right of the lamp panel is a gas meter connected to six different sized burners, a similar notice being posted upon the board over the meter, designed for the reading of gas consumers.

The printed instructions for reading electric meters consist of a sheet of cardboard about 5 by 7 in. upon which are inscribed regular meter dials with movable hands, so that various readings may be set up at will. Full directions follow the printed dials, and the card is fitted with eyelets and a hook, so that it may be used as a bill file.

By means of this object lesson the Denver Company meets its consumers frankly and squarely upon the hitherto vexing meter problem.

Foucault Pendulum Systems.

By Ernest K. Adams.

In a preceding issue of this journal* a number of electrical systems have been illustrated and described, whereby the vibrations of a Foucault pendulum may be prolonged. These systems are based upon the electrodynamic action of two coils of different diameters, the smaller of which is incorporated in the bob of the pendulum and the larger mounted symmetrically beneath the said pendulum. By simultaneously sending currents through these coils in the same or opposite directions, the pendulum coil may be accelerated respectively toward or away from the center of the large coil. The methods of controlling the accelerating current may be manual or automatic. From a test made with a 16-ft. pendulum, the results obtained would indicate that the principles of the systems are correct. The burden of the paper was to suggest a line of investigation in this subject to those who have the facilities for swinging pendulums whose lengths may run up to that of the original one in the Pantheon at Paris. In a recent communication to the Electrical World and Engineer, Mr. S. Tideman suggests that the pendulum may be accelerated by raising and lowering the suspension of the system when the bob of the same is traveling respectively away from and toward a vertical line passing through the point of suspension. While it is known that the suspension of a Foucault pendulum is the most sensitive portion of the organization, it may be possible to so accelerate it there that the component of the earth's rotation will not be seriously influenced in its action upon the pendulum. In the present paper the writer begs to suggest several designs for carrying out this idea. The first is a mechanical one, which is adapted to pendulums of moderate length, such as would be employed in general physical laboratory work, while the others are electrical in character and suitable for pendulum systems of considerable height, as would obtain in the Pantheon or other demonstrations. In all cases the movement of raising and lowering the suspension is caused to imperceptibly start and stop, the maximum rate of vertical motion occurring at the center of the predetermined displacement.

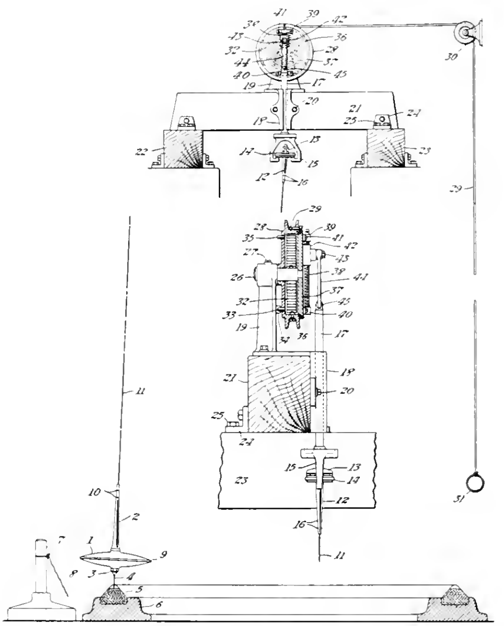


FIG. 1.—MECHANICAL SUSPENSION TYPE OF FOUCAULT PENDULUM.

MECHANICAL SUSPENSION TYPE.

The suspension of the pendulum is designed to be given its reciprocating travel by means of a drum, link and plunger combination, which is operated by drawing a cord when the pendulum is moving toward the center of its amplitude and slowly releasing the aforesaid cord during the outward passage of the pendulum. The cord may extend from the suspension mechanism down to the operator upon the floor below, irrespective of the length of the pendulum. The length of stroke of the suspension may be adjusted to suit any pendulum of moderate length, thereby adapting a given size of the apparatus to a majority of cases.

A diagrammatic view of the arrangement is shown in Fig. 1.

The pendulum consists of a disc-shaped bob, 1, having a post, 2, secured therein by a hexagonal nut, 3. Threaded into the lower extremity of the post, 2, is a fine needle, 4, which is adapted to make furrows through the top of a pointed heap of sand, 5, placed in a wooden ring, 6. This ring, 6, is mounted symmetrically beneath the pendulum system. The top of the ring, 6, is provided with angular graduations. A weighted standard, 7, is furnished for maintaining the bob, 1, at one side, preparatory to setting the pendulum in vibration by burning a thread, 8, in the customary manner. A small depression, 9, is turned in the periphery of the bob, 1, for enabling the thread, 8, to be conveniently tied around the said bob, 1. Held by a number of screws, 10, in the post, 2, is a steel wire, 11, which extends upward to a knife-edge suspension made up of a post, 12, knife-edged member, 13, rocking ring, 14, and knife-edged supporting member, 15. The wire, 11, is secured in the post, 12, by several screws, 16. The supporting member, 15, is threaded upon the lower extremity of a rectangular plunger, 17, which is adapted to move in an accurately planed guide, 18. For preventing oil from the guide, 18, from running down the wire, 11, a groove is turned in the top of the supporting member, 15.

The guide, 18, forms a part of a journal casting, 19, which, together with the aforesaid guide, 18, is rigidly secured by several bolts, 20, to a wooden beam, 21. This beam, 21, rests upon two wooden supports, 22 and 23, the three members being secured together by a number of angle irons, 24, and bolts, 25. Journaled upon a shaft, 26, which is held in the casting, 19, by a set screw, 27, is a drum, 28, around the periphery of which is wound a cord, 29. This cord, 29, is secured to the drum, 28, by tying a knot in it, and passes over a pulley, 30, which is fastened to any convenient support. The cord, 29, is terminated by a ring, 31, at any desired height from the floor. A helical spring, 32, is secured to both the shaft, 26, and the interior of the drum, 28. This spring, 32, normally maintains a pin, 33, let into the face of the drum, 28, against a rubber-covered stop, 34, mounted upon the casting, 19. For limiting the angular motion of the drum, 28, to one-half a turn, a second pin, 35, is let into the side of the aforesaid drum, 28. Secured by several screws, 36, to the front of the drum, 26, is a disc, 37, upon which a threaded shaft, 38, is journaled by two bearings, 39 and 40. A number of screws, 41, serve to hold the bearings, 39 and 40, in place. Mounted upon the threaded shaft, 38, is a member, 42, having secured thereto a bolt, 43, which journals a link, 44. The lower end of the link, 44, is journaled in the top of the plunger, 17, by a pin, 45.

Presupposing that the apparatus has been set up, the bob, 1, tied by the thread, 8, in the plane of the meridian, and the threaded shaft, 38, adjusted until the right eccentricity of the bolt, 43, is obtained for accelerating the pendulum system, the thread, 8, is burned and the pendulum thereby set in vibration. With each oscillation of the pendulum the needle, 4, will make an indentation in the sand, 5, and the angular change of the plane of vibration of the system will be thereby recorded. When the amplitude of the oscillations of the pendulum are noticed to be decreasing below that desired, the cord, 29, may be drawn down and the drum, 28, revolved through one-half a revolution while the bob, 1, is traveling inward. On account of the construction of the apparatus, the suspension during this motion of the drum, 28, will be caused to move downward through the predetermined displacement, beginning and ending its motion slowly and attaining a maximum rate in the center of its stroke. This action will give the pendulum an acceleration. Upon the bob, 1, now traveling outward, the cord, 29, may be slowly released, the drum, 28, being turned by the helical spring, 32, in the opposite direction to that just previously occurring, thereby lifting the suspension and giving the pendulum another acceleration.

This cycle of operations may be repeated until the amplitude of the vibrating system has been restored to that desired. After several trials the motion of the cord, 29, may be readily kept in step with the oscillations of the pendulum. By following the path of the needle, 4, over the graduations on the top of the ring, 6, or

*See Electrical World and Engineer, January 30, 1904, p. 211.

comparing the indentations made by the needle, 4, in the sand, 5, with the aforesaid graduations, the number of degrees angular variation of the pendulum's plane may be noted. If the pendulum should be mounted at either of the poles of the earth, the plane of oscillation would appear to make one complete turn in 24 sidereal hours. At the equator there should be no relative motion between the pendulum's plane and the earth. For intermediate points between the poles and the equator, the rate of revolution is proportional to the sine of the latitude of installation, the angle turned through in one hour being equal to 15 degrees multiplied by the sine of the latitude. The rotation of the plane is clockwise and anti-clockwise from above for northern and southern latitudes, respectively. For the latitude of New Haven, Conn., the hourly variation of the plane should be 9.903 degrees, or one complete revolution in 36.35 hours. In New York City the angular change should be 9.801 degrees per hour or one turn in 36.73 hours. It is hardly to be expected that these values can be exactly obtained experimentally. The best results will be obtained when the pendulum wire is of considerable length, the suspension rigidly mounted and the influence of air currents eliminated.

ELECTRICAL SUSPENSION TYPES.

The present Foucault pendulum systems are intended to be electrically operated, the methods of control being either manual or automatic. The reciprocating rectilinear movement of the pendulum's suspension is produced from circular motion by the same device as shown in Fig. 1. An electric motor is provided for continuously driving this mechanism in synchronism with the vibrations of the pendulum. A clockwork drive may be employed for this purpose, but on account of the necessity of having to frequently wind it up, it is believed preferable, particularly in a large pendulum system, to provide a continuously revolving motor. The motor is run at a fairly constant speed, and is allowed to operate the suspension whenever a releasing magnet is energized. The circuit of this releasing magnet is designed to be either manually or automatically closed in several ways by the pendulum at certain points of its amplitude. The first method shown consists in allowing the pendulum's needle and a stationary metal ring to form the terminals of the secondary circuit of a high-potential transformer. The primary of the transformer includes the releasing magnet and a suitable source of alternating current. When the pendulum is at the end of its swing, a series of sparks are allowed to pass through the small air-gap between the pendulum's needle and the metal ring, thereby temporarily closing the secondary circuit, increasing the current in the primary and operating the releasing magnet. By this method of control there need be no material contact with the pendulum system. In the second design the circuit of the releasing magnet is periodically closed by employing some electrically conductive substance such as graphite for the pendulum's needle to record the angular change of the plane of oscillation in. The employment of graphite thereby serves a double purpose. In the third illustrated method of control, the circuit of the releasing magnet is closed at intervals by a mercury contact.

By referring to the drawings, Fig. 2 is a diagrammatic scheme of the electrical pendulum system, Fig. 3 a wiring diagram of the modified method of controlling the automatic accelerating action by providing a conductive substance for the pendulum's needle to pass through, and Fig. 4 a detail of the mercury contact for the same purpose.

The construction consists of a pendulum wire, 46, which is fastened by several screws, 47, to a post, 48. This post, 48, passes through a disc-shaped iron bob, 49, and is secured therein by a hexagonal nut, 50. A fine needle, 51, is threaded into the lower end of the post, 48. The upper extremity of the pendulum wire, 46, terminates in a knife-edge suspension, which is made up of a central post, 52, knife-edged portion, 53, rocking ring, 54, and supporting knife-edged member, 55. The wire, 46, is secured in the post, 52, by several screws, 56. The supporting member, 55, is threaded upon the lower extremity of a plunger, 57, which is guided in a tube, 58. The tube, 58, passes through a wooden beam, 59, and a journal casting, 60, the said tube, 58, being held in place by a hexagonal nut, 61, and the casting, 60, secured by several bolts, 62. The plunger, 57, is prevented from turning by a pin, 63, which extends through the tube, 58, and a slot, 64, milled in the aforesaid plunger, 57. The beam, 59, rests upon two wooden supports, 65 and 66, the three members being fastened together by several angle irons, 67, and bolts, 68. The supports, 65 and 66, in turn are fastened in place by a number of angle irons, 69, and bolts, 70. A casting, 71, is pinned to a shaft, 72, which is journaled in the main casting, 60. Mounted in two extensions from the casting, 71, and secured therein by a bushing, 73, is a threaded shaft, 74. The upper extremity of the shaft, 74, is provided with several holes, 75, for enabling a close adjustment to be made. Mounted upon the shaft, 74, is a member, 76, having threaded therein a bolt, 77, which serves to journal a link, 78. The lower extremity of the link, 78, is journaled by a pin, 79, in the upper end of the plunger, 57. A mechanical combination is situated adjacent to the suspension for revolving the shaft, 72, with each vibration of the pendulum.

This arrangement consists of a journal casting, 80, which is fastened by several bolts, 81, to a wooden block, 82, in turn secured in place by several angle irons, 83, and bolts, 84. Journaled in the

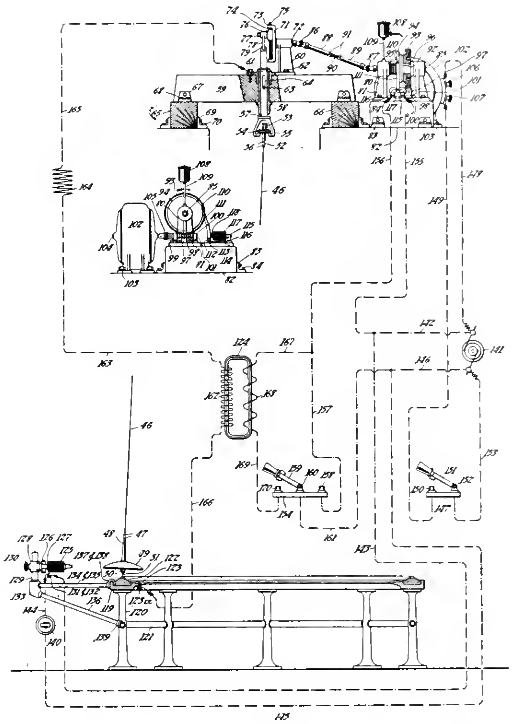


FIG. 2.—ELECTRICAL SUSPENSION TYPE OF FOUCAULT PENDULUM.

casting, 80, is a shaft, 85, which is mechanically connected with, but insulated from, the other shaft, 72, through the medium of two universal couplings, 86 and 87, tubes, 88 and 89, fibre joints, 90, and pins, 91. Secured upon the shaft, 85, by a key, 92, is a worm gear, 93. The left-hand side of the worm gear, 93, is adapted to form a friction clutch in connection with a disc-shaped member, 94, which is both journaled upon the shaft, 85, and maintained against the worm gear, 93, by a compression spring, 95, situated between the aforesaid disc, 94, and the journal casting, 80. A roller thrust bearing, 96, is placed between the worm gear, 93, and the journal casting, 80. A worm, 97, mounted upon a shaft 98, which is journaled in two bearings, 99 and 100, secured to the main casting, 80, by a number of screws, 101, meshes with the worm gear, 93. An alternating-current motor, 102, is secured by a number of bolts, 103, adjacent to the wooden block, 82, and the shaft, 104, of the aforesaid motor, 102, is connected with the worm shaft, 98, by means of a pin and slot coupling, 105. The terminals of the motor, 102, are numbered 106 and 107. An oil reservoir, 108, is mounted upon the journal casting, 80, by a standard, 109, the purpose of which reservoir, 108, being to lubricate the friction clutch.

Formed upon the periphery of the disc, 94, is a tooth, 110, which, by the rotation of the worm gear, 93, is maintained against the extremity of a lever, 111, journal in a casting, 112, secured to the main casting, 80, by several screws, 113. The top of the lever, 111, is maintained against the circumference of the disc, 94, by a retractile spring, 114, the right-hand end of which is fastened to a support, 115. The support, 115, which is secured to the main casting, 80, by two screws, 116, serves to mount an electromagnet, 117. An armature, 118, is secured to the lever, 111, adjacent to the poles of the electromagnet, 117. It will be understood that when the electric motor, 102, is running, the disc, 94, will be normally prevented from revolving, the worm gear, 93, rotating independently of the aforesaid disc, 94. When, however, the electromagnet, 117, should be temporarily energized, the upper extremity of the lever will be moved away from the tooth, 110, and, by reason of the friction drive, the disc, 94, will be allowed one complete revolution. With this movement the suspension will be lowered and raised in its accelerating function. The amount of work consumed at the friction clutch when the worm gear, 93, is revolving and the disc, 94, stationary, should be more than the work required to turn the suspension shaft, 72. The power of the motor, 102, should be considerably more than that required to overcome the friction between the worm gear, 93, and disc, 94, in order that there will be no appreciable variation in the speed of the aforesaid motor, 102, when the disc, 94, is revolving or stationary. The speed of the motor, 102, is also so chosen and the worm gearing so proportioned that in the normal running of the aforesaid motor, 102, the disc, 94, will make, when magnetically released, one complete turn in approximately three-quarters or seven-eighths of the time of one oscillation of the pendulum.

Situated symmetrically beneath the pendulum system upon the floor is a wooden ring, 119, which is made in sections and supported by a series of iron posts, 120, and tubes, 121. The wooden ring, 119, is provided with a groove in which sand, 122, is placed. Secured to the inner surface of the ring, 119, is a metal annulus, 123, which is made in sections, and forms one of the terminals of the secondary circuit of a high-potential transformer, 124. The pendulum's needle, 51, performs the function of the other terminal of the secondary circuit of the transformer, 124. A binding post, 123A, is secured to the metal ring, 123. The outer surface of the ring, 119, is provided with angular graduations. A magnetic device is furnished for starting the pendulum in vibration. This arrangement consists of an electromagnet, 125, which is lightly journaled by two pointed screws, 126 and 127, in a casting, 128, maintained in any desired vertical position upon a standard, 129, by a knurled headed screw, 130. The terminals of the magnet, 125, are fastened to two binding posts, 131 and 132, which are mounted upon one end of the aforesaid magnet, 125. The standard, 129, is threaded into a casting, 133 in which three tubes, 134, 135 and 136, are secured. The tubes, 134 and 135, are terminated by two hook-shaped castings, 137 and 138, respectively, which are adapted to engage the circumference of the ring, 119. The lower end of the tube, 136, is provided with a casting, 139, which is so shaped as to rest upon one of the tubes, 121. It will be evident that the bracket thus formed may be moved to any desired position around the wooden ring, 119.

The operation of starting the pendulum system in vibration, presupposing that the apparatus has been carefully set up and the threaded suspension shaft, 74, adjusted to the correct position for accelerating the pendulum, consists firstly in moving the starting magnet, 125, around until the center of the ring, 119, and the said magnet, 125, are in the plane of the meridian. The pendulum bob, 49, is now brought up to the poles of the magnet, 125, and the said magnet, 125, energized by closing a switch, 140, which allows electricity to flow from a source, 141, of alternating current through a circuit made up of two wires, 142 and 143, binding post, 131, magnet, 125, binding post, 132, conductor, 144, switch, 140, together with the wires, 145 and 146. The sand, 122, in the ring, 119, is now pointed with a piece of cardboard. When desired the switch, 140, is opened, and the magnet, 125, now being without magnetism, the bob, 49, will be released and the pendulum set in vibration. The needle, 51, will now begin to chisel small furrows through the sand, 122. The induction motor, 102, is next started by closing a switch, 147, which completes a circuit made up of the source, 141, wire, 148, binding post, 106, motor, 102, binding post, 107, conductor, 149, clip, 150, switch blade, 151, journal post, 152, and wire, 153. When the motor, 102, has attained its normal speed the manual or automatic acceleration of the pendulum system may begin.

The manual acceleration is accomplished by closing over to the right-hand side for an instant a switch marked 154, when the pendulum bob, 49, is at the end of its amplitude. This action allows current from the source, 141, to flow through a circuit consisting of the wires, 142 and 155, releasing magnet, 117, conductors, 156 and 157, clip, 158, switch blade, 159, journal post, 160, together with the wires, 161 and 146. The magnet, 117, now attracts the armature lever, 111, which moves out of the path of the tooth, 110, thereby allowing the worm gear, 93, to revolve the disc, 94, for one turn, and giving the suspension of the pendulum a gentle downward motion while the bob, 49, is traveling inward and a corresponding upward displacement during the outward passage of the aforesaid bob, 49. On account of the speed of the motor, 102, being chosen such that the disc, 94, requires approximately seven-eighths of the time of one beat of the pendulum, the vertical motion of the suspension will cease when the bob, 49, is just about at the end of its outward swing. This will give sufficient time to again temporarily close the switch, 154, before the bob, 49, begins its return motion, at which time the same accelerating cycle will be repeated. The pendulum system can be constantly accelerated in this manner or periodically depending upon the adjustment of the threaded shaft, 74. As in the mechanical form of apparatus already described, the beginning and ending of the vertical stroke of the suspension plunger, 57, is gradual, the maximum rate of travel taking place at the middle of the stroke. This method of acceleration should not disturb the normal action of the vibrating system.

For the automatic operation of the pendulum, the threaded shaft, 74, should be so regulated that, when the system is constantly accelerated the bob, 49, will terminate its travel a short distance outside of the circular bank of sand, 122. Presupposing that the pendulum system has been set in motion in the plane of the meridian by the starting magnet, 125, the motor, 102, is running, and the amplitude of the pendulum has been allowed to decrease until the needle, 51, stops just outside the sand, 122, the blade, 159, of the switch, 154, is closed over to the left-hand side when the bob, 49, is in the middle of its swing. Upon the needle, 51, slowly passing over the metal ring, 123, as the pendulum is about to terminate its outward swing, the secondary of the transformer, 124, will be closed and a succession of sparks will pass through the small air-gap between the needle, 51, and ring, 123, the circuit consisting of the transformer secondary winding, 162, wire, 163, non-inductive resistance, 164, conductor, 165, suspension apparatus, pendulum wire, 46, post, 48, needle, 51, ring, 123, binding post, 123A, and conductor, 166.

This closing of the secondary has increased the current in the primary circuit, which is made up, from the source, 141, of the wires, 142 and 155, releasing magnet, 117, conductors, 156 and 167, primary transformer winding, 168, wire, 160, clip, 170, switch blade, 159, journal post, 160, together with the conductors, 161 and 146. With the increase of current in the primary circuit, the magnet, 117, has been energized and the disc, 94, allowed to slowly rotate, thereby giving the pendulum an acceleration during the ensuing return oscillation, the speed of the motor, 102, being so regulated that the turning of the disc, 94, will stop when the bob, 49, is within a short distance of the metal ring, 123. It will be noted that when the bob, 49, started its return motion the needle, 51, again passed over the metal ring, 123. This action caused the releasing magnet, 117, to be again energized and the lever, 111, moved away from the periphery of the disc, 94, thereby producing no result or insuring the starting of the aforesaid disc, 94, if for any reason it failed with the outward swing of the pendulum just previously occurring. When the needle, 51, against reaches the other side of the ring, 123, the same accelerating cycle will again take place, thereby maintaining the pendulum system in vibration.

The rotation of the plane of oscillation of the system that is recorded in the sand, 122, may be measured at any time by comparing it with the graduations upon the top of the wooden ring, 119. It may possibly be found that the stroke of the suspension plunger, 57, cannot be adjusted quite close enough to insure a constant amplitude of the pendulum system. If this should be the case, although with the threaded shaft, 74, a fine adjustment can be obtained, the regulation should be so made that the amplitude will in time increase slightly, when by manually opening the switch, 154, for a short time the vibrations can be allowed to die down to the original amount. This function may be made automatic if desired. The reason for arranging the secondary circuit to be closed at the end of the pendulum's swing, instead of at its center, which may be accomplished by providing a vertically adjustable metal disc for the needle, 51, to travel over when at the center of its motion, is because the suspension plunger, 57, would have to be normally resting at the lowest point of its stroke in order to properly accelerate the system. This would mean that the bob, 49, would be normally below the ring, 119, and would come in contact with the said ring, 119, either when about to start the pendulum oscillating or when in operation the action of the releasing magnet, 117, should fail for any reason. The contact in the center for this case would have to be comparatively large, for the pendulum bob, 49, would be traveling its fastest when passing over it.

The second method of controlling the releasing magnet, 117, of the suspension mechanism is shown in Fig. 3. This consists in substituting for the sand, 122, some electrically conductive substance, 171, such as powdered graphite, copper or other metal filings. The substance, 171, rests upon a metal annulus, 172, which is placed in a wooden ring, 173. The ring, 173, is mounted upon the posts, 120, of the preceding design, and is graduated into angular degrees. A binding post, 172A, is fastened to the metal annulus, 172. When the pendulum needle, 51, passes through the conductive substance, 171, a furrow will not only be recorded, but an electric contact will be made, which is employed for controlling the releasing magnet, 117. The operation of the pendulum system is analagous to that already described. The wiring, however, is different. The circuit for the starting magnet, 125, consists from the source, 174, which in this case may be a direct-current generator if desired, of the wires, 175 and 176, post, 131, magnet, 125, post, 132, conductor, 177, switch, 140, together with the wires, 178, 179 and 180. For operating the suspension motor, 102, a circuit is provided which is made up from the source, 174, of a conductor, 181, post, 106, motor, 102, post, 107, wire, 182, journal post, 152, switch blade, 151, clip, 150, together with the conductors, 183, 179 and 180.

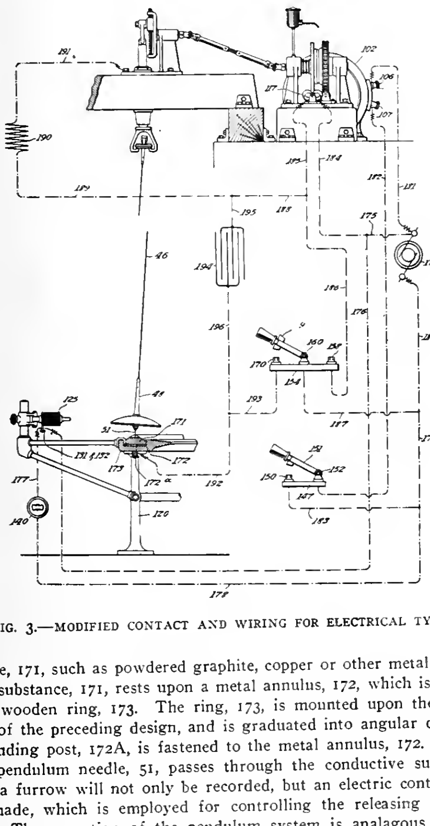


FIG. 3.—MODIFIED CONTACT AND WIRING FOR ELECTRICAL TYPE.

The circuit for manually accelerating the system embodies the source, 174, wires, 175 and 184, releasing magnet, 117, conductors, 185 and 186, clip, 158, switch blade, 159, journal post, 160, together with the wires, 187 and 180. The circuit for automatically controlling the pendulum consists from the source, 174, of the conductors, 175 and 184, releasing magnet, 117, wires, 185, 188 and 189, non-inductive resistance, 190, conductor, 191, suspension apparatus, pendulum wire, 46, post, 48, needle, 51, conductive substance, 171, metal annulus, 172, post, 172A, conductors, 192 and 193, clip, 170, switch blade, 159, journal post, 160, together with the wires, 187 and 180. For the elimination of sparking at the needle, 51, and conductive substance, 171, a condenser, 194, is shunted between the conductors, 189 and 192, by means of two wires, 195 and 196. If desired a relay may be employed in the controlling wiring. This would allow a potential of but several volts from a battery to be used at the needle, 51, and conductive substance, 171, the releasing magnet, 117, being operated directly from the source, 174. Such an arrangement would reduce the arcing to a minimum. Powdered graphite will give satisfactory electrical conductivity, and will probably offer less mechanical resistance to the passage of the needle, 51, through it than metal filings.

In Fig. 4 the third contact arrangement is illustrated for controlling the action of the releasing magnet, 117, of the suspension mechanism. Threaded into the lower end of the pendulum post, 48, is a screw-eye, 197, which has a light metal chain, 198, fastened thereto. The lower end of the chain, 198, is terminated by a platinum rod, 199. Mounted upon the iron posts, 120, of the railing, which is situated below the pendulum system, is a wooden ring, 200, having a groove formed therein for a mercury bath, 201. Resting in the groove in the ring, 200, is a metal annulus, 202, to which a binding post, 202A, is secured. The upper surface of the ring, 200, is provided with angular graduations, 203. The wiring for the pendulum system is the same as in Fig. 3, the contact for the circuit of the releasing magnet, 117, being made by the rod, 199, which dips into the mercury bath, 201, each time it passes the same. The angular change of the pendulum's plane may be noted when the rod, 199, is traveling over the graduations, 203. The chain, 198, and rod, 199, are both made light in order not to disturb the motion of the pendulum. The chain, 198, should also be short for preventing the rod, 199, from swinging unnecessarily.

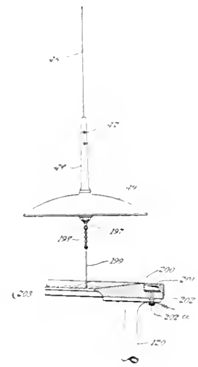


FIG. 4.—MODIFIED CONTACT FOR ELECTRICAL TYPE.

Other contact arrangements may be employed for periodically closing the circuit of the releasing magnet, 117. A flexible copper brush, for example, consisting of a small number of strands of fine wire, may be secured to the under side of the pendulum post, 48, and allowed to lightly pass over the surface of a metal ring when the pendulum is near the ends of its swing. The tilting of the pendulum bob as it swings from side to side may perhaps be made to actuate a mercury contact arrangement, incorporated in the interior of the aforesaid bob. Such a dispensation would embody a small twin concentric pendulum conductor, insulated knife-edge suspension and a bob so constructed that, when it is placed vertically, as would be the case when it is in the middle of its swing, a mercury bath inside of the bob will not short-circuit the two wires of the pendulum conductor. When, however, the bob is at one of the extremities of its amplitude, and is, therefore, in a tilting position, the mercury bath will short-circuit the two pendulum conductors, and thereby allow current to pass to the releasing magnet, 117, of the suspension driving mechanism. Various constructions and adjustments of the pendulum bob may be provided for this purpose. The principle of the coherer, in conjunction with the spark-gap arrangement already described, may possibly be taken advantage of for controlling the magnet, 117.

Let one of the above electrical designs be applied, for example, to a Foucault pendulum system having the dimensions of the original one in the Pantheon at Paris. There the length was approximately 220 ft., with a consequent period of 16.4 seconds or 8.2 seconds for each swing. The amplitude was 10 degrees and the diameter of the sand ring was a trifle over 26 ft. The pendulum bob weighed 61.72 pounds. If the beat of the pendulum is 8.2 seconds the time of one complete turn of the disc, 94, of the suspension driving mechanism would probably be about 7 seconds, or at the rate of 8.57 r.p.m. Inasmuch as the motor, 102, should have a surplus of power, let a ½-hp machine be chosen with a speed of 1,200 r.p.m. If the worm, 97, has a single thread the worm gear, 93, will then have 140 teeth in order to drive the disc, 94, at the desired rate. The worm gear reduction may be readily changed to suit the speed of any alternating or direct-current motor that it may be desired to run on the lighting system available at the locality of mounting. The stroke of the suspension plunger, 57, will have to be experimentally determined, it being probably not over 6 in. for a 200-ft. pendulum. The most advantageous potential for the secondary winding in the step-up transformer, which is employed in the wiring system shown in Fig. 2, may preferably be settled by experiment, it depending upon the air-gap. For an arcing distance of one inch, the secondary voltage would be approximately 20,000 volts. Since, however, the air-gap can be made much less, the ratio of the windings in the transformer need not be so great.

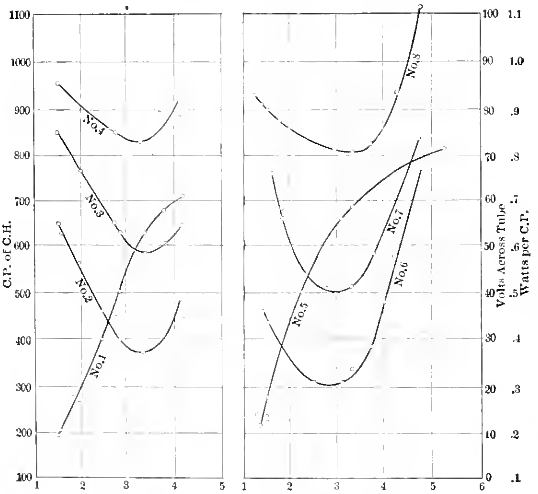
In the communication, mentioned at the beginning of the present paper, it has been suggested that a large Foucault pendulum system be installed at the Exposition in St. Louis. It is believed that such a feature would be an attractive one, and, besides being of physical interest, might form one of the chief exhibits of some college laboratory or physical instrument maker.

Candle-Power Tests of Cooper Hewitt Mercury Vapor Lamp.

By L. A. Freudenberger.

THE tests described below were made at Delaware College, Newark, Del., on a Cooper Hewitt mercury vapor lamp of the type known commercially as Type H-4. The lamp, which is rated at 3 amp. and designed for a 110-volt circuit, has a tube diameter of 1 1/16 in. and a length of arc of 45.67 in.

The lamp was mounted at one end of a five-meter photometer bar and enclosed in a long wooden box at right angles with the axis of the photometer bar. At the middle of the box, in line with the axis of the bar, was a 2 x 2-in. opening. The box was well ventilated so as to give conditions as near normal as possible. The illumination from a two-in. length at the middle of the Cooper Hewitt light was measured and the corresponding candle-power multiplied by the ratio 45.67/2, the length of the light-giving arc to the length of tube used. The lamp and box were inclined to the horizontal plane through the axis of the photometer bar by an angle of 11° 20′. The lamp was compared with a standardized 32-cp incandescent lamp. The screen used was a Lummer-Brodhun. The balance point



FIGS. 1 AND 2.—CANDLE-POWER TESTS OF VAPOR LAMP.

on the photometer bar could easily be located within one centimeter, although the two sides of the screen showed a great contrast in color. In the course of taking readings the screen was, of course, reversed, and the average reading taken.

In Fig. 1 curve 1 represents the variation of candle-power and current; curve 2, the variation of watts in lamp per candle-power; curve 3, the variation of total watts per candle-power with current; curve 4, the variation of current and volts across tube. In Fig. 2 curve 5 represents the variation of candle-power and current; curve 6, the variation of watts in lamp per candle-power and current; curve 7, the variation of total watts per candle-power and current, and curve 8, the variation of current and volts across the tube. In Fig. 3, curve 9 shows the variation of line voltage and current, and curves 10 and 11 the relation of minimum watts per candle-power and current. The curves of Fig. 2 were taken when the lamp was new. The curves of Fig. 1 were taken after the lamp had been running about twenty-four hours.

The reduction in candle-power noted is due to a coating, at first gray and afterward black, which gradually forms all over the inside of the tube. No life tests of the lamps were made, but of two lamps which have been run continuously, one burned out after 800 hours

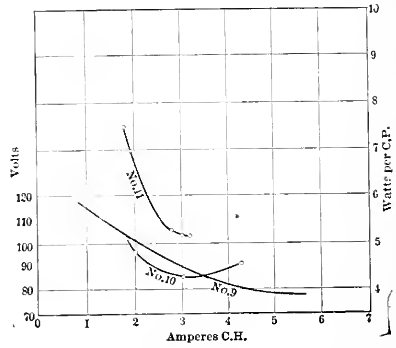


FIG. 3.—CANDLE-POWER TESTS OF VAPOR LAMP.

and the other had not burned out after running 1,000 hours. The lamp that burned out blackened somewhat similar to an incandescent lamp. The immediate failure was due to the impairment of the vacuum, principally through leakage at the leading-in wires.

For all curves the currents were read after the lamp had settled to steady temperature conditions, and the values used as abscissæ. All instruments were calibrated by means of standard cells and standard resistances.

Curve 6 on Fig. 2 was obtained by multiplying volts across the tube by current and dividing by the candle-power corresponding to the current. It represents the watts per candle-power consumed by the lamp itself. Curve No. 7 was obtained by multiplying line volts (assumed constant at 110 volts) by current and dividing by corresponding candle-power. The efficiency in watts per candle-power includes the loss in the ballast resistance in series with the lamp. The curves on Fig. 1 are precisely similar to the curves on Fig. 2, except that they were taken after the lamp had been running about twenty-four hours.

Curve 9 of Fig. 3 merits some explanation. A value of ballast resistance was chosen and the line voltage lowered slowly until the lamp went out. The line voltage and current were taken at the point where the lamp went out and plotted on curve 9. Curves 10 and 11 were obtained by calculating watts per candle-power, using the voltage given by curve 9. Curve 9 shows the minimum line voltage at which it is possible to run the lamp with a certain current. The difference in ordinates between curves 8 or 4 and curve 9 would give the drop in the ballast resistance under this condition.

The above tests were submitted as a thesis in electrical engineering by Mr. F. Schabinger. Thanks are due to the Cooper Hewitt Electric Company for furnishing the lamp, and also to Mr. H. Spoehrer, of the Brooklyn Navy Yard, for furnishing a standardized 32-cp lamp.

Michigan Electric Light Association.

Managers of a number of electric lighting plants in Michigan met in Detroit on June 9 and formed the Michigan Association of Electric Light Managers. Mr. E. F. Phillips, assistant manager of the Edison Illuminating Company, of Detroit, was elected president, and E. S. Hubbell, of Milford, was chosen as secretary. Several committees were appointed to take charge of the work of perfecting plans for future action. The meeting was only preliminary and the association will not get down to business until these committees have reported.

Lost and Unaccounted-for Current.

In our report of the Boston meeting of the National Electric Light Association we referred particularly to the paper by Mr. C. W. Humphrey with the above title, and owing to its exceptional interest it is reprinted below in full, excepting a few of the sheets of tabulations.

The object of the paper was stated to explain in full the calculations of losses, known and unknown, for alternating and direct-current circuits, and to give the records of some of the results obtained and tabulated during the past two years. Most of the data given was compiled from results obtained on the lines of the Denver Gas & Electric Company.

The lines in Denver are now all 2,400-volt, single-phase feeders, but the calculations are approximately the same for all systems of distribution, regardless of voltage, frequency or phase. Even in high-tension transmission lines the same methods may be used, there being no actual losses introduced by inductive drops. Most high-tension lines, however, have integrating wattmeters on both ends of the line. The difference in the readings will indicate the total loss in transmission. This loss may be easily subdivided into resistance losses and transformer losses.

Direct-current losses may be calculated in much the same manner as those of alternating-current circuits, although resistance losses and meter shunt losses are all that must be accounted for. The "drop of potential" method was found the most satisfactory for calculating the line losses, following along the same lines as described for alternating-current circuits (mentioned later). The meter shunt losses were taken care of in the same way as for alternating currents.

The different losses in an alternating-current system may be classified as follows: Transformer iron losses; primary resistance losses; secondary resistance losses; meter shunt losses. For the transformer iron losses there is a card index system consisting of two sets of cards. One set has a card for each transformer on the lines and also those in stock, and shows the date of purchase, where set, manufacturer's number and type, iron and copper losses as shown by test, and also whether or not the transformer has been removed and for what cause, as well as a retest on its iron loss before it is again placed in service. In fact, these cards show the entire history of each transformer from the date of purchase up to the present time. The other set of cards, which is called the feeder index, shows the exact location, make and number of transformer, also the number of feeder on which it is located. These cards are arranged according to location and feeder, while the other index is arranged numerically according to the make and number of the transformer. The records are not as complete as the above statement might seem to imply, due to the fact that these records have all been started within the past two years and do not include full data on transformers purchased prior to that time.

In a great many instances transformer iron losses were tested while in service. This was done in a very unique way and without interruption to service. There is a small testing board, which includes a wattmeter, voltmeter and a small variable resistance. To these instruments are attached two flexible duplex cables of sufficient length to reach from the ground to any transformer on any pole. The primary fuses of the transformer are pulled, the neutral of the secondary is disconnected (that is, if the transformer is on a three-wire network), one side of the secondary is left intact and the other side is cut, and the wattmeter and resistance are inserted in the circuit by means of one of the flexible cables, the other cable being used for pressure wires. The secondaries are kept alive by the other transformers on the system. The resistance is then so adjusted that normal voltage is impressed across the secondaries of the transformer. Readings are then taken on the wattmeter, which indicates approximately the iron loss and may be corrected for instrument losses in the usual way.

There is also kept a transformer record sheet for the purpose of more readily finding the transformer iron losses as soon as possible after the first of the month. These sheets have a line for each day of the month, on which is placed the number of transformers of each size and make according to the different headings. On the extreme right of the sheet is a column for the total transformer iron loss for one day. This represents the total 24-hour loss on that particular feeder, which is the summation of all the individual losses pertaining to the transformers on each line. At the end of the month this last column is totalized, and this represents the total loss for the month on that feeder.

The next known loss to consider is the primary resistance loss. This loss has been more difficult to ascertain correctly and keep up from month to month than any of the other known losses. Four different methods of calculating this loss have been used and each different method and endeavor will be discussed to show the advantages and disadvantages of each.

The first method used was to measure up the length and size of wire in the primary feed, assuming one ampere to be flowing from the station to the first division point in the feeder, then assuming the current to divide proportionally to the connected load in each branch of the feeder; calculating and summing up all losses due to an initial flow of one ampere and using that as a constant. Then ampere-meter readings are taken at short intervals at the station during a period of 24 hours. Each of these readings is then squared and multiplied by the constant. The summation of these losses will give the total primary resistance loss for one day. This method is fairly accurate, but is long and tedious and cannot be relied upon any better than other more simple methods. One point of error in this method is the fact that a suspended wire stretches in course of time, making its cross-section smaller than it was originally and therefore of higher resistance. Joints and junction fuses also introduce errors of more or less magnitude. The results as obtained from this system are always considerably smaller than actual measured results.

The author undertook to accomplish the desired result by placing recording voltmeters at the station and at the center of distribution and then taking the difference between the two readings and multiplying by the load in amperes corresponding to the drop in voltage, and summing up as in the previous method. This would be a very satisfactory method if this drop could be ascertained correctly. A small potential transformer is usually employed for the purpose of stepping the voltage down for the recording voltmeter. The ratio of these transformers, when used on a 2,400-volt feeder, would be 20 to 1. These voltmeters cannot be read with an accuracy closer than one volt; therefore, it means an error which must be multiplied by a constant of 20, and when two voltmeters are used, one at the station and one at the center of distribution, it makes a possible multiplication of an error by a constant of 40. This error amounts to considerable where accuracy is essential.

The next method used was to place an integrating wattmeter in the primary lead just before it begins to feed, running pressure wires for it back to the center of distribution. Readings were taken the first and last of the month, and kilowatt-hour readings obtained subtracted from that obtained on the station wattmeter for the same period. This is a very good method, provided there are no grounds or individual taps taken off between the two wattmeters. If this should be the case, the results obtained might lead to an erroneous impression.

The method finally adopted and now used exclusively is a measured resistance method. With the use of this method the feeder must be shut down at some convenient time, preferably during light load, and the primary fuses of all transformers pulled; that is, all those on the station side of the center of distribution. The primaries are then short-circuited at this point and the resistance of the circuit is measured by the "drop of potential" method with direct current, the direct current being supplied from a separate direct-current machine and the voltage varied so as to permit of a series of readings being taken. The loss is then calculated by means of ampere readings taken at the station at stated intervals, the same as in the first two methods. Or a better way than calculating each particular point is to calculate the losses for different amounts of current and plot a curve of watt loss and primary amperes. This curve also includes the primary copper loss of the transformer on the feeder, full load on the feeder being considered as the sum of the full-load capacities of the different transformers. The readings taken at the station may then be readily run off on this curve and summed up for a period of 24 hours, full-load copper loss of the transformers for the entire feeder being the sum of the individual losses for all transformers on the feeder. The copper losses of a transformer are assumed to be divided equally between the primary and secondary windings. This assumption has been borne out by tests. Fig. 1 is a curve showing the different primary losses as calculated above.

After losses are obtained for a period of one day, the total loss for the month must be calculated. This is done by multiplying the output on the feeder for one day by the number of days in the month and dividing into the total output for the month as obtained on the feeder wattmeter. This result is squared and multiplied by the loss for one day and multiplied by the number of days in the month. These results will be as close as it is possible to calculate them

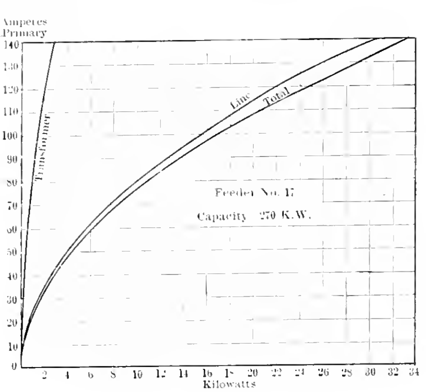


FIG. I.—CURVE OF PRIMARY LOSSES.

and would be very accurate if it were not for the fact that the characteristics of the daily load curve change during the different seasons of the year. The peak is very sharp in the summer with a very small morning peak, while in the winter the peak is quite broad and the morning peak is much more noticeable. For this reason these losses must be recalculated from time to time during the year as these characteristics change. Fig. 2 shows a curve of one of the principal

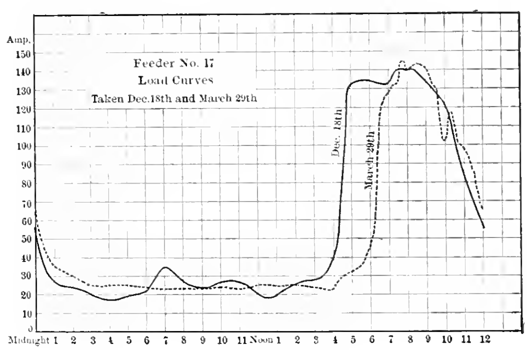


FIG. 2.—LOAD CURVES.

business feeders illustrating these different characteristics. The greater demand shown for March 29 is due to new business on that feeder. Evidence of new business is shown throughout the curve. Both December 18 and March 29 were clear days.

The kilowatt-hours lost due to primary resistance for one year, multiplied by the actual cost of generation, will show whether reinforcements would pay financially and to what extent they might be carried. By cost of generation is means the variable costs, which vary as the output; it does not include any of the fixed expenses.

The secondary resistance losses are somewhat more difficult of accurate calculations. Following is the method which was used exclusively for the three-wire secondary network.

In this calculation some things had to be assumed in order to arrive at results. The total secondary load is assumed to be divided up in proportion to the sizes of the different transformers, one-half the load on each transformer to feed each way, and this amount of current to feed one-fourth the distance between transformers. The assumptions have, however, been verified in each case by the testing of all transformers on the line. This assumption would not hold true, however, before the company began to test the transformers systematically and place them on the lines in accordance with the actual load carried, instead of depending, as is usual, upon the connected load. It was found that the actual load carried varied very widely from that calculated on a basis of connected load.

With these assumptions and the size and length of secondary feeds being known, the losses may be figured for several different amounts of current flowing, and plotted in a curve. The author also figured the loss due to current flowing in the neutral, but this loss was found to be negligible on his system of distribution, due to the fact that the transformers are so evenly balanced that there is a minimum flow of current in the neutral. This is not the case on the majority of distributing systems, as most of the transformers are in the same condition as his were before a systematic test was instituted by means of an instrument termed the "portable line meter." The instrument consists of an ammeter directly calibrated with a small series transformer having a two-piece iron core hinged together so as to permit of its being opened and clasped over a wire at any point. With this instrument he has been enabled to measure the exact load carried on a transformer at any time, also the amount of unbalancing. The loss in the neutral does not vary as the per cent. of unbalancing and is, therefore, inappreciable for small amounts of unbalancing. But in most systems of distribution, where this unbalancing is quite considerable, it becomes an important item. Unbalancing not only increases the losses materially, but also decreases the available capacity of the transformer quite materially. It has been claimed that transformers banked together on a three-wire network would adjust themselves to the total unbalancing of the feeder. This is not true, as the author found transformers of the same make and size on adjoining poles considerably unbalanced on opposite sides; and even in cases where transformers are banked together on the same pole, they will not divide their loads evenly. This was very strikingly illustrated by an occurrence that took place some time ago. During a breakdown in an isolated plant furnishing power for a theatre, the author was called upon to furnish them with light. In order to do this he placed six 10-kw transformers

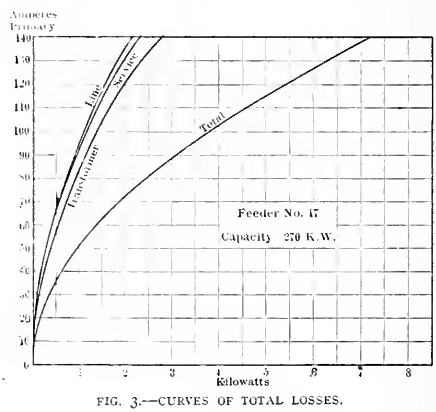


FIG. 3.—CURVES OF TOTAL LOSSES.

and one 20-kw transformer, all of the same make and type, just outside of the building and connected them up for 110 volts, lying them together with a 500,000-cm. cable, which fed the theatre. Following is the average load in amperes on each transformer during operation:

Size.	Load in Amperes at 108 Volts.
10-kw	106 amperes
10-kw	93 amperes
10-kw	130 amperes
10-kw	112 amperes
10-kw	90 amperes
10-kw	90 amperes
20-kw	158 amperes

The author also took into consideration the resistance losses in the service loops. This is taken care of by assuming the secondary load to be equally divided between the different service loops, and taking the average length and size of a service.

The secondary transformer copper loss is taken into consideration in the same way as in the primary losses. A curve is then plotted of the secondary resistance loss, secondary transformer loss and service resistance loss, and then a curve of the total losses is plotted. A sample of one of these curves (Fig. 3) is here shown, watts loss being plotted against primary amperes.

The all-day losses are obtained in the same way as with the primary, using the station ampere readings in the same way; the station ammeter not being relied upon entirely, a standard portable instrument being cut in and used, and the switchboard meters being calibrated at the same time.

The only known loss now left to determine is the meter shunt loss, a loss that one might think at first hardly worth considering, but which is nevertheless of considerable importance and assumes very large proportions in some instances. The loss can be obtained with a greater accuracy and less trouble than any other of the losses. Each different type and size of meter must be tested and the average of a number of different tests taken. The author uses a meter record sheet for the meter losses on each feeder similar to the transformer record sheets. These sheets are kept up from day to day, and at the end of the month the daily losses are summed up, giving the monthly losses. It was found to be much easier to keep up the records in this way from day to day on the different feeders than to wait until the end of the month and then figure up the losses for the past month. It is also the most accurate, and the total losses may be ascertained much more quickly after the first of the month.

The total sales are figured up at the end of each month, and as meters are read in three different divisions at different times, the results do not exactly correspond to the monthly output. The bills for one-third of our consumers cover a period from the first of one month to the first of the next month, one-third from the 10th to the 10th, and one-third from the 20th to the 20th. This variation might amount to considerable in one month, but, as everything is figured accumulative from month to month, the records are very accurate when figured over a space of several months.

After this full explanation of the methods for arriving at the known losses, it will be interesting to note the results obtained in some of the feeders for the past year. There are 24 different feeders, on all of which the above records are kept up from month to month. The author has plotted graphically the losses on some feeders, showing variation of losses from month to month and the gradual but steady decrease in the unknown losses. The first curve (Fig. 4) is

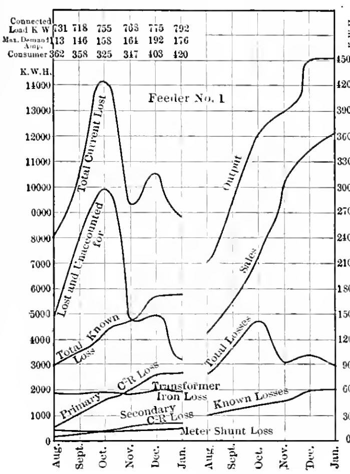


FIG. 4.—CURVES OF FEEDER LOSSES.

that of a residence feeder, which is designated as 1 West. It will be noticed that the output and sales have increased very rapidly. A slight hump will be noticed in the output during October; this is due to some unknown loss, as the curve of sales does not show this characteristic, neither does the curve of known losses. It will be noticed that both the primary and secondary losses show a steady increase due to the increase in the output. The transformer iron loss remains about the same and so do the meter shunt losses. The relation that the sales show to the output varies from 59.3 per cent. to 80.5 per cent., being almost a steady increase from beginning to end, the unknown loss increasing at about the same rate as the output for the first two months, dropping off the next month, and then remaining about the same for the remainder of the period, although both the sales and output increased considerably.

In the accompanying table is a tabulation of an alternating-current feeder for a period of six months. During that time the feeder was changed from a 1,000-volt individual transformer system to a 2,000-volt with a three-wire secondary network, with the exception that there are still some instances where individual transformers are used, due to the sparsely settled territory it covers.

This tabulation shows several very interesting things. During the first two months the individual transformers were done away with

TABLE SHOWING ECONOMY OF THREE-WIRE OVER INDIVIDUAL TRANSFORMER SYSTEM.

Month.	Output.	Sales.	% of output.	Lost and unaccounted for.	% of output.	Transformer iron loss.	% of output.	Primary C A loss.	% of output.	Secondary C A loss.	% of output.	Meter shunt loss.	% of output.	Consumers.
1	19250	7778	40.4	4877	25.4	5940	30.9	222	1.1	138	.7	295	1.6	273
2	15970	6630	41.5	2235	14.1	6475	40.5	229	1.4	92	.6	309	1.9	277
3	20042	10506	52.5	6140	30.6	2560	12.8	373	1.8	150	.7	313	1.6	281
4	35320	21166	60	9417	26.6	2390	6.7	1153	3.3	463	1.3	721	2.1	660
5	40140	28480	71.2	6421	16.1	2441	6.1	1440	3.5	580	1.3	770	1.0	692
6	40940	29113	71.2	6435	15.7	2425	5.9	1503	3.6	605	1.5	859	2.1	771

and replaced with a three-wire network showing a reduction in transformer iron losses from 6,475 kw-hours to 2,560 kw-hours, a decrease of a little over 60 per cent. At the same time the lost and unaccounted-for has taken a jump of nearly 170 per cent. The output and sales increased considerably the same month, due to combining another feeder with this one, adding 387 consumers, which were changed over at the same time to a three-wire distribution. In this instance the sales were increased to nearly double the original amount and the transformer iron loss was decreased to about one-half the original amount. The primary and secondary resistance losses were increased considerably, due to the increase in the output of the feeder.

A complete record sheet is kept for all the rest of the feeders. One of the interesting things on this feeder is that the watts per lamp of output remained about the same for the entire year, while the watts per lamp of sales increased during the same period to nearly double. The sales increased from 41.6 per cent. to 83.5 per cent., the known losses remained about the same, while the unknown losses decreased from 48.4 per cent. of output to only 5.22 per cent.

The lost and unaccounted-for current has been systematically followed up and decreased very materially. This unknown loss is due to leakage through grounds, faulty meter registration, errors and theft. These losses have been plotted graphically as shown in Figs. 5 and 6. Each circuit is tested for grounds, and when found these are traced down and removed.

The greater part of the lost and unaccounted-for current was

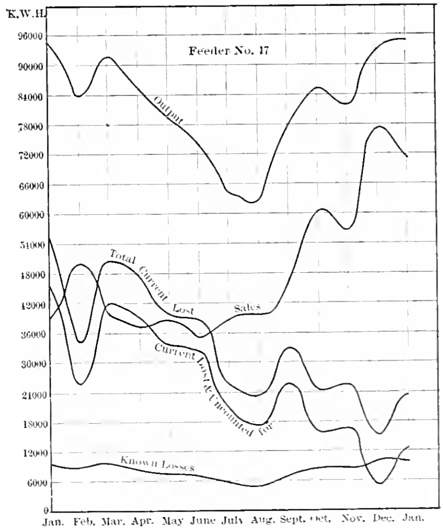


FIG. 5.—CURVES OF CURRENT LOSSES.

found to be due to thefts. These were found by systematic inspection of service loops and interior wiring. Theft of current was found to be done usually by tampering with the wiring, removing pressure wires and jumping out meters, installing lamps ahead of the meter, and in some instances tampering with the meter so as to retard its rotation. Some of these things are very difficult to find, especially in cases of concealed wiring. Some cases of slow meters were found by placing a check meter on the secondary of a transformer feeding a three-wire district, making an isolated district of it by opening up the junction fuses on each side of the transformer. There are quite a number of ampere-hour meters on the circuits, which accounts for some of the lost and unaccounted-for,

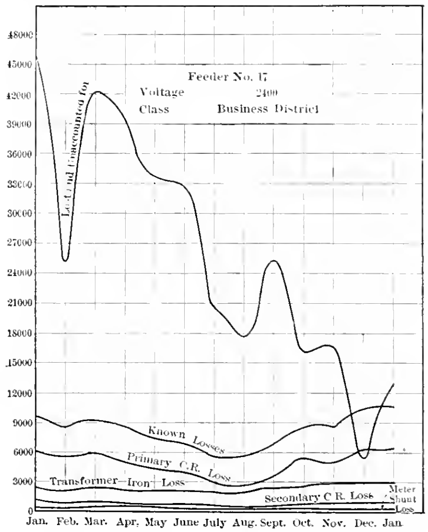


FIG. 6.—CURVES OF CURRENT LOSSES.

as an ampere-hour meter will not start on less than two to four 16-cp lamps. A check meter was placed on one district having nine ampere-hour meters and eleven integrating wattmeters. The results were as follows:

Registered on house meters	331.5	kw-hours
Shunt loss on 11 meters	6.14	kw-hours
Total	337.64	kw-hours
Consump. as shown by check meter	367.3	kw-hours
Loss	29.75	kw-hours, or 8.1 per cent.

About the only absolute method of preventing theft of current, and as yet only adopted in isolated instances, is to place all meters on the pole. This could be accomplished in the business districts of the city by placing a number of meters in one box on a pole and running all services from this box and, where possible, bunching the wires in one cable. This would be especially advantageous where feeding a large number of consumers in a large business block, and where the running of such a cable would not be more objectionable than the present practice of bussing such a building. The principal advantage of such a system would be the impossibility of stealing current from the light company. It should be getting paid for all current distributed and the losses would certainly be materially and permanently decreased.

This completes the discussion of all the principal items relative to the calculations of lost and unaccounted-for current. The importance of an analysis of the output of an electric station can be readily seen by the results given in this paper, and in the majority of instances such an analysis will show such startling results as will lead to investigations that will pay for the time and trouble many times over. In no other way about a central station can money be spent more profitably.

Recent Electrochemical Developments.

Four patents, granted on June 14, refer to battery invention. J. E. Haschke describes mechanical details of construction of a multiple-cell high-voltage battery of that general type in which the cells are put one upon the other like a series of dishes, the walls of the different cells serving as bipolar active plates.

M. Schneider patents mechanical details of a battery in which the positive pole electrode is formed of a number of downwardly converging ribbed lead cones, put one above the other and fastened in the center to a lead core, while the negative pole electrode is formed of a hollow metal cylinder encompassing the positive electrode.

A. J. B. M. Colletas patents a battery in which the active material of the negative pole is a layer of copper hydride (Cu_2H_2) on a copper plate, while the positive electrode is lead peroxide, with sulphuric acid as electrolyte. The electrochemical action during the discharge is the formation of copper sulphate and water and reduction of the lead peroxide to lead oxide.

J. R. Lord patents a general type of battery of which the following combinations may serve as example: The anode is a mixture of zinc and zinc oxide, the electrolyte a gaseous solution of potassium sulphate, and the cathode is copper with the addition of a depolarizer, PbO_2. The theoretical explanations of the inventor are somewhat peculiar.

New Telephone Patents.

A NOVEL RELAY.

Considering the fact that the contact relay has been developed to a point where certain forms have become almost standard, the appearance of an entirely new type may be noted as quite remarkable. Nevertheless, such a new type has appeared, being described in a patent issued to F. R. McBerty, of Evanston, Ill., and assigned by him to the Western Electric Company. This relay is designed for use in strips, the mounting strip, in fact, forming a common return pole piece for the group of relays mounted thereon. Reference may be made to Fig. 1, which shows well the appearance and construction of the relay.

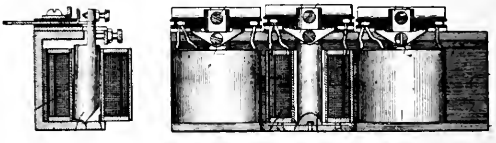


FIG. 1.—M'BERTY RELAY.

As will be noted, the core of the relay is free to oscillate within the coil spool, being supported upon its chisel-edged lower end. The contact circuit is carried through the body of the core, the contact anvil being clamped between insulating strips upon the top of the mounting strip. To avoid "cross-talk" between adjacent coils, these are encased in copper shells. The chief objection, at once apparent, lies in the necessity of removing a whole strip of relays in order to replace the parts of any one in case these relays be mounted in groups according to the present custom.

ELECTROMAGNETIC SIGNALS.

It is quite frequently desirable in telephony that a single signal give two different indications under substantially the same circuit conditions. Under such circumstances it has been necessary to provide auxiliary apparatus and circuits to control the signal proper.

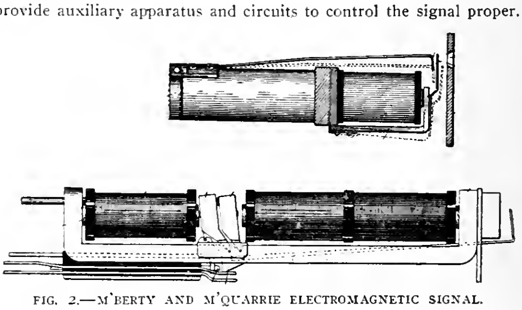


FIG. 2.—M'BERTY AND M'QUARRIE ELECTROMAGNETIC SIGNAL.

There have now appeared patents for several signals in which the secondary controlling device is combined with the signal to form a single piece of apparatus. In two cases the auxiliary device includes a movable shield for signal target, the target being displayed only when it and its movable shield bear the proper relation to a stationary shield. The means employed for controlling the movable shield differ. Both signals described are for use as line signals.

Of these one is shown in the upper part of Fig. 2. As indicated by the dotted lines, when neither coil is energized neither movable part shows. When the rear coil, that connected in the line circuit, is energized, in response to the rising of the hook switch of the subscriber, the target is displayed; and when the operator answers the front coil, in series with one of the jack circuits, becomes energized and elevates the movable shield to obscure the target. This signal is the joint invention of Messrs. F. R. McBerty and J. S. McQuarrie.

In the second line signal the signal and its corresponding jack are mounted together, so that the movable shield may be mechanically elevated by the insertion of a plug. This is the work of the same inventors.

The second type of signal uses another means as an auxiliary control, viz., an auxiliary locking armature. Such a signal is shown in the lower part of Fig. 2. The left-hand armature carries the target. The right-hand armature is the locking one, the weights of the parts being so proportioned that the two armatures acting together will overbalance the target, while the target will overbalance its own armature alone. The target shield is so arranged that the target will be displayed at the window when released by the locking armature. The normal actuating coil is, therefore, that controlling the locking armature. This coil is double-wound for line signals and single-wound for supervisory signals. The left-hand coil is connected with the third wire or local signal circuit to be energized only when a plug is inserted in a jack. The operation is then as follows: When the right-hand or actuating coil is energized the locking armature is pulled up and releases the target to fall before the window. When the operator answers, the restoring coil raises the target into the concealed position. Two patents cover this signal in its various uses, the one granted to F. R. McBerty and F. H. Loveridge and the other to J. S. McQuarrie. The Western Electric Company has obtained all of the above-mentioned patents by assignment.

A NEW LOADING COIL.

Dr. M. I. Pupin has patented a new type of loading coil for use, as the name signifies, in inductively "loading" cable or other conductors to reduce the attenuation of transmitted waves. The coil has a closed magnet circuit, the core being completely covered with windings threading through the aperture. In the specification the requirements for satisfactory loading coils and the limiting values of hysteresis and Foucault current losses in the iron are set forth and formulæ are given for the design of satisfactory coils. The matter is of too technical a nature to warrant detailed consideration here, but those interested will find much of value in the patent. Dr. Pupin has assigned his patent to the American Telephone & Telegraph Company.

LAMP JACK STRIP.

A new lamp jack strip forms the subject of a patent granted to H. P. Clausen, of Chicago. Mr. Clausen builds up his jacks upon a sheet metal strip, no partitions being provided between the lamps. On this account the lamps, except at the extreme end, are each encased in a sleeve of opaque material to prevent any confusion of signals. The opals are mounted permanently in the face of the strip, which face is removable as a whole. It is the inventor's idea to obtain a cheap yet serviceable construction. The patent for this socket strip has been obtained by the American Electric Telephone Company, of Chicago.

STEP-BY-STEP PARTY LINE SYSTEM.

A step-by-step party line system has been invented by E. W. E. Tomson. The system is adapted to permit of a central office selecting at will any station on a line to the exclusion of others. It depends for its operation upon the synchronous action of the instruments at all stations in response to properly timed current impulses sent out by the operator.

FIRE ALARM SYSTEM.

W. L. Denio, of Rochester, N. Y., has made and patented further improvements in his fire alarm system for use in connection with telephone lines. The present devices may be operated manually or by thermostats, to send to the telephone central office a vibratory flash signal appearing at the line lamp. This signal is repeated a number of times to indicate the location of the fire upon the subscriber's premises, the various thermostats being connected in groups to a signal box. A further feature is the automatic clearing of the telephone line for conversation as soon as the fire signal has been sent in.

TELEPHONE RECEIVER.

The last patent for present consideration is one granted to Ernst Gundlach, of Berwyn, Ill., for a telephone receiver and assigned to the American Telephone & Telegraph Company. This receiver is built upon the same general lines as one patented by the same inventor some six months since, and has for its most novel features a spring device for mechanically straining the diaphragm in a direction opposed to the magnetic pull, and the provision of a pole piece mounted at the center of the diaphragm. The core of soft iron but partially fills the spool aperture, the armature extending loosely within the upper portion of it. Great sensitiveness is claimed for this type of receiver.

Municipal Ownership at Ottawa, Can.

A correspondent at Ottawa, Canada, writes us as follows: "In an item taken from the *Canadian News* in your issue of June 4 the following appears: 'The city of Ottawa, some two years ago, voted for a civic lighting system, but at a recent meeting of the city council, in spite of the voice of the citizens, the Ottawa Electric Company was given a contract for street lighting for a period of ten years at $52 per light. Although this is a very favorable contract and a reduction of some $13 per lamp, yet there is much indignation manifested by the ratepayers that their wishes have been disregarded. The report of experts showed that the city could do its own lighting for $38 per lamp per year. Ottawa, therefore, stands to lose $80,000 over the ten years which the contract is to run.' It is quite evident that your correspondent is not only a partisan of municipal ownership, but also in sympathy with the Mayor and the few Aldermen who have been favoring the erection by the city of a distributing station for street lighting; electric power, therefore, to be purchased. The Ottawa Electric Company tendered for city lighting by direct-current enclosed lamps of 480 watts for ten years, at $52 per lamp, all night and every night. This is the cheapest rate in Canada, and it was accepted by the city council, a large majority of whom evidently believed that the city could not do better. Your correspondent would make it appear that this action on the part of the council had aroused public indignation; as a matter of fact, interested Aldermen did cause to be called an indignation meeting to protest against the action of the other Aldermen who did not share their opinions, but this meeting proved a veritable boomerang, ending up by the passing of a resolution by a vote of two to one, approving the action of the majority of the council in giving the contract to this company.

"An expert engineer employed by the city made an estimate of $38 per lamp per year, but other well-known experts employed by other parties showed that the city could not do its own street lighting on the plan proposed for less than $52 per lamp, so that the report that the city stands to lose $80,000 in the ten years is mere conjecture. The item is one of the kind that are dished out regularly by the municipal ownership partisan press, but it is quite misleading."

National Electric Light Association Membership.

At the twenty-seventh convention of the National Electric Light Association, held in Boston, May 24-27, an amendment to the constitution was adopted dividing the membership into six classes, as follows: Class A, Member Companies—Private corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use. Entrance fee, $25; annual dues for companies in towns of less than 20,000 population, $10; 20,000 to 300,000, $25; over 300,000, $50. Class B Members—Officers or employees of member companies, elected and continued from year to year with the written consent of the member company with whom connected. Entrance fee, $5; annual dues, $5. Class C, Instructors and Teachers of Engineering and Related Sciences—No entrance fee, annual dues, $4. Class D, Associate Member Companies—Electricians, electrical or mechanical engineers, manufacturers, corporations or individuals, who are directly or indirectly interested in advancing the interests of electricity. Entrance fee, $25; annual dues, $2. Class E—Officers and employees of Class D, elected and continued by written consent of the Class D member employer. Entrance fee, $5; dues, $5.

There will also be a class of honorary members without fees or dues.

CURRENT NEWS AND NOTES.

CHEAPER RADIUM.—Dr. George F. Lee, of Philadelphia, declares that he has discovered an electrochemical process of manufacturing radium for less than $500,000 a pound. Dr. Lee says he learned from the Curies that barium and thorium rock particles clung to radium. He set to work to thoroughly analyze these rocks and abstract their luminous properties. He placed the combination of barium and thorium in a box and found, after a time, that they produced a fluorescent substance that would penetrate metal. He states that it will be only a short time before he will be able to produce radium. It is not very clear that Dr. Lee has anything in particular.

ELECTRIC POWER IN SCOTLAND.—Mr. Rufus Fleming, United States Consul at Edinburgh, Scotland, says: "No trade here has a better prospect at this time than that of the electrical engineering firms. The demand for motors and all other electrical apparatus will undoubtedly continue to grow from month to month, and American companies prepared to compete in these lines of manufacture have now their best opportunity. The application of electricity as a motive power in various industries, for urban lighting and traction, as light and power for coal mines and other uses, examples of which are numerous, mark the real dawn of the electric power era in this part of Great Britain. American manufacturers have in the past few years furnished some of the heavy machinery for municipal generating stations and private plants, and also a considerable number of dynamos, motors, etc. American-English concerns have done much in this line—in fact, they seem to be well ahead of all others. Recent developments mean an expanding market, to which our manufacturers of electrical machinery and supplies may find it profitable to devote earnest attention."

LETTER TO THE EDITORS.

The Government and the Fessenden Wireless System.

To the Editors of Electrical World and Engineer:

SIRS:—Will you kindly permit me to make the following corrections to the statements reprinted in your issue of June 22 from the New York *Evening Post,* under the title, "A Government Wireless Mix-up," as some of the statements contained therein would do us considerable injustice unless promptly corrected.

1. The Agricultural Department is not in any tangle with Prof. Fessenden, but on the contrary relations between the Department and Prof. Fessenden are entirely harmonious.

2. The statement that the Agricultural Department now claims, or has ever claimed in the past, to own the system of Prof. Fessenden, is a falsehood manufactured out of the whole cloth. No such claim has ever been made by the Department or any of its officials.

The facts in the case are that after Prof. Fessenden had been developing his system for a year or more in Pittsburg, the attention of the Agricultural Department was attracted by some of the experiments which he had made in operating across the cities of Pittsburg and Allegheny. A contract was, therefore, entered into according to which the Department, in return for the expenditure of some $15,000, obtained the right to use all of Prof. Fessenden's inventions which were invented up to July, 1902, "For its use in receiving meteorological reports and transmitting Weather Bureau information." Subsequently to July, 1902, the development of the system was carried on by Prof. Fessenden at a further cost of over $200,000.

While, therefore, the Weather Bureau has made an extremely advantageous bargain for the Government in securing at cost of manufacture apparatus which would otherwise cost it some $500,000 or $600,000, the Department does not and never has claimed to have any right whatever to the Fessenden system, or any right to use the same for anything except the specific "Transmitting of meteorological reports and Weather Bureau information." According to the contract. "All commercial rights and privileges in connection with this invention are reserved by said Fessenden."

3. This system was not invented by Prof. Fessenden while in the employ of the Agricultural Department. Prof. Fessenden worked on this system for over a year before he entered Government service, and out of the total six years spent in the work but two years were spent in Government service. Also, of the total sum expended in developing the system, less than 7 per cent. was furnished by the Government, the remaining 93 per cent. being furnished by Prof. Fessenden and his partners.

4. The Navy Department is not committed in any way to the Slaby-Arco system. At the time when the Slaby-Arco apparatus was first installed, the Navy Department held that the prices asked by the Marconi and Fessenden Companies were too high, and never made any test of either of these systems. Tests were made of the Braun, Slaby-Arco. Lodge. De Forest and American Wireless systems. As a result, the Slaby-Arco system was adopted, but the fact should be clearly understood that neither the Marconi nor Fessenden apparatus was permitted to enter the competition on account of the prices asked.

The apparatus purchased, i. e., the Slaby-Arco, infringed the patents of both the Fessenden and Marconi Companies, but these companies had no recourse for the following reason:

It is impossible to sue Government Departments except where a contract has been made. This question has been decided several times in the Court of Claims, and though several judges have pointed out the inequity of the situation, the fact remains that the only remedy an inventor has, should the Government decide to use his inventions without paying for them, is by getting a special act of Congress passed. This, of course, practically no company in the early stages of its formation is able to do, and under the present laws Government Departments can and do habitually appropriate the property of inventors, without the inventors being able to obtain any redress.

From one point of view the situation is not as outrageous as it seems to the inventors, for the reason that it is the function of a Department to carry on its work in the most efficient way possible, and it cannot be expected to take up legal questions. Again, in many cases the inventor has a recourse in being able to sue the party who sold the apparatus to the Government, and if the seller is a responsible party can recover damages. Therefore, on the whole there would be no objection to the Departments acting in this way, *provided that they purchased apparatus only from responsible agents inside of the United States, and ones capable of giving bond to pay damages.*

However, this was not the case with the Slaby-Arco apparatus, as the apparatus was purchased abroad through a foreign agent, and imported free of duty. Under these circumstances, in spite of the fact that the Slaby-Arco Company infringed Prof. Fessenden's apparatus in several fundamental points, and in fact was merely a combination of the Fessenden and Marconi apparatus, neither of these companies had any recourse.

These companies, therefore, labored under the peculiar disadvantage that they were competing against a foreign company which manufactured its apparatus abroad where the labor costs less than half what it does in the United States, which had its apparatus introduced in the United States duty free by the Government, and which, by candidly appropriating the Fessenden and Marconi inventions, was thereby relieved of the enormous cost of experimental investigations.

The somewhat ludicrous situation is thus presented of a foreigner who had appropriated the ideas of an American inventor, receiving decorations and grants of large sums of money from his own government, while the American Government was purchasing this pirated apparatus, and introducing it free of duty on the ground that the American inventor asked too much, and in spite of the fact that the American Company had tendered exactly the same class of apparatus.

The situation has, however, improved considerably of late. There is this to be said for the Navy, that when the facts were finally placed plainly before the Department they realized at once the fact that the American company had not received justice in the matter, and it may be stated with some degree of certainty that the American systems will have an opportunity of showing what they can do, and that should any foreign apparatus be bought it will be bought of responsible agents residing in this country, and capable of paying damages should they be assessed against them by a court. The question of which system is to be adopted by the Navy is at the present moment an open question.

5. The Army is not experimenting with a combination of the De Forest and Signal Corps systems. The Signal Corps installed two stations at Forts Wright and Schuyler, and tried a number of

systems, including the Lodge, Slaby-Arco and De Forest. None of these were successful, until the De Forest Company manufactured two liquid barretters of the type invented by Prof. Fessenden, whereupon immediate success was had. The De Forest Company had sold the liquid barretter to General Greely before the National Electric Signaling Company became aware of it, and immediately upon learning of it the National Electric Signaling Company commenced suit against the De Forest Company, but the suit will not come up for hearing before October or November next. General Greely thereupon took the position that he would decline to buy apparatus from any company until the ownership of the patents was decided, and meantime instructed his officers to arrange a system solely with a view to its utmost efficiency, stating that the Department would later compensate the inventors when the ownership of the patents was decided. The system in use by the Army was, therefore, arranged by the officers of the Signal Corps, and is known as the Signal Corps' system. No company has any authorization to use its name in connection with the Alaska apparatus, and in view of the fact that the system embodies the wave chute (rendered necessary by the frozen ground of Alaska), the multiple vertical, the high frequency tuned steel guy supports, the tuned condenser circuit for prolonging the oscillations at the sending end, the liquid barretter, and closed tuned circuit at the receiving end, etc., covered by the Fessenden patents belonging to the National Electric Signaling Company, if the name of any company is used it should be that of the National Electric Signaling Company.

With reference to the ELECTRICAL WORLD AND ENGINEER's editorial on the morality of a government appropriating the wireless business, this company naturally has the same opinion. While there have been many cases where the Government has acted unjustly and improperly, it is not believed that matters have yet got to such a point that a socialistic scheme for stealing property developed at an expense of hundreds of thousands of dollars can be rushed through Congress, either now or for many years to come. When the time comes that the American people are willing to see several hundreds of thousands of young men and girls working for from $3 to $5 a week with the ultimate prospect of just getting enough to pay their board, in order to keep down an annual telegraphic deficit, as is now the case in England and Germany, the times may ripen for such an act. But not now.

NATIONAL ELECTRIC SIGNALING COMPANY,
H. J. GLAUBITZ, *Manager.*

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Transformer Oil.—SKINNER.—An illustrated article in which the author discusses the properties required from oil for transformers and describes the methods of testing. Tests of the insulating value of an oil are made by determining its dielectric strength; the general method is to immerse a spark-gap in the oil, the gap being set at a known distance, and to gradually raise the potential until rupture occurs. The author gives very distinct rules on this test, also on the flash and fire test; he discusses evaporation, the deteriorating effect of moisture, the viscosity, the cold test, the color, the detrimental effect of sulphur compounds in the oil, and the formation of deposits. Transformer oil should be a pure mineral oil obtained by fractional distillation of petroleum unmixed with any other substance and without subsequent chemical treatment. The flash test of the oil should not be less than 180° C. (356° F.) and the burning test should not be less than 200° C. (392° F.). The oil must not contain moisture, acid, alkali or sulphur compounds. The oil should not show an evaporation of more than 0.2 per cent. when heated at 100° C. for 8 hours. It is desirable that the oil should be as fluid as possible and that the color be as light as can be obtained in an untreated oil.—*Elec. Club Jour.*, May.

REFERENCES.

Three-Phase Motors.—GROB.—For testing three-phase induction motors it is valuable to have simple and exact methods for determining the efficiency, phase difference, overload capacity, slip, etc., by means of simple measurements. This may be done with the diagrams of Heyland and Ossanna. The author develops a new and relatively simple diagram in which the effect of the ohmic voltage drop is taken into consideration (which was not done in the first Heyland diagram).—*Elek. Zeit.*, June 2.

Induction Motor.—BREGUET.—A mathematical article, illustrated by diagrams, on the Behrend-Blondel-Heyland diagram of induction motors.—*L'Eclairage Elec.*, May 21, 28.

Single-Phase Commutator Motors.—LEHMANN.—A theoretical paper in which he first briefly discusses the windings of such motors and then gives the theory of the repulsion motor.—*L'Eclairage Elec.*, May 28, June 4.

Repulsion Motor.—CARTER.—The first parts of an illustrated serial on the properties of the repulsion motor.—Lond. *Elec. Rev.*, May 27 and June 3.

Railway Motor.—ROBERTSON.—An illustrated article on the winding of a railway motor armature. He describes the construction through its different processes of manufacture, the Westinghouse No. 12A railway motor armature being taken as example.—*Elec. Club Jour.*, May.

Machine Design.—LOEWY.—In a continuation of his illustrated serial on improvements made during 1903 in design of electric machines, he deals with induction motors.—*Zeit. f. Elek.* (Vienna), May 22.

Two-Phase Synchronizer.—PERCY.—A description, with dimensioned drawings, of a two-phase synchronism indicator of the revolving light type.—*Am. Elec.*, June.

LIGHTS AND LIGHTING.

Street Lighting.—HALLBERG.—A full discussion of the system of street lighting by means of small candle-power enclosed arc lamps. They consume about 250 to 300 watts at the arc, and are operated either with direct or alternating current, and are connected either in multiple or in series. The advantages of these four systems are discussed in detail and for parallel connection of the lamps it is shown that the alternating-current system has about 10 per cent. higher efficiency than the direct-current system, but requires the installation of about one-third more in generator and transformer capacities. For series connection of the lamps the alternating-current system is also more efficient than the direct-current system and requires about the same generator capacity. From the central station operator's point of view the series alternating-current system is the most advantageous, the series direct-current system comes next, the multiple alternating-current system third and the multiple direct-current system is last.—*Am. Elec.*, June.

POWER.

Electric Elevator.—JAMES.—An illustrated lecture on the present status of the electric elevator. The direct-current drum type machine, with the most modern method of control, gives very satisfactory results up to a speed of 300 ft. per minute. The cost of maintenance of this machine is reasonable where it receives proper attention, the depreciation being less than 10 per cent. Direct-current electric machines of other types which have been designed to compete directly with the higher speed hydraulic elevators, have not yet come into general use. These machines are too complicated in control and design, too expensive to buy and maintain, and some types have not yet proved that they are entirely reliable in their action. A large number of direct-current machines have been built for speeds of 500 and 600 ft. a minute and are now in successful operation, but they have not so far gained the confidence of the public at large nor the unanimous confidence of elevator engineers. Direct-current electric furnace hoists up to 300 hp have been built and installed to run up an inclined plane 300 or 400 ft. a minute with large loads, and stop automatically at the top and the bottom: these machines have been in operation for several years, and are entirely satisfactory, but their cost is greater than that of steam furnace hoists and for this reason they are not as extensively used as their satisfactory operation warrants. For the induction motor the most promising field in elevator work seems to be in connection with hydraulic installations where the induction motor is used to drive a centrifugal pump. No installations using the centrifugal pump have yet been made, but the matter is in such shape that there probably will be several of them in operation shortly. These motors are being used with success to operate triplex pumps by allowing the motor to run constantly and by-passing the pump automatically when the pressure reaches the desired point.—*Elec. Club Jour.*, May.

Thermal Storage System.—An illustrated article on the Kensington and Notting Hill joint electric works, which supply three-phase currents at 5,000 volts to sub-stations. When extensions became necessary it was found there was room to place a 1,000-kw Parsons turbo generator in the engine room, but an extension of the steam-raising plant was a more difficult problem. It was decided to apply the Druitt Halpin thermal storage system and this experiment has been "conspicuously successful." The main idea of the system is roughly to increase the rating of the boilers at the hours of peak load, by feeding the boiler with water at boiler temperature during those hours, this water having been previously heated to the desired temperature by live steam during the hours preceding the peak hours. Additional boiler plant would, of course, only have been needed to deal with the maximum load for the two or three hours that the peak continues, and thus a substantial increase in the rate of steaming during this period is all that was required. It was found that the expedient answered even better than was anticipated, for an actual increase of boiler efficiency was observed, owing to the improvement in circulation, occasioned probably by the more steady feeding at boiler temperature when the boiler is working at its extreme output. Fig. 1 shows the arrangement adopted. The water tube boilers,

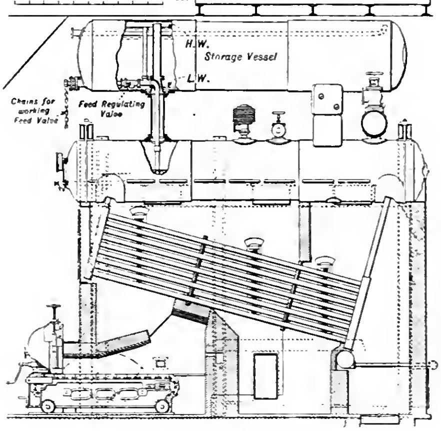


FIG. 1.—THERMAL STORAGE.

which are capable of evaporating 12,000 pounds of water per hour, have two steam and water drums, each 4 ft. in diameter by 24 ft. long, and the thermal storage vessels are placed directly above them, being carried at one end by a 10-in. stand pipe and at the other end by sliding cast-iron saddle pieces. The stand pipe forms a prominent connection to the steam space of the drums of the water tube boilers, so that the temperature and pressure in the boiler and in the thermal storage vessels are always equal. The whole of the feed water, after passing through the feed heaters (heated by the exhaust from the auxiliary engines), and the economizers, is introduced directly into the thermal storage vessel at the top, where, in passing through the steam, it is heated to the full boiler temperature, and it enters the boiler through the feed regulating cock, which is controlled by a spindle passing through a gland in the end plate of the thermal storage vessel. During times of light load the vessel is filled up, and when the heavy load comes on the feed from the pumps is stopped, and the boilers are fed from the water contained in the thermal storage vessels. During time the vessels are being discharged, the boilers are capable of evaporating two to three times the amount of water they can deal with when being fed from the economizers in the ordinary way. The extraordinary gain in the evaporation capacity would, however, not be attainable in the case of every boiler. The boilers at the station in question were originally arranged so that there should be more space for the furnace and freer excess of air to it than in accordance with the usual practice. The boiler tubes were elevated three feet higher than usual, so that the firebrick-lined combustion chamber is formed directly over the fire. There are two firebrick arches instead of one, and the flame-plate division wall between the furnace and the middle chamber is nearer the front of the boiler than usual, so as to raise the temperature and get more work done in the middle chamber.—Lond. *Elec.*, May 27.

Steam Turbine.—PARSONS, STONEY AND MARTIN.—A long illustrated paper read before the (British) Institute of Electrical Engineers on the steam turbine as applied to electrical engineering. The authors discuss at length the development of the Parsons turbine and state that up to the present there are about 600,000 hp of turbines of the Parsons type at work and on order in England and in continental Europe in various sizes ranging up to 7,000 kw.—Lond. *Elec.*, May 27, June 3. In an editorial discussion of the paper it is said that in the discussion G. Insull, of Chicago, gave particulars concerning the 6,000-kw Curtis turbines in one of his Chicago power stations. They were stated to give results 30 per cent. better than the plant in a reciprocating engine station of 17,000 kw. Merz contributed the first independent statement of an efficiency test of a Curtis turbine, namely, a 500-kw set installed at Cork. This set consumed 20.5 pounds of steam per kw-hour, with a vacuum of 27 inches and steam at 150-pounds pressure, superheated 100° F. With a vacuum of 28½ in. and 150° superheat, the steam consumption would have been reduced to less than 19 pounds. It is said that while these results do not excel those obtained with the Parsons turbine under similar conditions, they show that there is not much to choose between the two types as far as steam consumption is concerned; according to Stoney the floor space equipment as well as the capital cost is about the same in each case.—Lond. *Elec. Rev.*, May 27.

Oil Separator.—An illustrated description of an electrical oil separator used at the Leicester electric plant for effectively removing oil from the air pump discharge. There are two large wooden tanks, each divided into five compartments, and each compartment accommodates 10 plain sheet-iron plates ¼ in. thick. All the compartments are connected up in series across a 500-volt circuit and there are five plates in parallel. The liquid to be treated is divided into two streams at one end of the tanks. It then passes into the tanks and through each set of compartments in five parallel streams. Alternate plates are cut so that liquid passes first under one plate and then over the next and so on, so that the circulation is very thorough. The Leicester plant is capable of dealing with 6,000 gallons per hour and requires 12 amp. at 500 volts. The sheet-iron plates last from two to three years. After working for a certain time, they become coated with a deposit which is easily removable by causing the current to pass through the tanks in opposite directions. The deposit then rises to the surface and is cleaned off. This is practically all the attention which the process requires. The air pump discharge water is almost an electric insulator and it is necessary to add a minute quantity of ordinary water. The action of the current is to cause the emulsified oil to coalesce, and when the liquid has subsequently passed through a mechanical filter, there is no difficulty whatever in catching the particles of oil, thus allowing the remaining water, which is exceptionally pure, to pass to the hot well. The separator can be used in conjunction with any type of filter.—Lond. *Elec.*, May 27.

Electric Installation of Mines.—HOSEA.—An illustrated description of the plant of the Colorado Fuel & Iron Company at Primero. The power plant contains two 120-kw, 500-volt electric generators which furnish current for the inside haulage and for the operation of the elevators, screens and box car loaders at the tipple. They are wound for 500 volts and over-compounded 10 per cent. For hauling electric locomotives are provided with three 500-volt motors and equipped with series parallel control. They are capable of hauling a load of 228 tons on a level at a speed of six to 10 miles per hour.—*Mines & Minerals*, June.

REFERENCE.

Turbo-Generator.—WOODBURY.—An illustrated article on the test of a 5,500-kw turbo-generator, being the first of eight built for a

London traction company. It gives three-phase currents at 11,000 volts and 33 cycles and runs at a speed of 1,000 r.p.m.—*Elec. Club Jour.*, May.

TRACTION.

Single-Phase Traction.—An editorial referring to a recent article of Blanck on single-phase traction. It is further pointed out that the question of track equipment has received not enough attention. The question is whether the ultimate standard practice will be to feed the motor cars or locomotives direct from the high-tension line or from a third rail supplied from transformers distributed along the line. A system of the former type is that of the Oerlikon Company. The principle of this system is that the current-collecting device ought to follow the trolley wire and not vice versa; this makes a cheap and safe overhead construction possible. One of its weak points appears to be the shifting arrangement for the current-collecting device as a whole, which is necessary for avoiding obstructions offered to it on the line, such as tunnels, bridges with small clearances, lamp posts, etc., in stations. Concerning the Ward Leonard single-phase traction system, it is thought that this method in which the locomotive carries a sub-station in addition to its driving motors is not destined to be more popular than the Heyman locomotive in which the whole generating station was placed on the locomotive.—Lond. *Elec.*, May 27.

Tractive Resistance on Various Roads.—A note giving some figures on the tractive resistance on various roads, taken from a pamphlet of Max Schiemann. The tractive resistance on railways is from 9 to 18 pounds per ton, on tramways from 26 to 33 pounds, on good stone pavement from 44 to 55 pounds, on bad stone pavement from 66 to 78 pounds, on good macadam from 44 to 67 pounds, on bad macadam from 77 to 100 pounds, and on sand roads from 130 to 220 pounds.—Lond. *Elec.*, May 27.

REFERENCE.

Overhead Tramway Construction.—An article giving practical rules on the design, selection, arrangement and erection of overhead line material. The author deals especially with poles and line insulators.—Lond. *Elec. Rev.*, May 27.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Earthing Neutral Point of a Star-Connected, Three-Phase System.—TATLOW.—An abstract of a paper read before the Dublin local section of the (British) Institute of Electrical Engineers. He suggested an explanation for the fact that comparatively large currents which cannot be attributed to faulty insulation have been observed in the wire earthing the star connection of the three-phase alternators working in a Dublin station. He shows that the harmonic pressures of three times (or multiples of three times) the mean frequency are the same in magnitude and direction in all the three phases at any moment, whereas the fundamental and the other harmonics differ by 120° in phase in each of the three phases. It follows that in a mesh-connected winding, harmonic pressures of three times or $3n$ times the fundamental frequency, will, if present, add together and drive idle currents round the mesh, while the fundamental and remaining harmonics form balanced sets, the sum of the three pressures due to any of them taken round the mesh being zero at any moment. In the case of a star-connected winding these harmonics of the third order will tend to drive current into or out of the star point equally in all the three windings at any moment, and therefore they will be balanced, and, as far as pressures between any pair of the three wires coming from the machine are concerned, harmonics of the third order are eliminated by the star connection, and should not appear in the pressure wave. They would, however, appear in the pressure wave taken between any of the three leads and the neutral point if they happen to be set up in the windings, and the waves of pressure between lead and lead and between any lead and the neutral point would differ in form. Now, if the star point of the three-phase generator is earthed, and the three leads bringing current from the machine are in the form of a three-core, lead-sheathed cable, these harmonics of the third order will give rise to a capacity current flowing to earth from the neutral point and charging the sheath of the cable. The main potential of the three cores is not zero, but a fluctuating quantity which will give rise to a capacity current depending on the capacity between the three cores taken together and the sheath. In the Dublin cables the capacity of the two cables in parallel amounts to approximately 1.5 microfarads, and the author says that currents in the earth wire of the star of the order of one ampere or more might be expected. He expects to test his theory by bringing a coil connected to a telephone near to the earth wire, and observing the pitch of the note in the telephone.—Lond. *Elec.*, May 27.

Reverse-Current Relay.—An illustrated description of a reverse-current relay for use on direct-current circuits made by a British company. It is a moving coil polarized relay. The moving coil is operated by the fall of potential across the ammeter shunt. With current in the forward direction, the contact carried by the moving coil is held against the stop, but the effect of a reverse current, whose magnitude may be determined by a controlling spring, is to cause the moving coil to rotate and make contact in an auxiliary circuit. This auxiliary circuit contains eight Leclanche cells, and on being completed causes a small electromagnet to attract its armature. This latter closes a pair of heavy carbon contacts which complete the circuit of the tripping coil of the circuit-breaker. The object of the auxiliary circuit is to obviate sparking due to the induction of the trip coil at the necessarily light contacts carried by the moving part of the relay proper. The trip coil is connected across the bus-bars, and is constructed in such a manner that even if the bus-bar voltage should fall to ⅙ of its normal value it would be sufficiently strong to open the circuit-breaker. The connections are so made that a colored lamp is lighted immediately the relay operates, thus indicating at a distance which circuit-breaker has operated. The relay is provided with a push-button and on pressing this the device is caused to work and the circuit-breaker to open.—Lond. *Elec.*, May 27.

WIRES, WIRING AND CONDUITS.

Cable Calculator.—An illustrated description of the Callender cable calculator, designed by Hastings for the purpose of easily determining the size of conductor which should be used under any given conditions. The apparatus is made up of a series of discs mounted upon a common spindle, each having a logarithmic scale upon its periphery. There are six factors which determine the size of the cable, viz.: power, distance, difference of potential, power factor, loss per cent. allowed, and the system of distribution employed. In the apparatus each of these factors is represented by a disc, and the seventh disc, which is fixed to the shaft, accumulates the sum of the movements of the other discs, thereby giving immediately the result of the conditions under which the cable has to work.—Lond. *Elec.*, May 27.

REFERENCE.

Telephone Cables.—SCHMIDT.—An illustrated article on the manufacture of multicore telephone cables with air insulation.—*Zeit. f. Elek.*, (Vienna), May 29.

ELECTRO-PHYSICS AND MAGNETISM.

Stationary Electric Waves.—FLEMING.—A description of an elaborate apparatus exhibited at a recent Royal Society conversazione for the study of stationary electric waves on spiral wires. The apparatus consists of a long solenoid of silk-covered wire, having 5,000 turns and a total length of 643 meters. This solenoid has parallel to it an adjustable earth wire and a divided scale. The solenoid is connected to one point on an oscillatory electric circuit, consisting of a couple of Leyden jars, having a capacity of 0.00068 microfarads, an adjustable inductance between 0 and 230 microhenrys and a silent discharger. When oscillations are set up in this circuit by induction coil discharges and the frequency adjusted, stationary electric waves are started in the solenoid. The position of the loops and nodes is ascertained by the use of a series of carbon dioxide vacuum tubes. The position of the first node is always well defined. According to the theory the distance from the end of the solenoid to the first node should be to the distance between the first and second nodes as 1 to 2.5, and the distance between the first and second nodes should be half the wave length. Experiments with the apparatus gave a mean value of 1 to 2.4 for the above ratio. The inductance of the long spiral is 100 microhenrys per centimeter of length and its capacity is 26×10^{-8} of a microfarad per centimeter of length. From these data it is found that the velocity of the wave along the spiral is about 196 centimeters per second. From the wave lengths experimentally determined, the corresponding frequencies are then found, and these accord substantially with the frequencies as calculated.—Lond. *Elec. Rev.*, May 27.

Radiographs.—D'ARSONVAL.—A paper giving a series of radiographs and showing how they can be produced by the same tube in an identical manner after a considerable interval of time and after using the same tube for various purposes in the meantime. He uses a milliammeter specially constructed by Gaiffe, in conjunction with an alternating-current transformer, raising the voltage from 110 to 60,000. There is also a rheostat and a voltmeter on the primary from which the effective voltage in the secondary may be determined. The current is taken from the supply network. The rest of the arrangement is that designed by Villard. The special milliammeter is only in circuit with the X-ray tube. The radiographs reproduced show that the quantity and quality of the radiation were the same in every case. A given tube may always be brought back to the same conditions of emission. When the pressure is the same, the intensity of the radiation is proportional to the current strength. The new apparatus enables radiographers to repeat any exposure under precisely the same conditions.—*Comptes Rendus,* May 9, Lond. *Elec.,* May 27.

Penetrating Radium Rays.—Paschen.—An account of an investigation in which he found that the γ rays, or penetrating radium rays, are not analogous to Röntgen rays, but are cathode rays or electrons moving with the velocity of light. If radium bromide is enclosed in a continuous casing of lead 1 cm. thick, the γ rays are capable of penetrating that thickness of lead, but the other radium rays are not. In spite of the packing, the positive charge of the radium preparation increases steadily by several volts per minute, which can only be due to the fact that the escaping γ rays carry a negative charge with them.—*Ann. der Phys.,* No. 6; abstracted Lond. *Elec.,* May 27.

Thermoelectricity.—Deguisne.—An account of some experiments in which a copper wire was heated for a distance of about 1 cm. to red heat by means of a Bunsen burner. If the burner is then moved along the wire in the one or the other direction for about ½ cm., an e.m.f. of some microvolts is measured, the direction of the current being in the direction of the movement of the burner. An e.m.f. is also obtained if two free wire ends of the same material, one of which has been preheated, are brought into contact. The author explains his results as follows: By first heating the wire at one place its structure at this place is changed and the wire becomes softer at this point. If the burner is kept at rest, the two points in which the soft wire is in contact with the other wire are of the same temperature and, therefore, no thermo-e.m.f. is observed. If the flame is moved to one side, a difference of temperature is produced between the two contact points and a thermo-e.m.f. is produced.—*Elek. Zeit.,* May 26.

REFERENCES.

Dielectric Constant of Water.—Vonwiller.—An account of the experimental investigation of the variation of the dielectric constant of water with the temperature in the neighborhood of 4° C. Thwing had found a critical point at 4° C., the dielectric constant rising to a maximum value at that point and then decreasing with rising temperature. The present investigator could not find any indication of the large effect observed by Thwing at this temperature.—*Phil. Mag.,* June.

Röntgen Rays in a Magnetic Field.—Walter.—An account of an experimental investigation in which he proved that if Röntgen rays pass through a unit magnetic field, or a field about six times as strong as the earth's horizontal magnetic force in our latitude, the radius of curvature of the rays, if not infinite, is certainly larger than the distance of the moon from the earth. This is another confirmation of the undulatory character of the Röntgen rays.—*Ann. der Phys.,* No. 6; Lond. *Elec.,* May 27.

Radioactivity.—P. Curie.—The first part of an article giving a summary of our present knowledge of radioactivity, with special reference to the most recent investigations.—*Phys. Zeit.,* June 1.

Units, Measurements and Instruments.

Units.—Robertson.—A communication on the completion of the practical system of electrical units. As was recently noticed in the Digest, he has suggested a system which involves getting rid of the 4π in certain equations by including it in the numerical value for μ, and the taking there of another factor, 10^7, in order to make the meter and kilogram consistent with the ampere, volt, ohm. He claims that his system is put forward as being both final and practical. It does not alter any of the given electrical units and it gives simple powers of 10 as the converting factors for the c.g.s. units of all non-electrical qualities. He emphasizes that in the present state of our knowledge there must be four fundamentals in a system of electrical units, and there is no reason why we should expect to reduce this number.. We know that the square root of the product of the electric inductive capacity and the magnetic permeability is the reciprocal of a velocity, but this only enables us to express one of these in terms of the other and length, time, mass.—Lond. *Elec.,* May 27.

System of Units.—Emde.—A very long paper read before the Berlin Electrical Society. A system of units has to fulfill the purpose of enabling the facts to be described in the simplest way. The author first gives a cursory review of the facts of electricity and magnetism and then discusses the dimensions of the various quantities and the various systems of units which have been proposed. He does not himself make proposals, but gives a very full review of the various systems of units proposed, partly with the aid of diagrams and formulas. Concerning Fessenden's proposal to make the ampere-turn the unit of m.m.f., he says that this means simply to sanction in theory what is already done by everybody in practice. The author discusses at great length the proposals made by Giorgi. In the discussion which followed Hagen claimed that international electrical congresses, like that at St. Louis, are not the place to decide about such questions, since the majority of the members of the congress would not be competent to discuss them; he thinks that such a question should be discussed exclusively by official delegates of the various countries. Goerges does not like the adoption of the ampere-turn as the unit of m.m.f., since there are m.m.f.'s which are not due to electric currents; he has always considered the distinction between m.m.f. and number of ampere-turns to be very useful. Emde called attention to the double sense in which the term kg. is used, sometimes as a unit of mass and sometimes as a unit of weight. He suggests the name hyl for the unit of mass.—*Elek. Zeit.,* May 26.

Variable Resistance.—An illustrated description of a simple and convenient arrangement for obtaining a variable resistance to work in conjunction with banks of lamps or resistance racks to give finer regulation of current. As shown in Fig. 2, five incandescent lamps

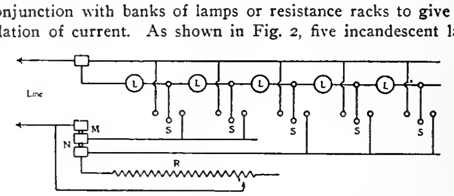


FIG. 2.—VARIABLE RESISTANCE.

are connected in series with the hinge jaws of the single-pole, double-throw switches. A german-silver resistance coil, with sliding contact, is connected by blocks at M or N, so that it may be used in series with various combinations of the lamps. The end lamp has twice the resistance of any of the others. If the coil be designed to have a resistance equal to that of a lamp, it will be seen that by proper arrangements of the switches and adjustments of the coil a great number of values of resistance may be obtained, which will range from a maximum, when the lamps are in multiple, to a minimum when the lamps are in series. Somewhat greater flexibility is attained by using two coils instead of one and connecting them in series or parallel as the occasion may require. This device is especially desirable for use in testing and calibrating instruments where very small currents are often used and where small changes of current values are necessary.—*Elec. Club Jour.,* May.

REFERENCES.

Measuring Small Capacities with an Adjustable Standard Capacity.—Gerdien.—An illustrated article in which the author describes an adjustable condenser which he has found useful as a standard instrument. It is essentially a combination of two coaxial cylinders, one placed in the other, the capacity being changed by pushing the inner cylinder more or less into the outer one. He then describes a simple method for using this standard condenser for measurements of small capacities.—*Phys. Zeit.,* June 1.

Electric Micrometer.—A note on an electric micrometer exhibited by Crompton at the recent Royal Society conversazione for measuring screws or other small mechanical parts. It is arranged so that a contact of the part with the micrometer screw is detected by the click of a telephone in circuit with the parts. This method is extremely delicate and very easily manipulated.—Lond. *Elec. Rev.*, May 27.

Measuring Currents in a Three-Phase System.—An illustrated note on a method used in switchboard wiring where it is desired to measure the currents in a three-phase system by means of one ammeter and only two series transformers, instead of three, which are usually necessary.—*Elec. Club Jour.*, May.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Magnetic Wave Detectors.—ARNO.—An illustrated description of a rotary-field detector of Hertzian waves. Ferraris has demonstrated that an iron cylinder is caused to rotate when placed in a rotary magnetic field, even when the cylinder is sectioned in such a manner that no Foucault currents can be induced in it; the rotation is then due to magnetic hysteresis, i. e., to the drag caused by the magnetization of the iron lagging behind the rotation of the magnetic field. If the iron cylinder is subjected to the action of a rotary field and at the same time to a high-frequency oscillating field, then its behavior indicates the existence of the latter. He proved this by suspending in a rotary field, by means of bifilar suspension, a disc consisting of a mixture of iron and steel powder and paraffin wax, on which was wound a coil having one end connected to earth and the other to the vertical air wire. After having read by means of mirror and scale the deviation of the disc under the action of the rotary field alone, the oscillator was brought into action, and a distinct increase in the deviation of the disc was observed. In order to increase the sensibility of the apparatus he now uses the arrangement shown in Fig. 3. The initial deviation of the moving member

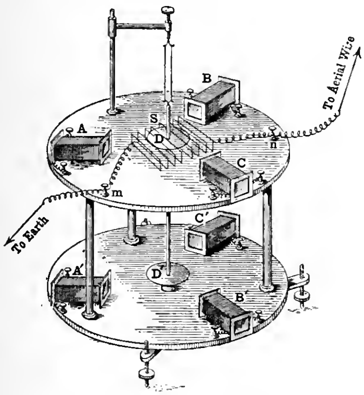


FIG. 3.—FERRARIS FIELD DETECTOR.

is always zero, whatever the intensity of the revolving field; for this purpose two perfectly equal discs, D and D^1, of magnetic dielectric material are suspended in two magnetic fields of the same intensity revolving in opposite directions; these two fields are obtained by means of the electromagnets, A, B, C, A^1, B^1, C^1, inserted in the three circuits of the three-phase system. Only one of the two discs is placed within the spiral, S, by which the terminals, m, n, are connected to earth and to the vertical air wire.—Lond. *Elec.*, June 3.

Duplex Telegraphy.—A note stating that a telegraph line from Vienna to Czernowitz about 650 miles long, had gradually become inadequate for the increasing traffic from Vienna to the southeast of Europe. As a second line would have cost about $62,500, it was decided, in spite of the fact that the line consists of iron wire, to try the differential system of duplex telegraphy, the cost of which amounted to but $1,040. The experiment succeeded and the system has now been working satisfactorily for some weeks.—Lond. *Elec.*, May 27.

MISCELLANEOUS.

REFERENCES.

Electrical Laboratory.—HOCHENEGG.—A fully illustrated description of the Electrical Laboratory at the Institute of Technology of Vienna. Three-phase and direct currents are available, the latter being supplied partly from the outside mains and partly from a storage battery. For the illumination of the lecture room 48 osmium lamps, each of 50 candles, are arranged in the ceiling, while the demonstrating table is illuminated by thirty-six ordinary candle lamps of 16 cp. This method of illumination is said to be very effective.—*Zeit. f. Elek.* (Vienna), May 1.

The Young Engineer.—SCOTT.—A reprint of the major portion of his address to the graduating class of 1903 of the Stevens Institute of Technology, on the young engineer and his opportunity.—*Elec. Club Jour.*, May.

New Books.

READY REFERENCE TABLES. Vol. I: Conversion Tables. By Carl Hering. New York: John Wiley & Sons. 196 pages. Price, $2.50.

This valuable reference book is very appropriately introduced by a quotation from Lord Kelvin as follows: "I look upon our English system as a wickedly brain-destroying piece of bondage under which we suffer." While many of the tables in the book would not be rendered superfluous if the metric system were in universal use, yet a glance through the pages reveals a distressing situation incident to the use of the English system of weights and measures. It is really refreshing when one comes to the section of the book devoted to electrical units and measurements which, forming part of the broad metric system, are naturally not handicapped with the burden of empiric, arbitrary relations which the English system imposes in other departments of applied science.

In this first volume all the various measures used in practice, and more especially those employed by engineers and physicists, are given, with their values expressed in terms of correlated measures likely to be used in practice. The reciprocals are also given, thus enabling every calculation involved in the conversion of one measure into another to be reduced to a single multiplication. The plan of the work involves the inclusion of every unit of measure used in practice, besides many that are now obsolete, but occasionally met with. Several hundred of the more usual foreign units or measures are also included.

A valuable feature of the book is that the conversion factors have not been merely compiled, but were all specially re-calculated for this volume under the direction of the author, from the exact legal values or the most authoritative data attainable where no legal value exists. In the preface it is stated that the calculations were in many cases made by two entirely different methods and the resultant values checked and cross-checked, often several times. In some cases the values were checked by the original authorities after the pages were electrotyped. A useful feature consists of approximate figures for values to the nearest fraction or other abbreviated number easily memorized, the approximations all being within two per cent. In many of the tables the logarithms of the values to seven places are given.

The introduction deals with the inter-relation of units, distinction between units and quantities, the absolute systems of units and dimensional formulas. The main body of the book is introduced by tables giving the physical quantities and relations in use, with their names, symbols, derivation and dimensional formulas and corresponding c.g.s. unit, these tables being an extension of a similar table which received official endorsement by the Chicago International Electrical Congress of 1893. Then follow the tables of conversion factors, which cover a wide range beyond the fundamentals of length, surface, volume and mass. Among the many headings in addition to the last-mentioned are pressures, energy, tractive force and energy, power, moments of inertia, angular velocity, linear and angular acceleration, plane and solid angles, water discharges, electric and magnetic units, photometric units and thermometer scales. The final pages deal with miscellaneous subjects, such as money, paper measure, scales of maps and drawings, useful functions of π, useful numbers, systems of logarithms, acceleration of gravity, mechanical equivalent of heat, specific heat of water, etc.

The sections on electric and magnetic units supply a great need, and give information that otherwise would have to be gathered from numerous sources, some not easily accessible. An admirable feature consists in numerous formulas giving the various relations of each quantity and the other electrical and magnetic quantities, including the numerical coefficient if there is one. For example, under ohms are given the relations with volts, amperes, coulombs, watts, joules, henries, maxwells, impedance, reactance, susceptance, admittance and frequency, thus enabling the ohms to be calculated from any two or more of these. In the same section are given many numerical values, accompanied by logarithms, of units of specific resistance, such as the mil-foot, circular millimeter-per-meter, square millimeter-per-meter, and following is a table giving the resistivity of copper and mercury in all these units and in others. Conductance, admittance and susceptance are similarly treated.

Under e.m.f. are given the values, in terms of the "international" volt, of the several volts that have been in use, and also the voltage of the several standard cells, with tables of values for the Clark and the Weston cells at different temperatures. All of the electrical and magnetic quantities are treated exhaustively along the above lines, the data collected relating to each being much more inclusive than has ever heretofore been attempted. Sections that will be of particular interest are those considering exhaustively the magnetic units and quantities, since these are given scant mention in most books.

The subject of photometric units is excellently treated under the main heads of intensity of light, flux of light, illumination, quantity of light and light efficiency, all of the many units used, as well as the system of units proposed by Blondel, being defined and inter-related quantitatively. The table giving the values of each of the second thermometer scales in terms of the others, from absolute zero to the temperature of the sun, is exceptionally interesting on account of including entries of the freezing, boiling or melting points of some hundreds of substances.

The book is prefaced by a table of symbols and abbreviations used in the text containing more than 300 entries, which should serve as an object lesson teaching the dire necessity of a uniform system of scientific and engineering notation. Though the price at which the work is published is remarkably high for a book of the size, yet it is well nigh indispensable to all who want to have at hand for ready reference the measures and values used in the physical engineering sciences. It is sincerely to be hoped that the author will supplement the volume by another giving tables of fundamental physical data, such as resistivities of solutions and metals and particularly of alloys, electrochemical equivalents, thermoelectric e.m.f's and e.m.f's of combinations of the various metals and electrolytes, Berthelot's heats of reaction, specific inductive capacities, and various other magnetic and electrical constants, many of which are not readily accessible, or when given in some publications are of doubtful authenticity.

Convention of Railway Telegraph Superintendents.

The twenty-third annual convention of the Association of Railway Telegraph Superintendents was held at Hotel English, Indianapolis, Ind., June 15 and 16. The meeting was called to order by President Charles S. Rhoads, who, in a brief address, congratulated the Association on its prosperity which, he said, is more marked at this time than at any other period in its history. He introduced the Hon. J. W. Holzman, Mayor of Indianapolis, who extended to the delegates a hearty welcome to the city. His Honor stated that he would not tender the keys of the city, as is usual on such occasions, because the gates would be left wide open during the sessions of the convention and no keys were necessary. He spoke a good word for the city of Indianapolis and the character of its citizens. Mr. Charles Selden, on behalf of the Association, responded to the Mayor's address, thanking the latter for his kind expressions of welcome.

After the transaction of some routine business several active, associate and honorary members were elected. Letters and telegrams of regret at inability to be present were read from several of the members, including Mr. Thomas A. Edison, and L. W. Stanton, of Cleveland. The morning session was concluded by the reading of the reports of the secretary and treasurer.

At the afternoon session a paper entitled "The Telephone in Railway Service" was read by Mr. A. G. Francis, railroad agent of the Chicago Telephone Company. Mr. Francis discussed the economy, development and equipment of railway signal towers. In the discussion of the paper it was brought out that railroad trains on many roads are being moved successfully on telephonic orders, and that up to the present time not a single accident, traceable to such orders, has been recorded. The subject of the paper was referred to the committee with instructions to bring the matter before the American Railway Association for the purpose of formulating orders permitting the movement of trains on telephonic orders.

Mr. F. G. Sherman, of the Central Railroad of New Jersey, read a paper entitled "The Economic Use of the Commercial Telegraph by Holders of Telegraph Franks Issued on Account of Railroad Contracts." In the discussion of this paper many abuses of the articles of contract were referred to.

At the evening session the first business was a paper by Mr. J. B. Taltavall, of New York, entitled "The Telegraph Operator in the Railroad Service." In the discussion that followed it was shown how improvements in the operation of the railroad telegraph system could be made without increasing operating expenses; and many of the members gave an account of the methods adopted by their respective roads as tending to improve the worth of the individual operator.

Mr. William Kline, of Toledo, Ohio, described the combination telephone system operated by nine of the railroads entering that city, which was used for the purpose of facilitating the exchange of business between the different roads. He stated that the results had so far been most satisfactory and that the movement of traffic had been greatly expedited. Along the same general line Mr. E. P. Griffith, of the Erie Railroad, read an exhaustive report on the subject of "Composite Circuits," which gave a list of the railroads in the United States at present using such circuits; also the results attained in each case. The interest of the subject to the members was evidenced by the fact that the discussion lasted until 10.30 o'clock, when the meeting adjourned until Thursday, June 16.

At the Thursday session the first business transacted was the election of officers and the selection of a place for the next meeting. The election resulted as follows: President, Mr. H. C. Hope, Chicago, Minneapolis & Omaha Railway, St. Paul, Minn.; vice-president, E. E. Torrey, Mobile & Ohio Railroad, Jackson, Tenn. Mr. P. W. Drew, of the Wisconsin Central Railway, Milwaukee, Wis., was re-elected secretary-treasurer. It was decided to hold the next convention at Chattanooga, Tenn., on the third Wednesday of May, 1905. President-elect Hope then assumed the chair and thanked the convention for the honor conferred upon him.

A paper by Mr. L. S. Wells, of the Long Island Railroad Company, on the subject of "The Typewriter in the Telephone Service," was then read. This was followed by a talk by Mr. William Maver, Jr., of New York, on "Recent Improvements in Wireless Telegraphy." The discussion of the subject of "Composite Circuits" was then resumed and continued until 1 p. m., when the convention adjourned.

An excellent programme of entertainment was provided for the guests and their wives, including a dinner at the Columbia Club, trolley excursions and a trip to St. Louis over the Big Four Railroad. The courtesies of the free use of telegraph and telephone services were extended to the delegates by the telegraph and telephone companies.

Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society was held at the Electrical Testing Laboratories, June 15. The report of the secretary showed that 101 members had been elected during the year; 54 had been dropped for non-payment of dues; 32 had resigned, and 3 had died; and that the total membership is now 631. The report of the treasurer showed that the income of the society for the year ending January 31, 1904, was $1,502.62, and the balance on hand was $34.37.

The revised constitution and by-laws were read for the second time before the society, and after being submitted to the meeting, were unanimously adopted. One essential point in the new constitution is that no officer except the secretary and treasurer shall be eligible for immediate re-election to the same office. The provision for proposed amendments is made much more stringent than formerly. One of the principal features in the amended by-laws is the provision for a nominating committee, which now consists of eight members appointed by the president, with the president ex-officio. Two of these members shall be past presidents, two shall be members of the executive committee, and four shall be non-office holding members, thus giving the largest representation on the committee to the general membership of the society.

The election of officers resulted as follows: President, Frank J. Sprague; vice-presidents, C. G. Young (re-elected), E. H. Mullin (re-elected), F. C. Bates (re-elected), Albert F. Ganz, Louis B. Marks, W. S. Rugg; secretary, George H. Guy (re-elected); treasurer, Henry A. Sinclair (re-elected).

After the business meeting the society was welcomed by Mr. John W. Lieb, Jr., president of the Electrical Testing Laboratories. Mr. Lieb gave a short history of the foundation of the laboratory, which has developed from a lamp testing bureau, founded by the Association of Edison Companies, to its present extensive and complete equipment. Since the laboratory has been opened, all kinds of electrical tests have been conducted, especially on the photometric value of arc lamps, breakdown tests of insulating material, the effect of the distribution of light due to shades and reflectors, meter tests, the standardizing of instruments, the preparation of photometric standards, etc.

Mr. Wilson S. Howell, manager of the laboratories, gave a short address on the "Importance of Testing." He showed that the matter of testing was equally important to the manufacturer and to the purchaser. Among instances given of complete testing equipments, he mentioned those of the Pennsylvania Railroad Company, the Brooklyn Navy Yard, the General Electric and the Westinghouse Companies, and it was demonstrated that the success of all those organizations was due to a great extent to their continuous testing, not only of their own purchases, but also of their own products.

Dr. Clayton H. Sharp addressed the meeting on the "Equipment of the Commercial Testing Laboratory," concluding his address with an exhibition of a number of slides, the most interesting of which were made by a triple oscillograph, showing an alternating e.m.f., and currents set up thereby with an inductance and a capacity in parallel. After an inspection of the equipment of the laboratory had been made a collation was served.

The Largest Rotary Converter.

We are glad to be able to illustrate herewith what is stated to be the largest rotary converter ever built. Although rated at 2,000 kw,

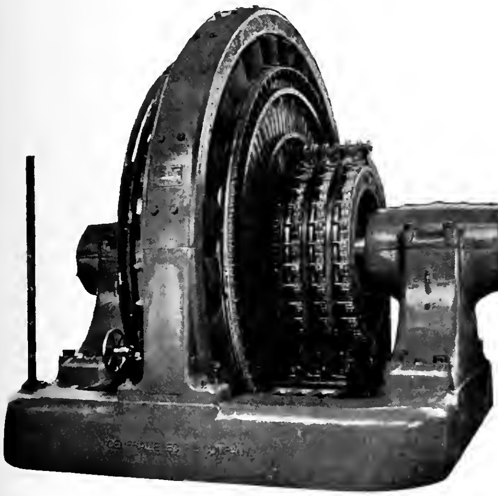


FIG. 1.—ROTARY CONVERTER.

it is actually of greater output, as the specifications call for its delivery of 2,500 kw continuously without any portion heating more than 45° C. It has met all the heating efficiency and overload guarantees with considerable margin. We are indebted to Mr. H. F. T. Erben, of the engineering department, for the data of this machine, whose design, we believe, should be credited to him.

In the nomenclature of the General Electric Company the converter is rated "HC-26-2,000-115-240/300 V.", i. e., it is six-phase, has 26 poles and operates at a speed of 115 r.p.m. Its normal full load is 7,400 amp. at any voltage between 240 and 300. Its armature is nearly 13 ft. in diameter, its commutator 11 ft., and its collector rings are 6 ft. Including the shaft, the revolving parts weigh approximately 35 tons, and the machine complete, with base and two bearings, 93 tons. The overall dimensions are as follows: Height above floor line, 14 ft.; width, 17 ft.; overall length, 15½ ft.

These converters are guaranteed for continuous operation at 7,400 amp. and 270 volts without heating more than 35° C. on any part, and for continuous operation at 9,250 amp. and 270 volts (25 per cent. overload) the temperature rise under this condition not to exceed 45° C. on any part. Immediately following either of the above conditions, 11,100 amp. at 270 volts (50 per cent. overload) for two hours was guaranteed not to produce a temperature rise exceeding 55° C. on any part. The converters have been thoroughly tested

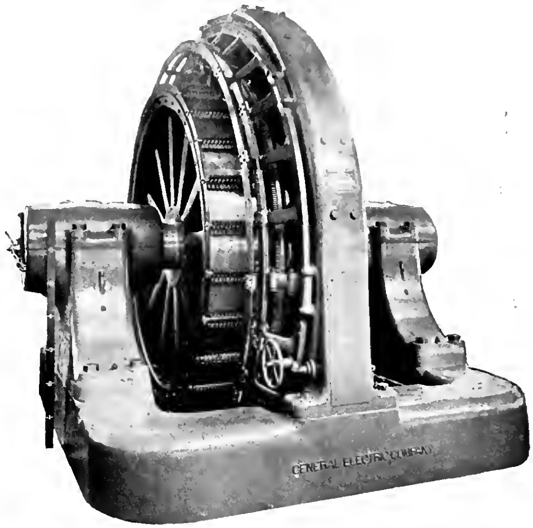


FIG. 2.—ROTARY CONVERTER.

at Schenectady under the normal and overload conditions, meeting the heating guarantees by a liberal margin and commutating throughout the range with practically no sparking at the brushes. Inclusive of all mechanical and electrical losses, the efficiencies were as follows: 1½ load, 95¾; full load, 95¾; ¾ load, 95; ½ load, 93½.

Four of these converters are to be used by the New York Edison Company on its lighting circuits.

45,000 KW Equipment for Niagara Falls Plant.

The Toronto & Niagara Falls Power Company, of which Mr. H. M. Pellat, of Toronto, is president, and Mr. F. S. Pearson, New York, consulting engineer, has just placed a very interesting contract for generators to be installed in its Niagara Falls plant.

There will be six generators of 7,500-kw capacity each. The contract was secured by the Canadian General Electric Company. The contract for the turbines has not yet been determined on.

Mr. W. P. Plummer, 29 Broadway, New York, who is purchasing agent for the Sao Paulo Tramway, Light & Power Company, Brazil, and the Mexican Light & Power Company, Limited, both of which concerns use huge quantities of Yankee equipment, supplies, etc., also acts in a similar capacity for the Toronto & Niagara Falls Power Company.

Allis-Chalmers Turbine Contract.

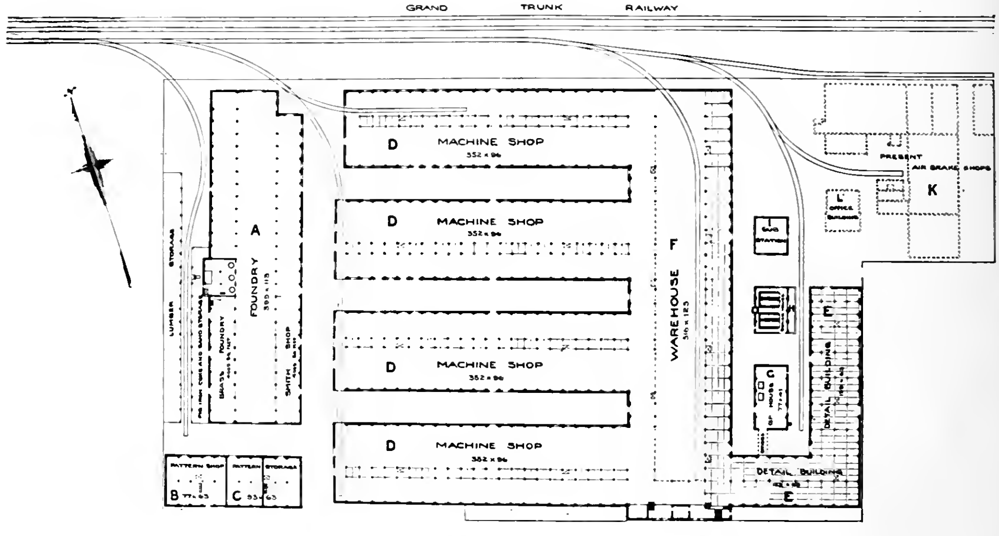
The Transit Development Company, acting on behalf of the Brooklyn Rapid Transit Company, has just placed a contract with the Allis-Chalmers Company for a 5,500-kw turbine to be direct-connected to a 25-cycle, 750-r.p.m., three-phase alternator, wound to give either 6,600 volts or 11,000 volts. This equipment is intended to be installed in the Kent Avenue and Division Avenue power station, Brooklyn. It will be the second generating outfit ordered for the same station, the Westinghouse interests having recently secured a contract for a 5,500-kw turbine and generator. The Kent Avenue plant, it is expected, will ultimately have a capacity of no less than 66,000 kw.

Canadian Works of the Westinghouse Companies.

The accompanying illustration gives a plan view of the new plant of the Canadian Westinghouse Company, Limited, at Hamilton, Ont. The choice for the location of the Canadian plant fell on Hamilton not only from the natural advantages of that city from the manufacturing standpoint, but as well from the fact that for a period of eight years another Westinghouse interest, the Westinghouse Manufacturing Company, Limited, has been located there engaged in the manufacture of Westinghouse air brakes. To join under one management the existing air brake business and the electrical business a new organization was formed under the name of the Canadian Westinghouse Company, Limited. Work on the electrical manufacturing plant has been vigorously pressed from the commencement, and notwithstanding an unusually severe winter, the work was not interrupted, and it is expected that the plant will be in operating condition this fall. The Canadian Company, through an agreement with the Pittsburg Companies, will have the benefit of all designs and processes of the older companies, and aided by the co-operation of many of Canada's most representative citizens the company can confidently count upon a prosperous future.

The new buildings consist of a foundry, pattern shop, pattern storage house, general machine shop, detail machine shop, insulation treating building, boiler house and transformer building. On the electrically driven, receives coke from railroad cars and deposits it in a bin suitably located on the charging floor. The general machine shop is arranged with a high bay covered by a 20-ton crane and a low bay served by a five-ton crane. In the former the heavier machine tools are located and it is here that mainly the stationary parts of generators and motors will be finished. The lower bay will be devoted to the preparation of rotary parts, and the gallery floor above the latter will provide space for the manufacture of commutators, brush holders, bearings, etc., and also for the tool room and the controller department. After the completed rotary part has received its winding in the eastern end of the low bay, it is passed by a jib crane along the mezzanine floor of the high bay, where it is placed in its corresponding stationary part, which has been under construction in this aisle, and the auxiliary parts are delivered at the same point by the elevator from the gallery floor.

In addition to the crane above referred to serving the main portion of the high bay, the eastern end or assembling floor is provided by an additional crane of like span, but of lower level, whereby machines can be delivered from the assembling floor under the west gallery of the warehouse into the middle bay of the latter building, where the north and south cranes can pick up the load for further handling. In the detail machine shop the ground floor will accommodate the coil winding and insulating departments, its loca-



Plan of Canadian Westinghouse Works at Hamilton, Ont.

accompanying diagram these various buildings are lettered from A to L inclusive in the order just given, with the exception that K is the brake plant and L the office building of this plant enlarged to accommodate the increased force of the new company. In laying out the manufacturing buildings two essential points were kept in view, namely, that progress of material from raw to completed shape should as far as possible be in a continuous direction; and that while the initial installation should constitute a complete plant, it should be capable of expansion along its own lines to an extent limited only by the total available property. As to the first point, raw material received on track west of the foundry progresses in general from this point to the warehouse, from which shipments are made over tracks located within the building. As to the second point, something less than half of the total installation shown in the illustration is at present under construction, the northern half of the foundry warehouse and corresponding machine shop buildings being left for future extensions.

In the foundry the main bay is served by a 20-ton crane, the length of the building being also traversed by traveling jib cranes operated at a lower level. An electrically-driven elevator is provided to deliver iron from the yard to the charging floor, and a conveyor, also tion being convenient both for the reception of the wire from the warehouse and delivery of completed coils to the winding and assembling floors at the east end of the general machine shop. The second floor is devoted to machine work necessary on switches, rheostats, meters, instruments, arc lamps, etc., and on the third floor are the assembling and testing rooms for these lines of apparatus.

The insulating treating building is separate from the main group, since the work here involves the use of inflammable materials. Communication with the detail building is provided by a two-story enclosed bridge cut off at each end by fire doors.

Power for manufacturing and testing purposes, as well as for lighting, is to be obtained from a local electric power company, which draws its supply from Decew Falls. Current will be received for general shop purposes. All the lighting distribution will be at 110 volts and transformation to direct current will be made to supply in the transformer house at 2,400 volts and distributed at 440 volts some of the cranes and tools. Transportation between the foundry and all buildings, including the air brake plant, will be by an industrial railway operated by a storage battery locomotive. The construction of the buildings is in the hands of Westinghouse, Church, Kerr & Co., of New York, as engineers and general contractors.

Exhibits at the Railroad Telegraph Superintendents' Convention at Indianapolis.

The J. H. Bunnell Company, of New York, was represented by its president and general manager, Mr. J. J. Ghegan, and Mr. Jesse H. Bunnell. Its exhibit consisted of a line of up-to-date telegraph apparatus; also a new type of star zinc and hanger and a new straight line type of line tapping clamp. Messrs. Ghegan and Bunnell distributed souvenir match boxes.

A Adams-Randall composite circuit set was shown in practical operation. The object of this device is to increase the initial energy of telephone currents to suit conditions and requirements.

Mr. C. K. Jones, of Quincy, Ill., exhibited his automatic telegraph circuit protector and signaling machine, which has received the warm commendation of the officials of the Illinois Central Railroad.

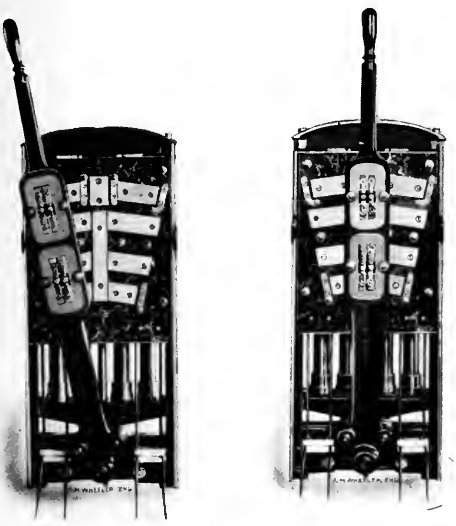
Mr. Vogel represented the Railway Supply Company, of Chicago.

The Safety Insulated Wire & Cable Company, of New York, was represented by Mr. A. P. Eckert.

The Allen-Bradley Electric Crane Controller.

The American Electric Fuse Company, of Chicago, has recently secured the exclusive manufacturing and sale rights to the Allen-Bradley electric controllers, and is now placing this line of apparatus upon the market. An exhibit of these controllers has been installed in the Electricity Building at the World's Fair, St. Louis, where they may be inspected.

While the Allen-Bradley controller is of the carbon resistance type, it differs from other carbon resistance rheostats, both in principle of operation and method of construction. The resistance medium is a column of carbon discs placed inside a non-combustible insulating tube, which in turn is enclosed within an external tube or shield. When an electrical connection is made between the top and bottom carbons, the flow of current through all of the intervening carbons will meet with a very high resistance, due to imperfect contacts between the several carbon discs. To reduce this resistance, a compression lever, operating in connection with springs, is employed to press the discs together, thereby making the contacts between them more perfect. This compression is gradually applied and affords an infinite range of control. When the compression



FIGS. 1 AND 2.—CRANE CONTROLLER.

is released, the carbons, by their natural elasticity, expand to normal condition and the resistance again becomes very great. Any desired resistance may be had by increasing the number of tubes or columns employed in the controller. A simple mechanical adjustment of the operating parts equalizes the compression upon all the tubes in the controller, as indicated in the illustrations, which show a controller having four tubes.

Among the points of superiority claimed for the Allen-Bradley controller are that it has no steps or contact points, and, therefore, the current is not regulated by jerks, while the controller is absolutely free from sparking, welding and arcing. There is no limit to the control of the current flow, and a motor can be driven as fast or as slow as desired, and without danger of injury either to the motor itself or to the controller. The resistance units being entirely enclosed from the air, are not endangered by heat even when the full resistance is left in the circuit for long successive periods of time. The machine is extremely simple in construction and practically indestructible under ordinary use, excepting from external causes. It is specially designed to stand the hardest usage, and to work under the most difficult conditions without breaking down. The controller is very compact, controllers up to 40 hp not exceeding 10 in. in width. It is possible, therefore, to place a much larger number in a smaller place than any other controller. The long leverage of the handle makes it extremely easy to mnnipulate, and the most inexperienced operator cannot injure. No repairs are necessary except when a controller is injured by accident. With ordinary use, an Allen-Bradley controller will last as long as the motor with which it is used.

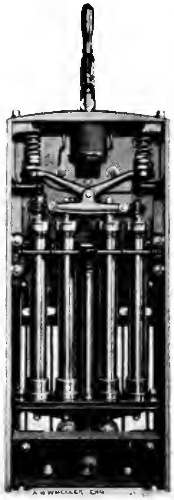


FIG. 3.—CRANE CONTROLLER.

Magnetic Apparatus.

The Electric Controller and Supply Company has designed an interesting line of magnetic apparatus, consisting of lifts, clutches and magnetically operated switches, some types of which we illustrate herewith.

FIG. 1.—LIFTING MAGNET.

Figs. 1 and 2 show lifting magnets in operation. This apparatus is made for the handling of pig iron, ingots, blooms, slabs, billets, bars, plates, rails, structural shapes, iron and steel pipe, and many other raw and manufactured products of iron and steel. A single design of magnet is not adapted to handling the full range of material above mentioned, and the magnet is designed to meet the form of material to be handled. For instance, there is a wide difference in the design of a magnet for lifting ingots or blooms and one adapted to the handling of thin plates. A magnet which would

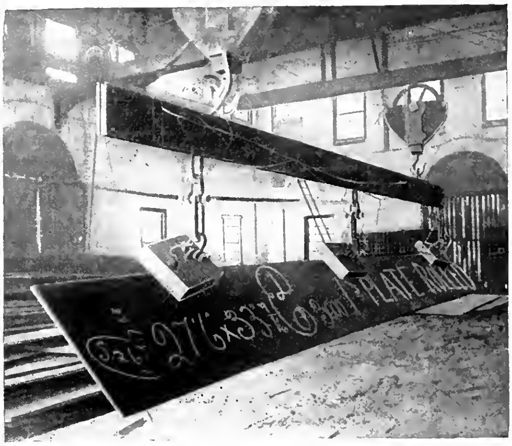


FIG. 2.—LIFTING MAGNET.

handle five tons in the form of an ingot might not handle five hundred pounds in the form of thin plates. The company has secured complete lines of data through the testing of some forty designs of magnets on a testing machine constructed for this special purpose.

In Figs 3 and 4 are shown the "magnetic cushion" type of electromagnet designed to overcome the objections to the employment of the usual type for lifting and other purposes. The initial pull of the magnet through the air gaps encountered in common practice is fully equal to that of a plugged or stopped type of magnet of

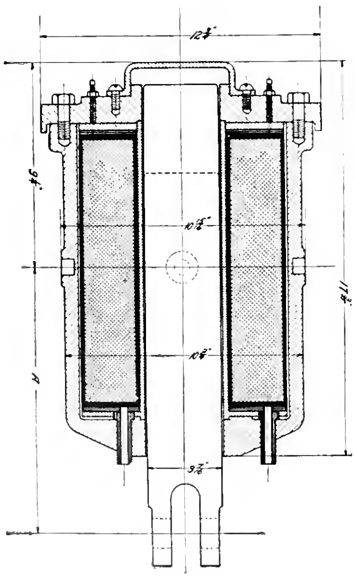


FIG. 3.—CROSS-SECTION VIEW OF ELECTROMAGNET.

equal weight, and a most desirable characteristic is obtained, in that the curve of tractive force is almost a horizontal line, which obviates rapid acceleration of the plunger toward the end of the stroke. The motion of the plunger is arrested simply by the action of the magnetic field, which gives rise to the designation "Magnetic Cushion." No mechanical stop is provided and there is no blow or shock when the plunger is brought to rest at the end of its travel. The magnet plunger, therefore, is silent in operation. For operation in exposed places, the winding of the magnet is completely enclosed

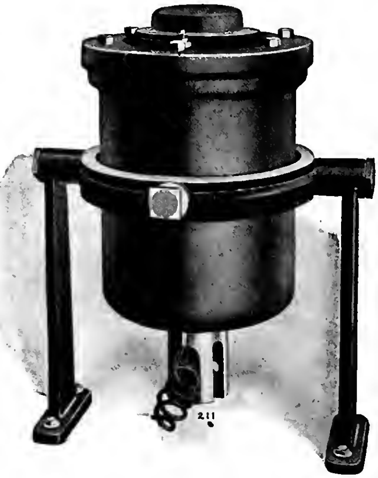


FIG. 4.—GENERAL VIEW OF ELECTROMAGNET.

and protected by the ironclad construction of the return magnetic circuit.

Fig. 5 shows a gravity type of magnetic switch, made in capacities from 1 to 150 amperes. In opening an electric switch circuit carrying a heavy current the switching device employed should meet the following requirements: First, it should open instantaneously; second, its contacts should be protected by a powerful magnetic blow-out, and third, in opening, its contacts should invariably be separated to such an extent that the magnetic blow-out will be instantly effective

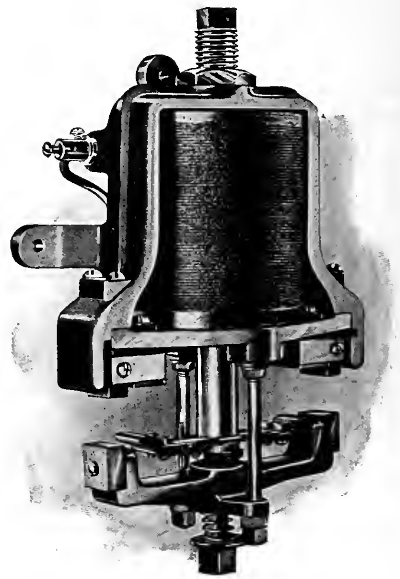


FIG. 5.—GRAVITY MAGNETIC SWITCH.

in rupturing any arc which may be formed. In closing, the switch should act promptly and positively, and the current carrying contacts should be drawn together and held with sufficient pressure to cause intimate contact between their surfaces. The switch illustrated is claimed to possess all of the above characteristics together with other valuable features of its own.

The switch is closed by the direct action of a vertical electromagnet on a movable plunger which carries the contact arm of the switch, and is opened by the action of gravity on the plunger and contact arm, the weight of which is sufficient to produce instantaneous separation of the contacts.

The main contacts of the switch are of copper and are protected by auxiliary contacts of carbon so arranged that the final opening of the circuit always takes place at the carbons, thus protecting the main

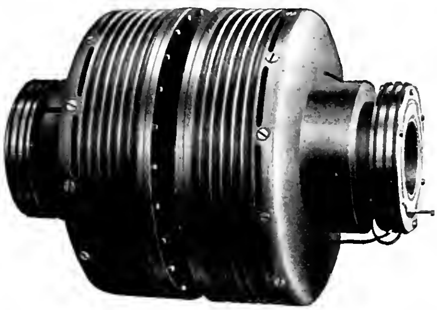


FIG. 6.—MAGNET CLUTCH.

contacts from the effect of arcing of even momentary duration. The construction of the switch is such that the frame of the electromagnet and the arm which carries the movable carbon contacts direct a heavy magnetic flux in the path of any arc which may be formed when the circuit is opened. The pressure between the current-carrying contacts when the switch is closed is produced directly by the pull of the magnet and is therefore positive and constant.

In Fig. 6 is illustrated a large magnet clutch designed for the rapid reversal of a very heavy load, a considerable amount of heat necessarily being generated at the friction surfaces at each reversal. The friction element of this clutch is composed of a plurality of friction plates, keyed alternately to the driving and driven elements and constantly bathed in oil, which serves to lubricate the plates and at the same time transmits the heat to the retaining case, where it is readily dissipated at the corrugated surface of the case.

Electrical Exhibits at the World's Fair, St. Louis.

The handsome booth on the Edison space is divided into three sections, the central one being the headquarters of the American Institute of Electrical Engineers, the one on the right being the office

FIG. 1.—EDISON STORAGE BATTERY EXHIBIT.

of the Association of the Edison Illumination Companies, and the third the office of the Edison historical exhibit. The Edison Storage Battery Company's exhibit occupies an adjoining space. Here are shown three of the latest types of the new Edison battery, one cell of each type having part of the side cut out to show the internal

FIG. 2.—BOOTHS IN EDISON SPACE.

construction. A 40-cell automobile battery is connected to a charging board to show the conditions under variable rate of charge and discharge, and demonstrates the high rates which can be used without effecting the battery. In one show case are the different parts used in the construction of the cells. Plates are exhibited from a cell of an automobile which has run 4,000 miles over rough roads and show practically no deterioration. In another case is shown an historical collection of Edison storage cells beginning with the first cell made and showing one of each type. There are also bottles containing the nickel and iron oxides and graphite used in filling the pockets of the plates. One bottle contains the electrolyte with all the sediment from a cell, which has gone 5,000 miles in an automobile. Only a very thin layer can be seen on the bottom of the bottle. On the wall are some enlarged curves showing battery voltage at various discharge rates. The exhibit also contains ten different types of the Edison-Lelande primary battery and some battery fans operated by them. Several of the Edison projecting kinetoscopes are displayed.

Some of the small motors and generators of the Roth Bros. & Co., Chicago, are adapted to special lines of work. One dynamotor of the transformer type is used by telephone exchanges for ringing bells

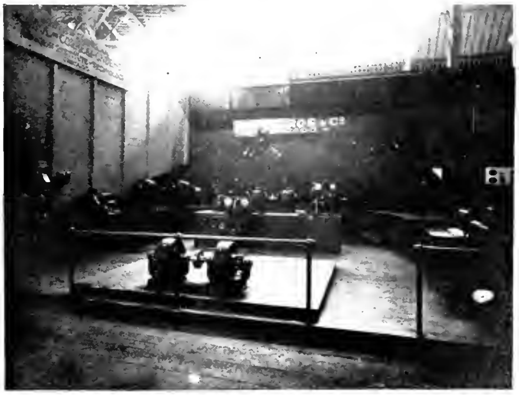


FIG. 3.—ROTH BROS.' EXHIBIT.

with attachments for the "howler," "busy back," "automatic ringing" and "pulsating current" for party lines. Electric grinding and polishing lathes, forge blowers, motor-generator charging sets, motors for 1/16 hp to 15 hp form interesting features of the display. A motor-generator set will furnish light and power for the exhibit.

The Electric Controller & Supply Company is exhibiting in Section 5 an entirely new system of control where the service requires frequent reversals of the driving motor under load. This control has been applied chiefly to the table motors in steel mills where a stop from full speed and acceleration to full speed in the reverse direction of a 50-hp motor under load is required in less than 30 seconds. The adaptation of this system to the operation of planers is shown

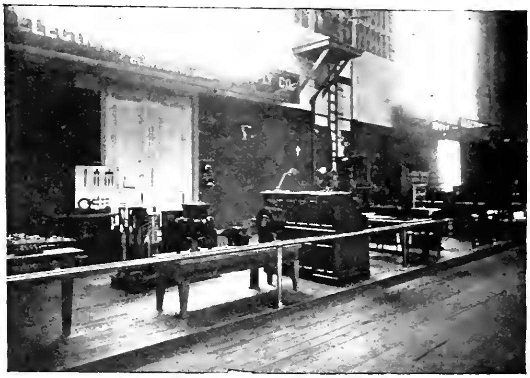


FIG. 4.—EXHIBIT OF ELECTRIC CONTROLLER & SUPPLY COMPANY.

on a 36-in. planer, which is driven through one pinion and gear of a 6-hp variable-speed motor. The motor being direct-connected, is reversed at each end of each stroke of the planer. The motor is compound wound, but the series field is only used for acceleration and is short-circuited when the motor comes to speed. The speed of the cut and return may be varied independently and through a very wide range. This planer is shown in actual operation cutting iron and steel, so that a complete demonstration is given. The advantages claimed for this controller are as follows: It absolutely limits the maximum current which may flow to the motor, thus protecting the motor, gearing and machinery from the effects of abnormal torque; the protection of the motor and machinery does not depend upon the judgment of the operator; the controller protects the motor perfectly in case the voltage of circuit fails. Even if the controller be left in the "full on" position, when the circuit is re-established, the controller will automatically start the motor with the normal amount of current; the operating controller is small and compact, easy of operation and protected from arcing.

A three-ton lifting magnet attached to a hoist is shown lifting steel plates and billets. Magnetic friction brakes and a cushion type

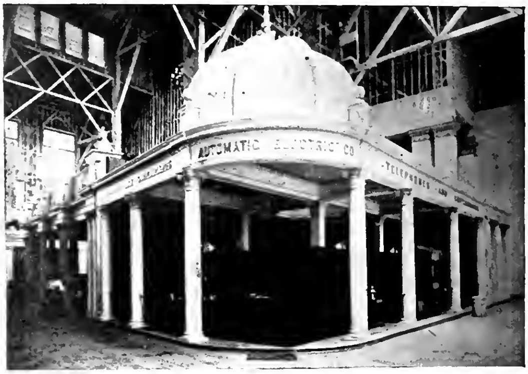


FIG. 5.—BOOTH OF AUTOMATIC ELECTRIC COMPANY.

solenoid are exhibited and in operation. The remainder of the space is filled with a line of controllers for all purposes, crane supplies, resistance units and a magnet for handling pig iron. Another operating exhibit is made by the company in connection with the Niles Tool Company in Machinery Hall, where a 90-hp electric reversing clutch operates a 12-ft. planer. This is the largest planer ever built and its operation by belts would be impossible.

The Automatic Electric Company's exhibit of telephone apparatus is attracting general attention on account of the time and trouble-saving features of the automatic system. This exhibit includes two complete working automatic exchanges of the 10,000 type, each with

FIG. 6.—EXHIBIT OF AUTOMATIC ELECTRIC COMPANY.

100 stations installed. These two exchanges, which are now giving service throughout the Electricity Building, are connected together by a system of trunks, similar to that generally used to connect branch exchanges to each other. The selection of trunks, however, is done automatically. The automatic system requires the use of no name prefixes, and the subscriber need not be aware that he is calling through more than one exchange, since the directory contains only numerical designations. In all cases three or four rota-

tions of the calling dial will secure instantaneous and direct communication with the telephone desired. The telephones exhibited are of three types, the wall, the desk and the pedestal. All of these telephones are fitted with the regulation calling dial, a circular metal piece, on whose periphera are ten finger holes numbered from 1 to 10. This dial is fixed on an axis at its center, and as the finger is placed consecutively in the hole corresponding to the digits of the number desired, and the dial turned once for each digit, electrical impulses are conveyed to the switches at the central office setting them in operation and bringing through them the proper connections.

A tollboard of ten stations is also in service, demonstrating the manner in which toll connections are given to users of automatic telephones. The rest of the apparatus displayed is of the same general character as that which may be seen in connection with any up-to-date telephone exchange, save the "tell-tale" board. This is simply a device for the instantaneous location of trouble, wherever it may arise, and consists of a number of lamps on a slate slab, together with a magneto bell. In case of trouble, this magneto bell rings calling the attention of the attendant, and a lamp glows, by the position of which on the board the location of the trouble can be instantaneously ascertained, and promptly rectified. The photograph shows the artistic booth which is elegantly furnished.

The exhibit of the Holophane Glass Company is one of the most striking in the building and is lighted by over 1,000 incandescent lamps. The booth is in the form of a Grecian temple, fronting on three aisles in Section 25. It has a frontage of 77 ft. on the main aisle and 31 ft. on each side aisle. Over the central doorway electric lights covered with Holophane globes form the word "Lux" in white letters and on each side is suspended a large Holophane 16-in. ball, hanging by three chains. On the door casings are torch brackets surmounted by pillars topped with Holophane globes, containing three colored lamps. These are suitably connected to a Reynolds flasher, so that a beautiful change of colors will occur at different intervals. Between these posts are plate glass cases containing samples of the different kinds of prismatic globes and reflectors manufactured by this company. The entrances from the side aisles are through two Grecian porches, the ceilings of which are studded with electric lights in different colors.

The center room of the interior is divided in two portions, showing two dining-rooms, which will be fitted identically, as far as furnishings and fixtures are concerned, but in one case Holophane globes will be used and in the other ordinary globes, so that a person can see at a glance, by looking at the two rooms, the difference in illumination. On each side of this room there is another apartment, suitably divided to show 12 dark rooms, in which there will be an opportunity to compare the different forms of Holophane globes and Pagoda

FIG. 7.—HOLOPHANE EXHIBIT.

reflectors with other kinds of globes and reflectors. The ceilings and walls are all of paneled oak and in the center of the main room is a $2,000 fireplace. The roof of the building will be used by the company for the entertainment of its guests and its offices. On each side of the main entrance are the two words, "Holophane" and "Pagoda" in 18-in. letters made of Holophane globes and will present an ever varying change in color scheme. First the words will appear in red letters, then in green, then in purple; then in red and green, red and purple, green and purple, and finally in red, green and purple. The exhibit is a joint one between the Holophane Glass Company, the Illuminating Appliance Company and the V. R. Lansingh Company.

A notable feature in the booth of the Heinze Electric Company is an induction coil capable of giving a 40-in. spark. Smaller coils for 30, 20 and 12-in. spark machines are also operating. A new

FIG. 8.—BOOTH OF HEINZE ELECTRIC COMPANY.

form of mechanical interrupter giving a maximum secondary discharge with a minimum primary current is especially adaptable for X-ray apparatus. There are a number of tubes capable of carrying heavy discharges necessary to make instantaneous radiographs, some of which have been taken in a fraction of a second.

In the Court of the Electricity Building, the Missouri Electra Water Purifier Company is exhibiting the Kune process of purifying water by electricity for commercial purposes. The electric purifier has a capacity of 500 gallons of purified water per day, the power consumption being 30 amp. at 15 volts. The apparatus consists of a purifier, generator, switchboard, a precipitating tank and

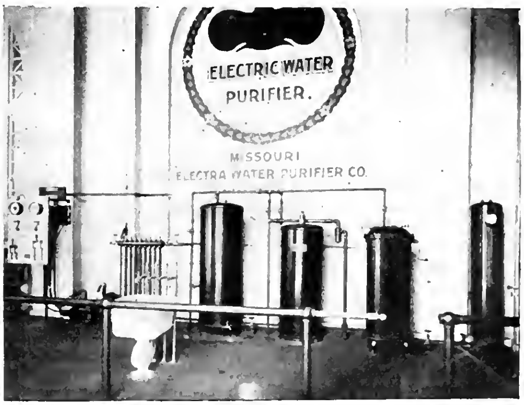


FIG. 9.—MISSOURI ELECTRA WATER PURIFIER.

a filter. The electric current destroys the bacteria and organic matter, also reduces the salts of lime, sodium, magnesium and the like, and any soluble salts of metallic compounds are eliminated. The electrolytic action of the anode produces an insoluble hydrate which acts as a coagulation gathering the released impurities together in an insoluble mass and precipitating them, so that when the water has passed through the strainer or filter, it is free from the impurities. Another interesting feature is a collection of samples of water from the principal cities of the United States, before and after being subjected to this treatment.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Business on the Stock Exchange was somewhat larger, although it was mainly of a professional character, a few stocks, notably Southern Pacific, constituting the bulk of trading. The favorable character of crop reports had a buoyant effect on the market. The standard stocks seemed to have fair support and there was a more or less buying movement in Manhattan Elevated. The other traction stocks, however, were neglected in spite of continued talk about the improvement in Brooklyn Rapid Transit earnings. On Friday Metropolitan Street Railway and Third Avenue developed exceptional weakness on the report that the Metropolitan Street Railway Company would not pay the first quarterly dividend of 1¼ per cent. on Third Avenue stock, under the terms of the lease of that road. The industrial list was neglected, apart from the firm tone of Steel preferred, which was due to the anxiety of the short interest in the latter owing to the continued intimations that the earnings for the June quarter may be as large as $18,000,000, and that the maintenance of the preferred dividend may be depended upon. In the traction list, Brooklyn Rapid Transit lost ¼ point and Metropolitan Street Railway 2⅜ points on the week's business. The former closed at 48⅛ and the latter at 111½, which was also the lowest quotation of the week. There was considerable trading in Metropolitan, the sales aggregating 50,600 shares. General Electric closed at 152¼, ex-rights, this being a net gain of 1¼ points over the last previous quotation. General Electric rights were sold at 5, which was also the closing figure. Westinghouse was steady throughout the week at 156. Western Union was quiet and unchanged at 87½, while American Telephone & Telegraph closed at the highest point, namely, 129¼, this being a net gain of 1¼ points. The curb market was generally reactionary following the trend of the exchange. There was a further sharp rise in Interborough Rapid Transit stock to a new high record. Following are the closing quotations of June 21:

NEW YORK

	June 14	June 21		June 14	June 21
Allis-Chalmers Co	7½	8	Electric Vehicle	8½	9¼
Allis-Chalmers Co. pfd	41	42	Electric Vehicle pfd	11	12
American Tel. & Cable	87	87	General Electric	158½	151
American Tel. & Tel	128¾	130	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	114½	110⅞
Brooklyn Rapid Transit	48⅝	48¾	N. Y. & N. J Tel	..	..
Commercial Cable	175	175	Marconi Tel	..	..
Electric Boat	30	32	Western Union Tel	87	86½
Electric Boat pfd	64	65	Westinghouse com	154	155¾
Electric Lead Reduction	*⅜	*⅝	Westinghouse pfd	180	175

BOSTON

	June 14	June 21		June 14	June 21
American Tel. & Tel	128¾	130⅛	Western Tel. & Tel. pfd	80	80
Cumberland Telephone	112	114¼	Mexican Telephone	1¼	1⅛
Edison Elec. Illum	234¾	234	New England Telephone	120	119
General Electric	156	..	Mass. Elec. Ry	18¼	18
Western Tel. & Tel	7⅛	8	Mass. Elec Ry. pfd	70	70⅛

PHILADELPHIA.

	June 14	June 21		June 14	June 21
American Railways	43	44½	Phila. Traction	..	96½
Elec. Storage Battery	54	54	Phila. Electric	6	6
Elec. Storage Battery pfd	54	54	Phila. Rapid Trans	12	11¾
Elec. Co. of America	8½	8½			

CHICAGO

	June 14	June 21		June 14	June 21
Central Union Tel	..	..	National Carbon pfd	*102	100
Chicago Edison	..	142	Metropolitan Elev. com	20½	18½
Chicago City Ry	175	*175	Union Traction	..	5
Chicago Tel. Co	.	120	Union Traction pfd	*30	27
National Carbon	26¼	26¼			

*Asked

DIVIDENDS.—The directors of the American Telephone & Telegraph Co. have declared the regular quarterly dividend of 1½ per cent. and an extra dividend of ¾ per cent., payable July 15. Otis Elevator directors have declared the regular quarterly dividend 1½ per cent. on the preferred stock, payable July 15. The directors of Detroit United Railway have declared the regular quarterly dividend of 1 per cent. on the capital stock, payable Aug. 1. New York Air Brake directors have declared the regular quarterly dividend of 2 per cent. The dividend is payable July 15. The Mackay companies have declared a regular quarterly dividend of 1 per cent. on the preferred stock, payable July 9. The Southern New England Telephone Co. has declared a quarterly dividend of 1½ per cent., payable July 16 to stockholders of record June 30. It is expected that the announcement of the terms of the new stock will be given out in July. The International Steam Pump Company has declared the regular quarterly dividends of 1½ per cent. on the preferred and 1 per cent. on the common. The regular quarterly dividend of 1¾ per cent. on Metropolitan Street Railway is payable July 15. The Cincinnati Gas & Electric Company's directors have declared a quarterly dividend of 1⅛ per cent., payable July 1. This is an increase of ⅛ per cent. Union Traction of Indiana directors have declared a dividend of 1 per cent. on the common stock, payable July 1. Directors of the Hall Signal Company have declared the regular quarterly dividend of 1½ per cent. on the common stock, payable July 1.

ROCHESTER (N. Y.) CONSOLIDATION.—The Rochester Railway Gas & Electric merger is regarded as virtually assured. More than 20,000 out of a total 25,000 shares of Rochester Railway common stock has been deposited in assent to the plan, and one of the lighting companies has ratified the agreement. Threatened litigation on the part of a rather large preferred stockholder in one of the latter companies is not expected to interfere with the consummation of the plan. The combining companies are reported to be earning the equivalent of at least 5 per cent on the preferred stock of the new company, the stock being entitled to 4 per cent. per annum the first two years. The receipts for the new common stock, $20 paid, are quoted at about 37 to 39. Rochester Railway common receives 120 per cent. in the new Rochester Railway Gas & Electric preferred.

BROOKLYN RAPID TRANSIT BONDS.—The Brooklyn Rapid Transit has sold $3,000,000 of its 4 per cent. bonds at about 79½. Of the total amount $1,000,000 each was taken by an insurance company and a trust company. The bonds are a part of the authorized issue of $150,000,000, of which only $5,000,000 has been issued so far.

BOSTON TROLLEYS.—The Boston Suburban Electric Companies are issuing new stock at $66.67 per block of one share of preferred and one of common. Stockholders can subscribe at the rate of one block for every four shares held. The issue is to consist of 15,848 additional preferred shares and 15,848 common.

VIRGINIA TROLLEYS.—Richmond (Va.) dispatches state that the Chesapeake Transit Company has applied to the Corporation Commission for authority to increase its capital to $1,500,000 from $1,000,000. The company operates an electric road from Norfolk to Virginia Beach.

THE NIAGARA, LOCKPORT & ONTARIO POWER COMPANY has voted to increase its capital stock from $1,000,000 to $10,000,000 to construct the canal from the Niagara River, under a State charter granted ten years ago.

MANHATTAN FIRE ALARM.—At a special meeting of the stockholders of the Manhattan Fire Alarm Company, held recently, the proposition to increase the capital stock from $500,000 to $700,000 was adopted.

Commercial Intelligence.

THE WEEK IN TRADE.—Conditions have been more favorable, among the features being a further improvement in leading crops and the ending of the tie-up on the lakes. General trade and industry still remain quiet. The notable underlying feature of the entire situation is the feeling that with an average crop of wheat and large yields of other cereals and cotton now in prospect, a good fall and winter business may be looked for. Prices of leading products have felt the influence of crop news, wheat, oats and cotton declining, while corn has remained steady on reports of backward conditions and small supplies offered. Railway earnings reflect current quietness in business, transportation business in general, however, being better than in 1902. Bank clearings show an enlargement over the week previous, but the grand totals are less than those of a year ago. Collections still reflect the influence of a backward spring in retail trade and are complained of as slow at a number of centers. Quietness prevails in the leading industries, iron and steel being dull and production curtailed. Prices, however, are a little firmer. Demand for structural material is inactive. The lumber trade is rather irregular, being much depressed on the Pacific coast, fairly active in the Northwest, but rather dull in the East. Dispatches to *Bradstreet's* from leading centers indicate a moderate business and conservative buying, not in all cases, however, equal to last year. The copper market was lower, weak and uninteresting. Prices are: Lake, 12⅝ @ 12¾; electrolytic, 12⅜ @ 12⅝; casting stock, 12⅛ @ 12¼. The exports continue on a large scale. There were 181 business failures during the week ending June 16, according to *Bradstreet's*, against 171 the week previous and 165 the corresponding week last year.

EXPORTS OF MACHINERY.—An interesting statement has just been issued by the Bureau of Statistics at Washington showing the rapid increase in exports of machine tools and allied apparatus. Exports of agricultural implements from the United States in the fiscal year about to end will amount to about $25,000,000 in value. This is an increase of about $4,000,000 over last year and about $9,000,000 over the preceding year. In no class of manufactures exported has the growth been more steady and persistent than in that of agricultural implements. Comparing the growth in exports of agricultural implements with that in other articles during the same period, it may be said that cars and carriages have increased from $3,333,000 in 1894 to a probable $12,000,000 in 1904; chemicals, from nearly $7,500,000 in 1894 to a probable $14,500,000 in 1904; scientific instruments, from $1,500,000 in 1894 to $8,000,000 in 1904; and manufactures of leather, from $14,000,000 in 1894 to approximately $33,000,000 in 1904, while agricultural implements have increased from $5,000,000 in 1894 to a probable $25,000,000 in 1904. A table prepared by the Department of Commerce and Labor shows that of the $19,000,000 worth of agricultural implements exported from the United States during the 10 months for which detailed figures are available, nearly $10,000,000 went to Europe, $4,000,000 to South America, $3,000,000 to North America, $1,500,000 to Asia and Oceania, and a little over half a million dollars' worth to Africa. The values of the exports of agricultural implements for the years 1897 to 1904, inclusive (May and June of this year being estimated), are as follows: 1897, $5,240,686; 1898, $7,609,632; 1899, $12,432,197; 1900, $16,099,149; 1901, $16,313,434; 1902, $16,286,740; 1903, $21,006,622; 1904, $25,000,000.

ORDERS FOR TELEPHONE APPARATUS.—The Attica Telephone Company, of Attica, Ind., has recently placed with Frank B. Cook, of 239 West Lake Street, Chicago, an order for his type L iron frame distributing rack, to be equipped with his protectors having the self-soldering heat coil. The distributing frame is equipped for 600 pairs, and the telephone company has recently discarded its old protective system. Among the other Indiana exchanges, which have recently been equipped with Cook's apparatus are Worthington (which has the same style of frame with a capacity of 400 pairs), South Bend, Fort Wayne, Bedford, Franklin, Garrett, Brookston, Frankfort and La Fontaine. Mr. Cook has also completed the shipment of a large distributing frame for the automatic exchange of the Home Telephone Company, of Los Angeles, Cal. This is what Mr. Cook styles his "No. 444," with self-soldering heat coils, and the frame is equipped for 4,875 pairs. He previously equipped the manual exchange of the Home Telephone Company with a frame having a capacity of over 10,000 pairs, and using Cook's well-known "No. 4" protectors. Mr. Cook has also recently filled large orders for his protective devices from the Pittsburg & Alleghany Telephone Company, and from the Kellogg Switchboard & Supply Company, for their Louisiana Purchase Exposition exchange. A large order has also been received from Rome, Italy, showing that the apparatus is well known in foreign countries as well as in the United States.

FLOATING INDUSTRIAL EXHIBITION.—The Northwestern Commercial Company, of Seattle, Wash., is to dispatch the S. S. "Victoria" from that city on November 15, to carry a floating industrial exhibition to visit the cities of Yokohama, Kobe, Nagasakai (Port Arthur and Vladivostock, if war conditions permit), Shanghai Hong Kong, Manila, Singapore, Colombo, Mauritius, Delago Bay (Johannesburg and Pretoria), Cape Town, Adelaide, Melbourne, Sydney and Honolulu. The "Victoria" is large, commodious and fast. She was purchased from the Northern Pacific Railroad Company and her first-class passenger accomodations have been renewed at an expense of about $100,000. The vessel has accommodations for 226 first-class passengers, but the number on this exhibition tour will be limited to 100 actual exhibitors, with the opportunity of 50 of them to take their wives, making a total maximum number of 150. The lower decks of the vessel, ordinarily used for second and third-class passengers, will be arranged in the most convenient manner for exhibition purposes. These decks are large and spacious, and will be divided among the exhibitors. They will be decorated and brilliantly lighted by electricity, and while the vessel is in port the exhibition space will be open to the general public from 8 a. m. to 11 p. m. Steam or electric power will be furnished to any exhibitor requiring same. The scheme is not altogether new and will remind some electrical people of the "Great White Special" of a few years ago.

MAY EXPORTS AND IMPORTS.—The statement of imports and exports of merchandise, gold and silver for May and for eleven months ending May is notable as showing that imports of merchandise are, in a measure, stationary, while the exports of merchandise show rather large fluctuations. This fact is borne out by a comparison with May in 1903, the merchandise imports for the month being about $1,000,000 more than in May, 1904, while merchandise exports decreased about $11,000,000. The excess exports of merchandise for May were the smallest since August, 1903, due in a large measure to the falling off in the demand for American wheat and cotton, the exports of which were greatly restricted by high prices prevailing here. For the eleven months ending May the exports of merchandise are the largest on record, with the exception of 1901, and the imports for the eleven months are the largest on record with the exception of the same period in 1903. From present indications the excess exports for the current fiscal year which ends June 30 will be in the neighborhood of $470,000,000, which would compare with $349,372,000 in 1903, $478,398,000 in 1902, and $664,592,000 in 1901.

1,500 MILES OF COPPER CABLE.—The Mexican Light & Power Company, whose New York offices are at 129 Broadway, has placed a contract for copper cable which is claimed to be the largest ever awarded. The contract calls for no less than 1,500 miles of cable, equal in carrying capacity to 3/0 B. &. S. gauge and weighing nearly 2,000 tons. The cable is to be utilized on the power transmission line now under construction by the company between its power plant at Necaxa, which is to have an initial capacity of 45,000 hp and an ultimate development of 80,000 hp, to Mexico City and from there on to El Oro mining district. It will be supported on steel towers in spans of 500 ft. The length of the spans, together with the necessity of reducing the dip as much as possible and the high wind pressure to be withstood make the matter of cables one of considerable importance. The cable was designed by Mr. W. G. Clark, the electrical engineering expert of Seattle, Wash. The Ansonia (Conn.) Brass & Copper Company has been allotted the contract.

EQUIPMENT FOR APARTMENT HOTEL.—A 12-story apartment hotel is to be built at Eighty-ninth Street and Central Park West, New York, which will be installed with an electrical plant. Mr. Peter Banner, of 648 Broadway, is to be the owner; Mr. Robert T. Lyons is the architect. Mr. Percival Robert Moses, 35 Nassau Street, has been retained as consulting engineer. There will be three horizontal return tubular boilers of 150-hp capacity each. The engines will be three simple automatic high speed horizontal type. Two will be 14 in. x 14 in. while one will be a 13 in. x 12 in. They will operate at from 275-300 r.p.m. The generators will be direct current, compound wound multipolar, 240 volts. There will also be an extensive storage battery system.

NERNST LAMP ORDERS.—That the Nernst lamp is rapidly coming into favor in the city of Chicago, is evidenced by the fact that many of the company's customers are placing orders to increase the size of their Nernst lamp installations. Among these are Armour & Co., also Nelson & Morris at the Union Stock Yards. The former company has recently added six 6-glower and nine 3-glower Nernst lamps to its system, while Nelson & Morris have increased their already large installation with twelve 3-glowers. In this connection it may be mentioned that Swift & Co. in the same locality have 125 6-glower and 750 3-glower Nernst lamps in satisfactory operation.

HEINE BOILER ORDERS.—The Heine Safety Boiler Company has secured a contract for a 500-hp outfit to be installed in the additional plant to be constructed by the Quincy (Ill.) Gas & Electric Co. The Edison Illuminating Co., of Pottsville, Pa., is also about to extend its plant, and will put in a 250-hp boiler equipment. Two 250-hp Heine boilers are to be installed in the electric power plant at the new Wabash passenger station at Pittsburg. The Marysville (O.) Water & Light Co. has ordered a 300-hp outfit for its plant.

GENERATORS FOR WAR DEPARTMENT.—The Ridgway Dynamo & Engine Company, Ridgway, Pa., has just been awarded a contract for four 75-kw direct-connected generating sets by the War Department, through the Major of Engineers at Seattle, Wash. These sets are for lighting and power purposes at various Pacific coast army posts and are to be delivered immediately.

G. E. MOTOR EQUIPMENT FOR JAPAN.—Eight hundred G. E. 54 motor equipments will be used in the cars for the Tokio Street Railway Company, which concern is building some 30 miles of electric traction system in Tokio, Japan. The power house equipment will be of 7,000-kw capacity and will be the largest electrical plant in the Far East. Curtis turbines will be installed.

EQUIPMENT FOR NEW OFFICE BUILDING.—Orders are about to be let by the Geo. A. Fuller Company, New York, for the electrical equipment to be installed in the new office building under construction at 78 Wall and 158 Pearl Streets for the Taber Company. There will be two 12-in. x 11-in. engines direct-connected to 50-kw generators.

THE WATERTOWN STEAM ENGINE COMPANY is now installing a 400-hp compound condensing engine in Catskill, N. Y. It has just shipped three engines aggregating 600 hp to Trinidad, Col., and is now building a fourth to develop 1,000 hp arranged for direct connection to a 600-kw General Electric generator.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—The Phoenix Independent Telephone Company which has just been organized is now soliciting business in this city, and is endeavoring to get 500 subscribers. It is stated that the initial expenditure for installation will be about $50,000.

LOS ANGELES, CAL.—The Pacific Coast Telephone Construction Company, of Los Angeles, has been incorporated with a capital stock of $25,000. The directors are Charles F. Guthridge, Charles L. Zahn, Arthur Wright, and others.

DAHLGREN, ILL.—The Dahlgren People's Telephone Company has increased its capital stock from $5000 to $10,000.

SHELBYVILLE, ILL.—The Duvall Mutual Telephone Company has been incorporated with a capital stock of $420. The directors are C. E. Kreig and others.

SUMMITVILLE, IND.—The Boone Township Telephone Company has incorporated with a capital stock of $1000.

PORTLAND, IND.—The Farmers' Co-operative Telephone Company of Jay County has filed articles of incorporation with the Secretary of State. The capital stock is $15,000. W. H. Harkins, Suphus Straley, E. W. Polly and others are the incorporators.

ST. JOHN, KAN.—The Albany Telephone Company has been incorporated with a capital stock of $840.

BARNARD, KAN.—The Barnard Telephone Company has been incorporated with a capital stock of $5000.

DELPHOS, KAN.—The Rural Telephone Company has been incorporated with a capital stock of $3400.

HOXIE, KAN.—The Sheridan Telephone Company has been incorporated with a capital stock of $2000.

MAHASKA, KAN.—The Mahaska Telephone Association has been incorporated with a capital stock of $3500.

CHAPMAN, KAN.—The Chapman Mutual Telephone Company has been incorporated with a capital stock of $5000.

EUREKA, KAN.—The Greenwood County Telephone Company has been incorporated with a capital stock of $33,000.

LOUISVILLE, KY.—The London and East Bernstadt telephone companies, connecting Clay and Laurel counties, have been consolidated, with a capital stock of $14,000.

BREAUX BRIDGE, LA.—There is a movement on foot in this town to organize an independent telephone company. It is proposed to operate an exchange here and build toll lines to St. Martinville, and other points in the parish.

CASCO, ME.—The Casco Telephone Company has been organized with a capital stock of $10,000. The officers are: President, Richard Cook; treasurer, Herman L. Cook.

WATERTOWN, MINN.—The Watertown Telephone Company has filed articles of incorporation, the capital being $25,000. The officers are: President, F. A. Barth; vice-president, G. F. Peterson; secretary, G. E. Halgren; treasurer, R. J. Burke.

SENECA, MO.—The Seneca Telephone Company has applied to the city for an extension of its franchise for 20 years.

LINCOLN, NEB.—The Western Telephone Company has been incorporated with an authorized capital stock of $1,000,000. The incorporators are Charles J. Bills, Mark Woods, George J. Woods, Frank H. Woods and Thomas H. Ewing. The company intends to construct long-distance lines to make connections with the independent system in Lincoln. One line has been constructed already, the wires running from Lincoln to Havelock, and there connecting with the Plattsmouth Company that has run its wires to this town. Five other long distance lines are projected. One is to Nebraska City; another taps the southeast section of the State and runs generally in the direction of Falls City; a third will run for the business of Saline and Fillmore counties; the fourth will be in the direction of York, and the last will run to Davey, where the Golden Rod system is already installed.

TRENTON, N. J.—The system of the Interstate Telephone Company between this city and Atlantic City has been completed, and direct telephone communication between the two points is now possible. The line goes to Atlantic City by way of Philadelphia.

ALBANY, N. Y.—The extension of the Rensselaer County Telephone Company's system through the city of Rensselaer is one of the future probabilities. Application for a franchise is now being made. The company will have connection with the Home Telephone companies of Albany and Schenectady.

CATSKILL, N. Y.—The telephone war in this village, which was noted last week, has been brought to a close, the West Shore Company agreeing to raise its wires and thus avoid lengthy litigation if it persisted in obstructing the construction of the lines belonging to the Hudson River Company.

ELIZABETH CITY, N. C.—A company has been organized to construct a telephone line from this place to Weeksville, a distance of 16 miles. Contracts for the construction work have been awarded.

MARSHFIELD, ORE.—E. C. Drew and Ed Riggs propose to establish a telephone system here.

WELLSTON, OHIO.—The Wellston Mineral & Athens Telephone Company has increased its capital stock from $2000 to $30,000.

WESTMINSTER, OHIO.—The United Farmers' Telephone Company, of Westminster, has increased its capital stock from $10,000 to $20,000.

CLEVELAND, OHIO.—The United States Telephone Company, it is stated, is about to begin construction work, the wire alone for which will cost $160,000. This work will include the new line between Dayton, O., and Richmond, Ind., which will give long distance connections through Indianapolis and St. Louis to Kansas City. Lines will be strung into Cincinnati and Wheeling, W. Va.

CHARLESTON, S. C.—A commission has been issued to the Coast Line Telephone Company, of Charleston, which will establish a telephone system on the coast islands. The capital stock is placed at $15,000, and the petitioners are: C. B. Jenkins, F. W. Towles and Julian Mitchell, Jr.

HAMMONDSPORT, S. C.—The several rural telephone lines centering in Hammondsport have formed an association known as the Hammondsport Rural Telephone Association. The following officers have been elected: Robert Sherer, president, and Maurice A. Hoyt, manager.

AUSTIN, TEX.—The Bay City & Matagorda Telephone Company, of Bay City, has been incorporated with a capital stock of $5000. The names of the incorporators are W. W. Boulden, R. H. Taylor, of Bay City, and A. W. McNab, of Matagorda.

DENISON, TEX.—The Grayson County Telephone Company will make improvements to its system between Denison and Sherman at a cost of $50,000. Fifty thousand feet of cable will be purchased and the equipment will be renewed and improved wherever necessary.

GALVESTON, TEX.—It is stated that H. E. Huntington has absorbed twenty-three additional independent telephone systems and leased lines in Texas, Arkansas, Indian Territory, Louisiana and Oklahoma, many of them being located in prominent cities, including Galveston, Houston, Dallas, Fort Worth, San Antonio, South McAlester, Little Rock and Oklahoma City, Okla. It is understood that Mr. Huntington and his associates have set aside $10,000,000 with which to organize a rival company to the Southwestern Telephone & Telegraph Company. It is also learned upon good authority that the Southwestern consolidation is but a nucleus with which to initiate a telephone organization that will give local and long-distance service throughout the United States.

EVERETT, WASH.—The Tualco Telephone Company has been incorporated with a capital stock of $1000. The names of the incorporators are F. E. Ferguson, F. E. Phelps and T. W. Bennett.

RACINE, WIS.—The Citizens' Telephone Company has purchased a site in this city on which it will erect a new telephone exchange. The company was organized three years ago and now has 2000 subscribers.

HONOLULU, HAWAII.—A quasi-government system of telephone has just been completed on the island of Molokai and is worked in connection with the wireless telegraph system of the Hawaiian Islands, and through that with the Pacific cable. The system is a sort of communal one, the people themselves agreeing to maintain and keep in repair the portion of the line in their respective districts.

ELECTRIC LIGHT AND POWER.

LUVERNE, ALA.—It is proposed to construct water works and an electric light plant at a cost of $10,000. No engineer has been selected as yet. Bids will be received after July 1. A. B. Brooks is city clerk.

NASHVILLE, ARK.—It was voted June 2 to construct water works and an electric light plant.

OXNARD, CAL.—The Oxnard Light & Power Company is having plans prepared for an electric power house and plant.

NORFOLK, CONN.—J. H. Roraback, of Canaan, is interested in the construction of an electric light plant on Mill River to furnish power to Canaan and Norfolk.

HARTFORD, CONN.—The Hartford Electric Light Company, Hartford, Conn., has bought a tract of land and will erect a power plant to take the place of its present Pearl Street plant. The company's Westinghouse-Parsons turbine will be removed to the new plant, and it is understood that it will install another turbine set of the same type, as well as increase its boiler capacity.

MONTICELLO, FLA.—The electric lighting plant, owned by J. M. Henry, of this town, was destroyed by fire some time ago and has not been rebuilt. The town is greatly in need of a plant and the erection of a new one is now in contemplation.

ALBANY, GA.—It was voted June 9 to issue $10,000 bonds for improvements to the water works and electric light plant.

WOODHULL, ILL.—The Woodhull Electric Light Company proposes installing a new dynamo and will be in the market for the same.

INDIANAPOLIS, IND.—H. C. Hendrickson is preparing plans for a brick power-house for the Martinsville Light & Power Company.

ELKHART, IND.—The Elkhart City Electric Company has been incorporated, with a capital of $50,000. Incorporators: C. G. Conn, P. L. Turner and W. J. Gronert.

OXFORD, IND.—The managers of the municipal electric lighting plant here are figuring on lighting two other small towns at a distance of 5 and 8 miles. Current will be transmitted at a voltage of 6600 to the most distant town and step-up transformers will be required.

BOONE, IA.—It is stated that the Council will take up the matter of an electric light plant for the city at once.

AFTON, IA.—It is proposed to give the municipal electric lighting plant in this place a general and complete overhauling.

LOUISVILLE, KY.—The American Electric Lighting Company, of Oakdale, has filed articles of incorporation, the capital stock being fixed at $10,000. The incorporators are Charles A. Hess, Mary Rosenfield, Louis F. Otto and Thomas Flordon.

BANGOR, ME.—The Underwriters' Light, Heat & Power Company has been organized at Bangor, with $3,000,000 capital stock. E. T. Nealey, of Bangor, is president, and Frank L. Goodwin, treasurer.

BALTIMORE, MD.—Bids will be received by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., June 27, for the installation of an elevator plant and electric house pumps at the U. S. Post Office, Baltimore.

BOSTON, MASS.—Sealed proposals for boilers, engines, generators, cables and conduit for electric light and power plants will be received at the office of the United States Engineer, in this city, until July 11. Information can be obtained on application to W. S. Stanton, Lieut. Col. of Engineers.

KALAMAZOO, MICH.—The Council has under consideration the matter of issuing $18,000 bonds for improving the electric plant.

ROYALTON, MINN.—Plans and estimates are being prepared for a municipal lighting system, and the matter will be submitted to a vote of the people.

CHISHOLM, MINN.—The Chisholm Light & Power Company has filed articles of incorporation, the capital stock being $20,000. The incorporators are Nils Anderson, of Virginia, Henry A. Liedel and Daniel D. Crowley, of this city. Duluth will be the principal place of business.

BOONEVILLE, MISS.—Business men of this place have organized a company to establish an electric light plant and telephone system. A franchise has been granted and application for a charter for the new company will now be made. Contracts for the building will be let.

HOBOKEN, N. J.—After a lively meeting of the city council a few evenings ago the contract for street lighting was awarded to the United Electric Company at $100 per light per year. A joint committee from the Taxpayers' Association and the Hoboken Innkeepers' Association urged the mayor to withold his signature and veto the contract, asserting that they could produce independent bidders if the bids were readvertised for and guaranteeing to make a much lower bid than $100 per light. As the committee refused to divulge any of the names of these proposed bidders, the mayor announced that he would sign the contract.

NORTH ELBA, N. Y.—The Ausable Valley Light, Heat & Power Company, of North Elba, has been incorporated with a capital stock of $30,000. The directors are Wallace Murray, P. A. Gould, A. K. Botsford, of Saranac Lake.

SAG HARBOR, L. I., N. Y.—A proposal to construct an electric light system and issue bonds in the sum of $24,000 to pay for the same was defeated at a special corporation meeting on June 9. This is the third time that the question has been before the people.

ROCHESTER, N. Y.—Papers were filed in two suits on June 10, to prevent the projected merger of the Rochester Gas & Electric Company, the Rochester Railway Company and the Rochester Light & Power Company. The plaintiffs in each case are minority stockholders in the Rochester Gas & Electric Company. The complainants claim that the proposed merger is unlawful and against public policy. At a meeting of the stockholders of the Rochester Gas & Electric Company the proposition to consolidate with the Rochester Light & Power Company was ratified.

LEXINGTON, N. C.—It was voted June 7 to issue $60,000 bonds for the construction of water works and an electric light plant. J. L. Peacock is City Clerk.

WILSON, N. C.—The Wilson Light & Power Company, of Wilson, has been incorporated, with a capital of $125,000, by J. C. Hales, B. T. Lane, Claudius Aycock, and others.

SALEM, OHIO.—The Salem Light & Power Company has been incorporated with a capital of $10,000, by J. S. Khinefelter, J. G. Wilson, C. M. Wilson, and others.

MASSILLON, OHIO.—Bids will be received July 9 by the Board of Trustees of Massillon State Hospital at the office of F. L. Packard, architect, Columbus, for furnishing and erecting in the power-house at said hospital a 450-hp engine, two 350-hp boilers, one 300-kw generator and a switchboard. Address H. C. Eyman, M. D., secretary.

READING, PA.—A bill calling for a special election to obtain the assent of voters for a $200,000 loan for a municipal electric light plant was defeated in the Select Council.

MAHANOY CITY, PA.—Application has been made by Harrison Ball and John I. Mathias, of Mahanoy City; T. D. Jones, of Hazleton, and others, for a charter for the Economy Light, Heat & Power Company.

CHATTANOOGA, TENN.—The City Council has agreed to issue $1,000,000 bonds for the purpose of constructing an electric light plant to be operated by water power. The plant will be erected and controlled by private parties, who will pay the city 5 per cent. for the use of the capital to be derived from floating the bonds, upon which the city will pay interest. The city reserves the right to purchase the plant at the expiration of 50 years, and during the existence of the contract is given 500 free lights.

SHERMAN, TEX.—The Sherman Gas & Electric Company has been incorporated with a capital of $200,000. J. F. Strickland, Dallas, is one of the incorporators.

EL PASO, TEX.—The Mimbres River Water Company has been incorporated for the purpose of carrying on the business of a water company, and construct electric light and power plants for supplying electric lights and power for domestic and public uses in the city of El Paso and other communities: capital, $2,000,000. The principal place of business is Albuquerque, N. M. Incorporators: Geo. W. Delamater and Jas. S. Delamater, of Pittsburg, Pa.; Allan G. Kennedy, of Santa Fe, N. M. and Edw. L. Medler, of Albuquerque, N. M.

BRANDON, VT.—At the annual meeting of the Neshobe Electric Light Company, which was held here recently the directors elected officers as follows: President, Dr. O. C. Baker; vice-president, Charles Dewey; treasurer, George H. McLeod.

SNOHOMISH, WASH.—The plant of the Cascade Cedar Company was completely destroyed by fire, the loss being $6000. The company has secured temporary equipment pending the rebuilding of the plant.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CAL.—San Francisco and San Jose capitalists have been granted a franchise by Secretary of the Interior Hitchcock to build an electric railway into the Yosemite National Park. This is the first franchise ever granted by the Government for an electric railway into any Government reservation. Stations are to be constructed every 10 miles.

AUGUSTA, GA.—The stockholders of the Augusta & Elberton Railroad have authorized an issue of first mortgage gold 6 per cent. bonds, $10,000 per mile, or a total issue of $750,000. Fred T. Lockhart, secretary and treasurer of the company, says the construction of the line will now soon begin.

MONTPELIER, IND.—The Portland, Montpelier, Warren & Huntington Traction Company has organized by electing the following-named officers: James West, president and general manager; Scott Mills, vice-president; D. A. Williamson, secretary; Levi Huffman, treasurer; George Champe, of Toledo, chief engineer. The final survey of the road will be begun at once, and several agents will be put to work buying the right of way preparatory to immediate construction.

INDIANAPOLIS, IND.—The annual meeting of the stockholders of the Indianapolis Traction & Terminal Company was held here Wednesday, June 8. The only change was that in the election of John J. Appel to succeed James M. Jones as second vice-president of the company. Mr. Jones resigned recently. His place as assistant general manager was not filled. The officers are Hugh J. McGowan, president; H. P. Wasson, first vice-president; John J. Appel, second vice-president, and W. F. Millholland, secretary and treasurer.

SIGOURNEY, IA.—Twenty-five hundred dollars has been raised and a board of directors selected for a company which proposes to construct an electric interurban railway from Sigourney to Newton. The board of directors is as follows: C. B. Holmes, of Chicago, president: H. G. Brown, Thomas Kelly, J. W. Lesan, and others.

PADUCAH, KY.—Word is received here of the financing in New York of the Kentucky & Ohio River Electric Railway, which plans to build from Paducah to East Cairo, Ky.; thence possibly across the river to Cairo, Ill. J. J. Freundlich, of Paducah, and W. H. Paul, of East St. Louis, are interested.

GULFPORT, MISS.—Col. J. T. Jones, of this place, who is interested in the electric railway now under construction here, says the line will most likely be built to Biloxi, Mississisippi City and Pass Christian. Financial interests recently looked into such a proposition, and are said to be willing to put up the money.

WILLIAMSTOWN, MASS.—The Hoosac Valley Street Railway Company has completed the plans for the new line from the Williamstown station to the Vermont line.

ST. PAUL, MINN.—It is reported that St. Paul men, among whom is President A. B. Stickney, of the Chicago Great Western road, are considering a proposition to build an electric railway in Minnesota, to run south from St. Paul to Rochester, linking a number of small towns.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Railway Company plans the construction of another belt in the West End. A franchise application has been presented to the Council asking for permission to lay tracks in seven streets.

PATCHOGUE, N. Y.—The South Shore Traction Company is soon to apply to the Railroad Commissioners for permission to build its line. The line will extend from the New York line at Central Avenue, Jamaica, to the Connecticut River at Brookhaven, a distance of 60 miles, a considerable portion of which will be over private right of way. The following are directors for the first year: R. Lee Slingluff, A. C. Hume, James A. Hawes, S. H. Thompson, F. D. Shaffer, Samuel Worthington, Edward Phillips, Charles Hall Davis, C. G. Perrott. James F. Heyward, formerly connected with the electric railways of Baltimore, is interested in the company as a stockholder.

STEUBENVILLE, OHIO.—The Steubenville & Canton Railway Company has been incorporated, with a capital stock of $10,000, to build an electric railway from Steubenville to Canton, there to connect with the electric railway to Cleveland. The incorporators are Howard H. Smith, Elmer E. Francy, Thomas H. Loomis, Sheridan B. Pyle, James Carl Bibber.

CINCINNATI, OHIO.—The owners of the Cincinnati Interurban Railway Company, operating between Cincinnati and Hamilton, are planning extensive improvements to the portion of the road south of Carthage, in order to make it possible to run the large interurban cars into Cincinnati without change.

POTTSTOWN, PA.—After a fight to enter the borough, lasting over a year, the Pottstown & Reading Street Railway Company has finally been granted a franchise by the Council.

JERSEY SHORE, PA.—The newly chartered Jersey Shore-Antesfort Railway Company has secured a site in this place for a power house. The capital stock is $30,000 and the steam road act, under which the company is chartered, gives it the right to carry freight.

BRADFORD, PA.—A special meeting of stockholders of the Bradford Electric Street Railway Company, and the Olean, Rock City & Bradford Railway Company, will be held in this city July 29 for the purpose of voting on an increase of the companies' indebtedness.

WAYNESBORO, PA.—Surveys have been completed to Pen-Mar of the proposed Catoctin & Meyersville Electric Railway. Connections will be made at Pen-Mar with the Chambersburg, Newcastle & Waynesboro line. The line as surveyed for the Catoctin & Meyersville road runs from the Frederick-Middletown line at Myersville, to Pen-Mar Station, Western Maryland Railroad, a distance of 22 miles. The incorporators of the new road have elected the following officers: J. H. Maugans, president; A. H. Hauver, vice-president; H. M. Warrenfeltz, secretary; Chas. U. Grossnickle, treasurer.

HOUSTON, TEX.—Surveys are now being made for the proposed electric railway between Houston and Galveston. Col. Slosson, of Houston, is the chief promoter.

New Industrial Companies.

THE DOSSERT ELECTRICAL APPLIANCE COMPANY, of New York, has been incorporated with a capital stock of $5000. The directors are: W. F. Blake, Sound Beach, Conn.; James C. Minehan, Albany, and J. E. Calder, New York.

THE DAVID ELECTRIC LIGHT COMPANY, of Alton, Ill., has been incorporated with a capital stock of $2000. The company will conduct a business of electrical construction. The incorporators are: C. B. Davis, B. C. Davis and C. E. Whitney.

THE AUTOMATIC ELECTRIC PUMP COMPANY, of Davenport, Ia., has been incorporated with a capital stock of $30,000. The officers of the company are: President and treasurer, Henry Brehmer; vice-president, William J. Pugh, and secretary, F. J. Peto.

Legal.

RESPONSIBILITY FOR ACCIDENT.—In the suit of Wendler vs. the Red Wing Gas & Electric Company, the Supreme Court of Minnesota has held: 1. The doctrine that the master is not in law bound to instruct an employe as to special dangers incident to the employment if such information is fully within his knowledge, reaffirmed. 2. Certain evidence adduced at the trial fails to show prima facie that an injury was inflicted upon appellant by the negligence of respondent in failing to furnish and maintain proper electrical appliances in conducting its electric light plant, or from failing to keep the same in a safe condition.

BELL WESTERN-UNION ROYALTIES.—Special Master Everett W. Burdett has started hearings in the American Bell Telephone-Western Union Telegraph Company royalty suit, in accordance with the degree of Judge Colt, of the United States Circuit Court, as of Feb. 3, 1904, ordering the American Bell Telephone Company to furnish an accounting to determine to what extent it is obliged to the Western Union Telegraph Company for failure to turn over for 17 years 20 per cent. of stock and dividends it received from sub-companies, in addition to 20 per cent. of the cash rentals. The rental and royalty contract was made between these companies in November, 1879. The amount involved is between $2,000,000 and $4,000,000. In return for these royalties and rentals the Western Union agreed to go out of the telephone business, and turned over all its telephone property to the Bell Company, the latter also agreeing not to interfere with the telegraph business.

GRANT OF RIGHTS IN STREETS.—The Supreme Court of Nebraska in the appeal by the Nebraska Telephone Company to prevent the city of Fremont from destroying its poles and wires, has sustained the lower court and has ruled: 1. When a city ordinance prescribes that permission to occupy the streets by a public service corporation shall be obtained with the consent of the mayor and council, such consent is sufficiently proved by an entry in the records of a meeting of the council, presided over by the mayor, reciting that a motion granting it was offered by a member and adopted; there being nothing to indicate that the mayor dissented. 2. Forfeiture of the franchises and easements of a public service corporation in the streets can be declared and enforced only by a court of competent jurisdiction. The city claiming a forfeiture cannot be a judge in its own cause, or invade the privileges or destroy the property of such a corporation in the absence of judicial warrant for so doing.

CHARGES AGAINST PATENT OFFICE.—In the matter of the charges of Thomas A. Edison against two examiners in the Patent Office, in connection with the grant of letters-patent for an electrical invention by Ernest W. Jungner, the Secretary of the Interior has approved an opinion rendered by Assistant Attorney General Campbell. The opinion holds that nothing is shown in Mr. Edison's petition that involves any cause for the exercise of supervisory authority at the hands of the Secretary, and for that reason the Secretary is advised that the Commissioner of Patents should be left to his own discretion in dealing with the case. The transfer of the examiners from one division to another is recommended by Acting Commissioner Moore, of the Patent Office. Mr. Edison charged "incompetence, neglect of duty and maladministration of office in connection with the grant of a United States patent to Ernest W. Jungner for reversible galvanic battery, No. 738,110, dated September 1, 1903." The findings of Acting Commissioner Moore were that there was absolutely no evidence of malfeasance or intentional wrongdoing on the part of the examiners.

INJURY THROUGH NEGLIGENCE.—In the appeal of Baries vs. Louisville Electric Light Co., for personal injury, the Court of Appeals of Kentucky has reversed the verdict of the lower court for the defendant on various grounds as follows: 1. Under Code Civ. Prac. § 341, providing that a new trial shall not be granted on account of the smallness of the damage in an action for an injury to the person or reputation, nor in any other action in which the damages equal the actual pecuniary injury sustained, a verdict and judgment for one cent for personal injuries resulting in loss of time worth about $800 may be reversed. 2. Plaintiff in a personal injury action alleged that he had been and was unable to do any kind of work. The evidence showed that the time lost by him in consequence of his injury would equal more than $800. The jury gave him a verdict of one cent. Held that, as he had not pleaded special damages, he was not entitled to a reversal. 3. A verdict of one cent for a personal injury consisting of a withered arm, from which plaintiff appeals, will be treated by the Court of Appeals, in considering the errors alleged, as one for appellee. 4. An electric light company, whose failure to properly insulate its wire on a building results in injury to a house painter at work thereon, is not relieved from the consequences of its negligence because the painter's employer knew that the company desired to cut the wire when that portion of the building was to be painted, or because there was a custom that contractors should notify the company when working on houses to which its wires were attached so they could be cut, though the company received no notice in this instance. 5. Where an electric light company had actual notice that house painters were at work on a building to which its wires were attached, evidence of a custom to give it notice of the fact so the wires could be cut is inadmissible in an action by a painter for injury from a defectively insulated wire. 6. The improper admission of evidence in a house painter's action against an electric light company for injuries from a defectively insulated wire on the building he was painting, that a custom existed to notify the company that painters were at work so its wires could be cut, is ground for reversal.

Personal.

MR. C. T. YERKES has sailed again for England to watch his London underground electric railway enterprises.

MR. JOHN A. HEANY has been awarded the John Scott medal of the Franklin Institute, for his magnetic-clutch arc lamp.

MR. H. BEVIS, director of the General Electric Company, Ltd., of London, is again in this country on one of his frequent trips.

MR. J. M. ANDERSON, of the Albert & J. M. Anderson Manufacturing Company, Boston, Mass., was in New York this week.

MR. JOHN G. EMERY, manager of the Shaw Electric Crane Company, Muskegon, Mich., was on a visit to New York for a few days last week.

MR. J. F. FAIRMAN, author of "Telephone Wiring," now in press, has accepted a position with Waterbury & Company, New York City, in their electrical sales department.

MR. ERNST J. BERG, of the General Electric Company, was married week before last to the daughter of Hon. Morgan J. O'Brien, Justice of the New York State Court of Appeals.

MR. F. P. THORP, who has been representing the Power & Mining Machinery Company at Boston, Mass., is now in charge of the Pittsburg offices of that company located in the Farmers' Bank Building.

MR. F. W. PARDEE, who for some time had charge of the telephone department of the Chicago Writing Machine Company, has accepted the position of general manager with Frank B. Cook, of that city.

PROF. W. HALLOCK is to lecture on the influence of radium and other radio-active substances on ionization and the conduction of electricity in gases, with illustrations, during the fifth summer session of Columbia University, which will begin July 6.

MR. H. D. WALBRIDGE has been elected president of the Rochester, N. Y., Gas & Electric Company in the place of Mr. G. W. Archer, and will have associated with him in the management, it is said, Mr. W. M. Eaton, formerly general manager of the Grand Rapids Gas Light Company.

MR. FRANK B. COOK returned recently from a trip to the Black Hills, where he had been looking after his interests in the Deadwood Home Telephone Company, which he owns. He reports the company in a flourishing condition. Mr. Cook returned by way of Omaha, Council Bluffs and Des Moines.

MR. FRANCK Z. MAGUIRE made a demonstration before the Royal Society last year of the Cinematograph in application to travel, engineering, plant growth, cloud effects, etc., and has just issued in pamphlet form his remarks directing attention to interesting features of this work, and its possibilities.

MR. E. B. SWINDEN, of the Montevideo firm of Swinden & Acosta y Lara, which concern is a considerable handler of Yankee electrical supplies, machine tools, etc., is now on a short visit to the United States. He may be reached by addressing the New York banking house of H. B. Hollins & Co., 15 Wall Street.

MR. H. J. M. ELLIS, of H. J. M. Ellis & Company, New York, is now on a visit from Singapore for the purpose primarily of making arrangements with American manufacturers of electrical equipment, supplies, machine tools, etc., to represent their interests in the East Indies. Mr. Ellis intends to sail for Singapore on July 2.

MR. GEORGE E. WILLARD, of the Syndicate of American Manufacturers, 24 South William Street, which concern conducts a considerable business in electrical equipment, supplies, etc., for the South American markets, is about to leave on a trip to the Argentine Republic and the west coast of South America. He expects to be absent fully six months.

MR. R. CRAWFORD has been promoted from superintendent to general manager of the Stamford, Conn., Gas & Electric Company, and Mr. G. B. Leland has been appointed superintendent in his place. Mr. Crawford is also devoting time to the Oven Equipment & Manufacturing Company, a new concern which is making a specialty of gas burners for enameling ovens and core ovens; also for all special heating work.

MR. GUSTAF L. OBERG, secretary and general manager of the Shanghai, China, Mutual Telephone Company, is spending several weeks in the United States on his way to a short visit to his former home in Sweden. The Shanghai exchange has grown so rapidly that plans have been prepared for a large new building which will be equipped with new exchange apparatus, including a 30,000-station switchboard. During his stay in this country Mr. Oberg has visited some of the most recent exchanges, and it is quite probable that the equipment for the new exchange will be purchased in this country.

MR. G. MARCONI made but a short stay here and has sailed again for Europe. Before leaving he stated that the Cape Cod station would be opened very soon for the receipt of wireless messages for the Cunard Line steamers from Boston, as well as the other steamships of the trans-Atlantic fleet. During his return voyage Mr. Marconi will equip the *Kaiser Wilhelm* with his new receiving apparatus. Discussing the reported intent of the United States Government to control wireless telegraphy in the United States, Mr. Marconi said he felt no uneasiness or apprehension as to such action and expressed the opinion that no attempt would ever be made to carry out the reported plan.

Trade Notes.

COLUMBIA LAMPS are the subject of some very pretty and tasteful "dgers" and folders issued by the Columbia Incandescent Lamp Company, of St. Louis.

THE EMPIRE ELECTRIC SUPPLY COMPANY, of Chicago, reports a large demand for Yost sockets, of which it carries a large and complete stock for prompt delivery.

BULLOCK BULLETIN.—Bulletin No. 1020 of the Bullock Electric Mfg. Company is devoted to multipolar motors and generators. The first section of the book illustrates the various parts in complete detail, and the latter part gives a number of engravings of plants that have been installed.

THE TETER-HEANY DEVELOPING COMPANY, York, Pa., has opened business in manufacturing wire insulated with its fireproof insulation. Its product has already met with widespread approval and success, and in consequence of the demand it has begun to enlarge its plant at York.

MR. HORACE F. RUGGLES, 106 Wall Street, New York City, has secured a large Cuban contract for sugar machinery which will be electrically operated. He is figuring on a substantial contract for a sugar plant to be installed in Porto Rico, in which electrical machinery will play an important part.

NERNST LAMP COMPANY.—The Chicago office of the Nernst Lamp Company, in charge of A. E. Fleming as district manager, has been removed from 638 National Life Building, La Salle Street, to 99 E. Lake Street. The new offices are larger and better equipped in every way to care for the increasing business of the company in that locality.

TELEPHONE SUPPLIES.—Bulletin No. 12 of the Empire Electrical Supply Company, 55 W. Jackson Boulevard, Chicago, illustrates a large number of telephone instruments and small types of switchboards. Particular stress is laid upon the "Empire No. 15" receiver, which is claimed to be the most efficient, sensitive, serviceable receiver made.

B. F. STURTEVANT COMPANY announces the removal of its entire plant from Jamaica Plain to Hyde Park, Mass. The new plant has nine acres of floor space and is equipped throughout with the most modern appliances for the manufacture of the well-known Sturtevant products: blowers, engines, motors, economizers, forges, steam heating, ventilating and drying apparatus, etc.

NORTHERN ELECTRICAL MFG. COMPANY, of Madison, Wis., has issued a very neat little leaflet or folder devoted to sawmill practice. One picture in it shows an Italian sawmill of the primitive type—two men sweating over a beam with a hand saw, and two other pictures show a northern spherical motor driving a swing cut-off saw and a Fay buzz saw. The contrast makes a good resetting of an old saw.

LAMBERT SCHMIDT TELEPHONE MFG. COMPANY, of Weehawken, N. J., shows in its catalogue No. 11 on interior telephones an interesting variety of apparatus for private and intercommunicating telephone purposes. All its telephones for this work are equipped with special long-distance cartridge type transmitted and double-pole receiver, and work on its patented central energy circuit, which requires but one bank of batteries.

AN INCANDESCENT LAMP that can stand up under the jolts and jars and hard knocks of street car service is a rare article and few are the factories that can produce it. The Electric Appliance Company, of Chicago, however, claims to have a lamp fitted for this strenuous service and as proof of its statement the company points with pride to the many large traction companies throughout the country which have adopted the Packard railway lamp.

PELTON WATER WHEELS.—The Pelton Water Wheel Company, San Francisco, informs us that it was awarded the contract for the water wheels for the North Mountain Power Company of that city. The statement in our issue of June 11 that the contract had been given for Stillwell-Bierce wheels was an error. The Pelton Company will furnish two double wheel Pelton units, for direct connection to 750-kw, 500 r.p.m., alternators, the wheels to operate under a 600-foot head.

THE F. BISSELL COMPANY, Toledo, Ohio, has added to its list of specialties, novelty potheads, sleeves, terminal heads, etc., for telephone cable work. This business has been purchased outright from the New Haven Company, the transfer including all patents, special machinery, good will and merchandise, finished and unfinished. The Bissell Company announces that, owing to its very advantageous location and special additional facilities, it will be in much better position to serve the trade promptly and satisfactorily.

GARTON LIGHTNING ARRESTERS are the theme of catalogue No. 40, recently issued by the Garton-Daniels Company, of Keokuk, Ia. A large part of this handsome pamphlet is devoted to a discussion of the principles of the subject and the successful manner in which the company's system has been worked out as a preventive and cure of lighting and other "strikes" of a high voltage character. The Garton arrester and its application are clearly illustrated, as well as kicking coils and other details. It is a most interesting summary of the subject.

"NORBITT" TEMPORARY SOCKETS.—At the Elks' convention, to be held in Cincinnati, July 8 to 25, there will be used nearly 30,000 "Norbitt" porcelain temporary sockets for decorative purposes, illuminating the streets for thirty-seven blocks. Oven 500 "Norbitt" temporary sockets will also be used in making a huge American flag, which is to be hung over Government Square. These handy little devices, which can be installed in a very few moments without scraping the insulation from the wire, are manufactured by the Crouse-Hinds Company, of Syracuse, N. Y.

ABNER DOBLE COMPANY, of San Francisco, engineers, manufactu- of tangential water wheels with needle regulating nozzles, dealers and - facturers in iron, steel and metals, announce the organization of its c engineering department, in charge of Mr. Robert McF. Doble, who has siderable experience in the design, construction and operation of hydro-electric power plants and long distance power transmissi Doble Company is now prepared to take entire charge of the de struction of power plants, pumping plants and other engineer

UNIVERSAL ELECTRIC COMPANY.—A new organizat Universal Electric Company, jobbers in everything elect. general sales offices in the Ellsworth Building, 353 Dearborn Street, Ill. Its executive officers are F. C. Royal, president, and F. B. Kavanaugh, secretary and treasurer. Mr. Royal is a well-known Chicago business man, having been connected with the Nelson & Morris packing house for a number of years, while Mr. Kavanaugh was formerly with the Sterling Electrical Mfg. Company, Warren, Ohio, and late with the Brilliant Electric Company, Cleveland, Ohio. The new company is the Northwestern distributer for the Brilliant Electric Company, of Cleveland, Ohio, makers of the Universal tipless incandescent lamps. In addition to this product it will job a full line of arc lamps, fans, motors, generators, telephone systems, etc., as well as several special lamp accessories.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 14, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

762,279. TELEPHONE LAMP-JACK; Henry P. Clausen, Chicago, Ill. App. filed Oct. 12, 1901. (See page 1198.)

762,297. THIRD RAIL INSULATOR; Henry L. Fritze, Jersey City, N. J. App. filed Oct. 27, 1903. Details.

762,318. CONDUCTOR AND COLLECTOR FOR ELECTRIC RAILWAYS OR TRAMWAYS; Donald Kempt, Buenos Ayres, Argentina. App. filed March 11, 1903. A number of sharp-edged disks run in the groove of a third rail to take off the current.

762,319. CONTACT BOX AND CONDUCTOR FOR ELECTRIC RAILWAYS OR TRAMWAYS; Donald Kempt, Buenos Ayres, Argentina. App. filed Sept. 23, 1903. Details.

762,331. ELECTRIC SIGNAL; Wm. D. Marks, Westport, N. Y. App. filed March 12, 1903. Details of a block signal system.

762,336. SIGNALING APPARATUS FOR TELEPHONE-SWITCHBOARDS; Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill. App. filed Feb. 20, 1902. (See page 1198.)

762,337. SIGNAL FOR TELEPHONE SWITCHBOARDS; Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill. App. filed July 2, 1902. (See page 1198.)

762,338. RELAY; Frank R. McBerty, Evanston, Ill. App. filed Oct. 27, 1902. (See page 1198.)

762,341. EARTH OR GROUND WIRE ATTACHMENT; Joseph J. O'Connel, Chicago, Ill. App. filed March 10, 1904. A spring bracket is bound to a water or gas pipe by turns of the conductor to be grounded and extra tension or strain is put upon the turns to perfect the contact by a screw working through the bracket and against the pipe.

762,358. ELECTRIC METER; William Stanley, Great Barrington, Mass. App. filed Dec. 6, 1901. While an oscillating needle is approaching the medial line of its oscillation, the magnetic field is increased independently of variations in the load which determines the normal working field.

762,364. TELEPHONE-CALL INSTRUMENT; Edward W. E. Tompson, Brookline, Mass. App. filed May 18, 1903. (See page 1198.)

762,370. ELECTRIC SIGNALING SYSTEM; Samuel M. Young, New York, N. Y. App. filed Jan. 19, 1903. A system in which the cars are moved by direct current and the signals by an alternating current, the latter being transmitted along the conductors conveying the direct current and interference being avoided by the use of properly disposed reactance coils.

762,379. TROLLEY WHEEL; John S. Briggs, Los Angeles, Cal. App. filed April 25, 1903. In the tread of the wheel, a spring is wound to give yielding contact with the wire to avoid arcing.

762,391. TELEPHONE FIRE-ALARM SYSTEM; William L. Denio, Rochester, N. Y. App. filed May 11, 1903. (See page 1198.)

762,409. SYSTEM OF MOTOR CONTROL; George H. Hill, Glenridge, N. J. App. filed Nov. 3, 1903. A motor control system in which the power-actuated switches are automatically operated in succession and in which the progression may be stopped at any desired point; a master controller is used and the motorman can operate at any speed he desires independently of the automatic progression.

762,410. SAFETY APPARATUS FOR USE WITH OVERHEAD ELECTRIC CONDUCTORS; Herbert F. Hill, London, England. App. filed June 10, 1903. A grounding wire is supported adjacent to a trolley wire and the latter carries brackets arranged to come in contact with the grounding wire in case the trolley wire unduly sags or breaks.

762,425. ELECTRICAL BATTERY; John Roger Lord, San Francisco, Cal. App. filed June 5, 1903. (See page 1198.)

762,430. ELECTROMAGNETIC SIGNAL; Frank R. McBerty, Evanston, and Frederick H. Loveridge, Chicago, Ill. App. filed May 9, 1902. (See page 1198.)

762,432. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; James L. McQuarrie, Chicago, Ill. App. filed May 9, 1902. (See page 1198.)

762,503. ELECTRIC ARC LAMP; Gesa Szuk and Wenzel Hackl, Budapest, Austria-Hungary. App. filed June 3, 1903. Details.

762,535. ELECTRIC PLUG OR SOCKET EXTENSION; Wm. H. Kelsey, Cambridge, Mass. App. filed Oct. 9, 1902. A block of insulating material having a plurality of openings therein containing the parts of lamp sockets or receptacles whereby a number of lamps may be connected with a single plug.

762,571. SWITCH PLATE; John Alexander, Hartford, Conn. App. filed Oct. 29, 1903. The plate is cheaply made by electro-depositing a hard metal face upon a cheap metal body.

762,620. PUMP CONTROLLER SYSTEM; Authur C. Eastwood, Cleveland, Ohio. App. filed Feb. 13, 1903. A magnetic clutch is placed between the motor and the pump, so that the motor may be run continuously and the pump connected when necessary.

762,621. MAGNETICALLY OPERATED SWITCH; Arthur C. Eastwood, Cleveland, Ohio. App. filed July 27, 1903. Details.

762,622. MAGNETIC CLUTCH; Arthur C. Eastwood, Cleveland, Ohio. App. filed March 5, 1904. A series of plates alternately carried by the two clutch members, provided with an arrangement of wedges to take up the wear, a coil supplying the necessary magnetism to bring the plates into frictional contact.

762,623. MAGNETIC CLUTCH; Arthur C. Eastwood, Cleveland, Ohio. App. filed April 1, 1904. The two magnetic members together form one clutch member and clamp between them the edge of the other clutch member, the latter not being in the magnetic field.

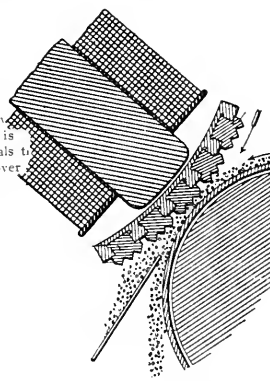
762,628. APPARATUS FOR PROMOTING FLOW OF OIL AND GAS IN WELLS; Fulton Gardner, Chicago, Ill. App. filed Jan. 25, 1904. A number of electric heaters arranged to be placed at intervals in a well and connected on one circuit.

762,644. ELECTRIC KEY SELECTING AND STRIKING MECHANISM; Andrew J. Leonard, Denver, Colo. App. filed Feb. 21, 1902. A number of comparatively small magnets are used to select the key to be operated, while a single large magnet accomplishes the striking of any selected key.

762,669. INSULATED RAIL JOINT; George A. Weber and Percy Holbrook, New York, N. Y. App. filed Nov. 13, 1903. An insulated rail joint, comprising the meeting ends of pairs of rails, with a plurality of longitudinally-extending filling blocks arranged side by side between the rails, and bolts for securing the parts of the joint together.

762,671. AUTOMATIC POTENTIAL REGULATOR; Wm. S. Andrews, Schenectady, N. Y. App. filed Oct. 1, 1902. The invention consists of a multiple pole switch having a plurality of pairs of stationary contact segments, a movable arm carrying a single pair of contacts adapted to bridge each pair of stationary segments in succession and terminals connected with the contacts on the arm and adapted to be connected with a voltmeter.

762,675. MULTIPLE POLE VOLTMETER SWITCH; Charles C. Badeau, Schenectady, N. Y. App. filed July 27, 1901. The connector is used between cars and the male and female parts are so constructed that it is impossible to connect together any except the terminals of the same circuit.



762,752.—Apparatus for Magnetic Separation.

762,684. CONNECTOR; Frank E. Case, Schenectady, N. Y. App. filed Oct. 3, 1902. Details.

762,686. ELECTRIC RAILROAD CROSSING SIGNAL; Thomas C. Clark, Cambridge, Ohio. App. filed Dec. 29, 1903. Details.

762,695. SIGNALING APPARATUS; Ernest A. Faller, New York, N. Y. App. filed Oct. 14, 1903. By this apparatus it is proposed to effect from one operation such as the pushing of a button, all that is necessary to provide the motive power for the sending of a signal as well as the locking of the mechanism against duplicate use.

762,697. REACTANCE COIL; John J. Frank, Schenectady, N. Y. App. filed Oct. 16, 1902. A fluid-cooled reactance coil, having a laminated core with air gaps formed in the layers to increase the magnetic reluctance and prevent the formation of stray fields.

762,709. ELECTRIC MOTOR; Gaylord C. Hall, New York, N. Y. App. filed March 7, 1901. In combination with a motor and resistance, means for varying the resistance, oppositely actuated by the difference of potential around the motor and around the resistance.

762,715. ELECTRICAL BATTERY; Julius E. Hasche, Chicago, Ill. App. filed Feb. 8, 1904. (See page 1198.)

762,720. PORTABLE ELECTRIC LIGHT; Conrad Hubert, New York, N. Y. App. filed Jan. 25, 1904. A small pocket case containing battery cells and a bullseye lamp with circuit closer.

762,735. MANUFACTURE OF INSULATED OR COVERED WIRES AND MACHINE THEREFOR; Charles Martin, Nottingham, England. App. filed May 18, 1903. A machine for successively placing upon a wire layers of yarn and of rubber and finally a knitted layer.

762,738. AUTOMATIC REGULATOR FOR MOTORS; Hans S. Meyer, Rugby, England. App. filed Sept. 4, 1902. An induction motor-regulating device which will vary the potential so as to cause it to decrease with an increase of speed of the motor and to increase with a decrease of speed and which is controllable by the speed of the motor.

762,744. MEANS FOR REGULATING DYNAMO ELECTRIC MACHINES; Charles R. McKay, Cincinnati, Ohio. App. filed Nov. 23, 1901. A dynamometer connected across two of the leads of a three-phase circuit, actuates the arm of a rheostat connected across the armature terminals of a dynamo.

762,740. TROLLEY; Rowley K. Ortt, Reading, Pa. App. filed Nov. 4, 1903. The wheel is swiveled on ball bearings to turn laterally to accommodate itself to kinks in the wire.

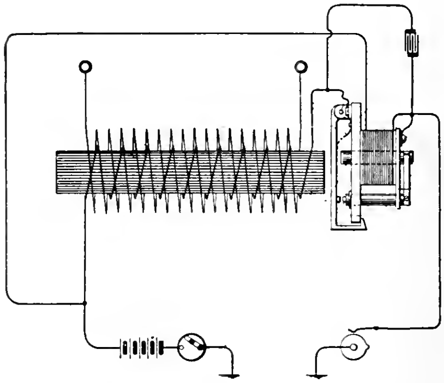
762,751. SEPARATING CYLINDER FOR MAGNETIC ...; Clarence Q. Payne, Stamford, Conn. App. filed Aug. 17, 190... vention consists in the shape of the pole faces whereby large con... face for the adherence of magnetic particles is provided.

762,752. APPARATUS FOR MAGNETIC SEPARATION; Clarence Payne, Stamford, Conn. App. filed Aug. 30, 1901. A modification of preceding invention.

762,753. APPARATUS FOR MAGNETIC SEPARATION; Clarence Payne, Stamford, Conn. App. filed Oct. 3, 1903. A further modification.

762,768. RAIL; Louis Steinberger, New York, N. Y. App. filed Dec. 16, 1903. The third rail is L-shaped in cross section and saddled loosely upon the supports which permit it to rock.

762,769. SUPPORT FOR RAILS; Louis Steinberger, New York, N. Y. App. filed Feb. 11, 1904. Another construction permitting of freedom of movement of an ordinary **T-third rail.**



762,776.—Induction Coil Vibrator.

762,770. DOOR OPENING APPARATUS; Henry S. Stewart, Chicago, Ill. App. filed March 24, 1904. A magnet controls a dog that holds a door from opening under the tension of a spring; by operating a push button, the door is released and opened.

762,776. INDUCTION COIL VIBRATOR; Richard Varley, Providence, R. I. App. filed Jan. 22, 1904. The vibrator is in a floating condition between the head of the coil on one side and a magnet on the other; the current automatically shunts from one coil to the other and thus actuates the vibrator in opposite directions. All adjusting screws are avoided and the vibrator can be hermetically sealed.

762,791. TROLLEY HANGER; Montraville M. Wood, Schenectady, N. Y. App. filed Dec. 15, 1902. Details.

762,792. ELECTRIC RAILWAY APPARATUS; Granville T. Woods, New York, N. Y. App. filed Oct. 12, 1901. The delivery of current to the sections of a sectional conductor is controlled by four magnets, whose circuits depend upon one another.

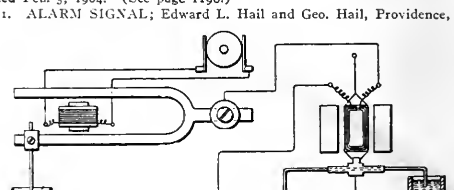
762,798. RAILWAY SIGNALING SYSTEM; Marion A. Born, Lawrenceville, Ga. App. filed Nov. 7, 1902. Details.

762,803. ELECTRICAL ACCUMULATOR; Alfred Jean Baptiste Maxime Colletas, Paris, France. App. filed Sept. 12, 1901. (See page 1198.)

762,812. ELECTRIC SIGNALING SYSTEM; John Dianovszky, Passaic, N. J. App. filed July 18, 1903. Details.

762,820. ELECTRIC TELEPHONE; Ernst Gundlach, Berwyn, Ill. App. filed Feb. 5, 1904. (See page 1198.)

762,821. ALARM SIGNAL; Edward L. Hail and Geo. Hail, Providence, R. I. App. filed May 14, 1902. An elevator car approaching a landing from either direction sounds a signal at the landing until the landing is passed.



762,829.—Receiver for Wireless Telegraphy.

762,823. TROLLEY WHEEL; Stewart J. Hanlin, Allegheny, Pa. App. filed March 29, 1904. Two trolley wheels mounted in tandem.

762,824. FUSE PLUG; Rudolph Hundhausen, Wilmersdorf, Germany. App. filed Nov. 24, 1899. Details.

762,829. RECEIVER FOR WIRELESS TELEGRAPHY; Oliver J. Lodge, Birmingham, Alexander Muirhead, Shortlands, and Edward E. Robinson, Birmingham, Eng. App. filed July 28, 1902. A wave detector consisting of two conducting surfaces having a film of fluid between them capable of being broken down upon the occurrence of a wave and immediately renewing itself.

762,831. TROLLEY BASE; Peter D. Milloy, Buffalo, N. Y. App. filed Oct. 27, 1902. Details.

762,840. FEED WIRE CONNECTION; Geo. L. Osborn, Boston, Mass. App. filed Sept. 2, 1902. A bracket intended to be soldered to the rail and having a pocket in which the end of the wire is soldered.

762,847. STORAGE BATTERY; Max Schneider, Dresden-Paulen, Germany. App. filed Sept. 4, 1903. (See page 1198.)